

# Efficiency and Responsibility in Education 14<sup>th</sup> International Conference

## Proceedings



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# STUDENTS' AUTONOMY AT HEIS IN UKRAINE: CASE OF SUMY NATIONAL AGRARIAN UNIVERSITY

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## ABSTRACT

The situation in the Czech Republic regarding tertiary education is heavily influenced by demographic shifts in the population, and the current surplus of tertiary education opportunities relative to student demand. Simultaneously, there is a need to evaluate the value of implementing new modern educational methods, models, and ways of teaching. The primary goal of this paper is to reflect how implementation of modern interactive graphical models can influence the results of students in courses microeconomics and macroeconomics (the bachelor degree) at the Faculty of Economics of the University of South Bohemia in České Budějovice. The most important result is significant influence on improvement of students' success at exams from macroeconomics and microeconomics has not been proved.

## KEYWORDS

Modern Interactive Graphical Models, University, Micro and Macroeconomics, Education

## INTRODUCTION

Universities must balance the declining number of potential students due to demographic change in the age-structure of the population with requirements to increase the number of graduating students in tertiary level of education. In addition, a new law requires, as part of the university's principal governing document, an increase in the quality of education which may be realized by various methods in courses with improvement in seminar tests and exam results as quantitative evidence of quality.

The authors' major goal of the paper was to determine, using statistical methods, the influence of implementing modern interactive graphical models on the success of students in microeconomics and macroeconomics courses.

Supporting the process of monitoring one's own understanding is a key characteristic of self-regulated learning (Ludvigsen, Krumsvik and Furnes, 2015). The new models of online interaction in learning may actually change the meaning of such interaction. If these models are transferred to blended learning, then attention will need to be paid to the various impacts they have on academic achievement, by comparison to the currently widespread online interaction models in which lecturers play a more important part in interaction processes (Castaño-Muñoz, Duarte and Sancho-Vinuesa, 2014). The findings of a multiple regression analysis by Choi (2016) showed that "metacognitive strategy" and "peer learning" led to learners' satisfaction in an online learning environment and contribute to a better understanding of how successful learning occurs in an online learning environment, and provide recommendations on designing an effective online learning.

Evans (2013) presented, in a comprehensive review of the literature, a valuable

framework for the concept of the feedback in assessment in higher education. Serral and Snoeck (2016) perceive as crucial to improve learning and foster students' development by providing feedback, and consider automating feedback as one of the most important challenges within the field of smart learning environments. According to Small and Attree (2016) students appreciate feedback when it is clear and instructive, and they value the critical opinion of academics, but there are still issues of power imbalance whereby students may still be unwilling to contact academics if the feedback is unclear and requires clarification. The systematic approach to analysing dialogic feedback may provide insight into previously undocumented aspects of feedback, such as the interactional features that promote and sustain feedback dialogue (Ajjawi, Boud, 2017).

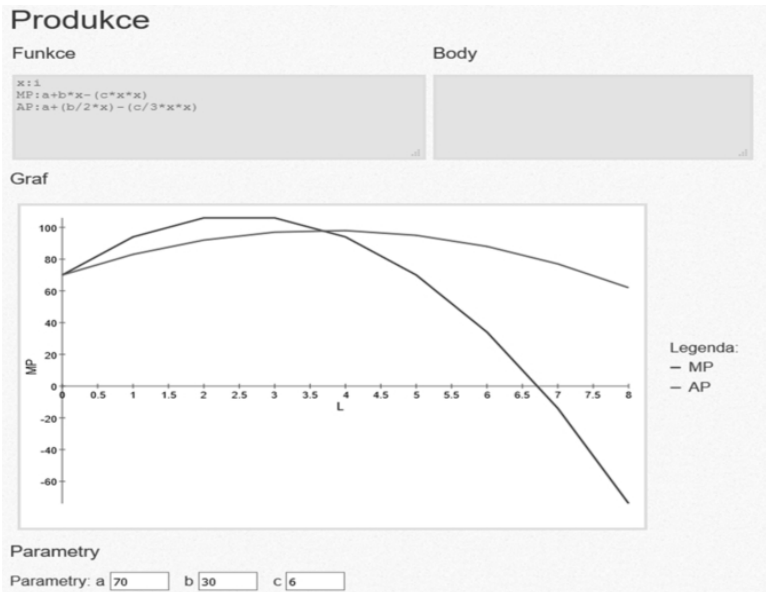
Generally, Firat (2016) says, that Learning Management Systems (LMS) helped increase academic achievement of students only when LMS included such features as effectiveness, interaction, reinforcement, attractive design, social media support and accessibility.

## **MATERIALS AND METHODS**

Data for the years 2007-2016 on courses, number of students, pass credits and exam results were mined from teachers' records and from the University of South Bohemia record system (STAG), which holds data for the Faculty of Economics in České Budějovice. The word "credit" is a translation of the Czech word "zápočet", which translates poorly into English. Students must fulfil course requirements to gain permission, "pass credit," from the teacher to take the exam. This system is used at Faculty of Economics of the University of South Bohemia in České Budějovice for most of courses.

Poor student outcomes in the microeconomics and macroeconomics courses led the Faculty of Economics to update economics education by introducing interactive graphic models for microeconomics and macroeconomics. The interactive electronic models are intended to improve the quality of education and student outcomes by facilitating individual study for both full-time students in a classroom-based course and for students completing the course by distance-learning. The electronic models are integrated into e-learning courses and are also used in classroom lectures and exercises. Interactive graphics models were created for both microeconomics and macroeconomics to give students a clearer understanding of both the graphs and the mathematical calculations associated with the models. By experimenting with the interactive models, students could use an active-learning approach to better understand the concepts and how the economic models respond to various economic changes. The models were created using Java script (Volek, Alina, 2013).

The interactive design of the models allows students to change the values of basic variables and observe the effects of those changes. An example (printscreen) of these models is found in figure 1. Terms are in Czech language because the model is only for Czech students. Students can change parameters ("Parametry") and in the field function (Funkce) is predefined economics function consequently changed according to values of parameters.



**Figure 1: Example of graphic microeconomics model - production**

The hypothesis test to compare relative frequencies was used to verify the validity of a stated hypotheses. One of the most commonly used hypothesis tests for various research and industrial applications is the Difference in Means test. It is used to compare the means of two samples, allowing us to compare the relative performance of two populations of students: those who had access to the interactive graphical models and those who did not have access to them. The hypothesis test allows us to make a statement about the relative performance of the two groups using a null (tested) hypothesis  $H_0$  and an alternative hypothesis  $H_1$ , which either rejects or fails to reject the statement of the null hypothesis, depending upon the value of the test statistic. The set of permissible values for the test statistic fall into two regions, those supporting the null hypothesis  $H_0$  and those supporting the alternate hypothesis  $H_1$ , separated by critical values determined by the level of certainty deemed necessary to reject the null hypothesis (Hindls et al, 2007).

This paper considers the case of two independent populations, assumed normally distributed. Population 1 has mean and variance  $\sigma_1^2$ , while population 2 has mean  $\mu_2$  and variance  $\sigma_2^2$ . Inferences will be based on two random samples of sizes  $n_1$  and  $n_2$ . We consider hypothesis testing on the difference in the means  $\mu_1 - \mu_2$  of two normal populations. Suppose that we are interested in testing that the difference in means  $\mu_1 - \mu_2$  is equal to a  $\mu_1$  specified value  $\Delta_0$ . We commonly specify  $\Delta_0 = 0$  so that we are testing the equality of two means (i.e.,  $H_0 : \mu_1 = \mu_2$ ). This test statistic would have a standard normal distribution under  $H_0$ . Suppose that the alternative hypothesis is  $H_0 : \mu_1 - \mu_2 \neq \Delta_0$ . A test of the mean success rates among two groups of students is tested. Case 1 is success of students (success in passing) before implementation of interactive models and case 2 is success of students after implementation of interactive models, using  $\alpha = 0.05$ .

Null hypothesis:  $H_0 : \mu_1 - \mu_2 = 0$ , or  $H_0 : \mu_1 = \mu_2$

Alternative Hypothesis:  $H_0 : \mu_1 - \mu_2 \neq 0$  or  $H_0 : \mu_1 \neq \mu_2$ .

Test statistic:

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s^2}{n_1} + \frac{s^2}{n_2}}} \quad (1)$$

$$S^2 = \frac{(n_1 - 1) * s_1^2 + (n_2 - 1) * s_2^2}{n_1 + n_2 - 2} \quad (2)$$

Statistic Z has when the validity of the hypothesis  $H_0$  a t distribution with  $n_1 + n_2 - 2$  degrees of freedom (Montgomery and Runger, 2006).

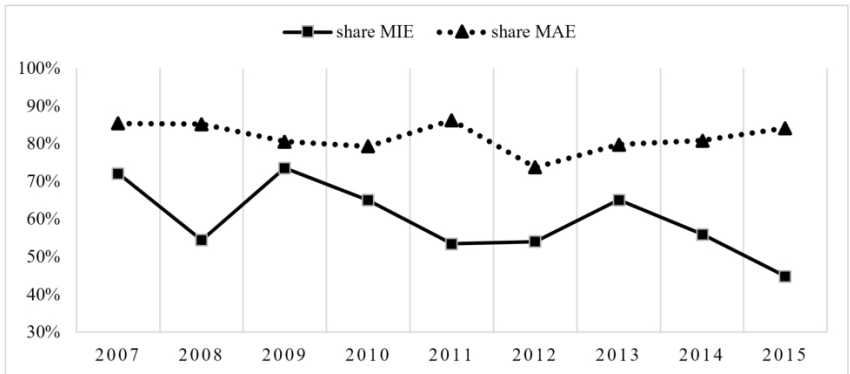
## RESULTS

As discussed above, this research has been aimed to observe and explore the influence of interactive models on student outcomes in macroeconomics and microeconomics courses and its correlation with pass credits and the results of exams. The null hypothesis is that students who studied microeconomics and macroeconomics in courses with interactive graphical models have the same rates of pass credits and satisfactory exam scores as students who did not have access to interactive graphical models. The alternate hypothesis is that students who had access to the interactive graphical models showed better results. Table 1 represents the number of enrolled students to first grade, credits earned, and exams passed in Microeconomics I (MIE) and Macroeconomics I (MAE) courses by academic year from 2007 to 2016, where the year 2007 represents data for the 2007/2008 academic year. From left to right, the columns

Year	Students total		Credit		Exam	
	MIE	MAE	MIE	MAE	MIE	MAE
2007	310	296	230	191	166	163
2008	269	265	215	156	117	133
2009	311	328	242	222	178	179
2010	307	324	249	241	162	191
2011	496	512	406	372	217	321
2012	403	349	298	297	161	219
2013	449	394	356	327	232	261
2014	426	359	302	292	169	236
2015	346	269	214	196	96	165
<b>Overall</b>	<b>3317</b>	<b>3096</b>	<b>2512</b>	<b>2294</b>	1498	1868

**Table 1: Course Microeconomics I and Macroeconomics I (source: own calculation)**

Figure 2 exhibits the trends in the shares of students gaining credit and passing exams by academic year.



**Figure 2: Trend of passed exam after admission in %, course Microeconomics I and Macroeconomics I (source: own calculation)**

	Mean 1	Mean 2	T-value	df	p	n <sub>1</sub>	n <sub>2</sub>	Std. Dev 1	Std. Dev 2	F-ratio Variances	p Variances
Exam/ Credit	0.7354	0.6732	0.9837	16	0.3399	10	8	0.1232	0.1453	1.3923	0.6292

**Table 2: T –tests; grouping models (source: own calculation)**

The F test did not find a statistically significant difference in the variances. (table 3, *p*-Variances). With regarding to the null hypothesis that the differences in means equals zero, we fail to reject the null hypothesis at the  $\alpha = 0.05$  level (table 3, *p*-value) based on the t-test of the differences in means. We conclude that using the interactive models in teaching of microeconomics and macroeconomics does not have a statistically significant impact on the success of students.

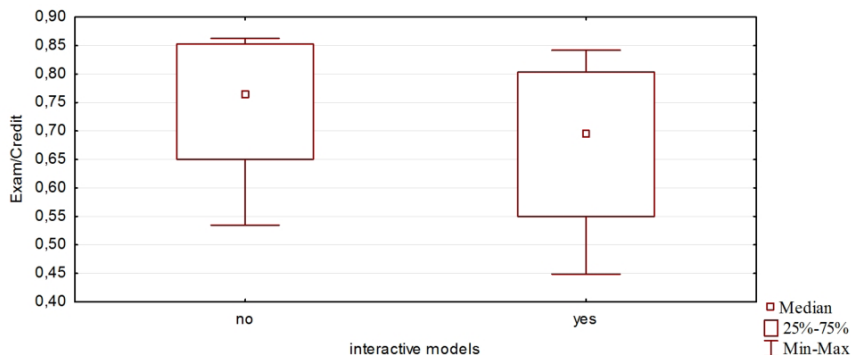
Graph 2 represent distribution of relative percent occurrence of student’s success in passing the exams for microeconomics and macroeconomics before the implementation of interactive model vs. after the implementation of these models. The Z graph to the right shows that the exam success of students in academic years 2012 - 2016 is more variable than in the earlier years. The median during 2012 - 2016 is 0,69, compared to the median of 0,77 from 2007-2012 and the average success rate (exam pass) of students in years 2012- 2016 was slightly lower than the pass rate before the introduction of the interactive models.

In the next phase of the analysis we considered potential impacts on the students’ success on exams. We first considered the effect of entrance exams on exam pass rates for the entire sample period from 2007-2016. The differences in means test for both macroeconomics and microeconomics was used with two groups, those who were accepted to study based on entrance exams and those who were not accepted based on entrance exams. The hypothesis test on the difference in means was tested once again.

The F test did not prove a difference in the variances between the two groups (table No. 3, *p* - Variances). The differences in means t-test for the null hypothesis that group means were equal was not rejected at the  $\alpha = 0.05$  level (table No. 3, *p*-value). We conclude that accepting students based on entrance examinations does not have statistical significant impact on the success of students in these courses.

The other influence we considered with respect to students’ success in microeconomics and macroeconomics courses is the age structure of students graduating from secondary

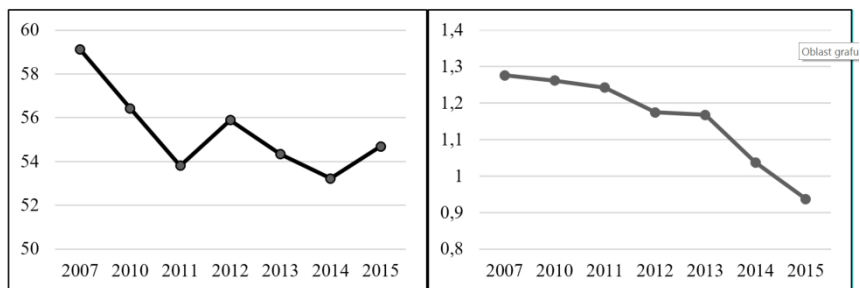
school relative to the age structure of the general population. Their success may be affected by different starting position with respect to their potential for study. We compared the trend of secondary school completion for 19 year olds over the study period to the proportion of the general population that was age 19. (see graph No. 4)



**Figure 3: Box graph with descriptive characteristic of students' success according to using interactive models (source: own calculation)**

	Mean 1	Mean 2	T-value	df	p	n <sub>1</sub>	n <sub>2</sub>	Std. Dev 1	Std. Dev 2	F-ratio Variances	p Variances
Exam/Credit	0.7446	0.6783	1.0526	16	0.3081	8	10	0.1063	0.1501	1.9919	0.3758

**Table 3: T-tests; grouping entrance examination (source: own calculation)**



**Figure 4: Share of the number of graduation students of secondary schools on 19 years old (left part) - Share of the number of 19-year-old on overall population (right part) (source: own calculation according to Czech Statistical Office (2016))**

The share of 19-year-old in population (at the right in graph 4) in the period of study declines steadily, while the proportion of 19 year olds who completed secondary school declines somewhat but is more stable after 2011, at around 54%.

## CONCLUSION AND DISCUSSION

The requirement to increase the number of high school graduates who attend the university isn't in accordance with demographic trends in the university-age population. In the development of education structure decreases the proportion of people with no more than lower secondary education and secondary education without direct access to tertiary education (Fiala et al., 2016). Problem is that current financial possibilities of

Universities do not suffice to a rapid increase in the number of students. A solution can be the introduction of ICT into a teaching process (Svoboda et al., 2016). The number of 19-year-olds declines faster than the share of graduating students at secondary schools, so universities are accepting who evidently, at the beginning of the study period in 2007, would not have been accepted to the university. The implementation of new study aids, such as interactive models, allows to students to better understand the problems due to its clarity and instant feedback. The interactive model's interface using contemporary ICT is a natural environment for the present-day student's generation. The interactive models may assist students in adapting to university studies and influence student success. These conclusions are consistent with those of Beranek and Remes (2016). There are more factors that affect student performance, such as the structure of the course, the number of students in the classroom, or the abilities of students. Nevertheless, significant influence of the interactive graphical models on improvement of student success at exams from macroeconomics and microeconomics has not been proved. Another matter of discussion raises from disparities between regions and experiences. In consequences of regional needs is absolutely necessary to observe present needs of economy, society and authorities as was researched by Dušek (2010).

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# EXPERIENCE WITH AUTOMATIC TESTING SYSTEM IN TEACHING C# PROGRAMMING

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## ABSTRACT

In this paper, we describe a system of automatic evaluation of students' assignments in teaching of programming in C# programming language. Within this teaching, the teacher uses the testing system. He creates a set of assignments and respective tests. Student inserts solutions of this assignments (their programming code) into the system. Student's code is then tested and automatic feedback is provided. The automatic testing system dramatically reduces the time of teachers in determining whether student's solution is correct, and shifts the emphasis on providing counselling and consultancy to students. Here, we present some particular experience with this testing system, we have acquired by the operation of this system within several years.

## KEYWORDS

Automatic Testing System, Programming Education, Self-assessment Technology, C# Programming Language

## INTRODUCTION

Programming is an essential discipline for students of computer science and applied informatics as well. They undergo a course of programming usually in the first year of their studies. Programming is a creative task. The programmer must deal with problems what algorithm to use, how it should be implemented, which data structure to use, what structure of a program to design, how to document written code, and many other problems. To assess the computer program, there are a number of criteria:

1. Correctness. This means, does the code (program) produces the correct answer? Does it give expected results? For example, does sorting program sorts a random sequence of numbers according to certain criteria correctly? Robustness of the program is associated with this criterion. That is how the program will cope with missing or erroneous data input. Will it not collapse?
2. Time complexity. It is, how fast the program returns the result for larger number of input data.
3. Space complexity. It means will RAM memory on my computer be sufficient for the computation?
4. Other criteria may also be elegance, readability of the programming code. That is, is not code too long? Is it easy to understand? Can it be easily extended? Is it well documented? Was the right algorithm chosen, data structure, and more?

In our paper, we deal with the teaching programming, especially in the introductory course from the point of view of testing students' code. Here, the first criterion is the most

important. It is better to have a slow piece of code that creates a correct answer than to have the one that is very fast, but produces the wrong answer (Beranek and Nydl, 2013). Also, our test system evaluates only the correctness of the solution. Criteria such as time and space complexity are among the tasks for initial teaching programming not too relevant (Ihantola et al., 2010). Also, other criteria such as elegance, readability, documentation of the code (Singh, Gulwani and Solar-Lezama, 2013) and others require manual review. These criteria are more relevant for advanced courses teaching programming (Verdu et al., 2012). The aim of our paper is to describe the motivation, design, implementation and experience with testing system in our programming courses Basics of programming. We will describe some details about testing and feedback system, explain its use in our environment and show some experience with this system by the teacher and the student. In literature, automated evaluation systems are described for example in (Douce, Livingstone and Orwell, 2005; Ala-Mutka, 2005; Ihantola et al., 2010) some conclude that the automatic evaluation can lead to increased student performance (Woit and Mason, 2003; English, 2002). Work from MIT and Microsoft (Singh, Gulwani and Solar-Lezama, 2013) introduces a model in which the system provides reference of implementation solutions, and its error model consists of a possible correction of errors that students can do. It derives automatically minimal corrections from erroneous solutions of students. Another relatively recent development is the adoption of a distributed, web-based training and assessment system (Verdu et al., 2012) as well as the ever popular MOOCs (Masters, 2011).

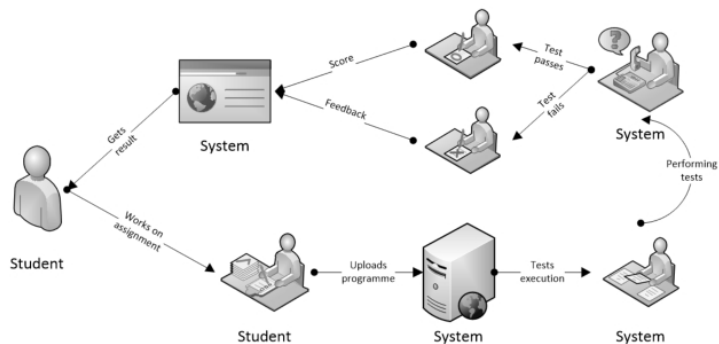
The rest of the text is structured as follows: The next section deals with the description of the test system and the system used by both the student and some statistics; section Results and Discussion describes our experience with the teaching and with the use of this system in the classroom and discusses achieved results. It also provides a brief view from the point of view of students. Section Conclusions presents some evaluations of reached results and future lines of our work.

## **MATERIALS AND METHODS**

Currently, programming language C# with integrated development environment MS Visual Studio is taught in the course Introductory programming at our faculty. Lectures that introduce programming language for beginners are usually scheduled over 14 weeks, with one 90-minute lecture per week. Following exercises in the computer lab are also 90 minutes long. Lectures will introduce new material, show what students can do with new commands and how to use the programming elements and how to design the structure of the program. Within all lectures, new commands and functions are presented via lecturer's live coding of small programs. Lectures are therefore a mix of traditional lectures and tutorial-like component where new material is used to solve the problem (Beranek and Remes, 2013). During the exercise, students independently solve more assignments. The teacher is here to provide help and advice when students have problems or questions, and checks whether the student's work is correct (i.e., computer program performs what has to do). Before the introduction of automated testing system in 2012, teacher spent large amounts of his time to check the students' assignments. Students also learned the result that their program was right up next week after completing work on the assignments. In 2012 we introduced the automatic testing system with provision of feedback that validates the accuracy of each student's solution. The providing of feedback to a student is available within a few minutes after the completion of the student's work. It saves a lot of time of teacher. Of course, the teacher must develop programming assignments at the beginning

of the course including the design of relevant tests. Assignments and tests must be put into the system before the start of lessons. The operation of our testing system in the classroom can be described as follows:

1. Working on the task from the assignment: The students are working on the tasks from the assignment. The difficulty of assignments corresponds to mastered the stint of a curriculum.
2. Submitting the code: When students finish their programmes, they upload source code to the system. Then, after the submission is done, the system starts processing tests on student's solution.
3. Testing the student's programme: Several automated tests are performed on student's uploaded code. First, open tests are executed. These tests are known to students, few examples are given within every single assignment. Thereafter, some specialized tests are performed to verify completely the uploaded solution.



**Figure 1: The flow diagram of student's code validation process.**

4. Tests performing: Check of each test gives partial score for code in question. Final result is counted as sum of partial scores. Range for final score is 0 to 100 points. If any of tests fails, system writes information about occurred problems to students.
5. Getting feedback and score: When the tests are done, the student gets complete result about their solution in their own log, which is accessible anytime later from student's account.

Automatic testing system was first used at our faculty in the academic year 2012/2013 to teach about 20 students of the study Economic Informatics, and has been used every year since then. The number of students has risen to 40 in the academic year 2016/2017. At the end of the semester, students have to pass an exam in the subject, including the designing a simple program according to the assignment.

Students solve selected assignments on every seminar in a computer lab with the aim to practice problems covered in the lectures. Their task is always to build a program on a certain topic. After completing, they insert their code into the testing system. The testing process will stop if any of the test criteria are not met. This approach supports the iterative process in which students are encouraged to focus on a particular bug, fix it and gain additional feedback that will improve the learning experience (Drlik and Beranek, 2015). Our process is similar to the test driven development strategy and it also serves students to introduction to the test-driven development (Beck, 2003) in a practical way.

The system records all relevant data about each submission, including the ID of the

student who inserted the code as well as the date and time of submitting and the code that is assigned to the task. Students can repeatedly re-submit their (revised) code, e.g., until all the bugs in their code are removed.

Also, we watch missing submissions especially in the first two weeks very closely, and we try to discuss individually with students, why they do not work, what problems they have, and other. Some students just need a little help with their first-ever programming exercises. We can intervene early in the semester and help those students to start with exercises and maybe to help them for the rest of the course.

We also try to analyze mistakes in students' programs. The objective is the identification of typical errors and to explain them during the next lecture or the next seminar.

Data on the performance of the entire class is available to teacher. He may acquire and analyze data from the testing system, he can look at the students' program code, or look at the data of submissions, and others. This key data can be presented in the form of tables or graphs showing the effectiveness of students' works and potential problems.

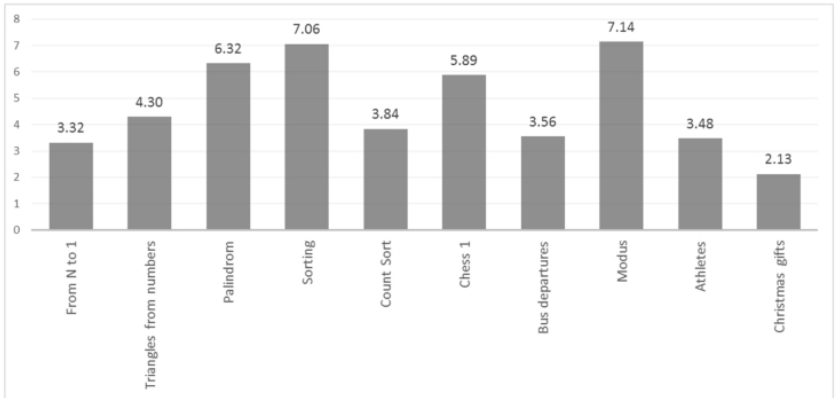
## **RESULTS AND DISCUSSION**

In this section, we present and discuss some relevant experience while we use the statistics from of our test system.

### **Students behavior**

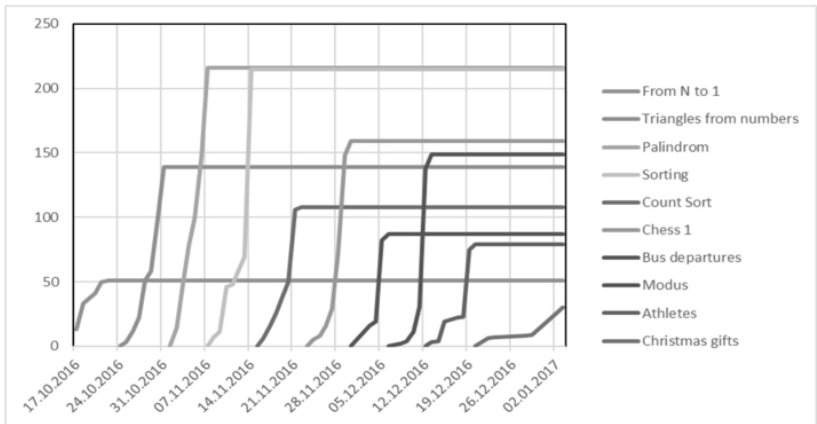
As we mentioned in the previous paragraphs students have the opportunity to submit their code into the system more times. They insert their code into testing system until this code is without errors, i.e., until their code pass all relevant tests. The process of error correction is also a form of learning process. Students always must find the bug and correct it. In Figure 2 we present the distribution of submissions of individual assignments during the semester per student.

The sum of total number of all submissions was 1322 with an average of 4.84 submissions per student. This shows that our concept, that students can improve their programs step by step, if needed and get quickly additional feedback, has been successfully implemented. However, relatively few students submitted correct code into the testing system on the first attempt. Approximately 20% of the students submitted a second revised version. The rest of students submitted their code into testing system several times. They used the possibility of further feedback after revision of their submission and properly done job. From this graph we can also see which tasks were difficult for the students, and which gave them less work. The first two tasks were easier, assignments on topics, e.g., the verifying whether a text is a palindrome, or sorting, or search a modus in the sequence of numbers, were more difficult for students. This summary is important for teacher, who can focus lectures and other exercises to improve the knowledge and skills of students in respective area.



**Figure 2: Histogram showing the distribution of submissions of individual assignments during the semester per student.**

Figure 3 shows the number of tasks submitted during the semester. Each task is assigned at a particular seminar. Students must then process the right program in C# programming language till the next seminar. We can see from the picture that most of the students worked hard just before the deadline. The positive was that only few tasks were submitted after the expiration of the deadline. The last assignment was optional. It is also seen in the Figure 3 that the students lingered with this task quite considerably.



**Figure 3: The number of submitted tasks during the semester.**

### Feedback from students

The use of automated testing and feedback system has proved successful. This system saves significantly the time of teachers who can devote more time for the consultations and the advising to students in their program designing. However, the view of student was very important for us too. Therefore, we conducted interviews with students and we asked them about their experience with the test system. We explored (i) the reasons why students liked the system and (ii) the reasons why students did not like the system. The answers

were not homogeneous enough to produce valid statistical statements. From that reason, we present here representative selection of students' comments.

Representative answers to the question why students like the testing system are especially:

1. *It provides fast response times.*
2. *Quick response, it is unbiased.*
3. *It gives a very fast feedback on whether the code has the desired effect.*
4. *It worked and you could submit and re-submit in my own pace.*
5. *It gave quick feedback and enabled the rapid reconsideration once the changes were made.*
6. *It is quick and easy to use.*
7. *It provides rapid feedback to training allows you to test things quickly.*
8. *This saves time and can quickly provide feedback. The resubmission exercise is very useful.*

We can briefly summarize and discuss the following students' views: students mentioned specifically the usefulness of the feedback system that allows them to identify errors, which made their work easier (3). In addition, some students explicitly mentioned the advantages of testing system as reassurance about the accuracy of the code, or the flexibility to do so at any time (4). It is interesting that one student mentioned the objectivity of such system (2) - probably this post is based on experience with the manual assessment.

Answers to the question why students do not like the testing system:

1. *Error messages are not easy to understand.*
2. *It takes some time to understand how to interpret error messages.*
3. *The system complains about negligible reasons, such as improper function names, etc.*
4. *Relentless machine.*
5. *Small errors resulted in a complete failure of the test.*

Several comments (1-2) stated that it was difficult to understand feedback messages from the automatic testing system. The reading of error messages is of course a key skill which importance is often underestimated. We think that the introduction of error messages from the automatic testing is generally very helpful, and we acquaint students with the meaning of error messages in advance. At points 3 and 5, it is unclear whether these comments relate to feedback on the code or assessment. If the observations relate to the code, then reflect misunderstanding (and thus lack in our teaching) of the importance documenting code and how important it is all right in software development.

The main advantage of using an automatic testing system is the reduction of the amount of exhaustive work at evaluation of the correctness of student solutions and at provision of essential feedback to the students' program code. This allowed us to very significantly increase the number of exercises that students perform as part of the course, which helped students to engage more actively with content and resulted in deeper learning and increased student satisfaction. These findings are also consistent with papers dealing with similar topic, for example (McBroom et al., 2016; Kyrilov, 2016; Keuning, Jeuring and Heeren, 2016).

The testing system spares time to teaching staff that could otherwise be devoted to manual testing, and which can now be used where necessary to repeat material, explain concepts,

discuss the elegance, purity, clarity and effectiveness of the code and suggest alternative or advanced design solutions for those who are interested in, without having to increase the number of contact hours.

Due to effective learning through active self-paced exercises, we were also able to increase the breadth and depth of materials in some of our courses without increasing the contact time or time devoted student of the course.

Other improvements based on the experience of the students is that the system allows and encourages flexible working hours. Feedback is available to students from anywhere (provided they have Internet access), any time of day or night, rather than being limited to the location and hours that laboratory sessions are scheduled. Those students who wish can get more feedback and consultation from our teachers. We believe that increasing the number of exercises is an effective way to educate students to become better programmers. Also, student had positive feedbacks on our automated testing system.

## CONCLUSION

We introduced an automatic testing and feedback system that we have developed and deployed to teach programming in our programming courses. We have provided some data from one semester of the use of our system. These data illustrate that students utilize well “iterative refinement” of their program codes. They also benefit from increased flexibility which this system brings them. The testing system has also helped to reduce of time of teachers which they would have spent on administration and manual testing. Hence, their time can be now devoted more effectively to the support of those students who need this. With the increasing number of students, we expect that our testing system will continue to provide us above mentioned advantages, and will give students the advantage of quick, effective and unbiased evaluation.

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# FINANCIAL LITERACY OF UNIVERSITY STUDENTS IN RELATION TO FINANCIAL SECURITY IN OLD AGE

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## ABSTRACT

The aim of the paper is to assess the level of financial literacy in full-time university students in relation to their financial security in old age. Processed primary data was obtained in the framework of quantitative research through a questionnaire survey ( $n = 484$ ), which was implemented in 2016 among full-time bachelor's and master's degree students of Business and Administration at Faculty of Economics and Management Czech University of Life Sciences. The results show that financial security in old age is currently an issue for 48% respondents, 76% of the respondents are planning to fund their needs in retirement by state provided pension with the need for another means of funding. The statistical analysis of the data obtained revealed demonstrable weak correlation between the level of education and approach to both of the above mentioned issues.

## KEYWORDS

Education, Financial Literacy, Income, Student, Financial Security, Old Age

## INTRODUCTION

Finances and financial flows are one of the most important elements in modern society. In this context, the significance of financial literacy as part of functional literacy of the population as a whole increases. Hidden nature of modern financial instruments, their inherent complexity on the one hand, and ease of use in practice on the other hand, leads to a significant rise in demands on financial literacy (Pavelková, Knaifl and Preuss, 2012). Bucher-Koenen et al (2016) point out that last but not least, knowledge of financial literacy is linked to economic behavior, including decision making and planning for retirement and financial security in old age. This is confirmed also by Vidovičová (2012), who states that due to the recent political and financial reforms the pressure on individuals has increased when it comes to responsibility for financial security in retirement. One of the tools for improving the ability to make informed decisions in financial security in the future old age is financial education of all age groups in order to assist them in taking responsibility for financial security of themselves and their families (Kazda, Petraskova and Rosa, 2016).

The issue to what extent people in the Czech Republic are planning retirement and how prepared they are for it, is dealt with in detail by Šlapák and Soukup (2007), who highlight that a surprisingly high number of future retirees do not pay any attention to this matter. In addition to the inertia of financial planning of a significant group of people, which is described in several foreign surveys, the cause is the low level of financial literacy and related knowledge. Following this, Svobodová (2009) indicates that most of today's

seniors had begun to prepare for their old age only after the fiftieth year of age, whereas a considerable proportion of them had not even thought about preparing for retirement in advance. Over time, however, there is a positive shift towards a more aware behavior as for financial security because most of today's young and middle-aged begin to prepare much earlier.

Based on the above mentioned, it can be said that the issue of financial literacy of young people in relation to financial security in old age is an important area of interest for future social and economic development of the Czech Republic, but also all economically developed countries.

The aim of the paper is to assess the level of financial literacy in full-time university (bachelor's and master's program) students in relation to their financial security in old age through conducted research. In the Introduction, a theoretical background of the examined issue is provided. The Materials and Methods section of this paper describes how the primary research was conducted as well as the samples of respondents. Results section presents the results obtained, in Discussion chapter, discussion and comparison of the final results of own research with similar studies in the context of the issue are conducted.

## **MATERIALS AND METHODS**

The theoretical background of this paper has been based on an analysis of secondary sources gained from scholarly papers, specialized literature and official web portals. Primary data have been obtained through an own conducted survey.

The survey was conducted in an electronic form during February semester of 2016/17 among full-time students of Business and Administration at the Faculty of Economics and Management at Czech University of Life Sciences in Prague. The sample was intentional and questionnaire survey on financial literacy was attended by 484 respondents from a total of 1,727 active full-time students of Business and Administration. Of the total number of active students, 1,093 were studying in bachelor's degree and 634 in master's degree programs.

Basic sociodemographic factors of the reference group of respondents were as follows.

### **Statistical Means for Analysis**

The contingency table is used for transparent visualization of mutual relations of two statistical variables. The type of the contingency table is given by the number of rows  $r$  and the number of columns  $s$ , is means  $r \times s$  (Hindls et al, 2007). Obviously,  $\chi^2$  is a measurement of the overall dissimilarity of  $n_{ij}$  and  $m_{ij}$ . The bigger the difference between observed and expected values, the higher is the test statistic  $\chi^2$ .  $i$  and  $j$  are indexes of rows and columns,  $n_{ij}$  are observed marginal frequencies,  $n_i$  and  $n_j$  are marginal totals,  $n$  is grand total of observations,  $m_{ij}$  are expected frequencies. We compare  $\chi^2$  to the critical value  $\chi^2$  with a chi-square distribution of  $(r-1)(s-1)$  degrees of freedom at the chosen level of significance. We reject the hypothesis if  $\chi^2$  is larger than the table value. This test is valid asymptotically, and thus can only be applied if there is a sufficient number of observations. All expected values ought to be higher than one (Hendl, 2009); at the same time, the table should not contain more than 20% theoretical incidence rates (frequencies) of less than 5. Where zero values occur in any of the fields, we proceed to analyze a derived table, created by merging a small number of categories (Hendl, 2009). Cramér's  $V$  was used to determine the degree of association between the variables.

Gender	Females	71.00
	Males	39.00
Level of study	Bachelor's degree	54.55
	Master's degree	45.45
Permanent Residence	Prague	50.21
	Central Bohemian Region	25.21
	Ústí Region	4.55
	South Bohemian	3.93
	Hradec Králové Region	3.72
	Pardubice Region	2.69
	Vysočina Region	2.26
	Plzeň Region	2.26
	Moravian-Silesian Region	1.45
	Karlovy Vary Region	1.45
	Liberec Region	1.24
	South Moravia Region	0.62
	Zlín Region	0.41
	Olomouc Region	0.00
Size of Place of Residence	up to 500 inhabitants	9.50
	501 – 2 000 inhabitants	12.00
	2 001 – 5 000 inhabitants	6.60
	5001 – 10 000 inhabitants	6.40
	over 10 000 inhabitants	65.50

**Table 1: Sociodemographic factors of respondents in % (source: Own research, 2016)**

The following hypotheses were the subject of the data analysis.

- H01: The fact that a student saves part of his/her income as a reserve in case of unforeseen expenditures does not depend on gender.
- H02: The fact that a student saves part of his/her income as a reserve in case of unforeseen expenditures, does not depend on level of study.
- H03: Whether a student has been thinking about old age provision does not depend on gender.
- H04: Whether a student has been thinking about old age provision, does not depend on level of study.
- H05: The means by which a student plans to finance their needs in retirement do not depend on gender.
- H06: The means by which a student plans to finance their needs in retirement do not depend on the level of study

Data were aggregated into pivot tables and processed by the above mentioned method. The following abbreviations are used in this paper: BAA: Business and Administration, CULS: Czech University of Life Science in Prague, FEM: Faculty of Economics and Management.

## RESULTS

In this chapter, the results of primary research in the field of financial literacy in university students are presented, including comments.

Sex / Response	Yes	No	Total
Females	271	75	346
Males	104	34	138
Total	375	109	484

**Table 2: The relationship between whether a student saves part of their incomes as a reserve for unforeseen expenditures and gender (source: Own research, 2016)**

Of the total of 484 respondents, 77% save part of their incomes as a reserve for unforeseen expenditures. The calculated chi-square value of 0.50 is smaller than 2.84, which is the critical value of the division by 1 degree of freedom at level 0.95. Null hypothesis cannot therefore be rejected. Saving financial reserves does not depend on gender of the respondent.

Level of study / Response	Yes	No	Total
Bachelor's degree	193	71	264
Master's degree	182	38	220
Total	375	109	484

**Table 3: The relationship between whether a student saves part of their incomes as a reserve for unforeseen expenditures and level of study (source: Own research, 2016)**

The calculated chi-square value of 6.84 is higher than the critical value of the division by 1 degree of freedom at level 0.95. Null hypothesis can therefore be rejected. Degree of association measured by Cramer's *V* reaches the value of only 0.11, and is thus weak. The differences between the calculated and actually measured frequencies indicates that respondents in master's degree programs save to a greater extent than bachelor's degree students. In both groups, vast majority of respondents save money. The proportion of those who do not save is practically half in higher degree students (27% of respondents in bachelor's degree program, but only 17% in the master's degree do not save). Creating a financial reserve for unforeseen expenditures depends on level of study.

Sex / Response	Yes	Rather yes	Rather no	No	I don't know	Total
Females	92	71	133	48	2	346
Males	42	28	47	20	1	138
Total	134	99	180	68	3	484

**Table 4: The relationship between whether a student has been thinking about their financial security in old age and gender (source: Own research, 2016)**

Of the total number of respondents, 48% have been thinking about their old age provision. For statistical evaluation, the answer "I do not know" has been aggregated with the semantically similar answer "No". The reason is that only three respondents have answered "I do not know".

The calculated chi-square value of 1.08 is smaller than the critical value of the division by 3 degrees of freedom at level 0.95, which is 7.81. Null hypothesis cannot therefore be rejected. Providing for retirement therefore does not depend on gender of the respondent. Considering provision in old age does not depend on gender of the respondent.

Level of study / Response	Yes	Rather yes	Rather no	No	I don't know	Total
Bachelor's degree	49	71	100	43	1	264
Master's degree	85	28	80	25	2	220
Total	134	99	180	68	3	484

**Table 5: The relationship between whether a student has been thinking about their financial security in old age and level of study (source: Own research, 2016)**

Also in this case, the columns “No” and “I do not know” have been merged for the purpose of calculation.

The calculated chi-square value of 30.90 is higher than the critical value of the division by 3 degrees of freedom at level 0.95. Null hypothesis can therefore be rejected. The degree of association, as measured by Cramer's  $V$ , is weak ( $V=0.25$ ). Considering financial provision in old age depends on level of study of the respondent. By analysis of shift in preferences, clarification of approach of higher degree respondents and increased interest in provision in old age are apparent in particular. The most significant is the shift of answers towards a definite “yes” (from 19% in bachelor's degree program to 37% in master's degree program). Percentages of all other responses are lower in higher degree study.

Gender / Response	By state pension and with other means	Just with other means	Total
Females	285	61	346
Males	84	54	138
Total	369	115	484

**Table 6: The relationship between how a student plans to fund their needs in retirement age and gender (source: Own research, 2016)**

Of the total number of respondents, 76.24% are planning to fund their needs in retirement through a pension provided by the state with the necessity of another means. The calculated chi-square value of 25.17 is higher than the critical value of the division by 1 degree of freedom at level 0.95. Null hypothesis can therefore be rejected. The degree of association, as measured by Cramer's  $V$ , is weak ( $V=0.23$ ). In both genders, prevailing respondents are those who think about providing for retirement through pension and other means (the group of respondents who thought only about providing for retirement without other means amounted to only 9 respondents and was therefore, for the purposes of processing, consolidated with multi-source provision proponents). The means by which a student plans to fund their needs in retirement does not depend on gender.

Level of study / Response	By state pension and with other means	Just with other means	Total
Bachelor's degree	285	61	346
Master's degree	84	54	138
Total	369	115	484

**Table 7: The relationship between the means by which a student plans to fund their needs in retirement and level of study (source: Own research, 2016)**

The calculated chi-square value of 11.79 is higher than the critical value of the division by 1 degree of freedom at level 0.95. Null hypothesis can therefore be rejected. However, the degree of association, as measured by Cramer's  $V$ , is weak ( $V=0.16$ ). The means by which a student plans to fund their needs in retirement depends on their current level

of study. In higher degrees of education, the results show a shift from relying on the pension system with other means of financial security to relying on other means only; however, although to less extent, preferences of combination of other means with the pension system prevail.

## **DISCUSSION**

The issue of financial literacy in university students has been the subject of scientific research for a longer period of time. Chen and Volpe (1998) conducted a survey among a sample of 924 university students and observed that a lower level of monitored knowledge was traced in students of non-economic fields, females and students in lower grades. The authors believe that the low level of knowledge in financial sector limits the ability of individuals to make informed decisions.

Of the total number ( $n = 484$ ), respondents corresponding to more than three quarters (77.48%) indicated that they have currently already been saving part of their incomes as a reserve for unforeseen expenditures. This fact reflects a responsible approach of university students to reality, which is also in compliance with the statement of Van Rooij, Lusardi and Alessie (2011), who believe that increasing financial literacy is associated with higher and more responsible approach to planning for the future.

Survey results show that in case of two of three monitored questions, gender differentiation was not proven. Moderate dependence was only found in connection between the planned means of funding the needs of the respondents in retirement and gender. In this question, some of the students took the opportunity to list other means of financial security provision when commenting on pension system, so the relevance of the results is smaller. The results, however, show evident respondents' distrust of using the pension system without other means of financial security. This distrust is greater among males than among females.

According to the views of some foreign authors (Bucher-Koenen et al, 2016; Lusardi and Mitchell, 2008; Chen and Volpe, 1998) females show a lower level of financial literacy than males. This can become a social issue due to the fact that females generally live longer than males and it can be assumed that it is highly likely they will spend part of their lives widowed (Bucher-Koenen et al, 2016; Lusardi and Mitchell, 2008). It should be noted that the results of the survey were probably influenced by the fact that the respondents were students of economic field, therefore it is possible to predict a higher level of awareness of financial issues due to the nature of their study. Bucher-Koenen et al (2016) consider improvement in the financial literacy of females as a key factor in their preparing for retirement and supporting their financial security in retirement.

Old age provision has somehow been considered by less than half (48.14%) of the respondents, 27.69% marked the response "yes" and 20.45% responded "rather yes". Unequivocally negative response ("no") was chosen by 14.05% and the response "rather no" was chosen by 37.19% of the students questioned. The results of research conducted by the Ministry of Finance CR (2016) shows that alternative forms of financing pensionis used mainly by people with university education. It can be stated that there is a direct connection between financial knowledge and planning for adequate financial security in old age Van Rooij, Lusardi and Alessie (2011) and an emphasis on accountability and policy of increasing financial literacy, will probably have a positive impact on saving and creating assets in young adults in the future Letkiewicz and Fox (2014).

According to Angulo-Ruiz and Pergelova (2015), external factors play an important role in financial literacy of young people. Also, sociodemographic factors and positive

family patterns play an indispensable role (Angulo-Ruiz and Pergelova, 2015; Lusardi, Mitchell and Curto, 2010). Despite the existence of cultural and national differences in individual countries, influence of the factors that affect the level of financial literacy can be generalized (Nicolini, Cude, and Chatterjee, 2013).

## CONCLUSION

Results showed that full-time students of bachelor's and master's study programs of Business and Administration at FEM CULS think about their future financial security in old age. Research demonstrated statistical correlation between level of study and approach to financial security in old age. Research shows that university students in follow-up master's degree programs save some of their incomes as a reserve in case of need. The mentioned students do so to a greater extent than bachelor's degree students, and these students also think more about the issue of their future financial security in old age and the form of its funding.

The theoretical contribution of the paper is to highlight the issue of financial literacy in relation to financial security in old age; the practical contribution of the paper is to present the results of financial literacy in university students of Business and Administration at FEM CULS and prove the relationship between this area of study and level of study.

The limiting factor of this paper may be the fact that the survey was conducted only among students of one economic field of study at one university. It is assumed that the research that was conducted will be repeated in order to compare results over time. A possible direction for future research is the implementation of a questionnaire survey within the non-economic fields of study at various universities for purposes of comparison with the economic fields.

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# SCIENCE REASONING AND CULTURE OF PROBLEM SOLVING

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## ABSTRACT

This contribution reports the results of a study, the aim of which was to find out correlations among the three components of the Culture of problem solving structure (Reading comprehension, Creativity and Ability to use the existing knowledge) and six dimensions of Scientific reasoning. The Culture of problem solving structure has been introduced by the contribution authors as a tool for describing the pupil's ability towards solving mathematical problems. Scientific reasoning is defined as a set of basic reasoning skills which includes systematically exploring a problem, formulating and testing hypotheses, controlling and manipulating variables and evaluating experimental outcomes. This survey was conducted among 23 pupils aged between 14–15 years. The results have shown that one component of the Culture of problem solving – the Ability to use the existing knowledge – strongly correlates with three dimensions of the Scientific reasoning structure: Proportional reasoning, Control of variables and Probability reasoning.

## KEYWORDS

Culture of Problem Solving, Mathematics Education, Primary School, Scientific Reasoning

## INTRODUCTION

The paper is one of the outcomes of the research project concerning with developing culture of solving problems in school mathematics. It deals with mutual relations between the Culture of problem solving (CPS) and Scientific reasoning (SR).

### The Culture of problem solving

In order to be able to describe a pupil's ability to solve mathematical problems, we have introduced the so-called Culture of problem solving construct within the research mentioned above. When composing the components of the structure, we drew on previous works (e.g. Herl et al., 1999; Wu and Adams, 2006), among which the work of Wu and Adams (2006) was the most relevant. The composition of CPS is described in detail in (Eisenmann et al., 2015). This structure consists of four components: intelligence (I), reading comprehension (RC), creativity (C) and ability to use the existing knowledge (UK).

There are no doubts about the indispensability of including *intelligence* in the structure of CPS. As Wenke, Frensch and Funke (2005) state, from the inception of the concept of 'intelligence', the ability to solve problems has featured prominently in virtually every definition of human intelligence. In addition, intelligence has often been viewed as one of the best predictors of the problem-solving ability.

The second component is *reading comprehension*. Obviously, this is one of the key competences without which successful problem solving would be impossible, as pointed out by a number of authors (Pape, 2004; Schoenfeld, 1992) and verified by Hite (2009).

The third component is *creativity*. The key role of creativity in problem solving is discussed for example by Sriraman (2005). Nadjafikhah, Yaftian and Bakhshalizadeh (2012) speak of creative problem solving. “At the school level, creativity in mathematics is generally related to problem solving and or problem posing.” (Nadjafikhah, Yaftian and Bakhshalizadeh, 2012: 290)

The fourth component is the *ability to use the existing knowledge*. This ability has been considered as a prerequisite to successful solving of non-routine problems. Whilst solving such kinds of problems, the knowledge itself is not sufficient; the solver must also be able to use it.

With respect to an individual pupil, we find the use of CPS in teaching important in three areas. The knowledge of a pupil’s CPS can help the teacher select appropriate problems the pupil will be able to solve successfully. Also, it may help eliminate a pupil’s weaknesses that may be an obstacle to solving problems. Knowing pupil’s CPS may help the teacher decide which heuristic strategies should be used and in being aware of the depth in which these strategies can be handed over to the pupil.

## **Scientific reasoning**

The literature dealing with this issue (Han, 2013; Zimmerman, 2007) suggests that SR (in early studies also the terms ‘formal reasoning’ or ‘critical thinking’ are used) is defined in terms of a set of basic reasoning skills which includes systematically exploring a problem, formulating and testing hypotheses, controlling and manipulating variables and evaluating experimental outcomes.

Science inquiry is considered to be the core component of STEM education (Science, Technology, Engineering and Math), therefore the scientific reasoning skills are emphasized in science education. Children’s scientific thinking is interesting not only for researchers but also for teachers who can determine the best methods for improving learning and instruction in science education. Some research has shown that particularly inquiry-based science instruction can promote scientific reasoning abilities.

## **The relation between CPS and SR**

Much research has been carried out to find out how scientific reasoning relates to other areas of learning. For example Shayer and Adey (1993) argue that instruction in scientific reasoning has a permanent impact on general learning ability. They carried out a study comparing students who received scientific reasoning-based teaching with those who did not. They showed that the reasoning-based group (at age of 16) outperformed the control group on tests not only in Science but also in English and Mathematics.

The P21 (Partnership for 21st Century Skills – a group of corporations who partnered with the U.S. Department of Education in 2002) has created a framework that identifies the key skills for success, the so called ‘21st Century skills’. These include, among others, creativity, critical thinking and problem solving. Scientific reasoning skills are good tools for the purpose of the development of these key skills. As CPS includes reading comprehension and creativity in its structure, we suppose that a relation exists between CPS and SR and this is the point we wish to focus on in our contribution.

## Objectives

We endeavour to find potential correlations between individual CPS components and SR dimensions by means of appropriate research with pupils. This contribution describes the first pilot research the aim of which, in particular, is to formulate first hypotheses concerning correlations between individual CPS components and SR dimensions. As it is possible to expect, with high probability, that intelligence (the first CPS component) has a relation to all above-mentioned SR dimensions, we have narrowed our pilot research to the testing of the three remaining CPS components. The secondary task of the pilot research is to carry out the mapping of any possible relations between individual SR dimensions.

## MATERIALS AND METHODS

The following subsections focus on the art of measuring both the constructs and the description of the sample.

### Culture of problem solving

As far as *reading comprehension* is concerned, the pupils were set a short text of 15 lines. Afterwards, their task was to answer correctly 9 questions (from 4-item-multiple-choice possibilities they were selecting one correct answer). The aggregate of all points has formed the total score. The test is built on the same principle as the one used in the PISA research.

*Creativity* was understood in the context of divergent thinking. Its level was measured by Guilford's Alternative Uses Test, which measures the following four dimensions:

- Fluency – how many relevant uses the pupil proposes;
- Originality – how unusual these uses are;
- Flexibility – how many areas the answers refer to;
- Elaboration – quality and number of details in the answer.

The pupils proposed as many 'uses of common objects' as possible. What is important here is how logical and practicable the answers were. Qualitative evaluation of each dimension was translated into points and the total score indicating an index of creativity. The higher the index, the more creative the pupil is assessed to be.

The pupils' *ability to use their existing knowledge* was assessed on the basis of a set of problems developed by the research team. Dyads of problems were used for this written testing – the first problem to find out whether a pupil has a particular piece of knowledge and the other to find out whether the pupil can use or apply it. The more frequent is the situation in which the pupil has the required knowledge and can use it at the same time (i.e. both the tasks of the given dyad are solved correctly), the higher is the score he will achieve in the area of this component.

Example of a dyad:

a) Solve the equation:  $6x + 4x + 2x = 18$

b) There are three vessels of water. Each of them has a different volume and in total they contain 19.5 litres of water. The largest vessel contains twice as much water as the medium one and the medium vessel contains four times more water than the smallest one. How many litres of water are in each of the vessels?

All three above-named CPS components have been tested during the course of a single 45-minute teaching unit. The section of the test focused on reading comprehension lasted 14 minutes, the creativity section was expected to be completed in 7 minutes, and the third

section, which concentrated on the ability to use the students' existing knowledge lasted 14 minutes as well. All tested pupils were working independently, they were not allowed to use either calculators or any other technological devices. All parts of the test were then evaluated by the authors of the contribution themselves.

## **Scientific reasoning**

Scientific reasoning was tested by the Lawson's Classroom Test of Scientific reasoning (Lawson, 1978) which has gained the largest popularity among researchers and teachers. Since its initial development, the test has undergone several revisions. We used the Czech version (Dvořáková, 2016) of the current version of Lawson's test released in 2000 and according to Han (2013) we carried out small corrections in items 8a and 8b.

The Lawson's test is a 24-item, two-tier, multiple choice test. Each of the two-tier items (from the total number of 12 pairs) consists of a question with some possible answers followed by a second question giving possible reasons for the response to the first question. The Lawson's test assesses students' reasoning abilities in six dimensions including conservation of matter (items 1, 2) and volume (CONSER) (items 3, 4), proportional reasoning (PROPOR) (items 5, 6, 7, 8), control of variables (VARIABL) (items 9, 10, 11, 12, 13, 14), probability reasoning (PROBAB) (items 15, 16, 17, 18), correlation reasoning (CORREL) (items 19, 20) and hypothetical-deductive reasoning (HYPDED) (items 21, 22, 23, 24).

The items have an increasing difficulty. With regard to the evaluation of the test, for tasks 1 through to 22 the points are awarded only when both the related tasks are resolved correctly. Only tasks 23 and 24 are independent and for that reason they are also evaluated independently.

In our study we aimed at the ninth grade of primary school because Han (2013: 86) found out that the Lawson's test worked well just with 9th graders. The pupils were solving the task during one teaching unit. At first they were briefly instructed by their teacher and then they received approx. 30 minutes for the solution of the test. They worked independently and were not allowed to use either calculators or tables. The test was evaluated by the authors of this paper.

## **Sample**

Altogether 23 pupils (12 girls and 11 boys) from one class of the ninth grade aged between 14–15, from one primary school in Teplice took part in our pilot study. Describing the pupils' school performance, they can be characterized as common learners, representing average class in the Czech Republic. Such evaluation has been backed up by two sources: the grade in mathematics and physics in the 2015/2016 school report and the evaluation of their mathematics and physics teacher. The arithmetic mean of the grade achieved in mathematics is 2.1 with standard deviation of 0.13, in physics 2.2 with standard deviation of 0.12.

## **Statistical evaluation**

On account of type variables we used Spearman's rank correlation coefficients to measure the strength of relationship between two variables. The calculation was realized by STATISTICA 12.0 (StatSoft, Inc.).

## RESULTS AND DISCUSSION

At first we explored correlations between RC, C and UK components of CPS construct. With none of the pairs it is possible to reject a null hypothesis that correlation coefficient is zero at the 5% level of significance. Similarly the correlations between the dimensions of SR were explored. The results can be seen in Table 1.

Pairs of dimensions	<i>N</i>	Spearman <i>R</i>	<i>R</i> <sup>2</sup>	<i>p</i> -level
CONSER & PROPOR	18	0.650940	0.423723	0.003436
CONSER & PROBAB	18	0.513511	0.263694	0.029280
PROPOR & VARIABL	18	0.616525	0.380103	0.006431
PROPOR & PROBAB	18	0.542618	0.294434	0.019981
VARIABL & PROBAB	18	0.504459	0.254479	0.032768
UK & PROPOR	15	0.814286	0.663062	0.000219
UK & VARIABL	15	0.574193	0.329698	0.025187
UK & PROBAB	15	0.541332	0.293040	0.037157

**Table 1: Spearman correlation coefficients**

Although the sample size is not so extent, we find five pairs of strongly correlated dimensions, in which we can reject the hypothesis of the zero-value of the correlation coefficient at the 5% level of significance. Therefore, four dimensions correlate together (CONSER, PROPOR, VARIABL a PROBAB), with the remaining two dimensions (CORREL a HYPDED) no correlation with any further dimension has been revealed.

The main target of our research, however, was to investigate correlations between the SR dimensions and the CPS construct components. Three strongly correlating pairs can be observed here, where we reject the hypothesis of the zero-value of the correlation coefficient at the 5% level of significance. With the UK component from the CPS construct three dimensions of SR correlate like this – PROPOR, VARIABL a PROBAB.

The correlation coefficients show that there is a narrow relationship between the first four dimensions of SR (excluding CONSER and VARIABL). The understanding of the conservation of mass and volume (CONSER) and proportional reasoning (PROPOR) are basic skills that children usually develop at a fairly young age. The abilities of the control of variables (VARIABL) and understanding probability (PROBAB) start to develop more significantly at the end of primary school and the process continues throughout the first years of secondary school (Han, 2013). Individual dimensions of SR are not independent, but they create a hierarchy, which means that the successful solution of tasks from the higher dimension supposes the mastering of tasks from the lower dimensions. Based on the discovery of strong correlations between the first four dimensions, we assume that their good mastering creates the necessary background for the successful development of reasoning skills in the area of higher dimensions for this age category (at the end of primary school).

In our research we have noticed only weak correlations between CORREL and the previous four dimensions, which are not, however, statistically significant. This finding could be connected with the fact that only a one pair-item is devoted to this dimension; thus pupils can get either two points or no point at all.

The hypothetical-deductive reasoning (HYPDED) is the most complicated ability in the Lawson's test, which represents the last stage of formal reasoning. This dimension is developed in particular during the students' stay at secondary school. Among the pupils of the ninth grade, its level is still very low and for that reason we did not come across a narrower correlation with other dimensions in our research.

As mentioned above, the first four dimensions of SR (CONSER, PROPOR, VARIABL, PROBAB) correlate together (with the majority of pairs correlating in a very strong way) and they therefore create the necessary background for the development of other, higher dimensions. In our research we have also found out that three of the dimensions (PROPOR, VARIABL a PROBAB) at the same time strongly correlate with UK (with UK also correlating slightly with the lowest dimension CONSER). On the basis of these findings we assume that the mastering of UK among students at the end of primary school is tightly linked with the development of more general skills at the level of the first four dimensions. We therefore think that dimensions PROPOR, VARIABL, PROBAB and component UK are important for the further development of learners in the STEM area. Similarly, also foreign research points to the necessity to develop not only content understanding, but also scientific reasoning (Bao et. al., 2009). Positive correlations between student scientific reasoning abilities and measures of students' gains in learning science content have been reported also by Coletta and Phillips (2005). These findings support the consensus of the science education community on the need for students to develop an adequate level of scientific reasoning skills together with a solid foundation of content knowledge.

No stronger relationship has appeared between creativity from the CPS construct and SR dimensions, which is a considerably surprising finding rather than what we would expect here.

We can observe all the above-mentioned relations between the SR dimensions and the CPS components well-arranged in Figure 1. Full arrows suggest relations between observed dimensions and components that correlate at the 5% level of significance.

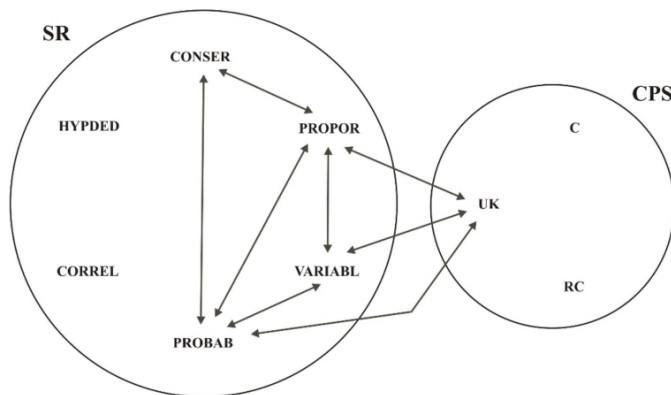


Figure 1: The scheme showing relations between SR dimensions and CPS components

## CONCLUSION

The results given in the previous chapter prove the legitimacy of the idea of exploring mutual relations between individual components of CPS and SR dimensions. In the sufficiently wide research ( $N = 200$ ) we will try to verify whether one of the components of the CPS structure, the ability to use the existing knowledge, really correlates so strongly to the three dimensions of SR – proportional reasoning, control of variables and probability reasoning, as it has been shown by the pilot study described in this paper. The aim of the subsequent research will be to verify the influence intelligence as the fourth component of CPS on individual dimensions of SR and in addition to that to confirm or disconfirm

a relatively surprising result of the pilot research that creativity does not correlate with SR dimensions. By means of demonstrating relations between both the constructs a path might be opened for teaching practice. It might show how to enable teachers to remove obstacles in pupils' problem solving more effectively, in particular with respect to courses in mathematics and physics.

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# PHYSICAL EDUCATION TEACHERS' CONCERNS AND THEIR RELATION WITH SELF-EFFICACY

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## ABSTRACT

The purpose of the study was to investigate the relation between teachers' self-efficacy and their concerns regarding physical education teaching. A total of 189 Physical Education teachers from different educational levels participated in the study. In order to measure the study variables, TCQ-PE and TSES were used. Results showed significant positive relations between self-efficacy and concerns in novice teachers, whereas they were negative in medium-experienced and female teachers. Our findings suggest the need to work on teachers' concerns and how to deal with them, especially in their early career phase.

## KEYWORDS

Physical Education Teachers, Concerns, Self-efficacy, Teaching Practices

## INTRODUCTION

Physical Education (PE) is nowadays considered as one of the most powerful vehicles for structuring healthy habits from early ages (SHAPE America, 2016), as primary and secondary education levels are in most of the countries obligatory, providing all kids with the possibility of being engaged in any type of physical activity, at the same time as they create a safe and controlled environment for such practices. In order to fight the increasing number of overweight and obese children worldwide (WHO, 2016), a well-structured curriculum and its articulation are necessary means for creating a high-quality PE environment. Thus, for conveying an impactful message, PE teachers and their teaching constitute essential elements of the process. Among the variables that may influence teachers' performance, self-efficacy, which represents teachers' beliefs and their perception of their own skills, has recently raised within the academic and research fields. At the same time, many researchers have focused on understanding and analyzing teachers' concerns, as they too contribute to the reflection and improvement of their practices. Raising teachers' efficacy, as well as providing them with tools to reduce their concerns, have become an integral part of many pre-service and in-service programs (Christophersen et al., 2016; Piovani, Both and do Nascimento, 2012).

According to Tschannen-Moran, Woolfolk Hoy and Hoy (1998) teachers' self-efficacy (TSE) refers to a belief in one's capabilities to manage and perform actions in a way to master established teaching tasks. Guskey and Passaro (1994) argue that this construct builds on teachers' believing in their own competencies to have a positive impact on students' learning processes. Related to specific and contextual requirements, resources, and constraints, TSE has been described as the reflection of successfully performed teaching tasks (Tschannen-Moran, Woolfolk Hoy and Hoy, 1998). However, due to the complexity of teaching, Klassen, Durksen, and Tze (2014) point to the differences in what

can be felt as a task conveyed with success. Owing to that, Tschannen-Moran, Woolfolk Hoy and Hoy (1998) suggested that the perception of one's success varies depending on different TSE domains. Consequently, the authors proposed a three-dimension model, constituting of instructional strategies (EIS), classroom management (ECM), and student motivation (ESE), that has been tested and supported in other studies (Holzberger, Philipp and Kunter, 2013; Skaalvik and Skaalvik, 2007). Considering the vital connection between self-efficacy and a successful content delivery, TSE has generated a rich line of research, demonstrating its positive correlation on student's engagement and achievement (Christophersen et al., 2016), or achieved outcomes (Tschannen-Moran, Woolfolk Hoy and Hoy, 1998), as well as being further linked to improved teachers' pedagogy (Lee, Cawthon, and Dawson, 2013), willingness to adapt new strategies (Brighton, 2003), and increased enthusiasm and persistence (Coldarci, 1992). As apparent from literature, believing in one's abilities to have a significant and meaningful impact on educational environments plays undoubtedly a vital role in carrying a high-quality teaching-learning process.

As mentioned above, another main contribution to teachers' growth, both professionally and personally, is represented by the understanding and analysis of their concerns of the teaching-learning process. According to Fuller (1969), teachers experience three different stages of concerns through their career. The first, known as *Self* phase, is also referred to as the survival stage, in which teachers are fighting to survive in real classroom settings, trying to develop skills related to classroom management, instructions, content knowledge, but also to be accepted by the teaching community. The author argues that once teachers get settled, they can move forward to the *Task*-related stage. In this phase, they shift their attention towards students' needs and their performance, as well as towards the teaching tasks they should conduct. Having overcome the *Self* period and built the belief that they can survive in any school context, in this stage teachers appear to be more open to trying new methods and strategies (Dubble, 1998). The last stage of teachers' concerns is related to the *Impact* that experienced teachers have on their students' learning. Although Fuller's (1969) theory proposes that teachers must firstly resolve the previous stage of concerns in order to move to the following one, findings have not been consistent, particularly in Physical Education (Behets, 1991; Hynes-Dusel, 1999). As suggested by Young (2012), this is due to the differences in the domains (cognitive, affective, and psychomotor) and nature of Physical Education compared to relatively stable classroom-based instructional activities (Ralph, 2004).

Considering the above stated arguments, it is clear that understanding both teachers' level of self-efficacy and stages of concerns is essential if we aim to plan appropriate training development programs for PE teachers. Although there have been many studies dealing with both variables independently, there are very few that would intend to determine a possible relation between them (Hong-Sik, 2010; Teixeira Ribeiro et al., 2016). For that reason, the objective of the study was to determine the relation between teachers' self-efficacy and their concerns. As a consequence, the following research questions emerged:

- What domains of self-efficacy are related to the domains of teachers concerns?
- What are the relation between TSE and Concerns based on experience level?
- What are the relation between TSE and Concerns based on gender?

## MATERIALS AND METHODS

The design was descriptive and cross-sectional, using a quantitative approach to investigate the relation between teachers' self-efficacy and their concerns towards the teaching-learning process.

The population included teachers from different urban areas of Monterrey, Mexico. The sampling technique was non-probabilistic based on convenience. The sample was originally composed by 200 primary and secondary school teachers. However, 11 teachers were excluded due to not answering to all questions of the instruments. Consequently, the final sample comprised of 189 teachers (Table 1).

To measure teachers' self-efficacy, we used the long 24-item form of the Teachers' Sense of Efficacy Scale (TSES) developed by Tschannen-Moran and Woolfolk Hoy (2001). The TSES is based on Banduras' (1977) model of self-efficacy factors, evaluating three major components (EIS, ECM, and ESE) through a 9-point Likert scale, ranging from 1 = 'Nothing' to 9 = 'A Great Deal'. To understand teachers' concerns we applied the Teachers Concerns Questionnaire – Physical Education (TCQ-PE), which was based on Fuller's theory of three stages of concerns, and consequently adapted by McBride (1993) for reflecting specifically the issues that PE teachers deal with during their career. The questionnaire consists of three dimensions: *Self*, *Task*, and *Impact*. Before filling the mentioned questionnaires, participants were asked to answer questions related to teaching context and demographics, including age, education background, number of years of experience, and the level at which they taught. Based on the years of teaching experience, the teachers were consequently divided into three groups: (1) novice – up to 5 years of experience; (2) medium experienced – from 6 to 10 years of experience; and (3) experienced teachers – from 11 years of teaching practice onward.

The obtained data was firstly deputed and an analysis of its quality was run, using *Standard Scores* and *Mahalanobis D<sup>2</sup>* techniques. Due to the non-parametric distribution of the data, *Spearman's* correlations test was used to establish the relation between the different dimensions of teachers' self-efficacy and teachers' concerns.

## RESULTS

The overall sample showed high mean values of ESE ( $7.17 \pm 1.03$ ), EIS ( $7.26 \pm 1.00$ ), and ECM ( $7.19 \pm 1.03$ ). In addition, above average levels of concerns were found in all dimensions (*Self* =  $3.04 \pm .87$ ; *task* =  $3.08 \pm .93$ ; and *impact* =  $3.07 \pm .91$ ). A summary of teachers' SE and concerns average scores by experience and gender is shown in table 1.

Spearman's analysis carried out considering the whole sample showed that only ESE was significantly correlated with self ( $r = .149$ ;  $p = .045$ ). However, when the sample was split by experience, significant correlations were found between SE and teachers' concerns in novice teachers. Regarding medium-experienced teachers, a significantly negative correlation was found between ECM and concerns about tasks ( $r = -.313$ ;  $p = .013$ ). No significant correlations were found for experienced teachers (Table 2).

Analyzing the sample by gender (Table 3), significant correlations were highlighted in male teachers for ESE with self ( $r = .229$ ;  $p = .007$ ), task ( $r = .186$ ;  $p = .029$ ), and impact ( $r = .174$ ;  $p = .042$ ); for EIS with self ( $r = .181$ ;  $p = .034$ ); and for ECM with self ( $r = .190$ ;  $p = .026$ ). In the female teachers' sample, negative significant correlations were found between EIS and task ( $r = -.372$ ;  $p = .012$ ).

Experience	Gender	N	Self-efficacy			Concerns		
			ESE	EIS	ECM	Self	Task	Impact
Novice	Male	36	6.99 ± .96	7.11 ± .96	7.03 ± .95	3.26 ± .87	3.31 ± .81	3.28 ± .87
	Female	10	7.00 ± 1.35	7.21 ± 1.00	6.82 ± 1.01	3.28 ± .77	3.36 ± .97	3.34 ± .83
Medium experienced	Male	44	7.22 ± .76	7.37 ± .83	7.32 ± .81	2.98 ± .79	3.07 ± .80	3.01 ± .80
	Female	19	7.35 ± .76	7.22 ± .86	7.31 ± .79	2.94 ± .75	3.00 ± .90	2.84 ± .93
Experienced	Male	58	7.20 ± 1.19	7.31 ± 1.10	7.26 ± 1.25	2.95 ± .98	3.03 ± 1.02	3.02 ± .97
	Female	16	7.21 ± 1.36	7.22 ± 1.35	7.10 ± 1.16	3.02 ± .91	2.71 ± 1.08	3.02 ± 1.01
Overall		189	7.17 ± 1.03	7.26 ± 1.00	7.19 ± 1.03	3.04 ± .87	3.08 ± .93	3.07 ± .91

Notes. ESE = Efficacy for Student Engagement; EIS = Efficacy for Instructional Strategies; ECM = Efficacy for Classroom Management

**Table 1: Descriptive results of teachers' self-efficacy and concerns dimensions by experience and gender**

Experience level	Self-efficacy dimension	Teachers' concerns		
		Self	Task	Impact
Novice	ESE	r = .369; p = .012*	r = .386; p = .008*	r = .392; p = .007*
	EIS	r = .461; p = .001*	r = .404; p = .005*	r = .456; p = .001*
	ECM	r = .433; p = .003*	r = .358; p = .015*	r = .478; p = .001*
Medium	ESE	r = .011; p = .929	r = -.116; p = .365	r = -.075; p = .561
	EIS	r = -.140; p = .273	r = -.220; p = .083	r = -.135; p = .293
	ECM	r = -.158; p = .217	r = -.313; p = .013*	r = -.204; p = .108
Experienced	ESE	r = .128; p = .276	r = .074; p = .532	r = .087; p = .460
	EIS	r = .037; p = .757	r = -.028; p = .814	r = -.004; p = .974
	ECM	r = .116; p = .325	r = .060; p = .611	r = .076; p = .521

Notes. ESE = Efficacy for Student Engagement; EIS = Efficacy for Instructional Strategies; ECM = Efficacy for Classroom Management; \* p < .05

**Table 2: Correlations between self-efficacy and concerns by level of experience**

Gender	Self-efficacy dimension	Teachers' concerns		
		Self	Task	Impact
Male	ESE	r = .229; p = .007*	r = .186; p = .029*	r = .174; p = .042*
	EIS	r = .181; p = .034*	r = .148; p = .084	r = .165; p = .052
	ECM	r = .190; p = .026*	r = .112; p = .089	r = .145; p = .189
Female	ESE	r = -.097; p = .527	r = -.160; p = .293	r = -.099; p = .520
	EIS	r = -.255; p = .091	r = -.372; p = .012*	r = -.256; p = .090
	ECM	r = -.170; p = .264	r = -.283; p = .059	r = -.199; p = .191

Notes. ESE = Efficacy for Student Engagement; EIS = Efficacy for Instructional Strategies; ECM = Efficacy for Classroom Management; \* p < .05

**Table 3: Correlations between self-efficacy and concerns by gender**

## DISCUSSION

The aim of our study was to assess the possible relation between teachers' self-efficacy and their concerns. Several findings in our study suggest that the higher self-efficacy teachers perceive, the more they are concerned about their performance. For instance, considering the whole sample, a significant positive correlation was found between ESE and *Self*. These outcomes are widely explained by the fact that in our sample all dimensions of TSE and concerns are significantly and positively correlated in novice teachers. Also,

male teachers perceiving themselves more efficacious in ESE demonstrated higher levels of concerns in *Self*, *Task*, and *Impact*. In addition, in the male sample EIS and ECM were positively related to the *Self* concern. This is a surprising result, as most of the authors in this field suggest that the more teachers believe in their skills and abilities the less they would be worried about the *Self* stage. Nevertheless, some studies showed outcomes in line with ours (de la Torre Cruz and Martínez-López, 2010; de la Torre Cruz and Cassanova, 2008). De la Torre Cruz and Martinez-Lopez (2010) relate the unexpected results to a stronger sense of commitment and failure at the same time. In other words, the more teachers believe in their skills and abilities, the more responsible they feel to reach the expectations. As a consequence, they set higher standards for their own teaching performance, which results in an increased fear of not achieving their in-class goals. On the other hand, our findings also revealed negative correlations between medium-experienced teachers' ECM and *Task*, as well as between EIS and *Task* in the female sample. Similar results were obtained in a study carried out by Boz and Boz (2010) who found a negative correlation between concerns variables and TSE constructs. This was also demonstrated in a previous work from Ghaith and Shabaan (1999), who argued that teachers who are aware of their abilities to successfully resolve issues related to their teaching tasks are less concerned about their teaching. This assumption has been also corroborated by other studies that demonstrated a positive relation between TSE and less stress or dissatisfaction.

## **CONCLUSION**

TSE and teaching concerns are essential elements influencing the enhancement of teachers' in-class performance. Based on the outcomes of our study, it seems to be clear that they both need to be taken into account in order to establish the most proper, individualized strategies in any Professional Development Program (PDP). Fostering self-efficacy might be crucial especially in novice teachers, as an increased perception of in-class efficacy could directly reduce teachers' concerns on the teaching-learning process. On the other hand, teachers with longer experience seem to believe to be always very efficient and thus have lower concerns. This attitude might in some cases lead to less willingness of self-improvement and to a stagnation of the teaching-learning process overtime. For this reason, PDP strategies for experienced teachers might focus on making them aware of possible incongruences between their high self-efficacy and their actual in-class performance, in order to raise their concerns and arouse their urge for enriching their knowledge and skills, if necessary. In order to satisfy students' academic, social, but also emotional needs, teachers should be given the possibility to discuss their concerns, as well as to obtain guidance, support, and advice on how to deal with their worries. Considering the important role that both self-efficacy and concerns play in shaping efficacious and self-confident teachers, it is important to explore more relations of these two constructs on both theoretical and practical level. This could provide us with a deeper understanding and enable us to create hypothesis connecting one's beliefs and practice. Therefore, we recommend to examine PE teachers' concerns and their relationship to their efficacy from both quantitative and qualitative perspectives. Moreover, other variables such as school features or academic performance could be explored.

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# THE ROLE OF SOCIAL NETWORK IN INFORMAL LEARNING OF THE GROUP OF DISTANCE LEARNING STUDENTS

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## ABSTRACT

Online social networks have changed a way of information sharing among people. Online social network has more capacity to disseminate information than conventional educational web platform and it is particularly suitable for communication among members of school class. Our paper examines how students of distance study used online social network system to participate in learning activities within their community. For this purpose, we used questionnaires and interviews with these students. We found out that most of interviewed student participated in learning activities within their community on online social network. This study indicates that students performed specific type of learning in informal learning space of online social network. The results can be used to enrich the whole educational process and improve the quality of communication among students, and among students and teachers.

## KEYWORDS

Social Network, Informal Learning, Case Study, Community of Inquiry Framework

## INTRODUCTION

At the present time, computer technologies penetrate increasingly into education. Web technologies known as Web 2.0 allow users to create their own multimedia content which they can share with other users. Users also can create personalized profiles and approaches that exploit the possibilities of linking with other web services. These technologies offer the best opportunities for innovation in education, for promotion of creativity and the use of collective intelligence (Greenhow et al., 2009; Arquera and Romero-Frias, 2013). Students have access to many information sources on the Internet or they can use various online educational systems. They use Internet application enabling and supporting various online social network interactions including informal cooperation in training, negotiation, discussions, peer reviews and mentoring. These communication activities can help students to manage their university courses, their individual school assignments and other. We still do not have enough experience and we are not fully aware of the implications of extent and the development of new technologies in education area. But growing body of research dealing with the challenges of how to reconcile the needs of students and schools with these technologies (Beranek and Nydl), and also how to improve our understanding of how these technologies affects learning (Greenhow et al, 2009; Tess, 2013). Meanwhile most existing studies have focused on the use of social networks within formal environments class (Churchill, 2009; Beranek and Remes, 2014; Shea et al., 2012), our study focuses on informal learning spaces within online social networks to investigate the formation and function of a learning community outside the formal classroom environment. Our research is focused on exploring the participation of students and informal learning processes within social networks.

The rest of the text is structured as follows: The next section deals with educational and social networks hypotheses proposed in this paper; section Results and Discussions describes experiments conducted with the intention to study the processes on-going online network and discuss the achieved results. Section Conclusions presents some evaluations of reached results and future lines of our work.

## **MATERIALS AND METHODS**

Tools for blogging or wiki are being now a common part of e-learning systems (for example Moodle), and universities often require students to use these tools (Beranek and Remes, 2013, 2014). Using social networking in education, however, is not as widespread, although these tools (especially Facebook) are ubiquitous and familiar to students. Just these last two factors contribute to the fact that possible ways to use social networks in education are studied intensively (especially Facebook) (Manca and Ranieri, 2013 Drlik and Beranek, 2015). Some research works explore social networks (Facebook), and their indirect relationship to learning and education (Selwyn, 2009). Other works (Madge et al., 2009) emphasize that the social network can be used by students for sharing their common experiences, practical and academic information. Social network can be used as an environment for discussions related to academic works, for the organizing meetings of students' work groups, and more. Manca and Ranieri brought in their paper (2013) an overview of the use of Facebook in the education area. Facebook, according to them, supports discussion among students, enables an easy development of multimedia content, contributes to resource sharing, increases availability of external sources for students, and supports their learning management. These authors noted that the use of Facebook for educational purposes is still relatively new, students may not be comfortable using Facebook or always willing to accept it as a tool used for educational purposes. One explanation drawn from this research is that students may perceive Facebook to be primarily a social tool; and its permeation with the life in the classroom, and the existing differences in status and authority among students and teachers can cause discomfort (Nadvornik, 2015).

Currently, the insight into the use of Web 2.0 tools also shifts from one platform, like Facebook, to the ability of individual students build their own Personal Learning Environment (PLE). PLE may include a combination of tools such as blogs, micro-blogging, social bookmarking, social networking and media sharing tools, but the selection and use of instruments is conducted solely on the basis of the individual student. PLE may be considered as a promising pedagogical approach to deliberate or intentional integration of formal and informal learning spaces and supporting self-regulated education in higher education (Dabbagh and Kitsantas, 2012).

In our work, we deal mainly with social networks in informal education. Formal learning is typically defined as learning that is sponsored by institutions, is planned and organized by teachers, consists of specific learning tasks, and generally leads to a degree or other certification (Hall, 2009; Dabbagh and Kitsantas, 2012). Definition of informal learning is not so clear. Some studies (Dabbagh and Kitsantas, 2012; Sackey et al., 2015) defines informal learning as learning that is initiated and carried out by students themselves. These activities usually take place outside of school institutions, and are relatively unstructured. Some authors proposed (Jeffs, 2010) that informal learning may also exist in the areas of school institutions such as corridors and canteens. Performed research highlights the advantage of the interpenetration of formal and informal educational spaces especially in the online learning environment. For example, it was found teaching to be most effective

when informal and formal learning coexist and different teaching methods are pursued through a more flexible learning ecosystems, which allow students to build on and to expand their formal education, and also to improve their attitude in learning processes (Dabbagh and Kitsantas, 2012). This study suggests that students are able to perform learning in such environments. Social networks outside the formal system and teacher supervision offer the possibility for students to suggest, to manage and to share content and focus of their study. Within a larger community, students can aggregate and share resources, participate in collective knowledge generation, and manage their own opinions.

## Research methodology

For exploring of the use of online social networks in informal classes, we used Community of Inquiry (CoI) framework, which was firstly formulated in the Garrison's works (Garrison, 2007, 2011; Garrison et al., 2000; 2006; Shea et al., 2012a; 2012b). Garrison defined basically three elements that allow scientists to determine whether the activities in examined learning environments (in our case within online social network) contain evidences of the educational experience and deeper levels of learning. Dimensions of CoI framework (see Fig.1) can be described as follows:



**Figure 1: Community of Inquiry framework (Garrison, 2007)**

Cognitive presence is an element, which includes four categories - triggering event (e.g., a feeling of incomprehension of specific topic), research (e.g., information sharing or new idea), integration (e.g., the formulation of solutions based on the integration of different ideas and messages) and solutions (e.g., testing or applying ideas). Social presence in the online environment (social network) is very important in determining the conditions for learning, because it creates a favourable environment to support critical thinking and interactions (Garrison, 2007). Contemporary social network technologies allow users easier to express emotions and social stimuli that can make online discussions more personal and appealing. This category can be detected, whether in an environment of social networks are expressing emotions, whether there is cooperation and mutual aid, and open communication.

The presence of teaching is represented by standard design and organizations (e.g., by defining of the goals of a study), and the existence of a direct instruction (e.g., instructions for debates). These actions are usually led by a teacher. Some authors suggest that some members of online community can initiate these tasks as well (Garrison et al., 2000; Garrison, 2007, 2011).

Our research worked with questionnaires and interviews in order to explore what dimensions of CoI framework are present in informal space of online social network used by distant study students.

### **Research questions**

Distance learning students study in different study programs at our faculty. During the semester, they meet approximately six times per semester within consultations in different subjects. Furthermore, they are reliant on self-recommended literature and e-learning courses. In some courses also, semester works or certain projects require cooperation among these students. For these purposes, combined study students use online social network (Facebook) as a tool where they can communicate with each other, where they can share experiences, challenges, results, materials, comments, documents, etc. Based on previous research (Drlik, Beranek, 2015), we assumed that students of distance learning study at our faculty would develop new learning ties as well as friendship links within their activities on the Facebook. Students, of course, are not obliged to use a social network in their education.

In this paper, we have examined the online social network as certain informal education space. We have tried to get certain overview of the activities that occurred within this informal education space. We have formulated the following research questions: 1. How much learning involvement occurs on online social network? 2. What type of participation occurs in informal learning spaces on these social networks, or more specifically, is there an evidence of learning in these areas?

### **RESULTS AND DISCUSSION**

We have obtained research data on basis of structured interviews with 28 students of distance learning. The interviews with students were conducted at the end of the winter semester of 2016. At first, demographic data were collected (the average age was 29.3 years). Subsequently, the students were interviewed about their experiences, feelings and motives of their activities on online social network. We were trying to get the data, particularly about active participation and contributions posted by them, content of contributions, their types, their number and more. We chose this methodology to provide a comprehensive view of how the participants used the social network to facilitate learning in the context of university education. Following types of contributions were defined: document - text created for sharing information, blog - post is typically used for sharing personal perspective, or reflection about some topic, discussion post - it is used to ask questions, to receive feedback, and to share content of interest to the community. Following the procedures used in previous research (Garrison et al, 2000; Garrison, 2007, 2011), we coded the responses of students with the aim to identify activities that would correspond to the categories for education, social and cognitive presence (according to the CoI model). However, we found out that the category of teaching presence cannot be detected reliably due to the lack of educational roles (e.g., no designated teacher) and learning objectives (e.g., no curriculum, no learning objectives). It was difficult to

determine whether some community members have tried to lead in a certain way informal community on online social network.

Also, research of other authors suggest that the original CoI framework cannot adequately explain the collaborative online learning activities among students (Shea et al., 2012a). These authors (Shea et al., 2012b; Scott et al., 2016) also state that motivational, metacognitive and behavioral activities, that students actively use within online social network show the characteristics the presence of learning. Therefore, a category learning presence was added to the original CoI model, see Table 2. Since our sample consists of communication that took place outside structured online classroom environment, behavior like students' self-regulation may emerge as community members pursue different personal learning and knowledge-sharing goals. Their cooperation is voluntary, and they are solely responsible for their own learning.

## Participation of community members

To estimate the degree of participation of community members, we dealt with quantitative data provided by students. Table 1 shows the total activity of 28 students. Of these students, 26 were actively involved, 2 students did not create any contribution, although they admitted that they were members of the respective Facebook group, and looked at some content, 4 students only responded to the contributions of other students, they did not create a new document or blog. In contrast, 22 students have been very active and has created 70 new posts (i.e., the documents or blogs, see Tab. 1). Average number of contributions per student was 12.6, which is quite a high number which testifies to the high engagement and close contacts of students. Overall, these results suggest active participation in learning beyond informal exchange group. But it is important to realize that this was a group of distance students who used Facebook to exchange messages, information, documents, objects within one semester.

Number of interviewed students	N = 28
Total number of created/initiated posts	352
Number of new posts <sup>1</sup>	70
The number of students who did not create any post	2
Number of active creators <sup>2</sup>	22
Number of posts per user	12.6

<sup>1</sup>Posts include new blogs and documents.

<sup>2</sup>Active creators are individuals who start a new post, not including people who only reply or comment on existing posts.

**Table 1: Participation of community members**

## Type of participation

The aim of our second research question was to understand the nature of participation and whether learning takes place in online social network. Table 2 shows the frequency of individual contributions as we placed them into specific categories.

Social presence occurs in the majority of messages (58%). 29% messages show the signs of cognitive presence. Learning presence appeared in 8% of analyzed messages. The teaching presence occurs less frequently than the other elements (5% coded messages). We researched also the number of messages not directly related to learning. This may be for example common event notification (meeting in a pub, etc.). Of the 352 reports mentioned, 40% are completely unrelated to learning.

Coded category	Coded subcategory	Number of instances	%
Cognitive presence		101	29
	Triggering event	39	
	Exploration	49	
	Integration	13	
Social presence		207	58
	Affective	61	
	Open communication	146	
Teaching presence		17	5
	Assessment	10	
	Design, organization	6	
	Direct instruction	1	
Learning presence		27	8
	Forethought, planning	7	
	Monitoring	7	
	Reflection	13	

**Table 2: Frequency and percentage of messages coded by presence category**

Based on these results we can say that the content of the communication in the framework of online social network contains an interesting mix of social, cognitive, teaching and learning interactions. It is not altogether surprising that social presence is present in most of these areas. However, we found a high level of cognitive presence and learning presence. Especially, learning presence suggest the existence of informal learning processes on students' online social network. More works deal with social networks in informal learning, but most of them focus on enterprise education, for example (Arquero and Romero-Frías; 2013). Although these works focus on a different area of education, they basically confirm our findings.

## CONCLUSION

In this study, we have shown that the social network supports the non-formal learning environment, and is therefore suitable for distance learning students whose personal contacts are limited. It allows community members to communicate, to share learning materials, to respond to certain stimuli from the study, to coordinate their activities (e.g., in the case of team projects). Although, the teaching presence is relatively low, the existence of learning presence category suggests that an online social network is an environment in which certain learning processes take place. So it seems that online social networks have the potential for informal learning within the different communities.

This study is limited by the methods of data acquisition and the size of the sample studied. Data were obtained on the basis of interviews. Distance learning students were interviewed about their activities on the social network. However, it was not possible to accurately verify their statements e.g., through direct access to their social networks.

Personal contacts of distance learning students are limited. But these students need to communicate, discuss, share study materials, experience, etc. Social network is a suitable environment for such activities.

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# IMPLEMENTATION OF TALENT MANAGEMENT ACTIVITIES IN THE CZECH ORGANISATIONS

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## ABSTRACT

The development of employees, their knowledge and abilities is an important issue of any organisation. The effort of every organisation is to have talented staff, and in the case that these employees are available in the organisation to ensure for them to be motivated to stay in the organisation. The aim of the paper is to evaluate the results of dependencies analysis of the implementation of talent management activities on selected variables and evaluate the approach of Czech organisations to this new trend. Data were obtained through questionnaire survey in selected Czech organisations ( $n = 389$ ). The results showed that in addressed organisations the chance of implementation of talent management activities in organisations operating on a national or international market was 2.726 times higher than that of organisations on a local or regional market as well as 1.752 times higher in organisations with more than 50 employees than in smaller organisations.

## KEYWORDS

Czech Organisations, Employee Development, Sign Scheme, Survey, Talent Management

## INTRODUCTION

The concept of the talent management has received much attention in recent years (Collings, Scullion and Vaiman, 2015) as confirmed by a large number of scientific publications on this topic. Ariss, Cascio and Paauwe (2014) and Lewis and Heckman (2006), however, mention the fragmentation of views on this concept, as well as the lack of a theoretical framework and its inconsistent definition. Farndale et al. (2014) view the talent management as a strategic resource integration that includes proactive identification, development and strategic deployment of high -performance key employees with a high potential. Tatoglu, Glaister and Demirbag (2016) agree with that, while pointing out that the talent management and activities connected with it should be seen primarily as a strategic response to changing market conditions faced by all organisations in the market. Among the most frequently mentioned changes is mainly aging of the work force, technological change, lack of talented workers and troubles with their attracting (Elegbe, 2010). As a result of these changes, it can be concluded that the training and development of talented workers within the talent management is one of the most important challenges for organisations in their way to success. This is also confirmed by Iles, Chuai and Preece (2010), who underline the ability of talent management to gain a competitive advantage through the identification, development and transfer of talented employees.

Talent management is understood as an important process through which it is possible to

ensure for the organisation to have staff in the required quantity and quality and to be in accordance with current and future business priorities (Wellins, Smith and Erker, 2009). Armstrong and Stephen (2015) see talent management as a certain process, which ensures for the organisation to have highly qualified people for achieving their goals. This is done through streamlining the flow of talents in the organisation or through encouraging new talents and maintaining their inflow. This investment in staff is comprehended by Turner and Kalman (2015) as a business strategy since talented employees can be crucial for the success and long-term survival of the organisation.

Thanks to continuous learning and employees' development, working potential is increased and it is beneficial to organisations, since the staff development is positively reflected in all organisational processes (Edgar, Geare, 2005). However, it is only one of the reasons why the human resource management with regard to training should be one of the main objectives of each organisation operating in the world nowadays. The possibility of education is in practice very often associated with a career growth and is often aimed at talented employees who have a high potential for an organisation (Wilden, Gudergan and Lings, 2010). However, in this way other employees, who may leave without using their potential, are often ignored.

Collings and Mellahi (2009) and Dries and Pepermans (2008) agree that despite the need for continuous development of the theory and practice of talent management, there is still a lack of empirical studies on this topic. In procedures of the talent management a number of errors can be found and organisations do not often have a comprehensive view and complex understanding of such concepts such as skills, abilities, key labour force or efficiency levels (Cheese, 2010). This situation is the fact that the study of the Boston Consulting Group in 2007 identified talent management as one of the five challenges for human resource management in upcoming years (Strack et al., 2007).

Turner and Kalman (2015) argue that talent management nowadays is quite different from the talent management known in the twentieth century. This is due to a number of forces such as globalisation, demographic changes, market, sector of operating or changes in the structure of organisations. These and other aspects have had an influence on the development of approaches to talent management and the implementation of individual activities within the framework of this conception. This contribution is a follow up to the article "Employee Development by Talent Management Implementation" (Fajčíková, Fejfarová and Urbancová, 2016) and extends the results with a more detailed analysis of selected variables dependencies. The aim of this paper is to evaluate the dependencies analysis results of the implementation of talent management activities on selected variables and evaluate the approach of Czech organisations to this new trend.

## **MATERIALS AND METHODS**

Theoretical resources related to staff training and development through talent management activities were obtained by the analysis of secondary sources. Primary data were obtained through a questionnaire survey, which covered the period from 10/2014 to 06/2015. The questionnaire survey was conducted in 389 organisations. It was a random selection of organisations from all regions and industries of the Czech Republic. A respondent was always a manager of human resources management in the organisation or an owner of the organisation (in the case of micro and small enterprises).

The electronic questionnaire was compiled of a closed or semi-open questions with several possible answers. The questions in the survey related to the activities of talent management in organisations. In total, 7 questions were asked, 4 of which were identifying. The research

questions regarding the implementation of talent management activities were asked. To test the dependence between qualitative characteristics, 4 null hypotheses associated with the application of talent management activities as an appropriate method of development of employees in organisations were determined.

1.  $H_{0_1}$ : Implementation of activities related to the talent management is not dependent on the market in which the organisation operates (local, regional, national, international).
2.  $H_{0_2}$ : Implementation of activities related to the talent management is not dependent on the sector of the organisation (primary, secondary, tertiary).
3.  $H_{0_3}$ : Implementation of activities related to the talent management is not dependent on the area in which the organisation operates (private, public, state).
4.  $H_{0_4}$ : Implementation of activities related to the talent management is not dependent on the size of the organisation (number of employees).

For the evaluation results, descriptive statistic tools were used, namely absolute and relative frequencies, dependence tests ( $\chi^2$  test) and tests of strength dependence (Cramer's V). If the  $p$ -value was lower than  $\alpha = 0.05$ , the null hypothesis was rejected. The scale according to De Vause (2002) was used to interpret the strength of Cramer's V dependence. To evaluate the outcomes SPSS 24 statistical software was used. For a more detailed assessment of qualitative characteristics, a sign scheme of deviations was used. It allowed to specify which sign combinations differ significantly from theoretical frequencies. Using sign scheme it is possible to determine which combination of signs affect the dependence of qualitative variables. For each box of a contingency table, an association table was formed and from it,  $\chi^2$  variable was expressed. The value of  $\chi^2$  variable affects the number of signs in single fields of the table:

- $\chi^2$  is smaller than 3.84, then the field is without the indication.
- $\chi^2$  is higher than 3.84 but smaller than 6.62, then the field is marked with one sign.
- $\chi^2$  is higher than 6.62 but smaller than 10.83, then the field is marked with two signs.
- $\chi^2$  is higher than 10.83, then the field is marked with three signs.

Intervals for a decision on the number of signs were determined according to respective critical values in the tables of  $\chi^2$  distribution at a significance level  $\alpha = 0.05$ ,  $\alpha = 0.01$ ,  $\alpha = 0.001$ . The decision about whether the sign will be positive or negative was influenced by comparing actual and theoretical frequencies of a contingency table. A positive sign has been assigned where an actual frequency is higher than a theoretical one, and a negative sign where an actual frequency is lower than a theoretical one. A calculation of the odds-ratio according to the following formula was carried out (Procházka, 2015):

$$OR = \frac{ad}{bc} \quad (1)$$

By means of this calculation it is possible to determine how many times the chance to carry out talent management activities is higher with selected dependent variables in a given sample of respondents.

## RESULTS

On the basis of testing dependencies between selected qualitative characteristics, 2 null hypotheses have been rejected:

- Implementation of talent management activities is dependent on the market of the organisation operation. The value of a test criterion  $\chi^2$  is 30.890 with 6 degrees of freedom ( $p$ -value = 0.000 Cramer's V = 0.199, low dependency).

- Implementation of talent management activities is dependent on the size of the organisation. The value of a test criterion  $\chi^2$  is 47943 with 6 degrees of freedom ( $p$ -value = 0.000 Cramer's V = 0.248, low dependency).

Testing dependencies between qualitative characteristics showed a relatively weak dependence between the implementation of talent management activities and the market of the organisation operation and the size of the organisation. Using a sign scheme, it is possible to determine which combinations of characteristics affect this dependence most of all, as indicated in the Table 1 and Tab. 2.

Question		Market of Organisation Operation			
		local	regional	national	international
Do you implement talent management activities?	Yes, on the basis of the strategy	0 --	6	14	25 ++
	Yes, on the basis of the intuition	17	22	37	55 ++
	No	47 ++	56 +	56	54 ---

**Table 1: Sign scheme of deviations – market of organisation operation (source: own calculation)**

The distribution of signs and of their number in the Tab. 1 shows that particularly international organisations implement talent management activities on the basis of the strategy and intuition. Furthermore, it can be said that local and regional organisations generally do not implement talent management activities. The biggest difference between actual and theoretical frequencies was found with organisations operating on the international market. For them, it is the least likely not to realise activities associated with the talent management.

Question		Size of organisation (number of employees)			
		1 - 9	10 - 49	50 - 249	More than 250
Do you implement talent management activities?	Yes, on the basis of the strategy	1 --	5 --	9	30 +++
	Yes, on the basis of the intuition	19	44	38	30
	No	54 ++	62	55	45 --

**Table 2: Sign scheme of deviations – size of organisation (source: own calculation)**

From Tab. 2 it can be concluded that organisations up to 49 employees do not deal with the implementation of talent management activities on the basis of a given strategy. On the contrary, organisations with more than 250 employees usually carry out these activities on the basis of a stipulated talent management strategy. At the same time, it is possible to say that it is not common for very large organisations to completely ignore these activities. From the above calculated sign scheme, it is evident that the implementation of talent management activities (whether based on a defined strategy or intuition) is primarily concerned by organisations on national or international markets, and at the same time large organisations that have more than 50 employees. For that reason, variables of organisations implementing talent management activities, operating on a national or

international market and organisations with more than 50 employees whose absolute frequencies are shown in the Table 3 and 4, enabling to interpret the results of odds-ratation (1) were merged.

Question		National or international market		Total
		Yes	No	
Implementation of talent management activities	Yes	131 (a)	45 (b)	176
	No	110 (c)	103 (d)	213
Total		241	148	389

**Table 3: Calculation of risks – market of organisation operation (source: own calculation)**

The addressed sample of respondents showed that for organisations operating on a national or international market there was a 2.726 times higher chance that they would implement talent management activities than for organisations operating on a local or regional market.

Question		Size of organisation with more than 50 employees		Total
		Yes	No	
Implementation of talent management activities	Yes	107 (a)	69 (b)	176
	No	100 (c)	113 (d)	213
Total		207	182	389

**Table 4: Calculation of risks – size of organisation (source: own calculation)**

For organisations with more than 50 employees there is a 1.752 times higher chance that they will implement talent management activities than in organisations with fewer than 49 employees.

## DISCUSSION

PricewaterhouseCoopers (2012) published in the Survey of Global HR Challenges: Yesterday, Today and Tomorrow the biggest challenges faced by today's organisations in the global environment. Organisations in Europe see a challenge, especially in the Change of Management (48%) Organisational Effectiveness (36%) and Staffing: Recruitment and availability of skilled local labour. Research, however, points to the challenge of the future, which will concern mainly the Leadership development. Research by Strack et al. (2014) published the Top 10 most important HR topics of the future with Talent Management and Leadership in the first place.

According to Krishnan and Scullion (2016) there are significant differences in the approach to human resource management, as well as to talent management in large national or international organisations and SME organisations. This is confirmed by the research regarding the dependence of the implementation of talent management activities on the size of the organisation and the field of its operation. Small organisations tend to focus on the administrative level of management and do not carry out talent management activities at all, or only those based on the intuition. Large international or national organisations implement these activities with a 2.726 times higher chance and with corresponding strategies.

Regarding the current state of knowledge and the implementation of talent management principles in practice, with the Zircon (2012) research it was understood that most organisations associate the concept of talent with terms such as values, abilities, potential, and also ambitions and that a mere fifth of organisations which have the talent management strategy can communicate it openly. Also, the Farndale et al. (2014) recommend that for the successful functioning of talent management it is necessary to develop the strategy. As already pointed out, this strategy must be consistent with the corporate strategy. Consequently, it is possible to create and apply individual personnel activities, which are important for talent management.

## **CONCLUSION**

Testing dependencies between qualitative characteristics showed that there was dependence between the implementation of talent management activities, the size of the organisation and the market in which the organisation operates. These dependencies can be described as relatively weak. Furthermore, testing did not show the dependence between the implementation of talent management activities and sectors, or fields of organisation activities. Using a sign scheme of deviations it was understood that the implementation of talent management activities based on the strategy and the intuition are dealt with mostly international organisations, and that local and regional organisations generally do not implement these activities. The sign scheme also showed that organisations of up to 49 employees rather do not deal with the implementation of talent management activities on the basis of a stipulated strategy. On the contrary, organisations with more than 250 employees usually carry out these activities on the basis of a stipulated strategy of the management.

Furthermore, the responses of addressed organisations showed that the chance of implementation of talent management activities in organisations operating on a national or international market was 2.726 times higher than that of organisations on a local or regional market as well as 1.752 times higher in organisations with more than 50 employees than in smaller organisations.

A theoretical contribution of the paper is to compare the views of individual authors of the talent management issues in practice, and a practical contribution of the paper is to present the results of the research in selected Czech organisations. The future research in the field of the talent management will be focused on single activities, which are primarily dealt by these organisations within the talent management, and how these activities differ from those in foreign organisations.

## **ACKNOWLEDGEMENTS**

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# TRAINING AND DEVELOPMENT OF EMPLOYEES IN COMPETENCY-BASED ORGANISATIONS

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## ABSTRACT

The article is focused on training and development of employees in organisations using the competency-based approach. The main aim is to assess the use of the competency-based approach in organisations in the Czech Republic in the period from 10/2015 to 06/2016, to compare the results obtained with the results from the previous period (10/2014–06/2015) and to examine relationships between selected qualitative variables. The research results showed that the competency-based approach in organisation management is used by 26.6% of organisations, i.e. about 5.4% more than in the previous period. The results also showed that 96.3% of organisations using the competency-based approach also provide training and development to their employees. However, only 65% of them assess training efficiency. The results confirmed the relationship between the use of the competency-based approach and training and development in organisations and the use of the competency-based approach and the assessment of training efficiency.

## KEYWORDS

Competency, Development, Efficiency, Organisation, Training

## INTRODUCTION

The concept of competence was first used by White (1959) for the description of personal characteristics related to above-average performance and high levels of motivation. Subsequently, McClelland (1973) identified competence as a more reliable factor for predicting job success than intelligence (Kandula, 2013). Based on his own research of more than 2,000 managers, Boyatzis (1982) defined a job competency as an underlying characteristic of a person in that it may be motive, trait, skill, aspect of one's self-image or social role, or a body of knowledge which results in effective and/or superior performance in a job. According to Woodruffe (1993), it is important to differentiate competency from competence. 'An essential distinction is between aspects of the job at which the person is competent, and aspects of the person which enable him or her to be competent' (Woodruffe, 1993: 30). These works have laid foundations for the competency-based approach to management. Competency-based human resource management according to Dubois et al. (2004) is primarily focused on the person rather than on his/her performance. Armstrong and Taylor (2014) state that this approach has a positive influence on HR processes, especially those connected with the recruitment, training and development of employees, performance management, reward management and succession planning (Wesselink et al., 2015). In the era of globalisation, competencies of human resources are becoming extremely important for organisations (Serim, Demirbağ and Yozgat, 2014). Unavailable competencies in the labour market are extremely hard to imitate or duplicate

by other organisations (Díaz-Fernández, López-Cabrales and Valle-Cabrera, 2014) which makes them a great source of competitive advantage. Succar, Sher and Williams (2013) agree and add that individual competencies are crucial for managing the performance of the organisation which is also confirmed by research results provided by Ngo, Jiang and Lio (2014).

In the context of competencies, the concept of competency models also needs to be explained. A competency model is a written description of the competencies required to achieve superior performance in a job group, work team, department, division, or even an entire organisation (Dubois et al., 2004). Fišer (2014) notes that a competency model is a system tool that allows the organisation to develop appropriately. Therefore, competency models must always be based on the strategy and objectives of the organisation. Suhairrom et al. (2014) believe that the implementation of competency models has positive implications for employees and the organisation itself. Employees are aware of what is expected from them and the management knows which employee characteristics are required. Competency models lead to the significant development of human resources that provides organisations the competitive advantage (Vazirani, 2010). Efficient competency models also bring transparency and fairness to performance management (KPMG, 2010), improve many processes in the organisation (including training and development) and help with the integration of HR processes, the establishment of clear expectations and the unification of an organisational culture (Vazirani, 2010).

This article is focused on training and development of employees in organisations using the competency-based approach in the Czech Republic. The main aim is to assess the use of the competency-based approach in organisations in the Czech Republic in the period from 10/2015 to 06/2016, to compare the results obtained with the results from the previous period (10/2014–06/2015) and to examine relationships between selected qualitative variables. The article has the following structure. The first part is focused on the theoretical solutions to the research issues. The second part specifies the particular research methods. The third part deals with the assessment of results of quantitative research and the follow-up discussion. First, the results from the period from 10/2015–06/2016 are assessed as well as compared and discussed with the results achieved in the previous period (10/2014–06/2015). Subsequently, the relationships between the selected qualitative variables are examined. The fourth part is focused on the general assessment and the fifth part consists of a list of references used.

## **MATERIALS AND METHODS**

In the period from 10/2015 to 06/2016, a questionnaire survey focused on the use of competency-based approach in organisations in the Czech Republic was conducted. This survey represents a part of long-term research focused on the use of competency-based approach in organisations in the Czech Republic (Fejfarová and Urbanová, 2015). The sample comprises 402 randomly selected organisations. The majority of organisations that participated in the survey comes from the private sector (70.6%). 68.1% of organisations are from the tertiary sector, 28.9% of organisations are from the secondary sector and 3% of organisations are from the primary sector. 41% of the organisations surveyed have less than 50 employees, 24.9% of these organisations have 50 to 249 employees and 34.1% of these organisations employ more than 250 employees. 62.2% of organisations operate on the national market, 37.8% of organisations operate on the international market. The structure of organisations is shown in Table 1.

Area operated	Private		Public	Total
	70.6		29.4	100
Economic sector	Primary	Secondary	Tertiary	Total
	3	28.9	68.1	100
Size	Small	Medium-sized	Large	Total
	41	24.9	34.1	100
Major participation	National		International	Total
	62.2		37.8	100

**Table 1: Structure of organisations in percentages (source: own elaboration)**

The following two hypotheses were tested:

$H_{01}$ : There is no relationship between the use of the competency-based approach and training and development in organisations.

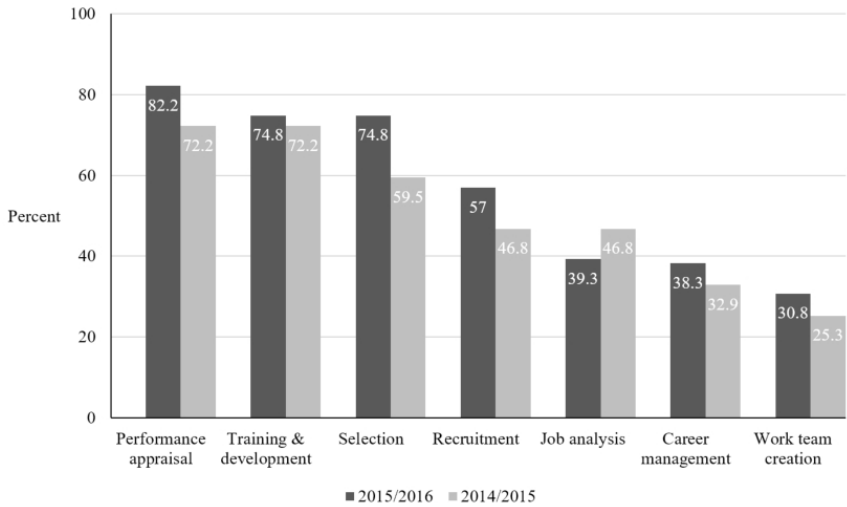
$H_{02}$ : There is no relationship between the use of the competency-based approach and the assessment of training efficiency in organisations.

To enhance the quality of the questionnaire survey, it was required for the questionnaire to be completed by a specialist from the HR department or an owner of the given organisation. The data were processed by means of absolute and relative frequencies using Microsoft Excel 2013 and IBM SPSS Statistics 24. The partial results obtained were compared with the results from the previous period 10/2014–06/2015. The testing was done by Pearson's chi-square test of independence. The level of significance was set at 0.05. To interpret the strength of relationship coefficients, a scale according to de Vaus (2002) was used.

## RESULTS AND DISCUSSION

The results from 10/2015-06/2016 showed that the competency-based approach in management is used by 26.6% of organisations (absolute figure 107 organisations), i.e. about 5.4% more than in the previous period observed (10/2014-06/2015,  $n = 373$ ). The competency-based approach is mostly used by large organisations (43.8% out of all large organisations addressed), medium-sized organisations (19% out of all medium-sized organisations addressed) and most rarely by small organisations (17% out of all small organisations addressed). The competency-based approach used by these organisations is largely used in following areas: employee performance appraisal (82.2%), training and development (74.8%), employee selection (74.8%), employee recruitment (57%), job analysis (39.3%), career management (38.3%) and creation of work teams (30.8%). The year-on-year comparison showed an increase in the use of the competency-based approach in all areas observed apart from the job analysis. This area exhibited a 7.5% decrease (Fejfarová and Fejfar, 2016). Figure 1 shows a year-on-year comparison of the use of the competency-based approach.

The research results showed that organisations do not use competency-based approach equally in all areas. It is always necessary to go by the competency model defined for a particular job when recruiting, selecting, performance appraising, training and developing one's own employees. Even if the employee recruitment, selection, performance appraisal, training and development belong to crucial areas used, i.e. the HR activities that mostly precede employee career management, organisations do not often use the competency-based approach in the area of employee career management. Organisations should not underestimate career planning and succession management. Vnoučková, Urbancová and Smolová (2015) emphasise that it is necessary to support career plans and development to retain employees in the organisation.



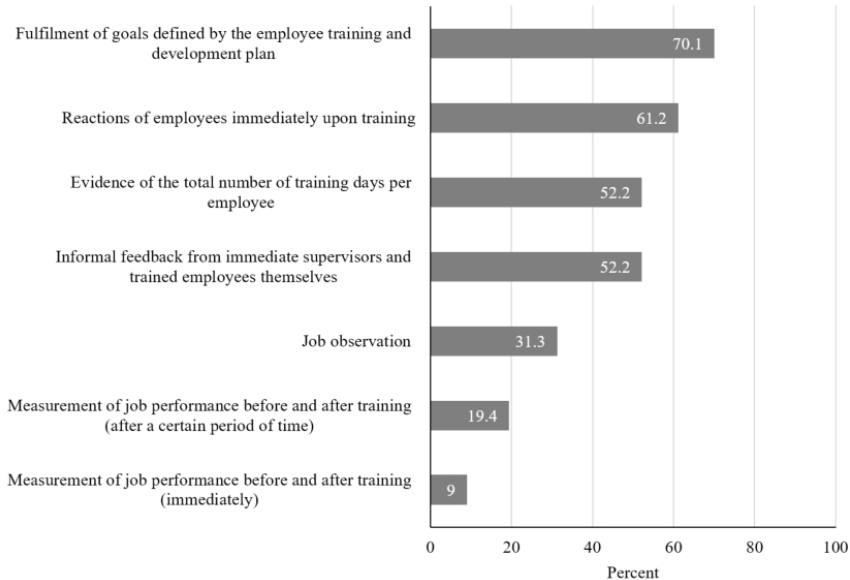
**Figure 1: Areas of the competency-based approach implementation (source: own elaboration)**

The results also showed that 96.3% of organisations using the competency-based approach provide training and development to their employees (absolute figure 103 out of 107 organisations). To compare the figures, results of the entire sample can be mentioned ( $n = 402$ ). In this case, only 82.3% of organisations provide training and development to their employees. Therefore, the relationships between the selected qualitative variables were observed, i.e. the use of the competency-based approach in organisations and training and development of employees in organisations ( $H_{01}$ ) as well as the use of the competency-based approach in organisations and assessment of training efficiency in organisations ( $H_{02}$ ). To verify the independence of statistical variables, the Pearson's chi-square test of independence was applied. To interpret the strength of Cramer's V, a scale according to de Vaus (2002) was used. The results of the test are presented in Table 2 showing the hypothesis, the Asymp. Sig. for Pearson's chi-square statistic (so-called p-value), the resolution on the hypothesis rejection, the value of Cramer's V and the strength of the relationship. The results of the test of  $H_{01}$  showed that there is the relationship between the use of competency-based approach and training and development in organisations ( $p = 0.000$ , Cramer's V = 0.220). The strength of the relationship is low. Even if most organisations using the competency-based approach provide training and development to their employees, only 65% of them conduct a systemic assessment of training efficiency provided (absolute figure 67 out of 103 organisations). The results of the test of  $H_{02}$  showed that there is the relationship between the use of the competency-based approach and the assessment of training efficiency in organisations ( $p = 0.000$ , Cramer's V = 0.388). The strength of the relationship is moderate.

No.	There is no relationship between:	Asymp. Sig. (p-value)	Decision (Rejecting H <sub>0</sub> )	Value of Cramer's V	Strength of the relationship
1	the use of the competency-based approach and training and development in organisations.	0.000	Yes	0.220	Low
2	the use of the competency-based approach and the assessment of training efficiency in organisations.	0.000	Yes	0.388	Moderate

**Table 2: Results of Pearson's chi-square test of independence for hypotheses H<sub>01</sub> and H<sub>02</sub> (source: own elaboration)**

Kalargyrou and Woods (2011) point out that much money is spent yearly on employee training, however, not all money is well spent. The efficiency of the training process can be measured from several specific points of view with regard to its content (Staňková and Drdla, 2012). Organisations assessing training efficiency mostly use the assessment of goals fulfilment defined by the employee training and development plan (70.1%), the assessment of reactions of employees immediately upon training (61.2%), the evidence of the total number of training days per employee (52.2%), the informal feedback from immediate supervisors and trained employees themselves (52.2%, job observation (31.3%) as well as measurement of job performance before and after training (after a certain period of time (19.4%) or immediately (9%)) to assess the efficiency of training. The methods of assessment of training efficiency for employees are presented in Figure 2.



**Figure 2: Methods of assessment of training efficiency for employees (source: own elaboration)**

The current dynamic business environment requires that organisation management realises the importance of the HR management. The use of the competency-based

approach represents an efficient tool for a systemic treatment of HR resources in organisations because it clears the way for the integration of HR processes into one single cluster (Vazirani, 2010), i.e. the possibility of integrating all areas of human resource management based on the competency-based approach (Sienkiewicz, 2014). On using the competency-based approach in training and development of employees, training and development in organisations are focused on removing the divergences between the current and required state and represent a logical consequent use of the competency model in practice. If competency models are created in the organisations for all key positions, and, at the same time, these models are integrated appropriately, the organisations might benefit from numerous advantages, which is also confirmed by Sienkiewicz (2014). Well-integrated competency models facilitate the unification of the language used in the organisation, the recruitment and selection of competent employees and their efficient training and development and they also facilitate finding the fair performance appraisal and reward and unbiased planning for career advancement. It is necessary to concentrate on an overall ability of the employees to adapt to the current dynamic business environment and worldwide globalisation (Varvažovská and Jarkovská, 2012). Therefore, the competency models must be updated in such a way as to reflect the changes in both the internal and external environment of the organisation.

## **CONCLUSION**

The article is focused on training and development of employees as a part of lifelong learning in organisations using the competency-based approach in the Czech Republic. The research results showed that the competency-based approach in organisation management is used by 26.6% of organisations, i.e. about 5.4% more than in the previous period observed. The research results also showed that 96.3% of organisations using the competency-based approach also provide training and development to their employees. However, even if most organisations using the competency-based approach provide training and development to their employees, only 65% of them assess training efficiency in a systemic way. Also, the research results confirmed the relationship between the use of the competency-based approach and training and development in organisations and the use of the competency-based approach and the assessment of training efficiency in organisations. The strengths of the relationships are weak and moderate. The most used methods utilised to assess training efficiency are represented by the assessment of goals fulfilment defined by the employee training and development plan, the assessment of reactions of employees immediately upon training, the evidence of the total number of training days per employee, the informal feedback from immediate supervisors and trained employees themselves as well as job observation.

The theoretical contribution of the article lies in the confirmations of relationships between selected qualitative variables (the use of the competency-based approach and training and development in organisations and the use of the competency-based approach and the assessment of training efficiency in organisations) and a summary of the most used methods utilised to assess training efficiency in organisations. The practical contribution of the article is focused on HR specialists and managers who can make the decision to implement these findings in practice.

The article is limited by the sample. The analysed sample of organisations is adequate for obtaining the data and makes it possible for the authors to describe the probable general situation in the area of the competency-based approach in the Czech Republic

(i.e. generalisation to the sample), but not to generalise the results to all organisations in the Czech Republic. However, that is a problem of most published research findings.

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# ON ALTERNATIVE METHODOLOGY FOR INCREASING DISCRIMINATION ABILITY IN THE SYSTEM OF PROFESSORS' EVALUATION

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## ABSTRACT

La Salle University in México City uses an internal system of professors' evaluation to evaluate professors' performance and secure high quality of teaching at all of its faculties. Results provided by the system indicate high teaching quality, which do not fully correspond with students' comments accompanied in the evaluation. Obtained results are skewed to maximal evaluation with low discrimination ability. To increase this discrimination ability, we have disseminated three different evaluations based on questionnaires among 228 students at Business School, La Salle University. Each evaluation consisted of different scales allowing different level of freedom in students' responses. The results of 1,269 individual responses indicate that there is no statistical significance, and, thus, the discrimination ability cannot be improved with higher level of freedom.

## KEYWORDS

Discrimination Ability, Professors' Evaluation, Students, Two Sample t-test

## INTRODUCTION

During the recent years, Higher Education Institutions (HEIs) have been involved in a competitive environment to provide high quality of teaching and research. As a result, many HEIs have introduced internal evaluation systems in order to secure and improve teaching quality. For this purpose, the use of students' evaluations of their professors have become very common and popular. The aim of these evaluations is to measure professors' performance and quality and to demonstrate HEIs' excellence in teaching (Davies et al., 2010). In most of the cases, the internal evaluation systems use online questionnaires with diverse set and types of questions divided into several dimensions. The most common evaluated dimensions are educative and pedagogic. However, an evaluation system can also consider different dimensions, such as social, ethics, teaching and learning (Hein, Kroenke and Rodrigues Júnior, 2015). The choice of these dimensions and related questions usually correspond to a university strategy and culture, as well as to the main purpose of the evaluation.

University authorities use the results of professors' evaluations to secure a constant development of a teaching quality. The results are used to solve teaching related problems, to motivate professors for their personal development, as well as for hiring and promotion decisions (Becker and Watts, 1999). As students have direct contact with

professors, evaluation systems can provide valuable results. However, to receive valuable results, any evaluation system must attract students' interest and needs (Brand Barajas, 2014). Furthermore, students must not be afraid to evaluate their professors. Therefore, professors' evaluation is commonly anonymous. What is more, students must perceive the evaluation as a chance to be involved in teaching quality improvements at university. However, we must be aware of several problems may arise regarding the reliability of the evaluation. As Braga, Paccagnella and Pellizzari (2014) point out, students' objectives might be different from those of the university authorities. "Students may simply care about their grades, whereas the university cares about their learning and the two might not be perfectly correlated, especially when the same professor is engaged both in teaching and in grading." (Braga, Paccagnella and Pellizzari, 2014: 72) As McAuley et al. (2017) observed, earn bonus points is one of the most important motivator to evaluate professors. Thus, students may evaluate their professors positively, although quality of teaching is not high. In this case, anonymity in professors' evaluation is the key feature of the evaluation system.

On the other hand, students may see the evaluation as something unimportant that does not serve for them. As a result of lower engagement with professors' evaluation, students might not be interested to dedicate their time to precise evaluation. As students must evaluate multiple course and professors, the evaluation can be lengthy and students may lose their interest (McAuley et al., 2017). Lower interest leads to students' unwillingness to dedicate sufficient time to the evaluation. Consequently, students might want to terminate the evaluation as soon as possible using same evaluation to all questions and all courses. This behavior skews the results, as students do not use whole evaluation scale. What is more, evaluation produces imprecise results that might not serve to its purpose.

This might be the case of evaluation system at La Salle University in Mexico City. La Salle University has developed System of professors' evaluation (SED 2.0) in institutional, educative and pedagogic dimensions, which has been used since December 2010. As it is seen in Figure 1, students in most of the cases use highly positive evaluations. Thus, the results indicate high teaching quality at La Salle University in all three evaluated dimensions. The pattern of distributions is skewed to the upper bound of the evaluation (10pts). What is more, the most common obtained evaluation in all three dimensions is the maximal 10pts. In average, 21.038% of evaluations in Institutional dimension are equal to 10pts, in Educative dimension 13.662%, whereas in Pedagogic dimension 16.689%.

Obviously, students do not use the whole scale for evaluation. Further, students use the maximal evaluation in huge part of their evaluation. However, the authorities of the university prefer the evaluation to be more discriminative, i.e. not skewed as it currently is, but preferably with a normal distribution. Normal distribution is uncommon and thus almost unachievable. However, we may achieve more discriminative results using different evaluation scales. For this purpose, we have prepared a research analyzing an effect of different scales on the evaluation. The objective of this article is to analyze, whether different scales can lead to better discriminative ability in the evaluation.

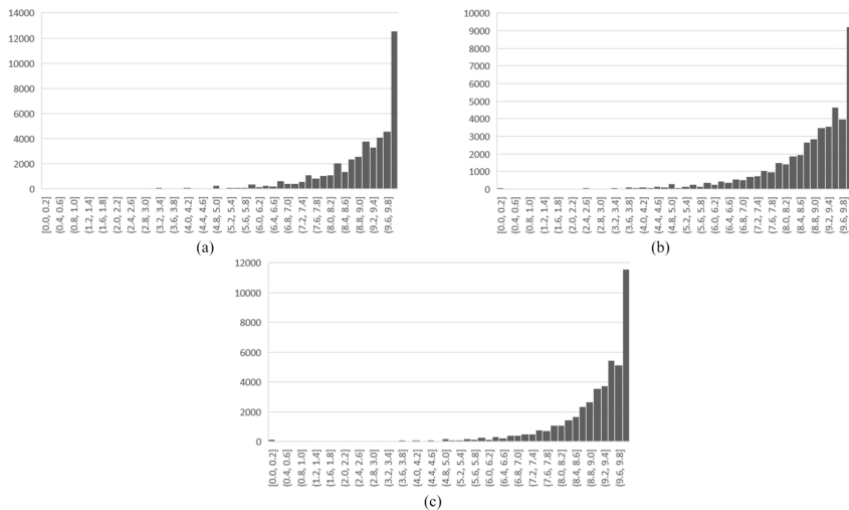


Figure 1: Distribution of evaluations in a) Institutional, b) Educative, and c) Pedagogic dimension, La Salle University, December 2010 – December 2016

## MATERIALS AND METHODS

### Evaluation system SED 2.0 (Sistema de Evaluación Docente)

Evaluation system SED 2.0 was created at La Salle University México in 2001. The purpose of the creation was a necessity to evaluate professors' performance in a fast, safe and reliable way according to the institutional philosophy centered on a person and its integral training. SED 2.0 is maintained by Department of Teacher Education (DPE), i.e. DPE maintains its design, development, results dissemination, etc.

Evaluation system SED 2.0 includes three dimensions: institutional, educative, and pedagogic. The objective of the institutional dimension is to evaluate professor's profile from the mission of La Salle (La Salle, 2017). This area applies to all professors of study programs with Recognition of Official Validity of Studies (ROVS). The indicators included in this dimension are related to personality, community and society. The objective of the educative dimension is to evaluate professor's profile based on abilities of student's graduation profile. Similarly, this dimension also applies to all professors of study programs with ROVS differentiated by education level (high school, bachelor level, and master level). The indicators included are related to professor's ability of problem solving, social responsibility, ethical judgment, usage of ICT, efficient communication, and information management. The objective of the pedagogic dimension is to evaluate professor's profile based on his/her capability of learning and teaching. This dimension applies to all professors of study programs with ROVS differentiated by education level and type of course, such as common area, laboratories and workshops, courses of initial phase (first two years), and courses of final phase (last 2 years). (Coordinación de Formación Docente, 2010). SED 2.0 consists of 15 questions: institutional dimension (3 questions), educative dimension (6) and pedagogic dimension (6).

Every student evaluates anonymously all his/her professors from all courses at the end of each semester. For this purpose, a scale consisting of five options (Never – Almost never – Sometimes – Almost always – Always) is used in the evaluation in each of the

three dimensions. The obtained scores are then transformed to a scale 0 – 10pts applying a specific algorithm. The approximate time to finish an evaluation is around 20 minutes. The evaluation is fully available online. Thus, students can make their evaluations at any computer at the university campus, at home, as well as using their mobile phones. The evaluation is opened for 12 days at the end of each semester. The responsible persons to the evaluation prepare daily reports to inform the university representatives about the progress in the evaluation (percentage of participation by each study program and group of students).

## Data

La Salle University México is based in Mexico City, Mexico. Nowadays, the university includes 7 faculties in area of higher education: Business School; Law School; Mexican School of Medicine; Mexican School of Architecture, Design and Communication; School of Chemistry; School of Engineering; and School of Humanities and Social Sciences. Regarding the last internal report (La Salle, 2016), in the academic year 2015/2016, there were 6,173 students enrolled in bachelor study programs at all faculties.

For the purpose of the research, we have selected a research sample at Business School, as we have direct access to its annual reports and statistics, as well as we know precisely the structure of its study programs. In the last semester (August-December 2016), 1,568 students were enrolled in 6 study programs at Business School: Actuary (ACT); Administration (ADM); International Trade and Business (ITB); Accounting and Finance (AF); Business Management and Information Technologies (BMIT); and Marketing (MKT). The enrollment level in all study programs differs semester to semester, as at the beginning of each semester (August and January) new groups of enrolled students begin. However, groups beginning in January are commonly much smaller. Currently, 2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> semesters consist of higher number of enrolled students. Considering the distribution of the enrollment, we have chosen students from 4<sup>th</sup> semesters (January – July 2017) as the representative sample for the research.

	ACT	ADM	ITB	AF	BMIT	MKT	Total
# of enrolled students (August-December 2016)	44	49	73	41	20	53	280
Share (%)	15.71%	17.50%	26.07%	14.64%	7.14%	18.93%	100%

**Table 1: Enrolled students in 3<sup>rd</sup> semester August-December, 2016 (source: own calculation)**

Official numbers of enrolled students in current semester are not available up to the date of writing this article yet. However, we worked with official data from the last semester where 280 students were enrolled in the 3<sup>rd</sup> semester. Thus, the potential sample represents 17.86% of all students at Business School (Table 1). We considered possible variability in these numbers (due potential students' reprobation), so we counted that the sample for dissemination could be max 5% bigger.

We have prepared three different questionnaires, all of them included the same 15 questions from SED 2.0. Questionnaire A evaluated each question on a scale Never - Almost Never - Sometimes - Almost always - Always (mathematically expressed 1 to 5), which gave exactly the same options as SED 2.0. Questionnaire B uses a scale 1 – 10 (10 as maximal) for each question, whereas questionnaire C uses scale 0 – 100 (100 as maximal). As each study program contains different courses, we have prepared all three types of questionnaires adjusted to each study program. The objective for different scales

was to find out whether bigger freedom in evaluation given to students would result in better discrimination ability in SED 2.0.

As we disseminated questionnaires at the beginning of the current 4<sup>th</sup> semester, we asked students to evaluate their courses from the previous 3<sup>rd</sup> semester. The reason for evaluation of the previous semester was reasonable as the students from the selected sample were not able to evaluate current courses yet, as the semester was just at the beginning. We consider time between current and past semester as considerable for students to remember their last semester courses (2 and a half months).

	ACT	ADM	ITB	AF	BMIT	MKT	Total
Questionnaire A	13 (65)	11 (66)	19 (114)	12 (72)	4 (24)	16 (80)	75 (421)
Questionnaire B	14 (67)	13 (78)	20 (120)	13 (78)	5 (30)	16 (80)	81 (453)
Questionnaire C	13 (65)	13 (70)	14 (83)	13 (78)	4 (24)	15 (75)	72 (395)
Total	40 (197)	37 (214)	53 (317)	38 (228)	13 (78)	47 (235)	228 (1269)

**Table 2: Distribution of obtained results regarding study program and type of questionnaire (source: own calculation)**

Questionnaires were randomly distributed among students. Table 2 summarizes the distribution regarding study program. We have received 237 questionnaires (84.64% of the potential population), out of them 9 questionnaires were filled completely wrong and cannot be used for the analysis. On the other hand, we kept in the analysis partially incomplete questionnaires where only a few answers were missing (such as missing answers to one question). Incomplete questionnaires do not affect the objective of the research, as we aim on different types of evaluation and not on courses evaluations. Thus, the final sample for analysis contains 228 students (96.20% of returned questionnaires). Numbers in brackets in Table 2 refer to number of obtained individual evaluations regarding of particular type of questionnaire and study program. In total, we have received 1,269 evaluations.

### Two sample t Test with equal variances

In the research, we would like to analyze whether there is difference between three types of evaluation scales. Thus, we suppose that  $x_1, \dots, x_n$  and  $y_1, \dots, y_m$  are two independent samples with means  $\mu_x$  and  $\mu_y$ . Further, we suppose that its corresponding variances  $\sigma_x^2$  and  $\sigma_y^2$  are known. In this case, we test hypothesis

$$H_0 : \mu_x - \mu_y = D_0$$

against one of the following alternative hypotheses

$$H_1 : \begin{cases} (\mu_x - \mu_y) < D_0 \\ (\mu_x - \mu_y) > D_0 \\ (\mu_x - \mu_y) \neq D_0 \end{cases}$$

where  $D_0$  is a specified value, which we desire to test. In our case, we seek to analyze that the difference between scales is 0 ( $D_0 = 0$ ). Therefore, we use two-tailed test, regardless of the direction we test the possibility of the relationship in both directions  $(\mu_x - \mu_y) \neq D_0$  (Triola, 2012). Analyzed samples do not have normal distribution (distribution is skewed similarly as in Figure 1), however all samples are sufficiently large.

As we have three different types of scale, we can apply one-way analysis of variance

(ANOVA) to analyze hypothesis that three means of samples are equal. In this case, we test hypothesis

$$H_0 : \mu_x = \mu_y = \mu_z$$

to obtain global significances.

## RESULTS AND DISCUSSION

In this section, we provide the results of statistical analysis of the achieved responses from three different types of questionnaires. We work with  $H_0$  stating that there is no difference between types of questionnaires. All the achieved results and conclusions made in this section are with regard to students of 4<sup>th</sup> semester at Business School. Therefore, we cannot generalize them to the whole La Salle University México.

In the first comparison between questionnaire A ( $N_A = 421$ ) and questionnaire B ( $N_B = 453$ ), we can conclude that there is no statistical significance between these two types of questionnaires. In Institutional dimension the results show that  $M_{A-INS} = 8.879$  ( $SD_{A-INS} = 1.445$ ) compare to  $M_{B-INS} = 8.857$  ( $SD_{B-INS} = 1.463$ ), with  $t(872) = .22$  and  $p = .826$ . Similarly, no difference in Educational dimension where  $M_{A-EDU} = 8.707$  ( $SD_{A-EDU} = 1.51$ ) compare to  $M_{B-EDU} = 8.644$  ( $SD_{B-EDU} = 1.723$ ), with  $t(872) = .572$  and  $p = .568$ , and in Pedagogic dimension where  $M_{A-PED} = 9.16$  ( $SD_{A-PED} = 1.195$ ) compare to  $M_{B-PED} = 9.142$  ( $SD_{B-PED} = 1.308$ ), with  $t(872) = .21$  and  $p = .834$ .

In the second comparison between questionnaire A ( $N_A = 421$ ) and questionnaire C ( $N_C = 395$ ), we can also conclude that there is no statistical significance between these two types of questionnaires. In Institutional dimension the results show that  $M_{A-INS} = 8.879$  ( $SD_{A-INS} = 1.445$ ) compare to  $M_{C-INS} = 9.003$  ( $SD_{C-INS} = 1.408$ ), with  $t(814) = -1.241$  and  $p = .215$ . Consequently, no difference in Educational dimension where  $M_{A-EDU} = 8.707$  ( $SD_{A-EDU} = 1.51$ ) compare to  $M_{C-EDU} = 8.754$  ( $SD_{C-EDU} = 1.505$ ), with  $t(814) = -.444$  and  $p = .657$ , and in Pedagogic dimension where  $M_{A-PED} = 9.16$  ( $SD_{A-PED} = 1.195$ ) compare to  $M_{C-PED} = 9.179$  ( $SD_{C-PED} = 1.199$ ), with  $t(809) = -.227$  and  $p = .82$ .

In the last comparison between questionnaire B ( $N_B = 453$ ) and questionnaire C ( $N_C = 391$ ), no statistical significance between these two types of questionnaires exists. In Institutional dimension the results show that  $M_{B-INS} = 8.857$  ( $SD_{B-INS} = 1.463$ ) compare to  $M_{C-INS} = 8.996$  ( $SD_{C-INS} = 1.413$ ), with  $t(842) = -1.39$  and  $p = .165$ . Consequently, no difference in Educational dimension where  $M_{B-EDU} = 8.644$  ( $SD_{B-EDU} = 1.723$ ) compare to  $M_{C-EDU} = 8.743$  ( $SD_{C-EDU} = 1.509$ ), with  $t(842) = -.882$  and  $p = .378$ , and in Pedagogic dimension where  $M_{B-PED} = 9.142$  ( $SD_{B-PED} = 1.308$ ) compare to questionnaire C ( $N_C = 386$ )  $M_{C-PED} = 9.171$  ( $SD_{C-PED} = 1.202$ ), with  $t(837) = -.326$  and  $p = .744$ . As we have three different questionnaires, we can also use one-way ANOVA test to analyze the sample. However, this analysis would just confirm the achieved results from the  $t$  test (as we get results in institutional dimension  $p = .692$ , in educational dimension  $p = .832$  and in pedagogical dimension  $p = .924$ ). As result, we do not reject  $H_0$  as well as there is no statistical significance between three types of questionnaires. Students from the 4<sup>th</sup> semester at Business School evaluate the courses taken in the 3<sup>rd</sup> semester in the same way. Thus, even though we gave them bigger freedom to express their evaluation (for example, scale 0-100 instead of 5-wide scale), the final effect is the same.

		Questionnaire B			Questionnaire C		
		INS	EDU	PED	INS	EDU	PED
Questionnaire A	INS	$t = .22$ $p = .826^*$	-	-	$t = -1.241$ $p = .215^*$	-	-
	EDU	-	$t = .572$ $p = .568^*$	-	-	$t = -.444$ $p = .657^*$	-
	PED	-	-	$t = .21$ $p = .834^*$	-	-	$t = -.227$ $p = .82^*$
Questionnaire B	INS	-	-	-	$t = -1.391$ $p = .165^*$	-	-
	EDU	-	-	-	-	$t = -.882$ $p = .378^*$	-
	PED	-	-	-	-	-	$t = -.326$ $p = .744^*$

\*significant at 5% level

**Table 3: *t* test results regarding types of questionnaires (source: own calculation)**

The objective of analyzing different scales for the system of professors' evaluation was to find out whether we could increase discrimination ability in the evaluation. However, the results show that bigger freedom in evaluation scale is not the case that would help us. Similarly as in the long-term evaluation (Figure 1), the evaluations achieved from three questionnaires indicate highly positive professors' evaluations, approximately around mean 9.0. Consequently, standard deviations indicate similar distribution in all three questionnaires. The idea behind the research supposed that students would appreciate higher freedom (variability) in their responses and use the whole range of points. Unfortunately, the results do not support the idea. Brief look at the results evokes high quality of teaching at La Salle University in Mexico City. However, students' qualitative comments accompanied SED 2.0 evaluation indicates several problems, and, thus, no correspondence with quantitative results. The priority is to obtain valuable results that reflect the real situation in teaching. Precise results can serve to improvements of a course structure, to professors' professional development, as well as to improvement of teaching quality at institutional level (Marsh and Roche, 1993; Santibañez, 2006).

Thus, we are getting back to the initial question, i.e. how to improve discrimination ability of the results. Nowadays, SED 2.0 is not connected to students' grading at all. Nevertheless, students are obliged to make the evaluation. So, we might leave the completion of the evaluation optional, free on each student's decision. This change might have positive effect, as well as negative one. Make the evaluation optional might directly lead to a drop in the total number of completed evaluations. Potential drop can be significant in the following period after the change is made (hardly predictable). However, after the initial decrease, this drop can consolidate and the total number of completed evaluations can begin rising again. What is more, we might obtain better distributed evaluations as only those students interested in the evaluation will express their opinions about teaching quality.

## CONCLUSION

The purpose of the research was to analyze whether it is possible to increase discrimination ability in professors' evaluation through different types of scales. We expected that higher freedom in responses would lead to better distributed results. Unfortunately, the distribution remains more or less the same, in all three types of scales, as the official results indicate. We may now turn our focus on identifying students' behavior regarding the evaluation. For example, what cultural aspects, hidden interests and perceptions drive the evaluation, i.e. to find the reason of highly skewed results to maximal evaluation.

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# ASSESSMENT TOOLS AND CRITERIA - WHAT TO APPLY TO TEACHERS' WORK

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## ABSTRACT

Criticism of schools and education continues also in the 21<sup>st</sup> century; the information age necessarily needs an education reform. As quality teachers are needed for the success of reforms, the attention is increasingly focused on teacher, their education and assessment of their competences. Existing forms and types of teacher assessment, however, are largely focused on what teachers do, how they teach, and less on what students learn in terms of the new requirements of the time and society. The research team of the project APVV-14-0446 has currently focused on the discrepancy between the current tools for teacher's evaluation and the new requirements on teachers. The team tends to approach the possibility of evaluating teachers from the aspect of the impact of their activities on pupils, add new content to existing assessment tools, and design a set of assessment tools, along with the criteria for the evaluation of the obtained data.

## KEYWORDS

Assessment, Competence, Gender, Head Teacher, Position, Teacher

## INTRODUCTION

Many times experts, politicians and the general public have already said that the foundation of quality education is a good teacher. General calls for the quality and efforts to identify the elements that determine achieving excellent and internationally positively assessed results of school education lead to attempts to analyze and evaluate the knowledge, skills and attitudes basis of the teaching profession. For this purpose a standard of teaching profession has been created, a complex teacher's competences matrix has been designed and a system of assessing the level of teaching practices based on attestation levels has been developed. But the question remains whether truly understandable and relevant tools for evaluating the quality of the teaching work have been created and to what extent the teacher's assessment is accepted by themselves as one of the ways to improve their own work?

The basis for the evaluation of the teaching profession is to define their professional identity and describe the development areas in which their professionalism has to be applied. Both can be defined either at the macro level or the micro level. At the macro level, from the perspective of the educational system, we are witnessing attempts to create a variety of models of competency matrices and professional standards (Bukvič, 2014; McDonald, 2014; Panahi et al., 2016) by means of which the system is trying to express,

as far as it is possible, all the requirements on the profession. The problem at this level is that it is very difficult to orient in the sets of requirements on teachers. Teaching profession is based on a broad complex of special interdisciplinary knowledge, resulting in the ability to associate a certain content and specialist fields with knowledge of pedagogical-psychological nature and involve in their work qualities of ethical, moral, and personal nature (Walterová, 2001). Helus (2012) uses the concept of pedagogical competence and indicates with it complex readiness of a teacher to cope with the educational tasks they have towards their students, to fulfill their responsibility for education and upbringing of school learners. This comprehensive competence readiness of teachers according to him includes knowledge which is essential for achieving educational goals, skills, and educational strategies (in more detail see Helus, 2007: 359 and the following pages).

At the micro level, teacher's assessment can be imagined in the relation to the problems teachers have to solve in everyday reality. The basis of evaluation and self-assessment is identification of standard and problematic activities, situations that occur in the school environment and classroom. Standard situations can then be reflected in the performance evaluation of teachers' workload (Průcha, 2002); non-standard situations are then an important aspect for the assessment of teacher's teaching mastery (Pařízek, 1990), of the level of their pedagogical work (Slavík, 1996), or the amount of teacher's workload (Urbánek, 1999). An important mechanism in teacher's evaluation is also the description of their feeling of preparedness to address specific situations and their ability to document their own procedures used in the solution process. The basis for the assessment in this case are not the general criteria or multiple scoring matrices, but sophisticated professional documentation, such as professional portfolio containing specific, individualized, and in practice usable and useful models of solving variety of teaching situations. These materials are the basis for assessment, self-assessment, and peer learning of teachers and teaching staff.

In the paper we focus on the importance of self-assessment of professional competences of teachers by teachers themselves, but also by school head teachers. The results are compared in the association with teacher's function/position (teachers x head teachers) and sex. The research analysis therefore deals with the perception of professional competences of teachers by their holders and their evaluators. Educators as holders of these professional competences are regularly assessed by means of those (tracked) competences. Due to the demands that are placed on teachers, evaluation has a specific position and in its realization, we expect that it will have facilitation effects. This effect can be seen just in how teachers and head teachers perceive competences assessment. The differences in the perception of teacher's professional competences can point to some intervening factors influencing the evaluation of teachers.

The paper concurrently presents partial results of the research, which dealt with personal and professional needs of novice teachers. Based on these results the relationship between needs and perception of professional competences of teachers can be assumed.

## **MATERIALS AND METHODS**

The results presented in the paper are based on the project 'Assessment of teachers' competences' (APVV-14-0446). The partial results of the project are focused on the perception of the professional competences of teachers by teachers themselves and their evaluators. Two questionnaires were used (Kerlinger, 1972; Reichel, 2009), one for teachers and the other one for head teachers separately. The research included 146 school head teachers (68% females, 32% males) and 730 teachers (82% females, 18% males)

in Slovakia. The biggest representation had the head teachers and teachers from primary and lower secondary schools, followed by grammar schools and vocational schools. All regions of Slovakia were covered. The collected data were processed using descriptive statistics and non-parametric test (Mann-Whitney U test), in which the evaluation related to function (position) of respondents (head teacher x teacher) and their gender was tracked. Since the results of the evaluation reflect the perceived readiness for the teaching profession, the paper marginally mentions also the data obtained in the Czech-Slovak project 'Personal and Professional Needs of Novice Teachers' (Mobility 7AMB14SK046, APVV CZSK-2013-0192), which investigated the needs of teachers in the early stages of their careers (up to 5 years of experience). Here, the research group was formed by 136 novice teachers in the Czech Republic and 121 in Slovakia (95 % females, 5 % males) in all types of schools (for presentation of the results in the context of this paper, these variables are not essential).

## RESULTS

Before we proceed to the presentation of the results related to the evaluation (perception of importance) of teachers' professional competences by teachers themselves, and school head teachers, we bring the results of the previous research of the authors 'Personal and Professional Needs of Novice Teachers' (Mobility 7AMB14SK046, APVV CZSK-2013-0192). In that research we consider relevant the findings which point out to areas that novice teachers have problems with. We ask the question whether just the activities in which teachers feel insecure and would like to get support are reflected in the assessment of professional competences of teachers, or vice versa. The data from the research are presented in Table 1 and Table 2.

I need help, advice when I:		always	usually	rarely	never
1.	select the appropriate teaching strategies, teaching methods and techniques	0.0	30.3	43.9	17.4
2.	manage the teaching process (establishing and keeping rules, maintaining respect and discipline pupils)	3.8	21.2	47.0	22.0
3.	set and formulate teaching and learning goals	0.8	20.5	53.0	19.7
4.	evaluate students	2.3	18.2	53.0	18.2
5.	select and plan teaching material (what to teach)	0.0	18.9	53.0	23.5
6.	work with pedagogical documentation	7.6	5.6	44.7	34.9
7.	realization of planned teaching material	2.3	10.6	53.0	27.3
8.	work with ICT	3.8	8.3	44.7	34.9

**Table 1: Problem areas perceived by novice teachers in Slovakia (in %), 2016 (source: own calculation) - the sum is not always 100%, this difference is caused by unanswered questions**

When interpreting the problem areas we base our reasoning on the sum of the items „always“ and „usually“ (disregard the fact that some respondents do not see any problem in these areas) and create the ordered list of the offered ‚needs‘ based on the sum of the two values. From the tables above it is then evident that many novice teachers in both countries do not feel confident enough about professional aspects of their teaching, such as managing the teaching process (2<sup>nd</sup> in the list of their needs for help in both countries), selecting the appropriate teaching strategies, methods and techniques (1<sup>st</sup> in the list of Slovak teachers and 3<sup>rd</sup> in the list of Czech teachers), and evaluating students (4<sup>th</sup> in the list in both countries). The only big difference between Slovak and Czech novice teachers is

in experiencing their need for help with pedagogical documentation. Czech teachers feel more helpless in this area (it is on the 1<sup>st</sup> place in the list of their need for help) than Slovak teachers do (it is on the 6<sup>th</sup> place in their list).

I need help, advice when I:		always	usually	rarely	never
1.	work with pedagogical documentation	8.1	33.1	51.4	7.4
2.	manage the teaching process (establishing and keeping rules, maintaining respect and discipline pupils)	4.1	24.3	50.7	20.3
3.	select the appropriate teaching strategies, teaching methods and techniques	2.7	21.6	60.1	14.9
4.	evaluate students	0.7	19.6	62.8	16.9
5.	select and plan teaching material (what to teach)	2.0	15.5	64.2	18.2
6.	set and formulate teaching and learning goals	1.4	14.9	64.9	18.9
7.	work with ICT	0.7	11.5	52.0	35.8
8.	realization of planned teaching material	1.4	10.1	59.5	29.1

**Table 2: Problem areas perceived by novice teachers in the Czech Republic (in %), 2016 (source: own calculation) - the sum is not always 100%, this difference is caused by unanswered questions**

In the questionnaire survey within the project APVV 14-0446 'Assessment of teachers' competences', one of the questionnaire items both for teachers and head teachers was the following one: Rate with numbers 1 to 5 degree of importance the listed professional competences of teachers for the success of their educational activities (1 = unimportant, 5 = very important):

- is able to identify pupil's developmental and individual characteristics,
- is able to identify crucial psychological and social factors for pupil's education,
- is able to develop pupil's personality and their competences,
- is able to create a positive climate in the classroom,
- is able to plan and realize their professional development,
- knows the content and teaching methodology of the taught subjects,
- is able to plan and design teaching/educational process,
- is able to select and implement teaching forms and methods,
- is able to use material resources/teaching aids in teaching process,
- is able to evaluate the process and outcomes of pupil's teaching and learning.

Further in the text the following abbreviations are used: U - Mann Whitney U test, AM - arithmetic mean, T - teacher, H - head teacher, F - female M - male.

If we look at the importance of professional competences how they are viewed by teachers, we can see that the most important ones are: 'is able to create a positive climate in the classroom, knows the content and teaching methodology of the taught subjects' (both AM = 4.70). Here the connection between the perceived importance of the competence by teachers and uncertainty of novice teachers (as presented in Tables 1 and 2) can be seen. It is very likely that the perceived importance of 'creating a positive climate in the classroom' is reflected in the uncertainty, i.e. a greater responsibility (I need advice/help in: 'managing the teaching process - establishing and keeping rules, maintaining respect and discipline pupils'). It also is interesting that although a very good rating is given by novice teachers to theoretical preparation at universities (they even suggest that the theory is at the expense of practice) and teachers consider it important to 'know the content and teaching methodology of the taught subjects', this again is an area in which novice

teachers often look for advice and support from their more experienced colleagues - cf. the results of the project *'Personal and Professional Needs of Novice Teachers' (Mobility 7AMB14SK046, APVV CZSK-2013-0192)* (see more in: Vítěčková and Gadušová, 2014; Vítěčková and Gadušová, 2015; Vítěčková, Gadušová and Garabíková Pártlová, 2014; Vítěčková, Procházka, Gadušová and Stranovská, 2016).

Regarding the comparison of the views of teachers and school head teachers, the differences are apparent in the item “is able to plan and realize their professional development” and item “is able to use material resources/teaching aids in teaching process”, in other cases there is a consensus in the perception of their importance. Statistically significant differences relate to the competence “is able to plan and realize their professional development” (AM-H = 3.91, AM-T = 4.11, U = 2.28) and “is able to use material resources/teaching aids in teaching process” (AM-H = 4.03, AM-T = 4.25, U = 2.95). Teachers attach more importance to the management of their professional development; they perceive this competence statistically significantly more positively than head teachers. However, among all of the professional competences this area has the lowest results of the arithmetic mean of its perceived importance (T = 4.11, H = 3.91) as perceived by both teachers and head teachers.

At the moment, when we focus on this evaluation from the perspective of women and men, statistically significant differences appear in more areas. Match of the perception of women and men appears in only one competence: “is able to develop pupil’s personality and their competences”. All the other tested professional competences show statistically significant differences in our research sample (see Table 3).

Professional competence:	AM-M	AM-F	U
is able to identify pupil's developmental and individual characteristics	4.15	4.34	2.70
is able to identify crucial psychological and social factors for pupil's education	4.04	4.24	2.74
is able to create a positive climate in the classroom	4.61	4.71	2.49
is able to plan and realize their professional development	3.92	4.11	2.67
knows the content and teaching methodology of the taught subjects	4.60	4.72	2.37
is able to plan and design teaching/educational process	4.42	4.67	5.64
is able to select and implement teaching forms and methods	4.41	4.61	4.14
is able to use material resources/teaching aids in teaching process	4.04	4.26	3.32
is able to evaluate the process and outcomes of pupil's teaching and learning	4.46	4.66	4.78

**Table 3: assessment of professional competences from the point of view of males and females (AM-M: arithmetic mean - males; AM-F: arithmetic mean - females; U- Mann Whitney U test), 2016 (source: own calculation)**

Only in the case of teacher's competence that can be seen as a complex teacher's role as an educator, in all the other competences the differences in the context of a gender perspective are statistically significant.

## DISCUSSION

Overall, the results, in the context of the tracked problem, are of notice. Differences based on sex are more remarkable than the ones based on function/position. Perception of teachers' professional competences is more consistent with teachers and women than it is perceived by head teachers and men. It also should be mentioned that the results are significantly more positive for teachers and women, indicating that teachers and women

attach more importance and attention to the tracked competences than head teachers and men do. The stated fact affects the evaluation processes and must be accepted and taken into consideration in the assessment.

In the research results statistically significant differences were found especially when gender of respondents was considered and to some extent also when function/position was taken into consideration. This supports the view that the evaluation of teachers is a difficult, complicated and complex process (Magová et al., 2016) in which it is necessary to take into account a huge number of intervening factors and some of them were discussed in our research analysis. Furthermore, it can also be stated that the specific point of view in a more negative perception of teachers' competences characteristic for head teachers, unlike teachers, was identified as well in the analysis published by Fandelová, Gadušová, and Lomnický (2016) which emphasized rather less facilitating benefits of either oral or written evaluation by the school head teachers.

Similar researches abroad point at variety of aspects worth to be aware of when judging and assessing teachers' competences, as, for example, study of Bukvić (2014: 1585), which discusses 'teacher's personal perception of their own competences for teaching SEN students in early and compulsory education'. In his research it was found that that 'about 70% of examined teachers have none or very little knowledge about teaching SEN students, and their attitudes are mostly negative but younger teachers experience higher competences'. And that is why (McDonald, 2014: 1569) 'on-going professional development and learning (PDL) should be a significant component of a professional's development'. According to McDonald (2014) teachers, like all professionals, need to be engaged in continuous learning to ensure that relevant knowledge and skills are being utilized in their day-to-day activities to ensure professional growth and improved students' outcomes. Nevertheless, PDL is only meaningful if it promotes change in teachers. Difficulties with the transfer of training occur because it is a misunderstood, controversial complex phenomenon and is consequently ill planned for PDL. Accordingly, PDL planning needs to incorporate a transfer plan that specifies a strategic framework and specific factors promoting on-the-job application of knowledge and skills.

## **CONCLUSION**

Assessment of teachers' professional competences is a permanent process and a part of the head teachers' position performance. It is carried out based on the Act N<sup>o</sup> 317/2009 on the teaching staff and other experts (head teachers should assess each teacher in their schools at least once a year). Given that the evaluation of teachers is an important process also on the way of the professional and personal development of each teacher, this gives its meaning also to the improved quality of education and it has society-wide importance. The research study, conducted in schools on a sample of 146 head teachers and 730 teachers by means of the questionnaire method, identified some factors that may intervene in the evaluation process and facilitate or distort its results. The perception of the importance of stated competences according to the participants, i.e. according to the head teachers and teachers, shows the range of importance which is attached to the different competences by the addressed respondents. The most significant differences were identified in the importance of the tracked competences based on gender and overall more positive attitude was demonstrated in the competences' perception by teachers and women than by head teachers and men. It is therefore likely that the head teachers and men may be less sensitive in how they perceive assessment of individual competences than teachers and women are. Identification of differences based on function/position and

gender showed that the differences based on gender are far more remarkable than those identified based on function/position. Evaluator (head teacher) and the evaluated (teacher) are not a unified, monolithic category and the impact of factors abstracted in the research should be taken into account in the evaluation process. The research study provides generalized data which support claims about the complexity and difficulty of teachers' assessment, but it also specifies the partial factors on the basis of which the assessment is conducted and which should be applied in the development of methodological basis for evaluation and assessment.

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# TEACHER ASSESSMENT IN INTERNAL QUALITY ASSURANCE SYSTEMS

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## ABSTRACT

Although evaluation and assurance of quality of education can be done in relation to its different dimensions, beyond dispute the key factor of the education quality phenomenon are teachers and their professionalism. The paper presents results of an international research aimed at teacher assessment carried out in frame of internal quality assurance systems at higher education institutions in seven European countries which followed implementation of European Standards and Guidelines for Quality Assurance (ESG) into the institutional quality assurance systems. In the conclusion the paper points out how the research results and experiences, which were obtained within EU, are further used and disseminated outwards to higher education institutions in Asia, particularly in Kazakhstan and Uzbekistan.

## KEYWORDS

Comparative Study, European Standards and Guidelines (ESG), Higher Education Institutions (HEIs), Internal Quality Assurance Systems, Teacher Assessment

## INTRODUCTION

Teacher, lecturer, tutor, mentor – in general an educator - is the core element within each teaching or learning processes, having among the other factors a decisive impact on their progress and quality. Currently quality assurance of education has become a stressed priority in national school policies worldwide and education institutions are supposed to create their internal quality assurance systems (Skolnik, 2016; Brady and Bates, 2016; Kohoutek, 2016). As a supportive tool for higher education institutions (HEIs) for these systems creation European Standards and Guidelines for Quality Assurance (ESG) were adopted in 2005 (EHEA, 2005; ENQA, 2006; ENQA, 2015). ESG have been designed to be applicable to all European HEIs and quality assurance agencies to promote mutual trust while respecting diverse national and institutional contexts and subject area (Orsingher, 2006; Crosier and Ruffio, 2009; Williams, 2010; Hašková et. al., 2013). As a monitoring of the ESG implementation in various EU countries an international research was carried out. A significant part of this research was devoted to the issues of teacher assessment in the context of the ESG implementation and creation of institutional internal quality assurance systems.

## RESEARCH SAMPLE AND METHODS

The research was carried out in 7 European countries (Czech Republic, Lithuania, the Netherlands, Poland, Portugal, Slovakia and United Kingdom). In each of them the research sample consisted of 4 randomly selected higher education institutions (HEIs) of

diversified size, location, mission and profile, so totally a research sample of 28 HEIs was monitored. Based on a common research methodology and the mentioned selected samples of the HEIs, national research teams collected relevant research data, analysed them, and prepared a National Report presenting summary of the partial results obtained for the relevant country. Consequently the National Reports were submitted to an international team of the experts who on the basis of the comparative analysis of the obtained 7 National Reports created a final Comparative Report. In Slovakia the co-ordinator of the national research and at the same time a member of the project international research team was Constantine the Philosopher University in Nitra (under a scientific guarantee of A. Hašková).

Methodology of the research carried out inside the involved countries comprised content analysis of the national and institutional documents and semi-structured interviews (Fraenkel and Wallen, 1993; Jaeger, 1988; Bogdan and Biklen, 1992) conducted with a number of respondents representing different HEI staff categories (e.g. HEI's management responsible for teaching performance at the institutional and faculty level, HEI's management responsible for internal quality assurance in teaching, HEI's staff responsible for human resources, HEI's teachers) but also with several representatives of the HEI's students.

Both the content analysis and the semi-structured interviews followed (in different scope, in dependence on the document/respondent category) 5 cardinal research questions, which reflected the European Standards and guidelines and which were (IBAR, 2013):

- Q1: What is the HEI's institutional policy regarding quality assurance (QA) of the teaching staff? How is it related to the national rules concerning QA and employment?
- Q2: What are the HEI's criteria of staff recruitment and appointment procedures? How do they assure the quality of teaching?
- Subquestions:
- What kinds of certificates and/or past experience in teaching (other experience) are required?
  - Is the teaching staff allowed to have more than one full time position? If so - what is the positive and negative impact of this fact on teaching quality?
- Q3: How is the HEI supporting quality of teaching performance?
- Q3a: How does the HEI support continual professional development of teachers (development of their teaching skills)?
- Subquestions:
- Are there trainings (programmes) aimed at assessing / developing / improving teaching skills? If so – are they compulsory for teachers?
  - How are teachers supported by the HEI when they are facing problems of diversification of students' competences or deficit of knowledge (e.g. secondary school graduates, students of master study programmes graduating from different bachelor programmes)?
- Q3b: How is the HEI enhancing quality of teaching performance by modernisation of teaching equipment, size of students groups and other possible factors?
- Q4: How (based on what criteria) is the quality of teaching assessed? How (in what

way, through which kind of means) is the assessment performed? How does the HEI use the results of assessment?

Subquestions:

- What are the main tools of assessment: student reviews, exam results, periodic general assessments of teaching staff, what other?
- What is the students' role in the assessment?
- Does it influence the HEI's human resource policy in any way?
- What happens if the teaching performance of a staff member continues to be demonstrably ineffective?

Q5: How are teachers motivated by the HEI to assure and improve the quality of their teaching performance?

Subquestions:

- How is the assessment of teaching used in the HEI's motivation systems?
- Are there at the HEI any financial and non-financial motivation tools enhancing teaching activities?

## **RESULTS**

As from the practical point of view answers to the questions Q3 – Q5 have a high predictability on the HEIS' internal quality assurance systems, thereafter only main findings resulting from the responses to the questions Q3 – Q5 are presented (Tables 1 – 3).

Country	Main findings related to the question Q3
CZ	A prevailing instrument supporting development of teaching skills are teacher training courses. In teachers' opinion some of them are beneficiary, but some aren't. Modernisation of the institution equipment/facilities and libraries is done on a regular basis at all HEIs.
LV	At large institutions there are special programmes for teaching skills development and improvement. HEIs are using available teaching equipment like computers, interactive whiteboards, internet access so the teachers can offer individual and team work to students of different level of previous knowledge.
NL	In all HEIs the teaching staff is largely encouraged and given opportunities to develop and value their teaching skills. The HEIs have set themselves to increase the targets of academic staff having university teacher qualification; they have dedicated units for teacher training at the central university level which provide short courses on professional skill development. In some institutions this is more and in others it is less formal.
PL	Systematic and formally confirmed training is not required. Some of the HEIs have programmes to improve teaching skills of the staff, some haven't. Modernization of equipment is often going on permanently, with outstanding role of the EU funds.
PT	At the HEIs different approaches to the issue were recorded: from lack of procedures and underestimation of this matter through teaching performance assessed together with research performance, up to some forms of support given to the staff' teaching skills development (e.g. trainings offered to teachers). In general there is a support given to teaching practice performance by means of teaching equipment modernisation and optimisation of the size of student groups and at the HEIs there is a satisfaction with these factors but always with some major or minor complaints.
SK	The main focus is put on the development of professional competences (knowledge) concerning content of taught subjects. Teaching experiences and pedagogical competences don't belong to the followed priorities. HEIs have very limited funds to cover costs of life-long learning programmes for their teaching staff as well as to upgrade teaching facilities and provide material and technical support to teaching processes. These kinds of activities have usually to be covered through national and international projects. Departments oriented on natural and technical sciences use cooperation with business companies to develop professional skills of teaching staff. The teaching staff doesn't have always sufficient motivation and interest in their further education.
UK	According to the UK Quality Assurance Agency for Higher Education Code of Practice (2012) "Members of staff new to their teaching or supporting student learning role are encouraged to engage in appropriate induction and mentoring opportunities made available by the higher education provider... throughout their career, staff engage with opportunities to develop and extend their teaching capabilities and to reflect upon their teaching practice", i.e. before any new staff members are allowed to teach students, they are required to participate in short 2-3 day courses (may differ in their forms) to acquire basic skills and concepts.

**Table 1: Overview of the main findings resulting from the responses to the question Q3**

Country	Main findings related to the question Q4
CZ	Assessment of the teacher performance quality is followed at all HEIs. It is assessed externally by means of (re-) accreditation processes and internally by means of student evaluations.
LV	Assessment of the teacher performance quality follows the National regulation and at the HEIs is based on assessment done by students. Student surveys are usually organized centrally through computer systems, accessible remotely.
NL	Teacher performance is evaluated through student course evaluations which are usually carried out electronically. The course evaluation systems are linked to the performance measurement of academic staff in the promotion processes at human resources policies. University teacher qualification is required to hold a tenure track position or to obtain a permanent position.
PL	Assessment of teachers is done at all HEIs systematically, as it is required by legislation. Teachers are usually assessed in 2 ways: by students (they are informed about the results in general way) and periodically by their supervisors – evaluation of achievements in research, teaching, administrative activities etc.
PT	Dimensions used to assess the staff are teaching, research, artistic and cultural creation, additional activities (dissemination, knowledge transfer, training) and HE administration. The particular dimensions could be given different weights, what depends on the HEI's own regulations establishing parameters, criteria and respective scores to assess each dimension. Pedagogic questionnaires emerge as a transversal tool for the assessment. Results of these surveys are available to external reviewers. Teacher performance assessment and its consequences are mentioned also in the legislation, but in general the assessment is understood as a motivating factor.
SK	Evaluation done by students (usually through questionnaire surveys) is required by the national law, as well as periodical reports on quality assurance prepared by the HEIs and faculties. The official external evaluator of the HEIs quality is the State Accreditation Commission. Students perceive their involvement in these evaluations positively, but they expect some feed-back. They would like to be informed about the results and expect some changes will be visible. Just the insufficient feed-back in direction to the students (insufficient information them about the results and from them derived realization of remedies) appears as a weakness of these evaluation processes.
UK	According to the UK Quality Assurance Agency for Higher Education Code of Practice (2012) "Higher education providers collect and analyse appropriate information to ensure the continued effectiveness of their strategic approach to, and the enhancement of, learning opportunities and teaching practices." List of data sources gathered by HEIs and its activities are very closely aligned to the guidelines in the QAA Code of Practice and in frame of the evaluation process the student voice has a very strong position.

**Table 2: Overview of the main findings resulting from the responses to the question Q4**

Country	Main findings related to the question Q5
CZ	Significant financial motivation tool for the HEIs academic staff are personal bonuses and financial rewards set in the institutional wage regulations. A serious problem is how to balance the impact of research and teaching activities on extra financial rewards of the academic staff.
LV	Each HEI has a sort of motivation system to recognize good teaching performance. The institution practice is to give annual prizes (premiums, presents) to the best teachers of each faculty.
NL	Presumption of the HEIs is that teachers are intrinsically /personally motivated. In some cases external motivation factors used at some of the HEIs are bonus payments or awarded prizes like “teacher of the year”. Negative reactions on repeated bad evaluation occur, but they are not too frequent.
PL	In general there is a relative absence of complex motivation systems for teachers of the HEIs, but some good practices can be found.
PT	There are almost no concerted and systematic strategies to motivate teachers to improve their performance at the HEIs. Current financial situation and excessive workload of teachers have a counter-productive impact on their motivation.
SK	Criteria of quality assessment of teachers` performance are derived from the criteria used by the Ministry and State Accreditation Commission and so they, ultimately, prefer research outcomes of teachers to the quality of their teaching activities. This results in a lack of interest to establish the quality assurance policy strictly in the area of teaching processes, including incentive systems for teaching activities. Main motivation of teachers to be a good teacher is still based on their internal positive attitude to their jobs.
UK	In case of the UK HEIs some challenges in implementing structural opportunities for the motivation of teaching staff were recorded, but there is a problem of the impact of the national funding models. The main obstacle seems to be the unbalanced positions of two key factors which are effective working environments to support enhancement of teaching and (versus) lack of time.

**Table 3: Overview of the main findings resulting from the responses to the question Q5**

## DISCUSSION

As the presented results show the level of the quality assurance culture at the HEIs in the surveyed countries varies according to its dimensions (for more details see in Eggins, 2014 or Hašková, 2015). To specify a critical point only on the basis of the presented results would not be respectable. Overall the responses to the stated research questions proved that HEIs quality culture has been developed in the Netherlands and the United Kingdom, while in Lithuania, Poland and Slovakia prevail external factors influencing creation and utilization of the internal quality assurance systems at the institutional level in a negative way. Another finding is that although the designed internal quality assessment systems do not follow the ESG goal-directedly, more or less they copy them (ENQA, 2006; ENQA, 2015).

An important aspect of the obtained results is the significance of the low effectiveness of the evaluation of teacher performance in view of insufficient funding of higher education and inadequately low earnings of university teachers, which are often combined with an excessive workload (Lithuania, Poland, Portugal). Financial insufficiency represents a serious threat to the ESG implementation in HEIs in all their aspects in each country. Lack of funds results in lack of consistent quality promoting institutional internal policy targeted at teaching quality assurance. Moreover overloading of teachers together with the possibility, or more strictly speaking a necessity, to have more part or even full-time

positions loosen the teachers' identification with their HEI. On the one hand it diminishes the identification of the teachers with the HEI's goals and on the other hand it reinforces the instrumental attitude to their work, perceiving it only as a means of money making, i.e. a destructive attitude towards quality culture can be observed here.

## CONCLUSION

Quality assurance has been a major theme of various international activities organized by different international research associations, e.g. EAIR – The European Higher Education Society, or CHER – Consortium of Higher Education Researchers. At the same time with the new ESG version implementation in 2015 (ENQA, 2015) the attention has started to be paid to the possibilities to disseminate the ideas of the Bologna process and concept of the tertiary education quality assurance also beyond the European Union, or rather beyond the Europe. The importance of higher education quality together with interest in the Bologna process priorities (EHEA, 1999) have been approved also in the Central Asia region. Countries of this region declared quality assurance processes and mechanisms as the national priority for Erasmus+, and Bologna process type reforms was set as the priority at the regional level. These facts are reflected in the project *Enhancing capacities in implementation of institutional quality assurance systems and typology using Bologna process principles*. The main goal of this two-year project, which started in 2016, is to use the experiences which the HEIs in the EU countries has gained at development and implementation of their internal systems of quality assurance, and to disseminate the relevant results and experiences into the HEIs of Kazakhstan and Uzbekistan. The representatives of all HEIs from Kazakhstan and Uzbekistan involved in the IQAT project declared coincidentally as priorities of their interest mainly the issues of teacher assessment to it relevant methodologies and tools (Gadušová and Hartánská, 2015; Gadušová et al., 2016). In this context, the results and experiences from the above presented research are further used in this project realisation.

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# BOLOGNA PRINCIPLES AND QUALITY ASSURANCE OF KAZAKH HIGHER AGRICULTURAL EDUCATION

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## ABSTRACT

For the development of higher education after the collapse of Soviet Union, Kazakhstan decided for combination of own approach and European educational system. Several reforms were implemented since that time. Our paper attempts to analyse current level of Bologna system implementation in Kazakh agricultural HEIs. Mainly qualitative methodology of desk-research of strategic documents, followed by focus groups discussion, interviews and open-ended questionnaires were used for data collection from two major agricultural universities in Astana and Almaty. Based on our results, we can conclude, that the quality assurance of Kazakh agricultural higher education is already well developed and most of the basic principles of Bologna system are already implemented. Both HEIs have also many elements of internal quality assurance system in place. However, the activities in the field of quality are still regulated and demanded externally mainly by the national legislation and ESG standards for internal quality assurance are implemented rather unsystematically.

## KEYWORDS

Bologna Process Expansion, European Standards and Guidelines, Internal Quality Assurance, Kazakhstan

## INTRODUCTION

After the collapse of Soviet Union, newly founded countries such as Kazakhstan had to start their nation building process and reform many aspects of their government and laws, including the educational system, which had to be transferred from the Soviet scheme into a new one. In term of higher education, there were two principal possibilities: European and American standard of educational system. Kazakhstan decided for combination of own approach and European educational system which is represented by the Bologna Process.

Identified as the most considerable and wide-ranging reform of higher education in Europe

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since 1968, the Bologna process aimed at creating the European Higher Education Area (EHEA), in which academics and undergraduates will have greater mobility and their qualifications will be recognized. It is one of the biggest revolutions in higher education system and it became a symbol of globalization in the educational space. It is based on a set of criteria that universities should fulfil - such as European Credit Transfer and Accumulation System (ECTS), 3-cycle higher education system (bachelor's degree, master's degree and PhD programme), lifelong learning and others so a national educational system can be integrated with the international one (EHEA, 1999). EHEA has currently 48 countries with full membership, including Kazakhstan. Several important steps for internationalization of Kazakh higher education were already successfully implemented, while several other challenges remain. Our paper attempts to analyse current level of Bologna system implementation in Kazakh higher agricultural institutions.

### **Evolution of the system of Kazakh higher education after the collapse of the Soviet Union**

In Kazakhstan changes came quickly after declared independence in 1991. The quality of education was emphasized as an important pre-condition of the future well-being of the country, as confirmed by the President of the Republic of Kazakhstan, Nursultan Nazarbayev, in his "Kazakhstan 2030" Strategy (Nazarbayev, 1997). Quality education was recognized by the head of state as a prerequisite for the realization of the potential of the new young generation, and at the same time the privileged means for the development of relations and friendship between the countries of Central Asia.

The reform of higher education targeted the restructuring of the system in order to open it to other countries of the world. It can be divided into four stages (based on Kukeyeva et al., 2014):

The *first stage* (1991-1994) focused largely on forming a legislative basis for higher education. In 1993, Kazakhstan's law "On higher education" laid the groundwork for accomplishing these tasks. In 1994, Kazakhstan approved a state standard on higher education, which introduced bachelor's and master's level degrees. Former institutes with a five-year program were converted into universities and academies with the four-year bachelor and one or two-year graduate master's programs.

The *second stage* (1995-1998) involved active measures aimed at modernizing Kazakhstan's higher education system. These measures included introducing a new list of specialties consisting of 342 specialties and promotion of private institutes of higher education.

The *third stage* (1999-2000) was characterized by decentralization of education management and financing, including expansion of academic freedom of educational organizations. In June 1999, Kazakhstan adopted a new law titled "On education" as well as a "model for the formation of a student society in institutes of higher education". The basis of the new model consisted of the implementation of entrance examinations for applicants in all specialties across the country, carried out by an independent and impartial body.

The *fourth stage* of Kazakhstan's education reform has been in process since 2001. This period is characterized by adopting a system of three-stage education. Other prominent features include the creation of a national education quality assessment system.

In March 2010, Kazakhstan became a signatory to the EHEA and as one of the first states of former Soviet Union joined the Bologna process and started full transformation from soviet system of education into a western one. Kazakhstan was praised for pioneering

efforts to reform its higher education system in accordance with the guidelines of the Bologna process. Consequently, the scale of the Bologna process to Kazakhstan's higher education system seeks to (Maudarbekova, Mizikaci and Dyusembinova, 2015):

- 1) Find a harmonious balance between Bologna convergence and state originality;
- 2) Establish the internal balance between the stages of the Bologna Process.

The implementation of the Bologna process included change of length of higher education studies from 11- year Soviet model to divided western one. Model of three-stage higher education looks as follows: 4-year Bachelor's degree (for some specialities as Veterinary or Architecture students study 5 years), 1-2-year Master's degree (1,5 Master's for professionals or 2-year Master's for scientific – pedagogical workers) and 3-5 year doctorate. Other important aspect was introduction of the ECTS and mutual acceptance of education programs. Now, there is one scientific degree - PhD and two academic distinctions are awarded by the Ministry of Education and Science of the Republic of Kazakhstan (the MES RK): associate professor (docent) and professor (Zhumagulov, 2012 in Nessipbayeva and Dalayeva, 2013). Later on agreements on cooperation in education area have been signed with more than 20 countries (Turumbetova, 2014).

Another important step for deeper internationalization of Kazakh higher education system so far was signing Magna Charta of universities which is the base of the Bologna Declaration. By the year 2015, 30 Kazakh universities already signed this document.

### **Kazakh agricultural higher education**

The higher education institutions (HEIs) functioning in Kazakhstan are universities, academies or institutes. Conservatories, higher schools and higher colleges have a similar status. In line with the Law “On Education”, selected state HEIs were granted the special status of “national universities”.

In 2009, there were 144 higher education institutions (55 State HEIs and 89 private). The number of non-state (private) institutions was gradually increasing until 2001 and began to decline in 2002. On November 26, 2012 after an optimization process 139 universities remained in Kazakhstan. For the 2009 – 2010 academic year, the total number of students in HEIs was 610.2 thousand. On average, there are 232 students per 10 thousand persons in the world. In Kazakhstan, this figure is 422.5 people (EACEA, 2012).

In the country, there are 3 main agricultural universities in cities of Astana (S. Seifullin Kazakh Agro-Technical University), Almaty (Kazakh National Agrarian University) and Oral (Zhangir-Khan West Kazakhstan Agricultural & Technical University). None of them is private. There are also other generally oriented universities (usually with statute of State HEI) with one or two agricultural-related faculties, for example:

- Sh. Ualikhanov Kokshetau State University with 5,000 students and 500 students studying at Agrarian – Economic Institute
- A. Baitursynov Kostanay State University with 20% of students studying at two agricultural faculties
- Pavlodar State University S. Toraigyrov with one agricultural faculty attended by 10% of university's students
- North Kazakhstan State University with 5% of students at one agricultural faculty
- Shakerim Semey State University with one agricultural faculty
- M.O. Auezov South Kazakhstan State University with one agricultural faculty
- Taraz State University M. H. Dulati with one agricultural faculty

## AIMS

All Kazakh agricultural universities have embarked on the journey of implementation of Bologna system since the country entered officially into EHEA in 2011. Number of important steps have been already implemented, while several challenges are yet to be overcome. Our paper, which is using the case study approach, aims to analyse current level of European standards implementation on the two biggest higher agricultural institutions in two major cities – Astana and Almaty. Systems of internal quality assurance play special role as the backbone of the European de-centralized systems.

## METHODS

In preparation of this research, the authors relied heavily on desk-research of published materials and information, including the text of laws on education, statistics on the agricultural HEIs, and additionally the impact of the Bologna process. Also, the analytical reports on the development of higher education in the Kazakhstan were given certain values according to the European Union Erasmus+ Program.

The qualitative methodology of focus groups discussion, interviews and open-ended questionnaires were used as the main methods, especially for data collection at S. Seifullin Kazakh Agro-Technical University (KazATU). The small working group comprised researches and 2 teachers, 2 representatives of the management and 1 specialist from Quality unit of the KazATU university. During the first face-to-face meeting in February 2016, initial pilot discussion framed the process of the whole research. After the period of desk-research, additional data was collected by the questionnaire communicated via email. The second face-to-face meeting of the group was organized in June 2016, where all the details were clarified and the results finalized. For Kazakh National Agrarian University (KazNAU) mainly secondary data and observation were used.

Majority of data was collected within the Erasmus+ Programme of the EU under the project *Enhancing Capacities on Implementing of Institutional Quality Assurance Systems and Typology of Using Bologna Process Principles* (IQAT) number 561685-EPP-1-2015-1-CZ-EPPKA2-CBHE-JP (IQAT, 2015). The project, which was implemented from 2015 till 2017, included partners from the Czech Republic, Slovakia, Latvia and Spain, and aimed on building of capacities of 6 central Asian universities in Kazakhstan and Uzbekistan.

As a main theoretical framework of the data collection tools, the standard structure of European Standards and Guidelines for quality assurance in the European Higher Education Area - ESGs was used.

The two analysed agricultural universities were:

Kazakh National Agrarian University (in Almaty)

Established in 1929 as Veterinary Institute. It was the first agricultural and the second HEI in Kazakhstan. It is non-commercial joint-stock company accredited for educational activity given by state Committee for Control of Education and science. In 2001, Kazakh State University of Agriculture was given a special status in accordance with the Decree of the president and the University became Kazakh National Agrarian University. In 2015, the university had 7,217 students (6,063 undergraduates, 1,021 masters and 133 doctoral) (KazNAU, 2015).

S. Seifullin Kazakh Agro-Technical University (in Astana)

Established in 1957 as Akmola Agricultural Institute. It is the largest agrarian HEI of

Central and North Kazakhstan, the first HEI of Astana. In 2007, the University was handed over to the Ministry of Agriculture and reorganized into the State HEI turned into joint-stock company. Number of students in 2015 was 9,707 (KazATU, 2016).

## RESULTS

### **Current level of the implementation of general Bologna principles at studied agricultural HEIs**

In September 18, 2009, the KazNAU joined officially the Great Charter of universities for support of the basic principles of the Bologna process thereby entered the European educational space. Since, it has realized training of specialists on divided levels - Bachelor's, Master's and Doctoral, introduced credit technology for evaluation of teaching, and actively established cooperation with many overseas universities. According to the second strategic direction – “Training competitive specialists” one of the aims is: “to improve the educational quality by ensuring the implementation of the Bologna process principles” (KazNAU, 2015).

At KazATU wide range of principles of the Bologna process are already implemented as well. First, there is the clear structure of the study programmes according to the scheme Bachelor –Master – PhD (doctoral). This structure is practices at all faculties.

At the same time the ECTS credit system is also implemented though with some specific rules. These rules can be found in the “Guide book” for students of KazATU: “*Over one semester the student shall master 12 – 18 credits, and during academic year at least 30 credits including 100% compulsory component courses*” (Sec. 2.2). “*To complete Bachelor's programme a student is to complete at least 129 credits of theoretical training and at least 10 credits of field internship and 4-8 credits of thesis defence*” (Sec. 3.3). Students now have the opportunity to build an individual study program based on personal needs and opportunities. To assist students in choosing their path of study at the university it is established a service of academic consultants - advisors.

After graduating, students obtain the state diploma with the Diploma supplement in three languages (Kazakh, Russian and English). If students request it, they can get standard European Diploma Supplement. KazATU is also full member of the Great Charter of Universities, which is the basis of expansion of European educational space.

### **Current level of the implementation of internal quality**

In addition to regulations of the MES RK, several internal regulations are in place at both universities. The internal assessment of education quality is the responsibility of HEIs themselves and includes various procedures of self-assessment and monitoring of academic achievements. This is fully compatible situation suggested for HEIs in Europe by the European University Association.

First of all, in terms of internal quality assurance, both universities have a well elaborated Quality Management System (QMS) in accordance with the norm ISO 9000. This system has been built during several years and covers almost all activities at the university. In the framework of this system some measures have been similar to the ESG standards. All the ISO 9000 measures are described in respective documents, but only some of them are publicly available.

At KazATU the Quality Service department has been established in 2004. The main task of this department was to create and implement the QMS and strategies. The department has these functions:

- to maintain the QMS in a working state,
- to monitor activities of individual units of KazATU by internal audits,
- to coordinate the preparatory works for institutional and specialized accreditation and to give consultations and methodological leadership,
- to gather and analyse data and information for participation of KazATU in international academic ratings,
- to organize the gathering of data and information for the complex evaluation of various units of KazATU,
- to supervise the documents about QMS, to secure the evidence and archiving of them.

Main priority areas in the field of education defined by the QMS are: qualitative training of specialists for the agricultural sector, competitive recovery and increasing the rating of the university both on the national and international level, the successful integration into the global educational and scientific space.

The important tool in QMS at studied universities is the internal audit. Its aims and procedures are at KazATU in details described in special document, which was issued in 2015. The internal audit evaluates the degree of the correspondence of the QMS with the norm ISO 9000 and with other relevant standards and contracts. The procedure of the internal audit is determined by the respective norms ISO 9000. However, evaluated activities are not specified in detail in the document.

As a more specific and closer to ESG approach may be regarded other instrument - complex evaluation of faculty departments. This new tool was specified within the framework of QMS in 2016. Assessment of HEI operation also includes the opinion of students on the quality of the teaching process. It is organized based on the questionnaire. Another specific tool of QMS is the system for determining academic ratings of lecturers and related system of the incentives.

Employers are also involved in the assessment of professional competence of graduates. Every year, in accordance with the order of the rector of the university, a meeting of senior students and employers is held at the departments' level. During the meeting employers give an assessment of knowledge of graduates on topical issues of professional activity (knowledge of modern legislation in the relevant industry, knowledge of new technologies and international standards etc.). The feedback goes back to the departments and to the program majors.

In terms of rankings the KazATU is a leader not only in the capital, but it is also among the top three out of thirty technical universities of the country. Agency for Research QS ranked KazATU into the world's 601+ universities, among 8 Kazakh Universities.

In March 2016, the Independent Quality Assurance Agency (IQAA) held a ranking of the best universities of Kazakhstan and the ranking of educational programs for specialty groups. In this rating, KazNAU took third place in the national ranking of the best technical universities of Kazakhstan (KazNAU, 2016).

### **Implementation of individual ESGs in internal quality assurance**

At the moment, the ESGs are not explicitly mentioned in any studied HEIs documents, however, most of them are implicitly involved in some activities related to the QA at institutional level.

In this part, we will indicate the most important of them:

- In relation to the ESG standards 1.1, there is not any publicly available policy document specifying internal quality assurance.

- Standard 1.2 discusses the importance of quality assurance of study programmes. At this moment, the study programmes are evaluated and approved by the MES RK and they are not subject to any specific internal evaluation. So there is not too much space for the institutional activity and QA at institutional level. Curriculum design and delivery is normally regulated by the MES RK. State standards are followed for core courses in all academic programmes offered by both public and private HEIs. State Compulsory Education Standards are developed in line with the Government Decree “On the procedure of developing, approving and term of validity of state compulsory education standards (SCES)”. There are two components of the SCES – a mandatory and an optional component. Generally, around 50% of the total academic workload in all academic programmes is mandatory and the other 50% is optional.
- ESG standard 1.3 specify the student-centred teaching according to published criteria, regulations and procedures. KazATU certainly has these regulations in some form but not explicitly in one document. The way of teaching, including the student-centred teaching is mostly left to the responsibility of the individual teachers. In recent years, the student-centred approach is preferred, nevertheless many lecturers still favour the teacher-centred approach because it is the way they were thought during their student years.
- ESG standard 1.4 deals with the students’ admission and progression. Admission to HEIs is carried out based on the Standard Admission Rules approved by an Order of the MES RK. The admission of students leaving secondary schools is based on the results of the Unified National Test (UNT). The rules and regulations for regular examinations have been developed at national as well as institutional levels of both analysed HEIs and they are (mostly publicly) available. Usual practice is that the assessment is carried out only by one assessor while the commission carries out the final examinations. Each student can use the formal procedure to appeal (against received marks, for example), if needed. Conditions for progression from one year to the next are regulated by an external Order of the MES RK. According to the Order it is mandatory to fulfil all the requirements of the curriculum of the previous academic period and pass an interim assessment (attestation). Graduates must pass the final state attestation in the form of a state examination and defence of a thesis (diploma) or project. Since July 2004, an interim assessment has been introduced - the Comprehensive National Mid-Term Test that third year students of medicine and all other second year students must take. Only those who have passed this test can remain enrolled. The problematic area of Bologna principles implementation is the recognition of HE studies and diplomas. It is regulated and made available only from the national level (the MES RK plays the main role).
- ESG standard 1.5 on “Teaching staff” focuses mainly on teachers recruitment, conditions of employment, professional development, teaching and research connections and teaching methods innovation including ICT exploitation. At both analysed universities, it is rather strict and well elaborated. It is a consequence of detailed regulations stipulated by the Law on education (the section related to the status of pedagogical staff sets that they are state employees). There are also institutional evaluation mechanisms of teachers (including the students’ evaluation of teaching through questionnaires), salaries’ bonuses (motivation) of successful teachers including their research achievements, special programmes for young teachers, teaching/training courses on teaching method innovation, ICT in education

for teachers etc. The problem can be found in the lack of public information about these activities. KazATU organizes regular evaluation of teachers, however the respective document(s) with results are not available. The students' questionnaires enabling to express her/his own view on quality of teaching are quite usual. Another possibility of students to enforce their views on various matters connected with their rights and responsibilities are the students' organisations.

- ESG 1.6. "Learning sources and students' support". The accreditation requires, in accordance with ESG, that teaching is usually left on the teachers themselves so for example the student-centred learning is not supported from the faculty level.
- ESG standard 1.7 "Information systems". Both universities have the own information system and gather the information and data about all topics mentioned in this standard. This is the responsibility of the Quality Service department.
- ESG standard 1.8 "Public information". Both HEIs publishes some information about offered study programmes on their website but the information is not so exhaustive as the standard supposes (no clear, up-to date and readily accessible data in accordance with ESG Standard recommendations).
- On-going monitoring and periodic review of programmes and Cyclical external quality assurance (Standard 1.9 and 1.10) are the processes running under the national legislative framework and thus rely on external quality assurance systems only.

The topic, which is going through all ESGs and the topic that is still to be developed is the students' participation in internal quality management. Active participation of students in this area is so far strongly overlooked. Student Councils are now mostly a symbolic gesture.

## **DISCUSSION**

The transformations that have affected the former Soviet countries, including Kazakhstan, were very deep and influenced almost all aspects of society (Hoen and Irnazarov, 2012; Aristei and Perugini, 2012). Our results show, that several important steps have been already implemented towards the harmonization with European Bologna system, including some standards for internal quality management of more decentralized educational system. However, some authors claim that higher education in post Soviet countries, including Kazakhstan and even Russia, continues to stagnate after the collapse of Soviet bloc even though quality of life is getting better and financial investments into science and education are increasing (Suleimenova et al., 2013; Dobryakova and Froumin, 2010). One of the big factors is a fact that last generation of students was raised in the transition period when educational system was going through major changes and therefore was not fully operational. From this period, many stereotypes are still alive. The main way to reach success are various corruption instruments, personal level of income and family-clan ties. The level of education has still minor influence on a career. This phenomenon is not problem only in Kazakhstan, it can be found in other countries with similar historical background (Obukhova et al., 2015).

The government tries to offset Slow pace of transformation of Kazakh higher education in some areas by involvement of Kazakh universities into European projects (Erasmus+ or formerly Tempus) and at the same time by widely available exchange programs for students and lecturers. More than 5,500 citizens of Kazakhstan study currently in over 35 countries around the world. Participants have full funding of all expenses during the time of their studies abroad but only under the condition that after graduation participant



must go back to Kazakhstan and work five years for the government. These are supposed to bring to Kazakhstan missing know-how in various fields and they are expected to be qualified to teach a new generation of students (Turumbetova, 2014).

## CONCLUSIONS

To summarize our findings, it is clear that quality assurance of Kazakh agricultural higher education is already well developed and most of the basic principles of Bologna system are already implemented. Both HEIs have many elements of internal quality assurance system in work. However, the activities in the field of quality are still regulated mainly by the national legislation (Law on Education) complemented by the several other normative documents like Standards for institutional accreditation for higher education institutions. Therefore, Kazakh HEIs have not any strong incentives to develop their autonomous systems of quality assurance. Nevertheless, the move from quality control towards quality assurance is gaining strength.

In terms of implementation of Standards and Guidelines for quality assurance in the European Higher Education Area (ESG), even though they are not explicitly mentioned in any internal guiding documents, they are elaborated in external quality assurance normative documents. At the internal level, some of them are implicitly present in similar practices.

Typical problem of current internal quality assurance is public availability of information. Even the quality policies and elements of the internal system are divided into several tools and are described in several documents. But the unification into one guiding document specifying general quality assurance policy, which can be available for example on the website of the university, is still missing.

Some of the elements of the systems seems to be very rigid. The control of teaching staff, for instance, is too heavy and top-down, which is probably not helping to improve teaching process itself. The teachers follow the strict rules, trying to fit into the given categories, but they are losing time and energy for their teaching performance.

The knowledge about the evaluation activities is not well distributed among the university employees. Also, students are not involved systematically into the process.

Despite many unrelated activities which focus on quality improvement, the results are not systematically available freely within the institutions. Regular reports on achievements of quality assurance are not published, they are used only for internal purposes of the top management. Therefore, any feedback or learning process is not supported.

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# SOCIAL BACKGROUND AND OTHER FACTORS AND THEIR RELATIONSHIP WITH FIELD OF STUDY OF UNIVERSITY STUDENTS IN THE CZECH REPUBLIC

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## ABSTRACT

The students' social, educational background, age, gender etc. are used to analyse their choice of study field in the Czech Republic. The analysis is based on the data from the EUROSTUDENT VI survey which was conducted by the Ministry of Education, Youth and Sports, during the fall of 2016. Multinomial logistic regression was the tool used for this analysis. Results show that the strongest relationship between parents' education and the chosen study field is observed for Health and welfare. The probability of students with lower educated parents are more than two times more likely to study Health and welfare compared to the reference category of Engineering, manufacturing and construction. Furthermore, the strongest relationship between age category and field of study was found for Education. The probability of students in the age category over 30 years to study Education is more than seven times higher compared to the reference category.

## KEY WORDS

EUROSTUDENT VI, Field of Study, Logistic Regression, Social Background

## INTRODUCTION

Motivation of students to study any concrete university field of study, or study specialization is mainly a subjective decision of each student. The question is if there are any factors which could be identified as indirect signals that shift probability to select some exact specialization to be more probable or less probable. It is widely known that social background of parents or current situation of students have an influence over their studies. The relationship between social background of parents and the studies of their children, with a special focus on lower income families in the Czech Republic was described by Šimková and Švarcová (2014). Moreover, Švarcová and Tůmová (2014) deal with how having a child influences a woman's studies.

More complex models were developed in the United States where Zafira (2012) analysed effects of students' background on their choice of degree. Initial models showed that age, gender and race have a significant effect on the field of study. He concluded that social background plays a role in choosing an academic field of study (but these results seemed to be less significant). Callender and Jackson (2008) developed models based on British data. Callender and Jackson (2008) wanted to find out how fear of debt and financial constraints affect prospective students' choices of where and what to study. The study concludes that financial issues constrain lower social class students' choice of university

but not their choice of qualification and subjects (field of studies). Moreover, research of Hällsten (2010) based on Swedish data, comes with the conclusion that class background affects program choice in tertiary education. Students from labour family backgrounds prefer shorter educations while findings show that students from service class backgrounds choose programs with higher earnings risk. In Austria, Schlögl and Lachmayr (2005) were concentrating on various aspects that lead to different choices for further education. In this research, the decision at the first interface is mainly decided by educational background, income and work of parents. In the research of Netter, Schweitzer and Völkerer (2008) data from the microcensus from years 2005, 2006 and 2007 were used. As in many other research papers prior to theirs, they found that the educational qualification and professional status of parents correlates strongly with the secondary school attendance records of their children.

The goal of this paper is to find similar or close relationships for the Czech Republic as were found in cited articles by using logistic regression as a statistical tool. The analysis is based on data from the EUROSTUDENT VI survey which was conducted by the Ministry of Education, Youth and Sports in 2016. The explanatory variables used for this analysis were; gender, age, study programme (Bachelor, Master), plans to continue studying, social situation of parents, education level of parents and type of secondary school.

## **MATERIALS AND METHODS**

For this analysis, we use data from the EUROSTUDENT VI survey that was intended for students from all public, both state and all private higher education institutions (hereafter: HEIs). Nevertheless, not all HEIs participated in the survey (see MŠMT, 2016). Thus, the survey was addressed to all students from participating HEIs. In total, more than twenty-thousand students took part in the survey. However, not all responses were complete or fulfilled the requirements from the handbook of the international organization which organized the survey among EU countries. At the end, we received 16,653 surveys that could be used for the analyses. Data was weighted according to the structure of students published by the Ministry; thus, the results depict the student population in the Czech Republic. The Final report of all students was published in fall 2016 and it is freely available to the public (MŠMT, 2016).

Table 1 presents the share of individual variables that were used within the analysis. HEIs in the Czech Republic are mainly attended by females (almost 60%), students in the age group 22 to 24 years (40.9%) and mostly students in bachelor studies (more than 60%). From the point of view of individual fields of study, according to the International Standard Classification of Education ISCED-F 2013 (UNESCO, 2014) the main share of students study Business, administration and law (16.4%) and Engineering, manufacturing and construction (16%). Students mainly have parents with higher education (53.3%) and they come from families with average financial situation (51.6%). They mostly attended grammar schools and secondary education with Matura.

To find out the main motivations of students to pursue particular fields of study we use logistic regression as it is the most appropriate statistical method. Logistic regression allows us to predict which of two categories a person is more likely to belong to given certain other information (Field, 2009). According to Hebák et al. (2015) binary logistic regression deals with finding a function which relates the outcome variable with only two possible categories, dichotomous dependent variable  $y$ . Explanatory variables can be continuous, categorical, dichotomous etc. This paper deals with multinomial logistic regression where the dependent variable has more than two levels. We use the maximum

likelihood method for the estimation of the model; goodness of fit and other tests were used for the validation of the model (e.g. Hosmer-Lemeshow test, Pseudo R-squared and Wald test). For all necessary formulas see Field (2009).

Gender	Female	57.9
	Male	42.1
Age category	Up to 21 years	29.6
	22-24 years	40.9
	25-29 years	17.8
	30 years or over	11.7
Study programme	Bachelor	62.9
	Master	25.8
	Long master (5 years)	8.6
Field of study	Education	10.9
	Arts and humanities	10.7
	Social sciences, journalism and information	12.3
	Business, administration and law	16.4
	Natural sciences, mathematics and statistics	9.1
	Information and communication technologies (ICTs)	7.0
	Engineering, manufacturing and construction	16.0
	Agriculture, forestry, fisheries and veterinary	4.9
	Health and welfare	10.2
Plans to continue studying in higher education after finishing current study programme	Services	2.5
	Yes	54.3
	No	23.1
How well-off financially do you think are your parents compared with other families?	I do not know	22.6
	Very well-off	4.8
	Somewhat well-off	34.2
	Average	51.6
	Not very well-off	8.3
Highest educational attainment of parents	Not at all well-off	1.1
	No higher education (ISCED 0-4)	46.7
Type of secondary school	Higher education (ISCED 5-8)	53.3
	Secondary with Matura	34.7
	Follow up courses	1.3
	Lyceum	6.8
	Grammar school (4 years)	28.4
	Grammar school (6 to 8 years)	25.6
	Higher professional school	3.2

**Table 1: Share of students in individual variables involved in the survey, % (source: MŠMT, 2016)**

## RESULTS AND DISCUSSION

Several individual models and one overall model were prepared as we wanted to find the motivations of students to study in the field they chose. For all models, field of study refers to the dependent variable with the reference category Engineering, manufacturing and construction. All results use 5% level of significance. For the purpose of this paper we

decided to describe individual models without the result tables and present only the table with the overall model.

The first individual model uses gender and the age category as explanatory variables. The results show that women are significantly more likely to study Health and welfare (6.870 times), Education (5.852 times), and Arts and humanities (5.031 times) in that order compared to Engineering, manufacturing and construction. Women are even less likely to study ICTs than Engineering, manufacturing and construction significantly (0.409 times). The oldest age category is significantly more likely to study Education than Engineering, manufacturing and construction compared to the youngest category (7.161 times). As a person gets older they are significantly more likely to study Social sciences, journalism and information (2.419 times) compared to Engineering, manufacturing and construction. The older group of people are significantly less likely to study ICTs (0.155 times) compared to Engineering, manufacturing and construction than the youngest age category. Apart from ICTs and Natural sciences the oldest age category is more likely to study anything other than Engineering, manufacturing and construction with significance. The second individual model was prepared for Bachelor and Master students separately. The reason lies in the differences between bachelor and master students and their decision to study further. The explanatory variables are further study motivation and parent's educational background. The dependent variable remains field of study with the reference category Engineering, manufacturing and construction. With lower educated parents, bachelor students are significantly more likely to study Health and welfare (2.506 times), Education (1.893 times) and Business, administration and law (1.764 times) compared to Engineering, manufacturing and construction in that order. Bachelor students are significantly less likely to be studying Engineering, manufacturing and construction than Health and welfare (3.425 times) if they are not planning on continuing their studies. If master students' parents have low education they are in contrast to bachelors, significantly less likely to be studying Health and welfare (0.615 times) compared to Engineering, manufacturing and construction. Master students with lower educated parents are 1.452 times more likely to study Education compared to Engineering, manufacturing and construction. Students who are not motivated to study further after their masters' are 2.013 times more likely to be studying ICTs compared to Engineering, manufacturing and construction. If they are not motivated to further studies after their master's they are less likely to be studying Natural sciences (0.433 times) and Arts and humanities (0.531 times) than Engineering, manufacturing and construction in that order.

The third model concentrates on the financial situations of students and their parents. As the explanatory variable the following question was selected, 'How well off financially do you think your parents are compared to other families?'. This question was selected since previous research (see Hällsten, 2010) focuses on the student's socio-economic background (family) and not how well off financially the student (individual) is doing right now. Apart from a slight significance in that the poorest perceived backgrounds would more likely choose Engineering etc. than Business etc., we found little or no significance that the finances of the parents would affect the choice of study field. This result corresponds to the one that Callander and Jackson (2008) found.

The last model focuses on the type of secondary education attended and its relation to the university field of study. The EUROSTUDENT VI questionnaire includes 6 different types of secondary education (see table 1). As only grammar schools have a sufficient number of respondents we decided to regroup the answers into 3 categories: grammar school (4 years), grammar school (6 to 8 years) and 'other secondary education' which

refers to the rest of the secondary education. Moreover, we switched the reference category for the dependent variable (field of study) to Business, administration and law as the proportion of students studying in this field was much higher in the category 'other secondary education'. The results show that there is no significant difference on what field of study students choose between grammar school (4 years) and grammar school (6 to 8 years) except for one case. Students from grammar school (6 to 8 years) are 1.578 times more likely to study ICTs than Business and law. Students from 'other secondary education' are significantly less likely to study Natural science (0.244 times), Health and welfare (0.453), and Arts and humanities (0.543) compared to Business and law.

The overall model (table 2) refers to all explanatory variables we found statistically significant in all individual models. The dependent variable remains field of study with the reference category Engineering, manufacturing and construction. This model was prepared only for bachelor students and presented here only for the five fields of study with the highest share of students in the population. The regression model can describe 28.1% of total variability of explanatory variable (according to Nagelkerke Pseudo  $R^2$ ). Table 2 presents results of the analysis related to chosen fields of study. Results show that Education field of study and Health and welfare are more likely to be studied by students from 'other secondary education', older than 30 years and more significantly females. These students are more likely to come from families where the parents do not have tertiary education. They are also more likely not to know if they want to continue studying after finishing their current study program.

Looking mainly at the Education field of study one can see that this category is 7.558 more likely to be studied by students over 30 years. This is caused by the Law no. 563/2004 about the pedagogical workers that orders the teachers who have not finished their tertiary education to complete their education otherwise they have to leave their job.

Results show that even though there is not very high relevance of the overall model we can identify some factors which are relevant to choosing the field of study. High variability can be caused by the high number of university students. These results can be compared with the results of Zafira (2012) where relationships between indicators and the field of study were strong when analysing the first generation of students (cohort 1993-1994) but weak or not significant for the second generation (cohort 2005). The reason for these differences Zafira (2012) identified was the higher ratio of university students.

Even if there is some impact of parents' education, there is very weak or no influence of parents' financial situation. These findings are similar to Zafira (2012). Callender and Jackson (2008) mentioned that the impact of the parents' financial situation is weak. In the research of Böheim and Judmayr (2014) the correlation of education and income between siblings was measured. Background of this investigation is the consideration that the environment, in which children are born, regardless of the later individual effort, has a direct impact on future living conditions as well as income and participation in social life.

	Education	Social sciences, journalism and information	Business, administration and law	Natural sciences, mathematics and statistics	Health and welfare
<b>Type of secondary school</b>					
Other secondary education	.691***	.590***	1.294**	.213***	.754*
Grammar school (4 years)	.475***	.848	1.005	.984	.696*
Grammar school (6 to 8 years)	-	-	-	-	-
<b>Age category</b>					
30 years or over	7.558***	2.265***	2.909***	.861	3.739***
25 to 29 years	3.639***	2.359***	2.194***	1.019	2.990***
22 to 24 years	1.321**	1.377***	1.152	.841	1.243
Up to 21 years	-	-	-	-	-
<b>Gender</b>					
Female	5.658***	3.282***	3.526***	2.602***	12.351***
Male	-	-	-	-	-
<b>Plans to continue studying in higher education after finishing current study programme</b>					
No plans continue	1.187	.851	1.478**	.431***	2.845***
I do not know	1.350**	1.265*	1.499***	.838	2.086***
Yes, I want to continue studying	-	-	-	-	-
<b>Highest education attainment of parents</b>					
Parents without higher education	1.524***	1.353***	1.492***	1.566***	2.154***
Parents with higher education	-	-	-	-	-

**Table 2: Multinomial logistic regression, filed of study, 2016 (source: own calculation)**

Note: Odds ratios, reference category Engineering, manufacturing and construction; \*0.05, \*\*0.01, \*\*\*0.001

## CONCLUSION

The aim of the paper was to describe the main factors which influence the field of study of the Czech university students. The EUROSTUDENT VI survey was taken as the data source and multinomial logistic regression as the statistical tool. Even if the validity of the complex model was not statistically high there were some strong relationships between selected variables.

Results show that the strongest relationship between parents' education and study field can be observed for Health and Welfare category. The probability of students with lower educated parents is more than two more likely to study Health and Welfare compared with the reference category Engineering, manufacturing and construction. This applies to bachelor students only and not for master degree students. The reason for this is the change in the study system in the Health specialization. The bachelor level covers jobs such as Nursing etc. and a bachelor's education is needed within the last decade only. Higher education that covers doctors and more specialized positions is more influenced by parents' education level.



The future analysis will focus on evaluation of the results from the EU-SILC (Statistics on income and living condition survey) data.

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# MINORITY SCHOOLS: THEIR ROLE IN MAINTAINING IDENTITY AND ASSISTING IN THE INTEGRATION OF THE MINORITY INTO THE MAJORITY

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## ABSTRACT

This paper is focused on the role of minority schools and their benefits to the minority community and the minority children. Successful minority schools can serve as institutions which help minority children with a successful integration into the majority society. The paper examines the relationship between the country, international law and the minority. In addition, this paper summarizes approaches to minority education from specific countries. Based on these examples, recommendations are developed for the best general approach for implementation of minority education that will be beneficial for the minority community as well as for the majority society. Specifically, a minority education should include an intercultural education of both groups, a bilingual education, teacher oversight, and state support.

## KEYWORDS

Minority, Minority Identity, Minority School, Minority School Outcomes

## INTRODUCTION

The current “minority issue” is connected to an increasing migration (Sam and Berry, 2006) and globalization (Verkuyten, 2004). These processes result in more ethnically, racially, and religiously diverse countries all over the world. The diverse societies face challenges with the integration of minority groups into the majority society (Cabrera and Leyendecker, 2016) and other challenges such as unemployment, legal status, and prejudice (Bengi-Arslan, Verhulst and Crijnen, 2002). Minority schools can serve as institutions which help minority children with a successful integration into the majority society. Education is one of the most important public assets which countries should provide for its citizens. The task of educating a minority is complex and every country handles this issue differently. Since minorities across countries differ, as well as the approach to their education, there is no general approach to minority education which can be used cross-culturally. Since different approaches are employed for minority education in differing countries, it is necessary to focus on specific examples to identify pros and cons of the minority education and attempt to identify underlining best practices. Specifically, the aim of this literature analysis is to summarize approaches to minority education from specific countries and develop general recommendations for the best approach for implementation of minority education that will be beneficial for the minority community as well as for the majority society. Briefly, this paper initially defines the concepts of ethnic group, minority, and minority school. The paper then presents what are the benefits of a minority

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education for the minority community and minority children through case studies. In addition, this study focuses on the state recognition of a minority as a critical issue for the establishment of a minority school. Finally, the conclusion gives recommendations for a general approach for a successful minority education and items for further research.

## **MATERIALS AND METHODS**

This study used the following criteria for searching literature on Clemson University's library website, which allows searching in 548 different databases in one search, including databases such as ERIC, Web of Science, and others. Criteria used for the search was the publication date must be post 2006 and must be in the following disciplines: anthropology, business, economics, education, international relations, languages and literature, philosophy, psychology, political science, social science, and sociology. "Minority school", "minority education", "minority", "minority community" were used as set of keywords for searching the literature. The result of this search was 279 publications. From this search, 26 publications were utilized since the majority of the publications focused on academic performance differences (outcomes) between the minority and majority children without sufficient explanation or evaluation of the approach to minority education in the particular country.

## **RESULTS**

### **Definition of the Basic Concepts**

An ethnic group is a collection of people who share common characteristic within a generation. What defines "common characteristics" is different for every group. Typically, these common characteristic are the customs, language, emanative region, religion, and race shared by the group. The members of the ethnic group identified themselves with the group (Rivera and Nadal, 2008). The concept of identification and demarcation of one ethnic group from another is called ethnicity (Myers, 2008). The ethnic minority is a smaller group in society which is not dominant (Erikson, 2010). Ethnicity is not only important in formal relationships but also in informal settings such as primary socialization, sexual relationships & marriage, and routine public interactions (Law and Swann, 2011).

The ethnic minority is a smaller group in society which is not dominant (Erikson, 2010). The minority can be distinguished between migratory minority (immigrant minority) from the historical minorities (indigenous minorities) within a specific territory; the migratory minority tends to be assimilated (participating in the host culture but not maintaining the culture of origin) while the historical minorities tend to be integrated (participating in the host culture and also maintaining the culture of origin) (Bojan, 2009).

Based on the literature review, the minority schools can be defined as schools which provide education to minority children though the type of education provided to minority children may vary across differing countries. However, to the author's knowledge, the current literature does not provide a comprehensive definition of what minority schools are and what is their goal in the education of minority children.

### **Minority Education and International Law**

International law has defined the minority's right for education. Specifically, a minority group's education is included in international laws. United Nations Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities

refer to minority education in Article 4: “States should, where appropriate, take measures in the field of education, in order to encourage knowledge of the history, traditions, language and culture of the minorities existing within their territory. Persons belonging to minorities should have adequate opportunities to gain knowledge of the society as a whole.” (UN, 1992). The International Covenant on Civil and Political Rights refers to minorities in Article 27 “In those States in which ethnic, religious or linguistic minorities exist, persons belonging to such minorities shall not be denied the right, in community with the other members of their group, to enjoy their own culture, to profess and practice their own religion, or to use their own language.” (UN, 1966). The Framework Convention for the Protection of National Minorities refers to minority education in Article 6 “The Parties shall encourage a spirit of tolerance and intercultural dialogue and take effective measures to promote mutual respect and understanding and co-operation among all persons living on their territory, irrespective of those persons’ ethnic, cultural, linguistic or religious identity, in particular in the fields of education, culture and the media.” (Council of Europe, 1995). The European Charter for Regional or Minority Language refers to minorities in Article 7 and 8 “The Parties undertake to promote, by appropriate measures, mutual understanding between all the linguistic groups of the country and in particular the inclusion of respect, understanding and tolerance in relation to regional or minority languages among the objectives of education and training provided within their countries and encouragement of the mass media to pursue the same objective” (Council of Europe, 1992). There are also particular laws which deal with specific minorities in specific locations, for example, the Treaty of Lausanne (Treaty of Lausanne, 1923). This treaty was signed between Greece and Turkey and provides rights to the Greek minority living in Turkey and as well as the Turkish minority living in Greece. This treaty provides special status for the Turkish/Greek minority also in the area of education where it guarantees receiving education in the mother language during the primary education (Boussiakou, 2007).

### **Recognition of the Country as a Critical Issue for the Establishing Minority Schools**

The recognition of the minority by the country is a necessary condition for establishing the minority schools. If the country recognizes the minority, it gives them a specific legal access. For example, the minority has the right for access to public services such as education, and health care (LeTendre, 2000). Notwithstanding international laws, the minorities can have difficulties in establishing minority schools because the minority is not supported and not recognized by the country. The difficulties can be seen in lack of funding, lack of bilingual teachers, and lack of adequate teaching materials. The discrimination of the minority with regard to education issues can lead to the group losing the minority language because the minority children do not have access to education (writing and reading) in their language and they are forced to use the majority language (Lipott, 2015). In spite of the educational challenges faced by minorities, the country policies towards ethnic groups are different across nations. The relationships between the country and the ethnic groups ranges from recognition and respect of the ethnic groups to ethnic conflicts. The polarization of the ethnic affairs and its attitudes towards them results in the creation or loss of respect of the minority (Miaoan, 2015).

Magos (2006) states that the assimilation concept of the minority has been found to be unsuccessful but we can still find in heterogeneous classes teachers who discriminate against minority pupils and want them to assimilate into the majority. This classification

can result in negative beliefs and attitudes toward the minority but also can be reflected in the minority itself. The problem among the teachers is often that they are not trained to identify and understand the individual pupil's differences. Even when classes are highly diverse, teachers often do not change their attitudes to accommodate the majority/minority ratio which can lead to an assimilation pressure for the minority children (Mansikka and Holm, 2011).

### **Minority Education Practice Across the Countries**

The minorities across countries differ as well as the approach to their education because there is no general approach which can be used cross-culturally. There is lack of information on how effective the minority schools are as well as studies which would review the minority education system in the particular countries. In addition, there is lack of information about what is the goal of a minority education for the particular country and a lack of detailed information about curriculums. This section of the paper will state examples of different approaches to a minority education among different countries.

One of the approaches to the minority education is an approach where the minority is educated only in the minority language (monolingual education). This approach was seen in Georgia with its minorities (Russians, Greeks, Kurds, Yezidis, Assyrians, Jews, Ukrainians, Armenians, and Azerbaijanis). The minorities were educated in the minority schools in the minority language which lead to problems with integration of the whole minority into the majority. Based on this, the Georgian educational system went through a reformation and the first bilingual schools were established. However, these minority schools faced many problems and continue to even today. The quality of education is not comparable to the majority schools with regard to textbooks and teaching skills (Tabatadze, 2017).

Another type of approach to the minority education is through bilingual education where the distinction between minority and majority is based only on language which means the school can simultaneously educate more ethnic groups which share the same minority language. An example of such a model can be seen in Latvia with the Russian speaking minority (ethnic Russians, Belarusians, and Ukrainians). The minority education system went through reformation in Latvia in 2004 and established minority schools with the language of instruction is 60% from Latvian (majority language) and 40% from Russian (minority language) with funding from the public budget. Every school can decide which classes will be taught in which language. The previous system was created during the Soviet Union and had two parallel education systems where one was taught in Russian and one was taught in Latvian, where both were official languages. This approach to education resulted in Latvians being bilingual and the minority was conversant only in Russian. This fact leads to reforms in 2004 as a protection of the majority language as well as an effort to integrate the minority. The problems in these reforms were cost (by the lack of funding), lack of teachers training, and lack of Latvian speaking teachers (Ivlevs and King, 2014).

The next approach to the minority education is intercultural education. The intercultural education is sometimes called multicultural education. According to Holm and Zilliacus (2009), the difference is in the dynamism of these two concepts, the less dynamic multicultural education describes the diversity of cultures and the more dynamic intercultural education is functioning in more diverse culture settings with emphasis on interaction and relationship between different cultures. The example of intercultural education can be seen in Romania with its minorities. Romania offer three types of

education based on the size of the minority population in the school district area; the first type is a school where the language taught is the minority language (Hungarians, Germans, Croatians, Serbians, Slovaks, Czech, and Ukrainian minority), the second type provides only a few classes in the minority language (Croatians, Turks, and Tartars), the third provides the minority language as a second language (Armenians, Bulgarians, Germans, Croatians, Greeks, Italians, and Polish). The schools in which the language of teaching is the minority language provide basically bilingual education where classes on history, Romanian language, culture, geography, and history is taught in Romanian. However, the minority schools face different challenges based on what the minority language is being taught at the school and which status the language has among the majority. German is popular among the majority which leads to the majority children, as well as other ethnic minority children, attending the German minority school, which is an example of intercultural education. In contrast, the status of Hungarian is not prevalent among other ethnic groups in Romania which results in a lower interest about the school among the public and the children from these schools have a lower ability in the Romanian language. However, the curriculum of the majority schools does not include any information about the minorities in the country (Bojan, 2009).

Another approach to minority education is multicultural education. This type of minority schools can be seen in Finland. Finland has a parallel publically funded educational system of two types of school where one language of instruction is Finnish and at the second type the language of instruction is Swedish; both types of schools have the same curriculum. However, in the last decades, the model of bilingual education has changed into the multicultural education where the minority school is not only for the Swedish minority but for all minorities in Finland regardless of their ethnicity or their language. According to Mansikka and Holm (2011), despite these changes, the teachers do not adjust their teaching styles to culturally diverse classes, their approach is more assimilative than integrative, and there is a difference between the agreed theory (integration) and practice (assimilation) among the teachers. Björklund (2013) further divided the multicultural educational system in Finland into three types of classrooms based on the number of minority students and the type of minority. The first type is a Finnish classroom with small number of Swedish students, the second type is a classroom with the same number of Finnish students and Swedish students, and the last type is a classroom which has students from more than these two previous minorities.

The last approach to the minority education is based on distinguishing between the minority and majority through their religion. This type of education can be seen in Greece with the Muslim minority which includes Turkish, Albanian, and Pomak. Greece has 251 primary and two secondary minority schools where Greek is taught as a secondary language together with Greek history, geography, environment, and civic education. Notwithstanding, the minority is distinguished by religion, the minority school's first language is only Turkish since there are not schools which have languages that are Pomaktsi or Albanian and children from these minorities usually attend the Muslims minority schools (Georgiadis, Koutsouri and Zisimos, 2011). According to Boussiakou (2007), the primary minority schools in Greece have a low quality and students tend to drop out of these schools more often than from the majority schools or go study in Turkey because they are not sufficient in Greek. The lower quality of education is a reason why some minority children attend the Greek schools, though they often face discrimination in the Christian-Greek schools and they are often not accepted by the minority because they are attending the majority school. Greek is taught at these schools as a second language

and starts during the first grade. Due to vast differences between Greek and Turkish, as well as ineffective teaching, the minority students have a lower ability in Greek language skills and therefore graduates from the minority schools have problems with integrating into the majority society.

### **The Benefits of the Minority School for the Minority Community**

The quality minority education is important for the minority as a whole because quality education can, from the long term perspective, rise the socioeconomic status of the minority (Alba, 2005). According to Zhang (2011) minority schools can decrease the possibility of poverty, result in an advanced academic path, achieve more skilled jobs, and promote an enhanced overall well-being for its former students. In addition, minority schools are key institutions for maintaining minority language, history, religion, culture values, and ethnic identity (Hansen, 2013). Minority schools can also serve the purpose of an institution which helps in the integration of the minority into the majority society (Georgiadis, Koutsouri and Zisimos, 2011). The fact that the minority has its own school can strengthen the sense of belonging within the minority community (Byram, 1986). The sense of belonging to the minority community also positively influence the collective identity. Lipott (2015) found that weak collective identity can be reflected in a decreasing school attendance and a reduced employment among the minority community.

### **The Benefits of the Minority School for the Minority Children**

The school environment is important for children because it is a source of information which they gain outside of the family. The education environment provides an opportunity to explore their identity, to understand how they are perceived by others, and to compare their capability relatively to other children (Thijs & Verkuyten, 2017).

A successful minority school can be seen as a mediator of two cultures (the culture of origin and the culture of host country) which prepares the children to be citizens of both countries. They should learn the history, traditions, music, literature, language but also the way of life and point of view of both ethnic groups (Byram, 1986). The intercultural understanding should be a goal of the minority education and it is based on intercultural learning between the minority and majority. According to Bojan (2009), the intercultural learning leads to an understanding of the worldwide society and prevents the creation of conflicts. Specifically, students can develop a sense of tolerance and solidarity, ethnic and religious education can develop empathy and openness, students should acquire fluency in languages, they should be encouraged to look at issues from different perspectives, the social and communicative competence can be used in conflict resolution and ability to dialogue, and they can learn about democratic and build an understanding of human rights.

The minority children can be successful graduates of the school in the case that the school prepares them for inclusion into the majority society and follows the outlines of the public school curriculum (Byram, 1986). The minority children also gain knowledge about different cultures, values, and languages after finishing the school. In many cases, minority schools are represented across the elementary, middle, and high school levels, but are rarely seen at the college or university ranking. This is one of the reasons why the minority education has to prepare children for integration into the major society so that they can progress to advanced studies beyond high school in the majority society (Hansen, 2013).

## DISCUSSION

Based on the previous summarization of different approaches to minority education, it is possible to formulate recommendations for the best approach for the successful implementation of minority education that will be beneficial for the minority community as well as for the majority society. These recommendations can be grouped in topic fields of: language skills, cultural awareness, teacher oversight, and state support.

**Language skills:** If a minority school only teaches their own language and cultural the student will likely be segregated from the majority population. It is also important to make sure that the majority learns about the minority and they have interactions, which can be promoted through a cooperation between minority and majority schools (Magos, 2007). Bilingual minority schools use their minority language as a tool to retain their culture while teaching the majority language to assist in the integration of the minority (Zhang, 2011). A bilingual education can improve the academic outcomes of the students and has positive long term effects on their careers and earning prospects. However, these can only be achieved under the conditions of a successfully implemented bilingual model of education that fosters inclusionary practices. In the case the implementation is not successful, the pupils can have low proficiency in both languages and weak academic outcomes (Ivlevs and King, 2014).

**Cultural awareness:** The successful minority schools should provide intercultural education, which includes learning about culture, customs, languages, and history of both groups (minority and majority). It would be beneficial for minority children who would have a better opportunity to succeed in the majority society. Successful bilingual and intercultural education can reduce the likelihood of prejudice, highlight the importance of culture diversity, and increase the likelihood that minority can integrate into the majority society (Mansikka and Holm, 2011). The children would be better prepared to compete for jobs because they have cultural awareness for both cultures and are bilingual.

**Teacher oversight:** The training of teachers is also critical for the successful implementation of the minority education. The teacher should put emphasis on human rights, policies against social exclusion, and protection of minority cultural differences. In addition, oversight of the teachers should be conducted to insure stated policies are enacted in the classroom (Mansikka and Holm, 2011).

**State support:** Developing the minority school would have a positive long-term effect on the students and it would positively influence the functioning of the minority community as well as the whole society. This is a state-level concern and responsibility. For the fulfillment of a harmonious society, its necessary that the minority has the legal and financial support from the host country (LeTendre, 2000). The success of minority schools is not only dependent on the minority but also on the majority and the government. The majority schools should include learning about the minority within every school in the country which has within its territory a minority population (Bojan, 2009). The minority schools should not be segregated from the majority schools. There should be cooperation between these two schools, and in the best case, have joined classes and be situated in one building. Through this route, the development of the minority educational system will be successful. If there is a historical tension between the minority and majority this can have a strong influence on defining the minority rights and its well-being. In addition, these ingrained attitudes are difficult to surmount. The state's own interest is to promote a society where minorities are integrated without conflicts and can be achieved by supporting cultural diversity. Both groups (minority and majority) need to attempt to integrate the minority as a full member of society while maintaining its own culture.



## CONCLUSION

Societies face challenges with the integration of minority groups into the majority society. Minority schools can serve as institutions which help minority children with a successful integration. The approaches to minority education differ cross-culturally. This study summarizes these different approaches and provides recommendations for a successful general approach to minority education. Specifically, a minority education should include an intercultural education of both groups, a bilingual education, teacher oversight, and state support. Future research should focus on examining how minority schools operate in practice and evaluate the specific curriculum of the minority schools cross-culturally.

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# DIGITAL FORENSIC TRAINING IN GENERAL IT EDUCATION PROGRAM

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## ABSTRACT

Cyber-crime business is instantly growing over the last few years. This creates a large demand for cyber security analysts, incident handlers and forensic analysts. Analysts must nowadays actively investigate custom tailored phishing and crypto-locker campaigns, where understanding of forensic methods is a great benefit. This article presents information about teaching process on University of Economics, Prague in the area of ICT security. It presents the possible knowledge and skills that could obtain successful graduates of the new course Digital Forensic Analysis and experience, which have been collected last semester by students and which are under detail evaluation at this time. By questionnaire identified reactions of graduate students on this course are positive.

## KEYWORDS

Digital Forensics, Evidence Handling, Forensic Analysts

## INTRODUCTION

Training of a forensic analyst (Arasteh et al., 2007) is a long and expensive process which takes approximately from three to five years of intensive education. The course of Digital Forensics at the University of Economics, Prague (UEP) does not aim for training independent analysts, but rather introduce different fields of digital forensics (Veber, Nedomova and Doucek, 2016; Beebe and Clark, 2005) to students so they can continue and start pursuing their career path if interested. The course is taught for students of graduate level in Czech study programme “Information Management”.

The course is designed to properly introduce state of art methods for digital evidence acquisition (Veber and Klíma, 2014) as well as best practices for handling and processing acquired evidence (Srihari and Leedham, 2003). The main expectation is that students who successfully pass this course will have strong understanding of the nature of digital evidence (Rippel and Teplý, 2011; Mitropoulos, Patsos and Douligeris, 2006) and its proper handling (Holoska, Doucek and Nedomova, 2017). The actual principles of forensic investigation must be observed but for an investigation to be effective and purposeful, it is also necessary to take into consideration the processes and potential procedural models designed for forensic investigation (Sonntag, 2016). It especially concerns the famous Zachman model (Zachman, 2002). A simple model presented in (Carrier and Spafford, 2004). The area keeps developing and there are attempts for its standardization not only on the part of scientific workplaces (Beebe and Clark, 2005; Carrier and Spafford, 2004) but also on the part of ISO organizations. However, the majority of these publications mainly focuses on how state authorities (the police), which most often conduct such investigations, should proceed (Doucek, 2008).

Scope for the Digital Forensic course was set to align with already gathered knowledge and experience of students on follow up Master’s degree at UEP. This means that the main target for the course is to deliver deep understanding of basic forensic methodologies and digital evidence handling procedures. All the theoretical and methodology classes are followed with practical skills carried out on custom built digital evidence image.

### Problem Formulation

The object of this contribution is to discuss the first experience with Digital Forensic course at the University of Economics, Prague. Further aim is to present student’s reactions on concept of this course in order to start the permanent improvement process of it.

### MATERIAL AND METHODS

The collected sample represents 16 records from 20 participants of the course in the first round. The number of collected records allows to use only basic statistical methods that were worked out in MS Excel software. The data collected for our research were set anonymous in compliance with the provisions of appropriate acts.

### METHODOLOGY

The course was designed as a simplified version of workshops and trainings originally designed for Law enforcement officers, expert witnesses and incident handlers. The overall targeted education for an independent forensic analyst would be very demanding as there is a requirement to cover multiple areas of computer science as shown on Figure 1.

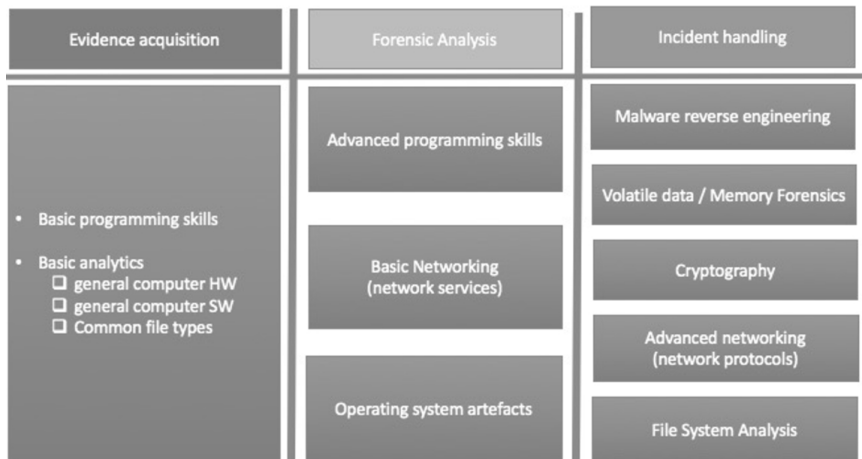


Figure 1: General IT skills in digital forensics (source: author)

A complete digital forensic training lasts from three up to five years of continuous education.

The course was simplified in a way that its content fits into a single semester and will cover, but in detail respect to preserve the key information for the students. Each lesson was separated into a section dedicated for technical introduction and repetition for a given subject, forensic methodology for evidence acquisition or analysis and handling. From technical perspective, the course consists of selected topics including Microsoft Windows artifacts, file system artifacts, data recovery, data processing and reporting case studies.

Case studies are set anonymous examples of real cases dedicated to outline how the presented forensic methods are used or misused in practice. Each case study is finished with debriefing with discussion.

## **COURSE CURRICULUM**

### **Methodology**

Forensic methods and procedures are founding stones for any successful investigation. Students are introduced to concepts like the best evidence, a forensic image, a working copy of a forensic image, an acquisition process, an acquisition report, a chain of custody. Later during the class presented the essential requirements for digital forensic examination.

- Conflict of interest. (Capek and Hola, 2016)
- Legal authority. (Capek and Hola, 2016)
- Integrity.
- Forensic documentation and Repeatability.

During the follow up hands-on assignment the students are challenged to set proper approach for evidence acquisition from a technical and a legal perspective based on a presented scenario.

### **Digital evidence**

Data in any form is the critical part for any investigation, the understanding how data are stored, processed, transferred and purged helps an investigator to interpret a course of action within a digital environment. Stored data are the easiest evidence to understand by students as allocated data that are used every day by all the computer users. The important information that students will learn during the lessons is that the regular files are not the only information stored within the file system. Mainly the NTFS file system is discussed in detail with focus on a Master File Table (MFT), time stamps and alternative data streams. Students have learned how to interpret file system metadata and how to produce a simplified timeline based on MFT data.

Stored data related topics:

- NTFS metadata related to time stamps
- Alternative data streams
- Data recovery process and its limitation
- Data processing and indexed keyword search
- Fuzzy hashing full text search
- Data integrity and one way hash functions
- MD5 collision in practice

Operation system related topics:

- Windows registry analysis
- Windows Event Log analysis
- Prefetch analysis (application execution history)
- Web browser history

Forensic methodology:

- Evidence acquisition
- Evidence integrity evaluation

### **Courseware tools**

Choice of a toolset for this course raised several issues during the preparation phase. At first, the commercial available tools are extremely expensive in perspective of education for limited number of students as each course is limited to 30 seats only.

Software tools used in practical assignments are mostly freeware or compiled Python

application developed by a forensic community as a proof of concept software. This allowed to distribute the tools to the students for after class projects or for later self-study activities.

Acquisition and basic evidence evaluation is performed with AccessData FTK Imager (Acessdata, 2017). FTK imager is freely available on a vendor support site and is an invaluable tool for basic computer forensics. It allows to acquire data from analyzed devices and store the data in forensically sound data format also known as forensic images for future analysis. The tool allows virtualization of stored forensic images, so the students could easily analyze and interpret the assignment data.

The only commercial tool used during the course was the evaluation license of Belkasoft Evidence Center (Belkasoft, 2017). The most important part of the experience for the students was the intuitive and automated processing of acquired digital evidence. Students were introduced ultimately different approach for artefacts processing, as they could simply load an Encase evidence file, choose artefacts types, they want to analyze and let the BEC do the difficult part of data processing and information interpretation. Automated processing altogether with a simple-to-use user interface allowed them to process and analyze non-trivial class assignments without any significant guidance and within limited time dedicated for hands-on exercises.

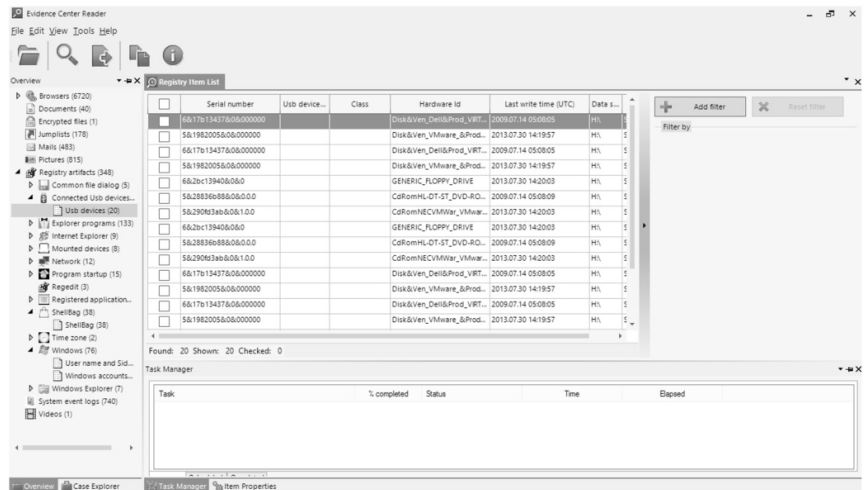


Figure 2: Belkasoft Evidence Center Reader (source: author)

The main decision for inter-corporate a commercial tool was an idea to show students the power of automated evidence processing. However, it was explained to the students that the knowledge of any forensic tool is a great asset for analysts' effectivity, but cannot and never will be more important than proper understanding of general forensic methodology and artifact essentials.

## RESULTS AND DISCUSSION

Discussion on course subjects and case studies were common part of the lessons. Some subjects generated a significantly larger response from students than was expected. Especially topics related to evidence handling in respect with integrity and personal integrity of an expert invoked a large discussing among the students. The main question

was the sustainability of forensic tools and software under heavy pricing restriction based on fifty years old legislation. The discussion regards integrity was aimed on the fact that the legislation has no clear requirements for new expert witnesses or the fact that fabricated expert whiteness reports are occurring in large in the last few years and that there has been done very little to systematically remediate the issue.

## Case Study

An example of a case study describing inappropriate evidence handling and data analysis: Expert whiteness was given a seized laptop and was asked to perform a stored data analysis to prove a connection between a suspect and the victim company.

The expert whiteness performed the analysis by booting up the evidence laptop and performed keyword search directly on the device using its original operating system.

Founding were written down on the exact device with use of a word processor installed on the evidence laptop.

Given to the above described course of analyst's activities we can conclude with statements that:

1. Evidence was not analyzed in forensically sound way.
2. The case cannot be revised because no forensic image was acquired from the best evidence before the analysis and the best evidence integrity was damaged.

During the discussion, the students are challenged to prepare a forensically sound process of evidence acquisition and keyword search.

## Student's feedback for course

After the testing period, the students were asked to come up with course feedback, most importantly to come up with topics they are interested in and that were not covered during the classes or the topic was not covered in the expected depth.

The methodological part of the course was evaluated positively while the hands-on labs received a lot of comments.

The most repetitive suggestions are summed in bellow list:

- Get a proper forensic environment with feel of real forensic laboratory.
- Prepare the hands-on exercises as a real case and cover the whole life-cycle for forensic investigation.
- Prepare a hands-on exam instead of written and oral exam.
- Create advanced follow up course.

Course evaluation statistics describe the overall satisfaction with the course. Number of all participants at the course was 20 and 16 from them participated in questionnaire research, the rate of participation is 80 %.

Option	Quantity	% respondents	% resp. co.	% stud.
I strongly agree.	14	88	88	67
I agree.	2	13	13	10
I agree with some objections.	0	0	0	0
I disagree.	0	0	0	0
I strongly disagree.	0	0	0	0

**Table 1: The Topic of the Course Was Interesting for Me (source: author)**

Option	Quantity	% respondents	% resp. co.	% stud.
I strongly agree.	15	94	94	71
I agree.	1	6	6	5
I agree with some objections.	0	0	0	0
I disagree.	0	0	0	0
I strongly disagree.	0	0	0	0

**Table 2: I Learned a Lot in this Course (source: author)**

Option	Quantity	% respondents	% resp. co.	% stud.
Far too high.	1	6	6	5
Too high.	1	6	6	5
OK	14	88	88	67
Too low	0	0	0	0
For too low	0	0	0	0

**Table 3: The Level of Difficulty of this Course Was... (source: author)**

Option	Quantity	% respondents	% resp. co.	% stud.
I strongly agree.	14	88	88	67
I agree.	1	6	6	5
I agree with some objections.	1	6	6	5
I disagree.	0	0	0	0
I strongly disagree.	0	0	0	0

**Table 4: Overall, I am Satisfied with the Quality of this Course (source: author)**

## Student's feedback for tools

At the end of the course, it is standard procedure to ask students by questionnaire to provide additional feedback for the tools we have used during the hands-on assignments. The evaluation revealed that few students were exploring the BEC capabilities beyond the subject of the course and could provide such a compact feedback. Some reactions of students are at first aggregated from questionnaire and they are presented below:

- For them were very useful to provide with an overview of what a vast amount of data can be acquired from various types of digital sources thanks to the Belkasoft Evidence Center. Moreover, the analysis is possible even without necessity to write a single row of code which helps to make the process of finding information faster and easier not only for a beginner.
- It is surprise, how easily and intuitively can be investigated digital evidences. Belkasoft captured my attention by automated data processing. With its help, we separated the important data in case studies. I would like to thank you very much for the opportunity to try Belkasoft. Also, it was very appreciate to get the opportunity to discover other areas of IT from a practical point of view.
- It was for the first time when student discovered a digital forensics software and he/she must say is was very inspirative to have a chance to use such a sophisticated on one side and intuitive software on the other side as the Belkasoft Evidence Centre truly is.

## DISCUSSION

In accordance with conclusions presented in (Rippel and Teplý, 2011) students obtain basic information about handling risk and using risk management methods for forecasting



and evaluation of ICT risk in business. Most important part of forensic education are the practical assignments which are dependent on the lab equipment (Yasinsac et al., 2003; Erbacher, 2002). What is missing in the course and what represents current limit of it are licenses of the e-discovery tools. At the end of second round of the course, the students expressed the expectation of having full case study examination hand-on. This kind of exercise requires a level of automation only available in commercial tools mainly due to class time limitations. Another topic that came from students is the ability to analyze they own devices for example for data recovery purposes. Action plan for next course run will be focused on extending our tool set, opening lab environment to the students outside class schedule and providing support for the students on their own projects.

Other experience obtained from courses in information security that are taught on UEP are rather similar. Students accept positive (in 90 %) practical skills in area of concrete software (Holoska, Doucek and Nedomova, 2017). Similar results also gave investigation realized in (Beebe, 2009). Some course in information security are oriented on theory (Information Security Management System), but courses with impact on increasing practical skills of students obtain more positive feedback then theoretical ones (Beebe, 2009).

## CONCLUSION

Formal targeted digital forensic education will be important topic within next years as the demand for practitioners is already larger then numbers of available analyst. As was mentioned on beginning of this article, the education life time for turning IT or IT security practitioner into digital forensic specialist is three to five years. Such a large content cannot be shared with students during single semester, but the basic technical aspects of digital forensics must be divided into multiple courses distributed across whole bachelor and master study programmes.

From perspective of students the digital forensic education will help to find a job in cyber security jobs in public and private sector.

## ACKNOWLEDGEMENTS

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# STUDENTS' REFLECTIONS ON TEACHING THE SYSTEM DYNAMICS AT CULS PRAGUE

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## ABSTRACT

This paper presents feedback from students on the newly designed course for 2<sup>nd</sup> grade (IT branch) students at Faculty of Economics and Management, Czech University of Life Sciences Prague. The course seeks to involve system dynamics. This branch of science is not taught at Czech universities to a larger extent. The course was designed to promote students' critical thinking and mindset, it was focused on practical application, motivation and self-education. The general aim of the course was to differentiate it from other similar subjects or courses. 30 students provided feedback in the pilot survey. Information gained from the questionnaire were processed using text mining and data mining techniques, e.g. by the Classification and Regression Trees. The results generally correspond to the main objectives and some findings have been incorporated for the updated course design for next academic year.

## KEYWORDS

Classification and Regression trees, System Dynamics, System Thinking, Text Mining

## INTRODUCTION

Despite the fact that the system science is the indivisible part of the study at the Faculty of Economics and Management (FEM), Czech University of Life Sciences Prague (CULS), the system dynamics (SD) itself still isn't fully integrated into the educational process. We can see the development of SD at various Czech universities (see e.g. Šviráková (2014)) since the Mildeová and Vojtko (2005) described the SD as a young discipline in Czech environment. We have also significantly improved the situation at CULS since Krejčí, Kvasnička and Dömeová (2011a) introduced one (mainly informative) lesson. The computer simulation is successfully used as support tool of management subjects at CULS (Švec et al, 2016). However, the long-term goal stated by Krejčí, Kvasnička and Dömeová (2011b) – full semester course haven't been reached yet.

Currently, we designed the course where the half of the semester is focused on the system dynamics, supported by the lessons on general systems theory, introduction to the discrete event and agent simulation. As we designed the course structure in 2016 we needed in the feedback to evaluate whether we reached the qualitative goals we placed at the beginning of the implementation process.

The system dynamics was invented as a practical discipline (Forrester, 1989). Therefore, we wanted the students to understand SD that way. For educational objectives we used the ideas of Cochran (2012) that he has for the education of operations research – stimulation of the students' interest, development of students' critical thinking, development of problem solving skills, demonstration of the value of the taught topic to the students. Therefore, according to Krejčí and Kučera (2014) we introduced a set of case studies and

project based learning. Stressing the real-life applications, encouraging the students to discussion together with avoiding the need of memorization should elevate the students reasoning skills (Bietenbeck, 2014).

The problem we face is that the description of successful inspirational courses usually deals with at least full semester course or whole bachelor or master study programme (Davidsen, Bjurklo and Wikström, 1993; Ossimitz, 2000; Pavlov et al, 2014; Pruyt, Enserink and Thissen, 2015). Therefore, beside the introduction of basic theory and selected modelling structures from Sterman (2000), Meadows (2008), Bellinger and Scott (2013) and Bossel, (2007a, 2007b), we created motivation program for the self-study.

The students were working on small team projects with the theme/problem of their choice. The project evaluation is scaled with the impact on final exam in the form of bonus points. The projects started from the CATWOE and Rich Picture and root definition of the system (Checkland, 1985) as mandatory minimum but the students could develop the project to the functional simulation model on voluntary basis.

Simultaneously, to support the self-study and thus to increase the probability of creating the fully functional simulation model the recommended literature was stated as possible theme of the oral part of the exam. The students were allowed to bring the SD book and discuss it with the teacher instead of traditional oral examination.

The aim of this article is to evaluate the success of the effort in developing the SD course at CULS Prague. We evaluate whether we have reached the declared goals:

- To ensure that students will consider the system dynamics the practical discipline
- To stimulate students' interest in system dynamics
- To motivate students' to self-study
- To raise the students' feeling that the course is different from the other courses in the way it increases the attractiveness of the topic

For these purposes, we use the open questions questionnaire and consequent text and data mining analysis. Nowadays text-mining and ancillary data mining techniques are very often used to analyse text documents (Lin, Hsieh and Chuang, 2009). There are even some pedagogical experiments, where text-mining techniques are used as an analytical tool (Horáková and Rydval, 2015; Poole, 2016). Text mining techniques are also used for example for mining sentiments of teaching evaluation (Leong, Lee and Mak, 2012), to characterize patterns of teachers' narratives and value-added patterns (Cavicchiolo, Alivernini and Manganeli, 2015), or for representations of study and students' academic motivation (Alivernini et al, 2015).

The article is divided as follows: In the first part we briefly introduce the fundamental ideas of preparing the course reasons why and how we stated the previous goals. The second part describes the sample and explains the text mining methodology. The third part describes and discusses the achieved results. The conclusion in the last part focuses mainly on the future plans and necessary steps.

## **MATERIALS AND METHODS**

### **The procedure of text mining and data mining analysis of questionnaire**

The questionnaire consisted of 10 closed-ended and 11 open-ended questions. The aim of the questionnaire was to do a feedback of the newly designed course in terms of difficulty of the course, interest and attraction of the course, the benefits of the course into practice and changes in perception and looking at problems or difference rate compared with other subjects/courses.

First, questionnaire responses (from open-ended questions) were analysed by text mining

tools in software STATISTICA 12 (StatSoft) program using its STATISTICA Text Miner module. Term document matrix (Srivastava and Sahami, 2009) for selected word classes that appeared in analysed text feedback was created.

Further, the relevant terms were filtered in terms of significance for subject evaluation. The rows of the matrix represent particular cases (text responses) and the columns represent the absolute frequencies of occurrence of observed selected terms. Based on this matrix, classification and regression trees (CART) were created in the STATISTICA Data Miner module. This module built classification and regression trees for predicting categorical predictor variables (classification). The program supports the classic CART algorithm popularized by Breiman et al (1984), see also Ripley (1996), and includes various methods for pruning and cross-validation, as well as the powerful v-fold cross-validation methods. In most general terms, the purpose of the analyses via tree-building algorithms is to determine a set of *if-then* logical (split classification variable) conditions that permit accurate classification of cases (Jiřina, 2003). CART classifies the terms used in questionnaire open-ended responses in connection with the data that we obtained in closed-ended responses.

### Sample of respondents

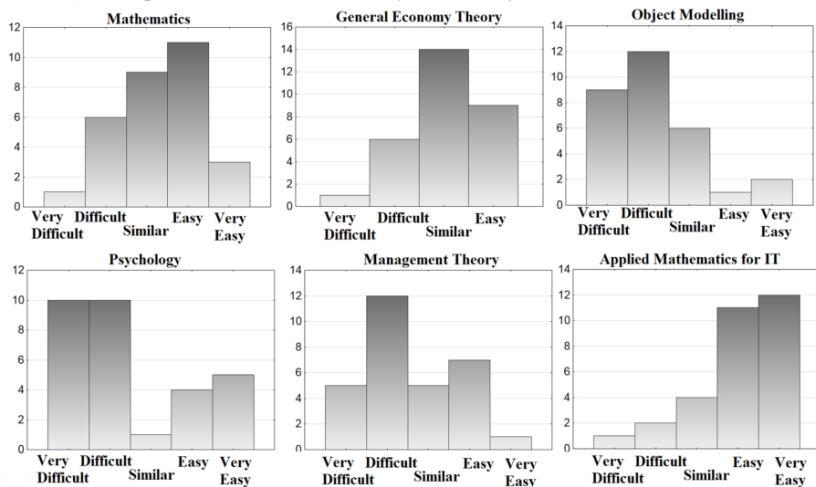
We did a pilot survey dealing with feedback about the newly designed course. We had 30 respondents (students) (90% men, 10% women). 83% of respondents regularly took part in most of the lectures. 76.7% of respondents said that this course influenced their way of thinking and looking at problems. 53.3% of respondents thought that knowledge from the course is used in practice. On a scale of 1 to 5 points, respondents evaluated the interest rate of course (1 = the least interesting, 5 = the most interesting): 53.3% of respondents judged interest rate of 4 points, 33.3% of respondents with 5 points and 13.3% of respondents with 3 points. On a scale of 1 to 5 points, respondents evaluated the difficulty of the course (1 = the easiest, 5 = the most difficult): 3.3% of respondents judged difficulty with 1 point, 26.7% of respondents with 2 points, 66.7% with 3 points and 3.3% of respondents with 4 points. Comparison of the difficulty of the newly designed course with selected courses taught at the FEM CULS shows Figure 1.

## RESULTS AND DISCUSSION

### Description of CARTs

Decision classification (tree CART 1) has 8 non-terminal and 9 terminal nodes. Based on the occurrence of terms in the reflection we can assign if the respondents evaluate difficulty rate of the subject with 1, 2, 3, 4 or 5 points, where 1 = the easiest subject, 5 = the most difficult subject. We have to start from the first node. The first classification variable is the word *Maths* if it occurs more than 0.5 times in one document, so the respondents evaluate the subject with 2 points. If a word *Maths* in the document occurs less than 0.5 times, then we have to observe another classification variable, i.e. *topic*. If the word *topic* occurs more than 0.5 times in the document then we have to observe another classification variable, i.e. *understanding*. If a word *understanding* occurs less than 1 times, the respondents evaluate the subject with 4 points; if it occurs more than 1 times, the respondents evaluate the subject with 2 points. If the word *topic* occurs less than 0.5 times in the document, then another classification variable is a word *terminology*. If a word *terminology* occurs more than 0.5 times, the respondents evaluate the subject with 1 point. If the word *terminology* occurs less than 0.5 times in the document, then we have to observe another classification variable, i.e. *a way of teaching*. If the word *a way of teaching* occurs more than 0.5 times,

so the respondents evaluate the subject with 2 points. If a word *a way of teaching* occurs less than 0.5 times, then we have to observe another classification variable, i.e. *interesting*. If a word *interesting* occurs more than 0.5 times, the respondents evaluate the subject with 2 points. If the word *interesting* occurs less than 0.5 times in the document, then we have to observe another classification variable, i.e. *thinking*. If the word *thinking* occurs more than 0.5 times, so the respondents evaluate the subject with 2 points. If a word *thinking* occurs less than 0.5 times, then we have to observe another classification variable, i.e. *reading*. If the word *reading* occurs more than 0.5 times, so the respondents evaluate the subject with 2 points, if less than 0.5 times, so the respondents evaluate the subject with 3 points. This procedure is applied till the final terminal nodes (last two mentioned nodes). CART 1 split classification variables are words: *Maths, topic, understanding, terminology, a way of teaching, interesting, thinking and reading*. Figure 2 depicts the first classification tree (CART 1) for dependent variable: Difficulty of the subject.



**Figure 1: Comparison of the difficulty of the newly designed course with selected courses taught at the FEM CULS Prague**

Moreover, other CARTs (CART 2, CART 3 and CART 4) that classify qualitative variables based on different data, were created.

CART 2 has 5 non-terminal and 6 terminal nodes. Based on the occurrence of terms in the reflection text (focused on perceived difference of the course) we can assign if the respondents perceive a change in the way of thinking (Yes/No/Don't know). CART 2 split classification variables are words: *understanding, conflict, change, influence, opportunity*. CART 3 has 6 non-terminal and 7 terminal nodes. Based on the occurrence of terms in the reflection text (focused on perceived difference of the course) we can assign if the respondents attempt the lecture (Yes/No). CART 3 split classification variables are words: *knowledge, complexity, analyse, thinking, teaching methods, programming*.

CART 4 has 11 non-terminal and 12 terminal nodes. Based on the occurrence of terms in the reflection text (focused on perceived difference of the course) we can evaluate the rate of interest of the subject with 1, 2, 3, 4 or 5 points, where 1 = the least interesting, 5 = the most interesting. CART 4 split classification variables are words: *lecturer, attract, knowledge, change, interesting, morning, understanding, practice, subject and illustrative*.

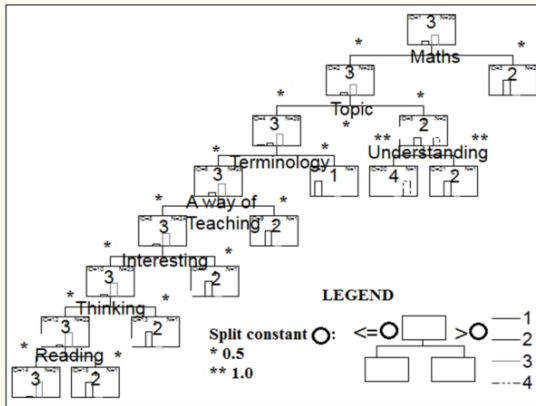


Figure 2 Tree graph (CART 1) for dependent variable: Difficulty of the subject

### Interpretation of CARTS

CART 1 shows that students identified a different way of learning and stimulation of thinking. Finally, students mention reading and motivation when they themselves must self-study. Also According to CART 2 the students identified a change in looking at problems. CART 3 shows that students who attended the lectures rather mention the changes in thinking and way of analysing some problems. These findings are in accordance with the goals stated on the basis of Cochran (2012) and Bietenbeck (2014).

CART 2 also shows that students identified some opportunities of acquired knowledge to practical use. The goal to ensure this understanding was stated in accordance with Forrester (1989). Also according to CART 4 students positively evaluated visual and practical examples at lectures and seminars.

CART 3 also depicts that students who did not attend more lectures in their reflections narrates programming and working with software, that was used in the project based learning according to Krejčí and Kučera (2014).

### CONCLUSION

The goal from Krejčí, Kvasnička and Dömeová (2011b) remains, we still plan to develop full semester system dynamics course. Moreover, even achieving that goal is only one step in long way to introduce the full system dynamics study programme in the Czech Republic. The goals we set during the developing of the SD course at CULS Prague were achieved as the students' responses reflected our basic ideas. Respondents were interested in the topic, they found it attractive, practical and the whole course was considered different in the way that could be interpreted as modern teaching according to the referred authors. More than 50% of the students decided to take the opportunity and read the book for the discussion during oral part of the exam. Considering the current state of art, we have evaluated only the "feeling" of the students about the SD. To evaluate the real impact of the designed course on students' system thinking skills we plan a similar system thinking testing as Sweeney and Sterman (2000) and Exnarová, Dalíhod and Mildeová (2011).

Seeing the current ratio of students/teachers we would like to strengthen the teachers staff to enhance the modern education in the way of small teams of students. Moreover, we feel

that the traditional schedule doesn't fit the course well and we would like to implement modelling workshop into the course structure.

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# RURAL COMMUNITY SCHOOLS IN THE CZECH REPUBLIC FROM PARTICIPANTS' PERSPECTIVES

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## ABSTRACT

The paper is based on the concepts of the learning society and community-led local development, specifically focused on community education in rural areas of the Czech Republic. The research question is connected with evaluation of the significance of Rural Community Schools for rural municipalities, from the perspectives of participants in educational courses. The aim is fulfilled through a secondary analysis of Rural Community Schools' websites and mainly through primary research carried out by a questionnaire survey and additional semi-standardised interviews conducted with course participants. The results of the study show that participants in educational courses evaluate RCSs as important organisations for promoting human capital within rural areas. However, cooperation with Local Action Groups should shift the perception of RCSs from educational organisations to the broader concept of community education – the promotion of rural development.

## KEYWORDS

Community Education, Educational Course, Learning Society, Local Development, Rural Community School

## INTRODUCTION

The paper is based on three levels of theoretical concepts. The most general is the concept of learning regions and the learning society, with a special focus on rural development (Lam, 2002; Morgan, 2007). The second level is formed by the concepts dealing with rural endogenous development (Atterton, 2007; Lee *et al.*, 2005; Shucksmith, 2000), which perfectly fit the performance of the learning process of community education through the collaboration of local actors (Hudson, 2007; Lundvall and Nielsen, 2007).

The third theoretical concept used in the paper is the concept of community education as a relatively new trend in education, which is also suitable for rural areas (Coleman, 1987; Heers *et al.*, 2011; Sanders, 2003). Community education is perceived as education which connects youth and adult education and uses local lectures and the local environment in the educational process (Krupar and Prins, 2016). Community education involves not only students but also teachers, members of the community, and representatives of other sectors in the educational process (Amalba *et al.*, 2016). This is important not only for knowledge creation, but also for rural community development (Heers *et al.*, 2014). In this context, community education is connected with the lifelong learning process (Staykova, 2012). Despite the fact that the concept of community education originates from the Anglo-Saxon environment (Heers *et al.*, 2011), it is also widespread throughout

other states. These include not only European states but also Egypt, China and other Asian states (Langsten, 2015; Efir, 2015; Maber, 2016).

However, the appropriate interpretative framework for community education is still missing (Kalenda and Smekalova, 2015), with the attention paid to community education in the Czech Republic still being marginal. This is due to the short-term application of this concept and little institutional support. However, Rural Community School in the Czech Republic is obviously defined as “an educational facility which is located at a municipality of less than 5000 inhabitants, with prescribed legal form (NGOs, municipal contributory organization, secondary economic activity of the local school), which offers lifelong education to adult residents of the catchment area, and regularly participates in community development activities and community life, managing its own budget and respecting the principles of financial self-sufficiency and sustainability” (Hudeckova and Husak, 2015).

Within this context, the paper strives to deepen the knowledge of Rural Community Schools in the Czech Republic. This paper, based both on secondary and primary research, deals with the ensuing research question: How do participants in educational courses provided by Rural Community Schools evaluate the significance of these organisations for rural areas? The main aim of the paper is to evaluate the functioning of Rural Community Schools (RCSs) from the perspectives of participants in educational courses, to identify the strengths and weaknesses of the functioning of RCSs and to propose possibilities for the future development of RCSs as perceived by course participants.

A secondary aim is to evaluate satisfaction with the functioning of RCSs by participants in educational courses, as well as with the supply of courses and the efficiency of promotion of RCS educational activities.

## **MATERIALS AND METHODS**

From the methodological perspectives, the paper is based both on primary and secondary research techniques. A secondary approach is used for the analysis of RCS websites, with special attention paid to educational courses. In addition, websites of the National Network of Rural Community Schools (NNRCS) are used for secondary analysis.

Moreover, the paper stems from the long-term focus of the authors on the issues of education and especially on community education in rural areas. At first, the significance of RCSs was identified by the author in 2010 under the project „Education for rural areas as a part of regional development priorities“, supported by the Internal Grant Agency of the Faculty of Economics and Management of the Czech University of Life Sciences in Prague (IGA FEM CULS). Within this project, the main educational activities in rural areas of the Czech Republic were identified. The ensuing research project in 2012, called „Rural community school—institute for education and innovation workshop (case study of rural municipalities in the territory of Local Action Group – LAG Pošumaví)“ and also supported by IGA FEM CULS, was specifically focused on the research of establishing a network of RCSs on the territory of LAG Pošumaví. The third research project supported by IGA FEM CULS in 2014 – „Appreciation of Natural and Sociocultural Potential of Rural Areas through Activities Contributing to Social Inclusion“ – was specifically focused on the selected activities of RCSs and mainly on socially inclusive activities. The aforementioned research projects were basically focused on the supply side of RCSs in the Czech Republic. This paper and also ongoing research (see Acknowledgements) are focused primarily on the demand side of RCSs (participants in educational courses). The

experience of the authors demonstrates their ability to evaluate the functioning of RCSs in the Czech Republic.

The proposed primary research is based on the above-mentioned experience. Out of the total number of 37 RCSs in the Czech Republic, 22 RCSs (after the correction in 2015) were identified as active (Husak and Hudeckova, 2015). Eleven of the most active RCSs were selected as the object for the research, by means of a questionnaire survey. Twenty questionnaires for course participants were distributed to each of the chosen RCSs. So, in collaboration with Community Coordinators, 220 questionnaires were distributed. The questionnaires consist mainly of the issues of the evaluation of educational courses, preferences of participants with regard to the course specialisations, and the overall evaluation of the functioning of RCSs. Unfortunately, the return rate of questionnaires was relatively low (31%; N=68). Considering structure of the respondents, there prevail women (87%) and respondents between 40 and 55 years old (59%). The other age categories are represented rather less – 26% respondents above 56 years old and 15% of respondents are 39 years old or younger. Therefore the results of second stage sorting are not relevant and statistically verifiable. According to Community Coordinators the sample corresponds to the structure of the educational courses participants (there also significantly prevail women and middle age generation). For the reason of low return rate of questionnaires, 6 semi-standardised interviews (each with a duration of approximately 60 minutes) were conducted with course participants to obtain the relevant information on the functioning of RCSs from the demand side. The interviews consisted mainly of the issues of the strengths and weaknesses of the functioning of RCSs, recommendations for successful future development of RCSs, and an explanation of standardised questions within the questionnaire survey. Therefore, the ensuing part of the paper consists of the hard data, as well as of the soft data from interviews.

## RESULTS

The concept of community education and community schools is fairly new – especially in the Czech Republic, where the first RCSs were established in 2005 (NNRCS, 2016). On the other hand, more than ten years' existence of RCSs is sufficient to evaluate their functioning. This involves not only evaluation from the perspectives of RCS representatives, but also from the perspectives of participants in educational courses (rural inhabitants). Perception of RCSs by the rural population is a crucial factor in their development. For this reason, special attention is paid to the preferences of participants, their satisfaction with the functioning of RCSs and also to the marketing of activities performed by RCSs.

Table 1 focuses attention on the preferences of participants with regard to the types of courses realised by RCSs (for a detailed distinction of the type of courses, see Husak and Hadkova, 2015) – courses focused on the personal growth of participants (A), courses to increase opportunities on the labour market (B), and courses with the mission of promoting active citizenship and local identity (C). Attention is also focused on a comparison of these preferences with the trend of the supply of courses and the strength of the trends.

The above-mentioned data depicted in Table 1 indicate the preferred type of courses and a comparison with the trends of supply of these courses by RCSs. The last column shows the percentage of RCSs with the depicted trend. The significantly highest preference is given to courses focused on the personal growth of participants. It is relatively consistent with the trend of supply of these types of courses. Stagnation prevails, as indicated by one-third of RCSs. The supply of other types of courses is decreasing and it is obvious

that a more balanced trend is shown in courses with the mission of promoting active citizenship and local identity (more than half of RCSs indicate a stagnation or increase). However, this type of course is least preferred by participants. Information from the interviews suggests that participants are satisfied with the supply of courses, despite the stagnation or decrease. They particularly appreciate language and PC skills courses. Only a few participants are usually interested in courses which are broadly or generally focused (e.g. local networking, local handicrafts, community discussions). Thus, participants prefer their own benefit to the benefits for the rural community. The interviews show that participants do not understand the significance of courses with the mission of promoting active citizenship and local identity. Nevertheless, local identity is considered as one of the key factors for the successful development of small rural communities (Lee *et al.*, 2005). There is space for the awareness of RCS activities which have two major missions – to bring education closer to the rural population and to support rural community development. Data from Table 1 show that RCSs try to support active citizenship, local identity and community development, despite the significantly low demand.

Type of course	Preferences of participants (%)	Prevailing trend of supply	RCSs with this trend (% of RCSs)
A	64.7	stagnation	66.7
B	23.5	decrease	63.6
C	11.8	decrease	46.7

**Table 1: Preferred courses vs. development of their supply (source: own calculation)**

Answers	Fulfilment of expectations (% of participants)	Plans to attend other courses (% of participants)	Recommendation to attend courses (% of participants)
Yes	88.2	58.8	88.2
No	11.8	41.2	11.8

**Table 2: Evaluation of courses provided by RCSs from the perspectives of participants (source: own calculation)**

Table 2 shows data relating to the satisfaction of participants with attended courses. Attention is paid not only to the fulfilment of expectations of participants, but also to the plans to attend other courses and potential recommendations to friends to attend courses. The data show a high level of satisfaction with attended courses – more than 88% of participants evaluate the courses as meeting their expectations. The same percentage of participants would also recommend attendance of courses organised by RCSs to their friends. According to semi-standardised interviews with participants, it is mainly the professionalism and erudition of lecturers, financial affordability, spatial availability, course contents and benefits for personal development of participants which are positively evaluated. Only a minority of issues are negatively evaluated – participants often mention classroom equipment and problems of the varying degrees of initial knowledge of participants (this is especially important with regard to language and PC skills courses). In this context, it is interesting that a relatively lower proportion (58.8%) of participants plan to attend other courses organised by RCSs. This means that nearly one-third of participants who are satisfied with courses do not plan to attend other courses. The data from interviews show the main reasons for this fact. Respondents mentioned in particular the limited variety of courses – the courses are the same or similar to those already attended. They also mentioned a lack of time to attend courses, their needs having been met by the completed courses, and a lack of interest in the contents of other courses offered. From these perspectives, there are two possibilities for the sustainable development of RCSs.

The first possibility is to supply a wider variety of courses, but this could sometimes be in contrast to the preferences of the majority of participants (see Table 1). The second possibility is to attract new rural residents to participate in courses organised by RCSs. The marketing of courses and other activities provided by RCSs is especially important for the second possibility.

Tools	How participants learned about courses (%)*	RCSs using the specific tools (%)*
Web pages	71.4	87.5
Local newspapers	57.2	73.3
Leaflets	28.5	38.5
From friends	42.9	x
Others (e.g. Facebook, Primary School, local radio)	14.3	66.7

\* *More possible answers*

**Table 3: Efficiency of specific promotional tools used by RCSs (source: own calculation)**

Because the sustainable development of RCSs is also based on the stable demand for their courses and other activities, it is also necessary to research the promotional tools used by RCSs, and their efficiency. Table 3 shows data on the promotional tools used regularly by RCSs (they are sorted in descending order, except for “Others”, according to the percentage of RCSs using the specific tool), and the usage of these tools by participants (in answer to the question: “How did you learn about RCSs and their courses?”). The most common promotional tool used by RCSs are web pages and local newspapers. This also corresponds with the percentage of participants who used these promotional tools to learn about RCSs and their courses. However, Community Coordinators state that, due to the social and age structure of the rural population, online communication and promotion are insufficient. On the other hand, it is also still the most utilised promotional tool by participants (rural inhabitants).

Comparing the values of promotional tools used by RCSs and participants, the most efficient promotional tool are leaflets. There is only a 10% excess of usage of this tool by RCSs over usage by participants (in comparison to 16.1% for web pages, 16.1% for local newspapers and 52.4% for other tools). Therefore, the money invested in the distribution of leaflets has relatively the highest impact on potential participants. On the other hand, web pages and local newspapers are also important parts of the RCS marketing portfolio. It is also necessary to mention the significance of recommendations of RCSs and their courses by friends who have already completed an educational course. Nearly 43% of participants learned about RCSs and their courses from friends. The data therefore show the importance of recommendations, positive feedback, satisfaction of participants (see Table 2) and goodwill for the sustainable development of RCSs. This is especially significant with regard to small rural municipalities with a higher importance on personal relationships and interpersonal trust, not only in the rural areas of the Czech Republic but also abroad, as stated by Laudams (2013).

## DISCUSSION

The evaluation of activities and educational courses of RCSs for rural areas in the Czech Republic is quite ambivalent. Participants in courses mainly evaluate the benefits of RCSs positively for themselves personally. The significance to rural areas of RCSs is not of interest to participants. From these facts, the strengths and weaknesses of the functioning

of RCSs, as identified by participants, are also apparent. Considering the strengths of RCSs from participants' perspectives, special mention is made of the convenient price conditions, courses organised within the locality, courses meeting the needs of the rural population, erudition of lecturers and the friendly environment of the courses and RCSs in general. Considering the weaknesses of RCSs from participants' perspectives, mention is made especially of the limited variety of courses organised by RCSs (with language and PC skills courses prevailing, and mainly the lack of courses focused on financial literacy and technically oriented courses), the limited number of courses, inconvenient times of courses (too early in the afternoon), and little knowledge about the organised courses. On the other hand, the data show that the demand for other types of courses (with the exception of courses oriented towards personal growth and the labour market) is minimal, and the promotion of RCSs and their courses is efficient. This difference probably results from the distorted ideas of the rural population about RCSs and their mission. Participants perceive with difficulty that RCSs are not intended only for the education of rural inhabitants, but also for the promotion of community-based rural development (the main issue of LAGs), as stated by Heers *et al.* (2014).

The results with regard to the marketing of RCSs and their courses show the great importance of recommendations of RCS courses by former participants. This acknowledges the results provided by Kalenda and Smekalova (2015), who mention the significance of local partnership, a good reputation among the local population and the close cooperation of RCSs with other local associations for the successful development of community education. In this context, they mention the relationship between community education and a consensual approach (rather than a conflictual approach).

## CONCLUSION

The paper is focused on the evaluation (from participants' perspectives) of the functioning of RCSs and community education in general within the rural areas of the Czech Republic. Special attention is paid to the satisfaction of educational course participants with the functioning of RCSs, the supply of courses, and the efficiency of promotion of the educational activities of RCSs. The issue is topical due to the ten years' existence of the oldest RCSs in the Czech Republic and due to the emphasis on institutional and knowledge-based approaches in current rural development theories.

Considering the main results of our research, it is possible to state that participants in educational courses evaluate RCSs as important organisations for the promotion of human capital (through education) within rural areas. However, they also mention some weaknesses of RCSs connected with the supply of courses. The importance of RCSs in the development potentials of rural areas is still omitted. For future sustainable development of RCSs, it is necessary to strengthen awareness of the significance of local identity and the use of special local resources for rural development. RCSs are able to take an active part in this process. It is also obvious that cooperation between RCSs and LAGs within community-led local development should support the change from the perception of RCSs only as educational organisations to the broader concept of community education as perceived by Heers *et al.* (2014).

An investigation into the existing or possible collaboration of RCSs with LAGs and the spatial distribution of this collaboration (with a special emphasis on regional/rural family policy) is also the focus of our ensuing research, starting in spring 2017.

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# STRESS AND ACHIEVEMENT OF FOREIGN UNIVERSITY STUDENTS

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## ABSTRACT

The paper reports results of the research focused on the level of stress caused by the adaptation to a new cultural environment as a factor influencing academic achievement of foreign students at Faculty of Economics and Management, Czech University of Life Sciences in Prague. The most important findings point to the fact, that cultural distance of the country of origin of the student plays crucial role in the level of stress and the level of the achievement and satisfaction with it. Some other results of statistical analysis, their possible implications for future research, and practice are explored as well.

## KEYWORDS

Academic Achievement, Adaptation, Student Sojourners, Stress

## INTRODUCTION

The high level of stress related to numerous demands placed on the university students frequently leads to the increase of perceived distress, discomfort and overall dissatisfaction. These issues, especially with the focus on coping with stress and its connection to the healthy behaviour patterns of the university students were described in details in Chýlová and Natovová (2013). As the result of these problems associated with adapting to a university environment low academic performance has often been reported (Cicognani, 2011; Nickerson, Diener and Schwarz, 2011). For students studying abroad, increased levels of stress must be expected through addition of a specific burden related to the transition to a new cultural environment. This text focuses on the stress level and the academic achievement of foreign students at Czech University of Life Sciences (CULS). It follows up on the above researches, in particular research dedicated to psychological adjustment of foreign students at Faculty of Economics and Management (FEM) at CULS (Chýlová and Natovová, 2014).

Students studying in a culture that is different from their own, must contend with new social and educational systems, different behaviour and expectations – in addition to it, they have to deal with the adaptation problems common to all the students in general. It is quite difficult, even when the sojourner is aware of the differences between cultures in advance, but even harder when newcomer is unaware and mistakenly assumes that the new culture operates similarly to his home country (Zhou et al., 2008). For this reason, it is important to pay attention to the preparation and training of the students for the stay in foreign country.

Probably the best-known comparative analysis of values of national cultures is Hofstede's research for IBM, from which gradually arose the Value Survey Inventory (VSM), edited and upgraded several times to currently distinguish seven national dimensions (Hofstede,

2008). Dimension values have an impact on the functioning of society and the individuals in those groups. Values determine e.g. relationship to authority, an individual's self-concept, ways of dealing with conflicts etc. (Kolman, 2008).

Researches have confirmed that the pedagogical and educational practices at universities in different countries substantially differ from each other (even across Europe), so the movements between them always require to adapt to a different learning style and a different study approach (Rienties, Luchoomun and Tempelaar, 2014). Although foreign students perceive as the most significant source of academic difficulties their limited language skills, there are still many other factors that affect the academic success and satisfaction. The most affected by intercultural differences are traditionally the expectations from education, learning styles and communication in the classroom (Ward, Bochner and Furnham, 2001).

Among the students, who live abroad, there was reported the relationship between cultural distance of their and host culture and social difficulties, unsatisfying relations with members of the host culture, and limited socio-cultural adaptation (Pedersen et al., 2011). From the positive side, it is important to emphasize that the belief in innate ability to handle the stress of the event, the use of effective strategies for coping with stress and increase overall satisfaction with life (well-being) certainly have a positive impact on its management (Ward, Bochner and Furnham, 2001) and therefore should be in the focus of interest of pedagogues and scientists.

Some authors (Bochner, 2006 or Zhou et al., 2008) remind that the foreign students can benefit from interaction with members of the host culture both socially, psychologically and academically. Researches confirmed (e.g. Searle and Ward, 1990) that the greater amount of interaction with host nationals has been associated with fewer academic problems, fewer social difficulties, improved communication competency, and better general adaptation to life abroad.

Furthermore, it appeared that the contact and friendship with the local students are associated with emotional benefits, as is the satisfaction of foreign students and a lower level of stress and better psychological adaptation. However, Zhou et al. (2008) points out that despite all the benefits of the interactions host-sojourner these interactions are in practice very limited, as foreign students are usually friendliest with students from the same culture. Similarly, Tanaka et al. (1997) reports increase of the well-being of students via social support, when Chavajay at the same time (2013) remarks, that in a research of perceived social support among international students it is common that they receive greater socioemotional and material support from other international students than from those from the host culture.

Rienties, Luchoomun and Tempelaar (2014) state that is widely expected to significantly raise the academic success when the student and the university are closely interconnected. Therefore, the institutions are often trying to improve the well-being of students and their social interactions in order to enhance their academic achievement.

Zhou et al. (2008) recommend to perform further research, that should be devoted to the issue of how the psychological well-being and socio-cultural adaptation of foreign students worse or improve their academic success. And so, the design of the current research was set accordingly.

Taking into account the eminent role of the achievement in general, and at the sample of sojourning students particularly, it is important to explore the issue of the consequences of the sojourn process. The present study aims to explore the relationship between the process of adaptation to a new cultural environment and the subjective level of academic

achievement of the foreign students at FEM, CULS. Authors expect the presence of a certain relationship between the level of ongoing acculturation stress and the changes in academic achievement. As it looks, the achievement should be modified by overall well-being and satisfaction with the sojourn as well. Furthermore, the cultural distance of the country of origin and the host country probably plays an important role in the level of academic achievement and therefore the null hypothesis *Academic achievement is the same independently on cultural distance of country of origin* will be tested.

The present study aims to explore and analyse the subject matter with the use of standardized questionnaire VSM 08 (Hofstede, 2008) completed with scales designed especially for this purpose. Statistical analysis of the outcomes from the questionnaire will be run in order to ascertain the plausibility of the hypothesised concept.

## **MATERIAL AND METHODS**

### **Participants**

The data were collected during academic year 2015/2016.

Group of respondents consists of students of English study programs at FEM, CULS (n = 319), foreign students comes from 50 different countries of the world. National composition of the sample fairly well copies the trend of representation of individual nationalities at FEM, CULS, with the exception of students from Slovakia, who usually study in Czech study programmes and are therefore in English programmes in the minority (see Černý, 2013). Due to the large number of different nationalities in the sample, it was necessary to merge the respondents into the groups based on cultural distance/proximity from the host country. The distance between the host (Czech) and sojourning students 'culture was determined on the basis of the Hofstede's dimensions of national culture (Hofstede, 2008).

The group of respondents consists of 138 men (43.3%) and 181 women (56.7%). The average age of the respondents was 21.2 years (min. 17 years, max. 35 years). 63 % of all the respondents were first year BSc. students, the majority of the students were from Economics and Management study programme at FEM.

### **Method**

For the collection of the data a standardized questionnaire - The Values Survey Module-VSM 08 (Hofstede, 2008) was used. VSM 08 contains 34 items and was developed to compare the cultural values and attitudes of groups of respondents from two or more countries. It allows the calculation of the outcomes on seven dimensions of national cultures. The first four dimensions (Uncertainty Avoidance, Masculinity, Individualism and Power Distance Index) will be used for our purpose of allocation of sojourners into clusters according to the cultural distance.

The VSM 08 was for the purpose of this research completed by the questions and scales measuring the symptoms of stress associated with the transition to a new cultural environment, includes a variety of expressions of distress – six items of specific manifestations rated on seven point Likert type scale, indicating agreement/disagreement with each of the item. In addition, there are scales assessing a feeling of general well-being, of satisfaction with academic achievement and subjectively evaluating change in current achievement – rated on the interactive scale ranging from 0 to 100 percent according to the degree of acceptance of the claim.

## Statistical analysis

First of all, the descriptive statistics was performed, to describe the sample (results were described in respective paragraph).

On the basis of the data obtained through Hofstede's questionnaire, the agglomerative hierarchical clustering with use of Ward's method (Norušis, 2012) was run. By this analyse the large number of different countries of origin of the sojourners were divided into desired number (3) of groups – culturally close/further/distant countries.

The normal distribution hypothesis was tested with the use of general Kolmogorov-Smirnov normality test and also Shapiro-Wilk's modification for smaller samples. With regard to its results, if necessary, Spearman's rank correlation coefficient will be used in order to ascertain the hypothesis of the relationship between the variables (instead of parametric Pearson's).

Considering the different size of compared samples, Levene's test of equality of variance will be computed. If convenient, Kruskal-Wallis nonparametric test will be run instead of ANOVA. The IBM SPSS 21 statistics program will be used (Norušis, 2012).

## RESULTS

The normal distribution hypothesis was tested, results are described in Table 1.

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Feel well	0.173	124	0.000	0.897	124	0.000
Stress	0.073	125	0.097	0.976	125	0.026
Satisfaction with achievement	0.146	124	0.000	0.923	124	0.000
Change in achievement	0.132	124	0.000	0.945	124	0.000

a. Lilliefors Significance Correction

**Table 1: Tests of normality (source: own calculation)**

Since we conclude that the data does not come from a normal distribution, the Spearman's rank correlation coefficient will be used in order to ascertain the hypothesis of the relationship between stress and academic achievement.

			Feel well	Stress	Satisfaction with achievement	Change in achievement
Spearman's rho	Feel well	Correl. coeff.	1,000	0.511**	0.387**	0.278**
		Sig. (2-sided)	.	0,000	0,000	0,002
		N	125	125	125	125
	Stress	Correl. coeff.	-0.511**	1,000	-0.230**	-0.157
		Sig. (2-sided)	0,000	.	0,010	0,080
		N	125	125	125	125
	Satisfaction with achievement	Correl. coeff.	0.387**	-0.230**	1,000	0.519**
		Sig. (2-sided)	0,000	0,010	.	0,000
		N	125	125	125	125
	Change in achievement	Correl. coeff.	0.278**	-0.157	0.519**	1,000
		Sig. (2-sided)	0,002	0,080	0,000	.
		N	125	125	125	125

\*-sig at 0.05; \*\* - sig. at 0.01

**Table 2: Results – correlation stress-achievement (source: own calculation)**

As it can be seen in Table 2, there exists statistically important relationship (in a negative way:  $\rho = -0.230$ ) between the level of stress and the level of satisfaction with academic achievement. The subjective evaluation of the change in academic achievement correlates highly with the feeling of well-being in general ( $\rho = 0.278$ ). Further, the general feeling of well-being has got close relationship with the satisfaction with the achievement ( $\rho = 0.387$ ). The highest correlations were detected at the change in achievement and satisfaction with achievement ( $\rho = 0.519$ ).

Whereas it has appeared that the cultural distance between countries of origin and host countries plays an important role in many aspects of the process of acculturation and its outputs, we may expect a certain influence in relation to the academic achievement of respondents as well. Therefore, it was examined whether, depending on the country of origin's cultural distance the academic achievement of the respondents will change considerably.

Results of agglomerative hierarchical cluster analysis run with the use of data from Hofstede's VSM 08 yielded desired number of clusters (groups) – for our purpose we used three groups of respondents from the resulting dendrogram (culturally close/more distant/culturally distant).

Considering the different size of compared samples, Levene's test of equality of variance will be computed before the use of further tests (results are in Table 3).

Levene's test	df1	df2	Sig.
2.396	6	109	0.033

**Table 3: Levene's test (source: own calculation)**

With regard to the result of homogeneity test, the non-parametric Kruskal-Wallis test will be used to compare the three groups of students from culturally different countries and test the hypothesis that *Academic achievement is the same independently on cultural distance of country of origin*.

	Total n	Test Statistic	Degrees of Freedom	Asymptotic Sig. (2-sided test)
Achievement change across categories of cultural distance	106	8.395	2	0.015*

\*The significance level is 0.05

**Table 4: Results – Kruskal-Wallis Test (source: own calculation)**

From the results displayed in Table 4, we may conclude, that the change in academic performance after coming into a new culture is statistically significantly different, depending on the cultural distance of the country of origin (Kruskal-Wallis: sig. 0.015). Students from culturally most distant countries indicate a greater change in academic achievement than their colleagues from culturally closer countries.

## DISCUSSION

Taking into account the above results on changes in achievement in relation to the cultural distance of the sojourner on one hand and the intercorrelation of feeling well, satisfaction with achievement and the change in achievement on the other, it may be argued, that culturally more distant students are regrettably less satisfied with the outcome of the whole adaptation process and are probably unsatisfied with their academic performance here. We can consider the possibility, that even though Zhou et al. (2008), reported that the contact with local students is associated with positive emotional benefits (e.g. satisfaction)

and lower levels of stress, that these interactions are in practice very limited. Similar issue is dealt with in Hes and Hesová (2015), who argue, that Czech society appears to be rather closed and indifferent to members of other cultures. Foreign students are often faced with an indifferent approach in the academic sphere. They separate, they don't let others get close other than is necessary and needed. On the other hand, even Czech students don't seek the company of foreign students.

However, it seems that there is a certain tendency for higher satisfaction with the academic performance rather at students from culturally closer countries, the question remains whether this subjective rating corresponds to the objective results, and these are at culturally more distant students lower, or whether this directing is determined by, for example, higher demands of these specific sojourners and cannot be easily satisfied. That this should also be considered to be the potential case might indicate previously published results, showing that CULS students are less satisfied with their life, judging their overall well-being to be lower than is usual at similar population (Chýlová and Natovová, 2013). In addition, the possibility of linking the above mentioned subjective assessments of academic success with objective study results would be a suitable stimulus for further validating research.

It should also be considered that, unlike in many foreign researches, in our case the language of the host country is not the communication language. In the literature (e.g. Ward, Bochner and Furnham, 2001; Furnham, 2005) quoted research studies are usually done with sojourners in the USA, the New Zealand, the UK and other countries where English is used as the language for communication in the work/university environment as well as for communication in everyday life.

With regard to the results concerning the level of stress and changes in academic achievement as a function of the cultural distance of country of origin, it is appropriate to consider the application of intervention resources as soon as possible after arrival of the sojourners into the host country. For example, Brown and Holloway (2008) recommend to the university services such as counselling to be prepared to help international students already in the first weeks of the stay, when they are needed the most.

## **CONCLUSION**

Coming to a new cultural environment undoubtedly bears the increased demands on the adaptation of the individual. In the case of sojourning students there is added even more of the stress arising from the requirement on academic performance.

The most important findings of presented research point to the fact, that cultural distance of the country of origin of the student plays crucial role in acculturative stress and the level of the achievement, the changes in the achievement and satisfaction with it.

Negatively perceived part of the acculturation process influences both the achievement and overall well-being, and also the overall rating of the host culture as such. Therefore, it is important to purposefully limit this part of the acculturation process.

Among other factors that influence the course of acculturation and, by extension, the academic achievement of sojourners, undoubtedly belongs the network of social relationships. We may employ adaptation programmes to facilitate this process.

Last, but not least, it could be recommended that the psychological counselling centre should offer its services notably to those who need them the most. In the light of the results, it seems to be especially the group of the students from culturally more distant countries.

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# BUILDING OF SCHEMA OF GEOMETRICAL CONCEPTS

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## ABSTRACT

The goal of this study is to illuminate the mechanism of birth and development of geometrical schema in a pupil's mind. Three manipulative learning environments in which pupils build their ideas about geometrical objects, relationships between them and inside of them, situations and processes are presented. The innovative nature of the presented approach to teaching geometry will be highlighted by its presentation on the background of description of historical development in geometry and in teaching geometry at schools in past 100 years. The new conception presents the results of our longitudinal research.

## KEYWORDS

Learning Environment, Schema of Geometrical Concept, Teaching Geometry, Theory of Generic Model

## INTRODUCTION

Geometry is an important part of mathematics education at all levels and offers a wide range of opportunities for development of intellect and creativity. Creativity is used and developed when looking for relationships inside objects and among objects, but mainly when discovering new objects. Unlike arithmetical objects, geometrical objects are not underlain by one principle that would guarantee their firm interconnections. History can name many thinkers who have tried to discover this principle. Three conceptions might be considered the milestones in geometrical thinking: Euclid, Descartes and Klein.

2300 years ago Euclid built the structural conception of plane geometry, in which he limits the world of geometrical objects to linear and "circular" objects. He comes out of the concepts of a point, line, straight line, angle of two lines, boundary, shape and congruence. The principle of connecting these concepts is axiomatic, i.e. the ground is logic, new truths and concepts are built on axioms in a purely logic way. The modern version of Euclid's conception comes out of David Hilbert, who modified the set of basic objects but not their nature or the way of building geometry.

René Descartes and Pierre Fermat put into practice the outstanding idea of transforming the solving of difficult problems from plane geometry into arithmetical problems, when they found the way of transforming geometrical objects into arithmetical ones. For example, a point becomes an ordered pair of real numbers, a straight line a linear equation, a circle a special quadratic equation etc.

The third conception of geometry comes from Felix Klein, who introduced it to the world in his famous Erlangen programme in 1872. Klein turned his attention from objects to geometrical transformations. The unifying principle of the world of geometry became the concept of algebraic nature – groups of transformations.

With respect to geometry at primary and lower secondary school level, the most important of the three above mentioned conceptions is without any doubt Euclid's conception. But even this conception is too advanced, especially at primary school level.

Teaching geometry in the Czech Republic has undergone significant changes over the past one hundred years. An important stage (in the negative sense) was the period of modernization of mathematics when the conception of teaching geometry at all levels changed from geometry of speculation to axiomatic structure of geometry. On primary school level this brought anchoring geometry in basic concepts of axiomatic construction. It is not surprising that pupils' ideas of these concepts were often deformed as they were not anchored in the pupil's life experience.

It was in the 1990s' that authors of curricular documents and textbooks became more informed about the mechanism of cognitive processes (Cobb, 1987; Lawrel, 1990). Didactics of mathematics has recently emphasized polarity and complementarity of two cognitive principles – process and concept. Based on the analysis of Tall and Gray (1994), Hejný (2000) showed the importance of proceptual transfer in a pupil's mind when they are grasping a processually perceived situation conceptually or conceptually perceived situation processually. And it is the latter of the two directions that is much more frequent in geometry than in arithmetic. That is why a possible absence of geometrical considerations weakens the pupil's ability to develop this important psychological ability. The ideas of constructivism (Noddings, 1990; Glasserfeld, 1990) that stress the need of developing creativity, that put emphasis on the ability to organize a set of phenomena, to look for solving strategies, to abstract etc. resulted in revival of geometry. School geometry is gradually becoming a stimulating learning environment for development of the above listed pupils' skills. We are convinced that school geometry is the environment offering space for a variety of pupils' activities, the environment supporting development of pupils' thinking, providing opportunity for combined aesthetics of art and logic. Thanks to its visual information geometry contributes also to cultivation of arithmetical ideas. Apart of the number theory it is the traditional environment for development of mathematical reasoning and argumentation and more than any other area of mathematics connects pupils' everyday experience with theoretical knowledge and verbal bridging of both areas.

## **MATERIALS AND METHODS**

Our perspective on teaching geometry comes out of studying history of mathematics education, of our longitudinal research focusing on development of understanding geometrical objects and their structure (Jirotková, 2001; Jirotková and Littler, 2003; 2004; 2006; Hejný and Jirotková, 2012; Jirotková and Vighi, 2015) and of theories of cognitive processes in geometry (Van Hiele, 1986; Duval, 2006). Our approach is primarily based on Theory of Generic Models which is described in detail in (Hejný, 2012). The theory describes the learning process in mathematics from the stage of motivation as the initial stage, through getting practical experience and its accumulation – the stage of isolated models, through the process of generalization, still at the level of real objects – the stage of generic models, to the stage of development abstract knowledge. We worked with another important idea which was brought into didactic of mathematics from psychology – the idea of mental schemas (Gerrig, 1991; Fishbein, 1999). Our conception of building mental schemas of mathematical concepts is based on the work in many mathematical didactical environments. We also focused on the study of mechanisms of learning geometrical objects (Littler and Jirotková, 2004) and structuring knowledge in pupil's mind (Jirotková and Littler, 2006) in our research.

Our conception of the geometrical concept building process will be illustrated with respect to one geometrical concept – trapezium. We will use the approach of P. Vopěnka. In his

study, Vopěnka (1986) introduces the concept of a ‘personality’ of a geometrical object. His approach enabled him to provide a deep analysis of genesis of geometrical thinking. In a simplified way, a geometrical object is considered as a ‘personality’ for an individual if he or she can associate the image with the name of an object, can describe some of its attributes, is able to recall the object on the basis of its verbal description, can represent it by a model or drawing, can recognize objects which are in some way related to it and describe the relationship. One of the first such personality is the square. At first the child sees the object in various situations and hears its name. Later the child is asked to build a square from wooden rods. If a pupil solves the problem well without seeing a square around him/her, then his/her concept of a square realized with wooden rods comes out of his/her mind. Then we can say the concept of a square is a personality for the pupil.

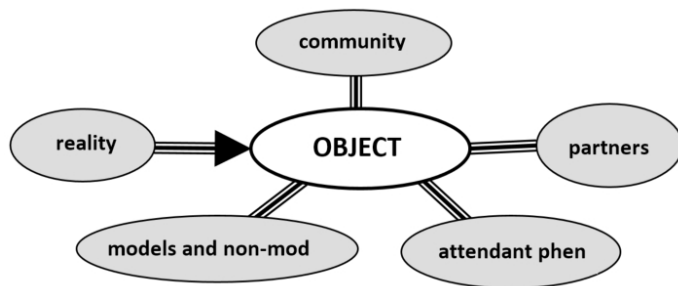
Each geometrical object can be characterized by attendant phenomena. The attendant phenomena of a square are, for example, vertices, sides (visible phenomena), diagonal, center, line of symmetry (invisible phenomena). When developing pupils’ geometrical ideas, we work with the bond: object ↔ its attendant phenomena (attributes). Each object is represented and clarified with the help of models and non-models. A model of a square is for example, a square cut out of paper, marked on a square grid, a window, a traffic sign, one face of a cube, a cross-section of a prism etc. By a non-model of a square we mean for example, a picture of a rhombus resembling a square.

Objects are connected by kinship ties to their partners. For example, a partner of the square is a circumscribed circle. A beautiful example of partner ties is the duality between Platonic solids – the cube and a regular octahedron, regular dodecahedron and regular icosahedron.

Objects are members of different communities, for example, the square belongs to the community of rectangles, regular polygons, quadrilaterals, convex polygons etc.

To cultivate thinking and understanding of geometrical phenomena means to broaden and precise the relationships within the schema in figure 1.

Real-life experience is the starting point for opening the world of geometry to primary school pupils. By connecting manipulation – verbal description of the implemented activity – the use of sign language we change the pupil’s knowledge in action into knowledge in words and concept knowledge. It is important to accompany all manipulative activities by verbal commentary. This is the best way of introducing new terminology to children. The richness of verbal repertoire enables further development of ideas.



**Figure 1: Schema of geometrical objects**

## RESULTS AND DISCUSSION

Our conception of schema-oriented education which has been developed by research team lead by M. Hejný and which was elaborated for the primary and lower secondary school mathematics textbooks (Hejný, 2007-2011) puts these ideas into practice through activities in many learning environments. Children move in these environments from the 1<sup>st</sup> to the 5<sup>th</sup> grade and sometimes get experience with them already at preschool level (Slezáková and Šbrtová, 2015). They solve problems, discuss, make conjectures, argue, pose new problems. It is very important that they work in a familiar environment, where difficulty of problems grows gradually and while solving them, pupils get introduced to deep mathematical ideas step-by-step (Semadeni, 2002). These deep ideas are the core of mental schemas built by pupils. This way of learning new concepts lies in deeper layers of a person's cognitive structure than where their ability to use the concept is.

In this paper, we will focus only on three manipulative learning environments of 2D in more details. We will show what shapes can be worked with in the environments, what relations are revealed and what properties of geometrical shapes are discovered in the environment.

### Wooden sticks

A set of equally long wooden sticks or matches is needed to solve the tasks. Many different shapes can be constructed from the sticks: equilateral, isosceles, right triangles (with sides 3, 4, 5), scalene triangles. From quadrilaterals children can construct squares, rhombuses, oblongs, rhomboids, trapeziums. They can assemble pentagons and many other shapes constructed from squares and triangles.



**Figure 2:**  
Five squares



**Figure 3:** Three  
triangles



**Figure 4:** Rectangles  
and square

The processes through which we may change the shapes and create new ones are: moving a stick, adding and taking away a stick or a combination of these. Let us show several illustrative problems.

Problem 1. Create the configuration in figure 2. Take away 2 sticks so that only 2 squares are left.

Problem 2. Create the configuration in figure 3. Take away 2 sticks so that 2 triangles and 1 quadrilateral are left.

Problem 3. Create the configuration in figure 4. Add 1 stick to make a) 2; b) 3; c) 4 squares.

Problem 4. Create the shape in figure 3. Move 2 sticks to make a) 2 triangles and 1 quadrilateral; b) 1 triangle and 2 quadrilaterals.

Problem 5. To create the sequence of 3 triangular cells we need 7 sticks (fig. 3). How many sticks do we need to create a) 7; b) 8; c) 9; d) 50 triangular cells?

Problem 6. To create the sequence of 2 'doublesquare' cells we need 12 sticks (fig. 2). How many sticks do we need to create a) 7; b) 8; c) 9; d) 50 "doublesquare" cells?

The problems bring knowledge and experience into many geometrical schemas. For example, problem 1 and 3 involve schemas square, perimeter and area of a square, congruence of squares, nonconvex hexagon, oblong. Problems 2 and 4 involve schemas of an equilateral triangle, rhombus, isosceles trapezium, parallelogram, area and perimeter of

these shapes, similar triangles. Problems 5 and 6 link arithmetic, sequences and geometry. Moreover, work with sticks develops fine motor skills and operational thinking.

The concept of trapezium is at first experienced by the pupils manually (fig. 3) without any special attention being paid to it. The pupil gains experience with one model of trapezium and works with its attendant phenomena. The number of sticks needed for its outline is the perimeter, the number of equilateral triangles its area. Having solved problem 4 the pupil places it into the community of quadrangles that belongs to the community of wooden stick shapes. The partner to the trapezium is here the rhombus, equilateral triangle and parallelogram.

### Paper folding

Another important manipulative environment where experience comes through pupils' hands is Paper folding. By work in this environment pupils develop similar competencies as in the previous ones. Let us again present some problems and show which schemas they involve and develop.

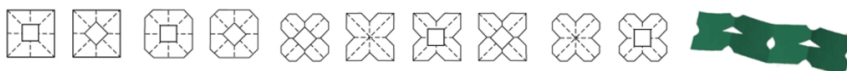


Figure 5: Decorations

Problem 7. Fold and cut the paper to get the decorations in figure 5.

By folding a square from a sheet of paper pupils learn a lot about a square and its properties, for example, congruence of two adjacent sides and their perpendicularity or parallelism of opposite sides. Children get a lot of experience from transformations such as line symmetry, composition of line symmetries, translation (fig. 5). They also get to know concepts like oblong, pentagon, right trapezium, parallelogram (fig. 6), octagon,.... By cutting out the interior hole in the square children learn that diagonals of a square are of equal length, are perpendicular and bisect each other. They get experience with congruence of squares or with area of different figures. There are also questions touching arithmetic, e.g. How many squares are created? Questions of the type What part of the big square is occupied by the small square is introduction into the concept of fraction.



Figure 6: Rectangular trapezium, parallelogram

By folding a sheet of paper the pupil gets to know yet another model of a trapezium in which one can easily verify parallelism of the two opposite sides and presence of two right angles (fig. 6). It is also meaningful to explore it with respect to the area of the original square from which it was created and to the perimeter if a unit of measurement is defined. The partners here are right isosceles triangle, square and parallelogram. Together they make the community of polygons.

### Geoboard

9-pin geoboard is another manipulative environment that will be presented in this paper. We will list activities incorporated in the problems and will present an illustrative problem. These are: 1. creation of a picture of one's own, 2. copying a picture or another geoboard

on a geoboard, 3. copying from a geoboard to a square grid, 4. copying from a square grid to a geoboard, 5. construction of a shape of given parameters (number of vertices, congruence of sides, line symmetry, perimeter, area, number of outline and interior pins), 6. recording a figure using arrows, 7. construction of a figure following arrow description, 8. comparison of two shapes (similarities and differences), 9. search for characteristic properties of a specific group of shapes, 10. shape transformation (rotation, translation, symmetry) in the language of arrows.

*Guess what object I am thinking about!* is an activity known from outside school activities. It allows pupils to use knowledge from all first three levels of insight into geometrical objects according to Van Hiele (1986). They work with geometrical objects, improve communication and develop logic.

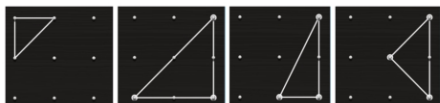


Figure 7: Triangles on geoboard

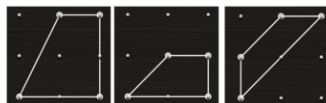


Figure 8: Trapeziums on geoboard

The gallery for the game may be e.g. the 4 triangles from figure 7, or all incongruent triangles on a geoboard. These are only 8. The choice of objects for the game is immense and variable and we can always select a gallery suitable for the selected purpose.

Figure 8 shows all three trapeziums that can be modelled on a geoboard. The last can be transcribed in the processual language of the arrows as follows: ●→→↑↑●←←●↓↓●. This serves as introduction to the analytical geometry. The concept of a trapezium is here enriched by a processual perspective, which is the arrow notation. Similarly to problem 4, the pupil discovers that a trapezium may be formed from a triangle by “cutting off” a part by a section parallel to one of the sides.

## CONCLUSION

The above briefly described approach to teaching geometry enriched by work in other related learning environments that contribute to building mental schemas of geometrical objects, relationships, processes and situations in pupil’s mind, fulfils the ideas of effective teaching, which Hejný (2012: 44) characterized by three cognitive goals:

- a pupil understands mathematics, his/her knowledge is not mechanical;
- a pupil is intrinsically motivated for work, he/she is not frustrated by mathematics;
- a pupil develops intellectually; by that, we mainly mean the development of the ability to:
  1. to communicate mathematically both orally and in writing;
  2. cooperate in a group or even lead a group to solve mathematical problems,
  3. analyse a mathematical problem situation,
  4. effectively solve mathematical problems and
  5. correct one’s own mistake.”

Let’s add that

- the language especially in geometry, plays an important role in every human activity. The pupil works with many languages, many representations of objects and uses them both in problem solving, i.e. as the means of development of thinking, and in

- communication, i.e. as the means of communication. Low level of knowledge of the language often results in the failure to grasp a problem or to understand each other.
- communication and reasoning are born and developed as a social activity. Only later are the more advanced pupils able to raise social communication to the level of cognitive argumentation. That is why discussion is of key importance for the process of pupils' communicative skills and reasoning.
  - many teachers in whose classes group work was the most frequent form of classroom management have observed that knowledge of the group or class is on a higher level than knowledge of an individual.
  - the ability to get and order experience using one's own manipulative, speculative and inquiry based activities, most often using trial-error method is best mapped by problems that lead the pupil to gain a set of partial results that can result in general knowledge. Pupils who are familiar with this approach apply it naturally. Pupils who lack this experience are lost if facing this kind of a problem.
  - even weaker pupils are capable to generalize the acquired knowledge, to discover regularities, formulate hypotheses, but it must be set in the level of abstraction the pupils are able to reach at that point.
  - a mistake is very often perceived as something that should be avoided and when it appears something that has to be corrected at once. This of course contradicts the ancient wisdom that one learns from their mistakes.

## ACKNOWLEDGEMENTS

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# SOME REMARKS ON THE DIFFICULTY OF TEST VARIANTS IN ADMISSION PROCESS

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## ABSTRACT

The differences of number of points in the test in mathematics between test variants in the entrance exams at University of Economics in Prague are analysed in present paper. These differences can be caused by various factors, e.g. the differences may arise due to the varying difficulty of test variants for students. The difficulty of test variants for students is poorly measured. For the multiple choice question tests, which are used at University of Economics, the difficulty of test variant for students depends also on variants of answers from which the correct answer is chosen. An analysis of the problem is in this paper.

## KEYWORDS

Entrance Exams, Mathematics, Statistical Methods, Test Variants

## INTRODUCTION

For entrance examinations are frequently used the multiple choice question tests. Advantages of these tests: the multiple choice question tests are objective and results can be evaluated easily for large number of students. Disadvantages of the multiple choice question tests: students can get some points by guessing the right answers (see e.g. Zhao (2006), Premadasa (1993)).

The difficulty of test variants for students is poorly measured. If we use the multiple choice question tests, the difficulty of test variants depends also on variants of answers from which the correct answer is chosen, e.g. the example

“absolute value of complex number  $z = (3 - 4i)/(2 - i)$  is (a)  $\sqrt{5}$ , (b)  $\sqrt{3}$ , (c)  $\sqrt{10}$ ” is more difficult than the example

“absolute value of complex number  $z = (3 - 4i)/(2 - i)$  is (a) negative number, (b) zero, (c) positive number”.

This problem shall be analysed for the test variants in mathematics which are used for the entrance examinations at University of Economics in Prague.

The three faculties (Faculty of Informatics and Statistics, Faculty of Finance and Accounting, Faculty of Business Administration) of the Prague University of Economics use the math tests, which have 10 questions for 5 points and 5 questions for 10 points – see Fig. 1. Analysis of these tests in mathematics in 2016 is provided in this paper (similar problems are solved in Brožová and Rydval (2013), Klůfa (2013), Hrubý (2016), Klůfa (2015b), Kaspříková (2012), Mošna (2013), Brožová, Rydval and Horáková (2014), Kučera, Svatošová and Pelikán (2015), Zhao (2005)). The results obtained will be used to further improve of the preparation of test variants in the coming years.

## MATERIAL AND METHODS

The results of the entrance exams of 3231 students in mathematics at University of Economics in Prague in 2016 will be analysed in present paper. Sixteen test variants (denoted A0, A1, A3, A4, A5, A6, A7, A8, A9, B0, B1, B2, B3, B4, B5, B6) were used for

the entrance examinations in mathematics at University of Economics in Prague in 2016. Part of the test variant A1 is on Fig. 1.

**Mathematics - A1**

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**Instructions to the test:**  
*There is only one correct answer in the question.*  
*Examples 1 to 10 are for the 5 points.*  
*Examples 11 to 15 are for the 10 points.*

1. The set of all real numbers, which satisfy  $\log_{\frac{5}{3}}(x-1) < 0$ , is:  
 a)  $(-1, 1)$ ,    b)  $(2, +\infty)$ ,    c)  $(1, 2)$     d)  $(-1, 2)$ ,    e) another answer
2. The lot contains 25 items. How many ways can we choose 3 items for inspection from this lot.  
 a) 75    b) 125    c) 4600    d) 2300    e) another answer
3. The number  $\log_{\sqrt{7}}(|1 - 2\sqrt{7}| - |\sqrt{7} - 1|)$  equals:  
 a)  $-1$ ,    b)  $0$ ,    c)  $1$ ,    d)  $\frac{1}{2}$ ,    e) another answer
4. The fraction  $\frac{\sqrt[4]{7}}{\sqrt[3]{\sqrt[3]{7} \cdot \sqrt[9]{7}}}$  equals:  
 a)  $\sqrt{7}$ ,    b)  $\sqrt[3]{7}$ ,    c)  $\sqrt[4]{7}$ ,    d)  $1$ ,    e) another answer
5. The sixth number  $a_6$  of an arithmetic series, which satisfies  $a_2 + a_3 = 13$  and  $a_4 + a_6 = 28$ , equals:  
 a) 16    b) 15    c) 18    d) 17    e) another answer
6. The sum of all real solutions of the equation  $\sqrt{x-3} = x-5$  is:  
 a) 3    b) 2    c) 0    d) 11    e) another answer
7. The real part of the complex number  $z = \frac{i^4 - i^3}{1 - i}$  equals:  
 a)  $-1$ ,    b)  $0$ ,    c)  $1$ ,    d)  $-2$ ,    e) another answer

**Figure 1: Part of the variant A1 in mathematics in 2016 (source: own construction)**

The test variants in mathematics have 15 questions, each question has 5 answers – see Fig. 1. Between these answers is the answer “e) another answer”. If e) is correct answer, to mark the letter e may be for the students more complicated than to mark the letters a, b, c, d. For example solution of the equation (see question 6 in the test variant A1, Fig. 1)

$$\sqrt{x-3} = x-5$$

is 7, i.e. the correct answer is e). The question 6 in the test variant A1 with variants of answers e.g.

a) 7 b) 2 c) 0 d) 11 e) another answer

may be easier for students. Therefore we shall study the dependence of the number of points in the test in mathematics (denoted Y) on the number of answers e) in tests variants (denoted X).

We shall use some statistical methods for analysis the results of the entrance exams of

3231 students in mathematics in 2016, one of them is ANOVA. Using ANOVA we shall verify the validity of the null hypothesis: mean number of points in test variants with 1, 2, 3 and 4 answers e) is the same. If the test statistic (for the test statistics see e.g. Anděl (1978))

$$F > F_{\alpha}(k-1, n-k), \quad (1)$$

where  $F_{\alpha}(k-1, n-k)$  is critical value of Fischer-Snedecor distribution with  $(k-1)$  and  $(n-k)$  degrees of freedom, the hypothesis is rejected at significance level  $\alpha$ . In our case is  $k=4$  (number of answers e) and  $n=3231$  (sample size for ANOVA).

For the study the dependence of the number of points in the test in mathematics (denoted Y) on the number of answers e) in tests variants (denoted X) we shall use methods of correlation a regression analysis, e.g. we shall use test of significance of correlation coefficient. We shall verify the validity of the null hypothesis: the number of points in the test in mathematics does not depend on the number of answers e) in tests variants. When the test statistic (see e.g. Rao (1973))

$$t = \frac{r}{\sqrt{1-r^2}} \sqrt{n-2} > t_{\alpha}(n-2), \quad (2)$$

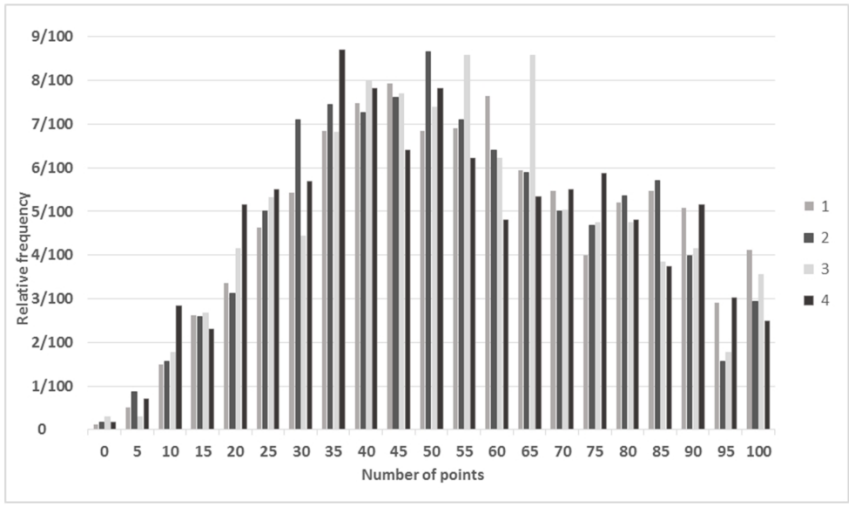
where  $r$  is the correlation coefficient and  $t_{\alpha}(n-2)$  is the critical value of Student  $t$  distribution for  $n-2$  degrees of freedom and significance level  $\alpha$ , the null hypothesis “the number of points in the test in mathematics does not depend on the number of answers e) in tests variants” is rejected at significance level  $\alpha$ .

## RESULTS AND DISCUSSION

The number of answers e) in tests variants which were used for the entrance examinations at University of Economics in Prague in 2016 is 1, 2, 3 and 4. We shall compare distributions of number of points in the test in mathematics in test variants with 1, 2, 3 and 4 answers e) - see Fig. 2 and Tab. 1.

Number of answers e)	Frequency $n_i$	Average number of points	Variance
1	1752	55.745	568.705
2	578	53.581	537.932
3	338	53.935	532.097
4	563	52.744	590.187

**Table 1: Distribution of number of points in test in mathematics in 2016 in test variants with 1, 2, 3 and 4 answers e) (source: own calculation)**



**Figure 2: Distribution of number of points in test in mathematics in 2016 in test variants with 1, 2, 3 and 4 answers e) (histogram) (source: own calculation)**

For the comparison distributions of number of points in the test in mathematics in test variants with 1, 2, 3 and 4 answers e) we shall test null hypothesis

$$H_0: \text{mean number of points in test variants with 1, 2, 3 and 4 answers e) is the same.}$$

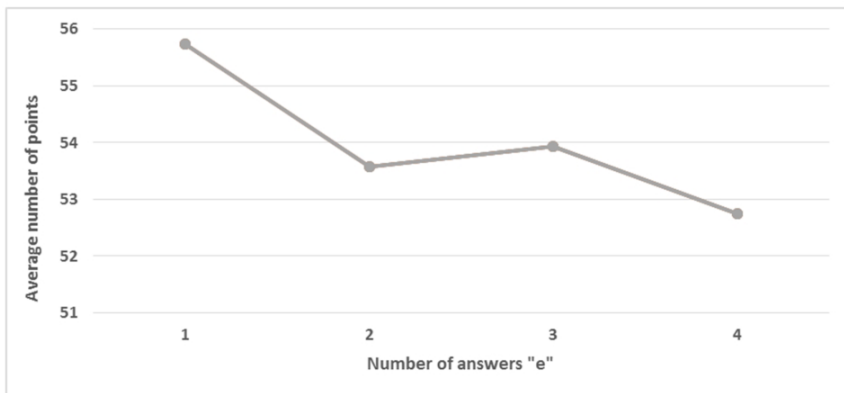
This hypothesis we shall test by ANOVA. We must verify assumption of this method “variance of number of points in mathematics in test variants with 1, 2, 3 and 4 answers e) is the same”. From Bartlett’s test (see e.g. Anděl (1978)) follows that the assumption of ANOVA is met (the hypothesis “variance of number of points in mathematics in test variants with 1, 2, 3 and 4 answers e) is the same” is not rejected at 1% significance level). The results of ANOVA are in Table 2. Because

$$F = 2.947 > 2.608,$$

the null hypothesis “mean number of points in test variants with 1, 2, 3 and 4 answers e) is the same” is rejected at 5% significance level. There are some differences between the test variants with 1, 2, 3 and 4 answers e), the differences between average number of points in test variants with 1, 2, 3 and 4 answers e) in Table 1 are statistically significant.

Source of variability	Sum of Squares	Degrees of freedom	Fraction	F	p value	F crit
Test variants	4977.88	3	1659.29	2.947	0.0317	2.608
Rezidual	1817191	3227	563.12			
Sum	1822169	3230				

**Table 2: Results of ANOVA (source: own calculation)**



**Figure 3: Dependence of the average number of points in the test in mathematics on the number of answers e) in tests variants (source: own construction)**

From results of ANOVA it seems that  $Y$ =the number of points in the test in mathematics depends on  $X$ =the number of answers e) in tests variants. Optimal trend is linear (it confirms the results of regression analysis, see also Fig. 3). Therefore we shall compute the correlation coefficient  $r$  and regression line  $y = a + bx$ . Correlation coefficient equals (see e.g. Feller (1970))

$$r = -0.0486$$

Since the correlation coefficient is near to 0, the dependence of the number of points in the test in mathematics on the number of answers e) in tests variants is weak or the dependence does not exist. Therefore we shall test null hypothesis

$H_0$ : the number of points in the test in mathematics does not depend on the number of answers e) in tests variants

According to formula (2) we shall compute ( $n = 3231$ )

$$t = \frac{r}{\sqrt{1-r^2}} \sqrt{n-2} = -2.76$$

Critical value of  $t$  distribution for  $n-2 = 3229$  degrees of freedom and significance level  $\alpha = 0.01$  is  $t_{0.01}(3229) = 2.58$ . Since

$$|t| > 2.58,$$

the null hypothesis  $H_0$  is rejected at 1% significance level, i.e. the dependence of the number of points in the test in mathematics on the number of answers e) in tests variants exists. Furthermore, regression line is

$$y = 56.552 - 0.998 x$$

From this regression line follows that expected the number of points in mathematics in the test variant with 0 answers e) is 56.552 and if the number of answers e) in tests variants

increases by 1, then the expected the number of points in mathematics decreases by 1 point (0.998).

The problem, which was studied in present paper, occurs in scientific papers rarely (the paper is original). Similar problem as in present paper is solved in Hošková-Majerová and Račková (2010). There are analysed entrance examinations in mathematics at the Faculty of Military Technologies of the University of Defence in Brno. The authors focus on such parts of mathematics that cause serious problems to the majority of students when passing university entrance test. The paper includes also problem of the difficulty examples in maths, the aim of the paper is similar. The entrance examinations in maths at University of Pardubice are analysed in Linda and Kubanová (2013). There is studied correlation between results of the entrance examination test in mathematics and examination in mathematics at the university, the aim of the paper is a little different. The entrance tests in maths at Faculty of mathematics, physics and informatics at Comenius University in Bratislava and their analysis is in Kohanová (2012). The aim of the paper is to find what types of examples should be included in the entrance exams if we want to select students who have good predispositions for study. There are used similar statistical methods as in present paper. The problem of the same difficulty of tests variants in entrance exams is solved also in Klůfa (2015a). There is shown that results of entrance examinations at the Faculty of Informatics and Statistics at University of Economics in Prague do not depend on the test variants.

## CONCLUSION

With aim of increasing the homogeneity of the test variants, the difficulty of the test variants in mathematics at University of Economics in Prague were analysed in this paper. The difficulty of test variants for students is poorly measured. For the multiple choice question tests, which are used at University of Economics, the difficulty of test variant for students depends also on variants of answers from which the correct answer is chosen. From results of the paper it follows that the number of points in the test in mathematics depends on the number of answers “e) another answer” in tests variants, but the dependence is very weak, i.e. the difficulty of the test variants in mathematics depends also on the another factors (e.g. if the test variant contains or does not contain complex numbers etc.).

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# THE INTENSIFICATION OF POSTGRADUTE PEDAGOGICAL TRAINING

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## ABSTRACT

The efficiency of university education results from the level of the academic staff competence. The professional experience level of Russian post graduate students is rather high, whereas their pedagogical competence leaves much to be desired. Postgraduate pedagogical training period according to the newly introduced educational standard is far from being a profound and extended one. The aim of the article is to prove that the intensification is an appropriate way of improving the efficiency of postgraduate pedagogical training within a limited time frame. Tests and interviewing methods revealed the insufficient development of pedagogical competences of 203 postgraduates. The SWOT analysis of the pedagogical training enabled to assess its pros and cons, the potential and possible directions of its further development. The article contains the recommendations for intensifying the postgraduate pedagogical training.

## KEYWORDS

Competences, Intensification, Pedagogical Training, Postgraduate, SWOT-analysis

## INTRODUCTION

A graduate according to the professional and educational standards is getting ready to start his teaching career. Having analyzed the Federal State Educational Standards (FSES 3+) of different postgraduate training programmes we found out that nowadays all the requirements coincide (The Ministry of Education and Science of the Russian Federation, 2014). A graduate is supposed to possess three groups of pedagogical competences including teaching competences: readiness to start a teaching career in the framework of main educational programmes. Preliminary pedagogical training of postgraduate students is very poor - the course of pedagogy and psychology of higher education in the master's programme. Since postgraduate classroom studies comprise only 30 credits the time frame for mastering pedagogical competences is really limited. In South Ural State University (National research university) (SUSU NRU) we have 40 classroom hours (lectures) and 100 hours for pedagogical practice. Moreover, the introduction of federal standards in the field of postgraduate studies in SUSU only made things worse. Earlier a postgraduate student could take an optional course (1080 hours) of a retraining programme "Pedagogical education" and get a qualification "An instructor in higher education". The present course is compulsory for all postgraduate students. According to new programme the course content includes the actual problems of developing of Russian and world university education; the questions of professional education as of the open system, of projecting, organization and delivering the education process. Next the postgraduates have pedagogical practice. At present the postgraduate pedagogical training is 140 hours,

while the demand of mastering pedagogical competences among postgraduates is really high. In a classical higher education institution where about one third of all scientific fields are engineering and technology and among the rest only 6% of postgraduates have a specialized pedagogical education the problem of lacking pedagogical competence for starting a teaching career is really a hot issue. We studied the initial knowledge and skills of 203 postgraduate students of various directions of training (technical, mathematical, chemical, physical, biological, medical, psychological, economical, law, information etc.), during three years, including all those who attended classes. The majority of first-year postgraduates (79.8 %) are not aware of the fact that higher education presupposes not only professional learning but also education and development. Postgraduates are not ready for implementing various methods of teaching; 81.2 % of postgraduates do not possess interactive teaching methods, have no idea how they can be applied in teaching and prefer traditional methods as a result; 69.5 % of students do not understand the terminology which is widely accepted in educational institutions: “competence”, “competency”, “knowledge”, “skills”, “abilities”, “mastery”, “learning”, “upbringing”, “education”, “educational and pedagogical interaction”. About 40 % of postgraduates do not have pedagogical experience. Summing up one can argue that postgraduates are not ready to manage and organize their learning process. All this provides a challenge to the academic staff: to intensify the process of mastering pedagogical competences within the period of time proposed by the education standard.

The article describes the research aimed at various means of intensifying postgraduate pedagogical training. The theoretical background of the current research is connected with the research done by scholars in different fields of pedagogy: process intensification, educational process, in particular, (Baibakov, Lysenko and Podgorecki, 2006); pedagogical training (Adashboev and Choriev, 2015; Pukite, Pukitis and Rezeknes, 2011; Voloshina and Krysanova, 2016); postgraduate education (Fischer and Lipovská, 2015a; Fischer and Lipovská, 2015b; Harris, 2009; Johanesen, Garcia-Bustos and Wood, 2016; Torres et al., 2011); self-development (Bauer, 2009; Baumeister and Vohs, 2004; Zhou and Zhang, 2016).

The research has the following tasks:

1. to provide grounds for the number of teaching competences for a young university teacher or a postgraduate (methods: analyzing scientific literature, analyzing the requirements of modern standards for the activities of an academic staff member);
2. to provide an empirical study of the formation level of pedagogical abilities and personal qualities of postgraduates (methods: observation; the assessment and analysis of the results of educational and professional tasks);
3. to conduct the SWOT-analysis of postgraduate pedagogical training, to notify its strengths and weaknesses and find the ways and means of its intensification (Materials and Methods section).

The Results section presents the levels of postgraduates' pedagogical competences; the postgraduates with an expertise in teaching are compared to the ones having no teaching experience. The SWOT analysis of postgraduate pedagogical training helped to define the ways of its intensification. The Discussion section contains the novelty of the obtained results, their uniqueness and difference from other researchers' results, as well as the pros and cons of the suggested ways of intensification. The Conclusion section sums up the results of the current research and introduces the areas for the future investigation of the problem.

## MATERIALS AND METHODS

To search the ways for effective postgraduate pedagogical training according to the 3+ standards we have held an entry test for three years and traced the dynamics of pedagogical competence mastery. To assess the results we elaborated the components of each competence and the levels of their formation. Low, medium and high levels of competence mastery were assessed according to the criteria in Table 1. We undertook a comparative study (2014 – 2016) concerning the level of pedagogical competences mastery and its dependence upon teaching experience. The size of the sample is  $n = 203$  people. The level of pedagogical competence mastery was assessed according to the following criteria: C.1. The knowledge of basic activities of an academic staff member. C.2. The knowledge of social and psychological peculiarities of college-age youth. C.3. The ability to work out an academic plan. C.4. The ability to work out a syllabus. C.5. The ability to prepare the educational and structural materials for teaching. C. 6. The ability to work out a class according to the formulated goals (learning, education and development). C.7. The ability to choose proper methodology of teaching and appropriate aids. C.8. The ability to maintain educational and pedagogical interaction. C.9. The ability to assess the outcomes of conducting a class.

Criteria of mastery	Indicators of		
	low level	medium level	high level
Knowledge of competences	The presence of some knowledge of teaching methodology	The knowledge of teaching methods and techniques	The knowledge and some experience of applying all kinds of teaching methodology, techniques and educational material in teaching and while doing research
Abilities to apply them	The absence of any abilities to apply it	Some teaching experience	
Teaching experience	The absence of teaching experience	The ability to work out a potential syllabus (work programme), prepare a class without taking into account all the details	
Attitude to education	Not regarding education as a value or having no definite reasoning	Regarding education as a value	Positive attitude to education, regarding it as a value and defending this opinion

**Table 1: Indicators of pedagogical mastery levels**

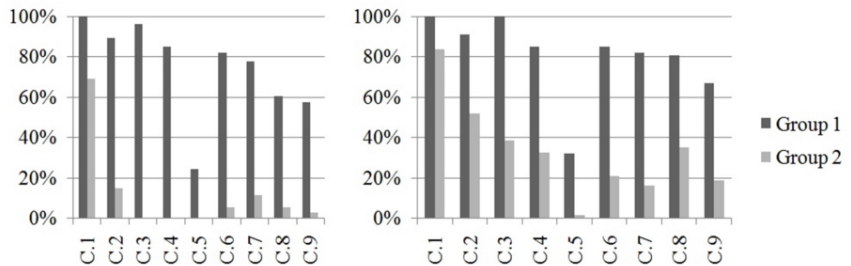
The study was performed with the use of the following methods:  
 quizzes (entrance and final) – to get the information about the teaching experience or quazi-teaching experience of postgraduates and about their attitude to teaching and readiness to start it;  
 the analysis of the essays, which contained the self-assessment results concerning the attitude of postgraduates to a teaching career, the necessity of continuous education and self-development;  
 the analysis of student tests; the tests were mainly professional not for training with the aim to use them in future professional work;  
 the SWOT analysis of postgraduate pedagogical training. The SWOT-analysis is a method of investigation in management and uses economic terms in its classical version (Kotler, Keller and Brady, 2009; Leigh, 2009). At the same time the potential of SWOT-analysis for searching the effective ways of overcoming the problem and further development is

widely used in educational sphere (Luo and Qin, 2012; Panfil, 2016). The SWOT-analysis helped to reveal the strengths and weaknesses of postgraduate pedagogical training. We have analyzed the opportunities to enhance the former and the latter level using the potential of the internal environment and the opportunities of the external one.

## RESULTS

The empirical study allowed to compare the pedagogical mastery level of postgraduates with and without teaching experience, at the beginning and at the end of pedagogical training (Fig.1). Group 1 consists of postgraduates who have a teaching experience (from 1 up to 15 years). Group 2 consists of postgraduates with no teaching experience. The study revealed that only 40.4 % of postgraduates have a teaching experience (predominantly as an academic staff member).

The diagram shows that the percentage of students of the second group who have acquired new skills has grown dramatically, while the rise in the first group was much slower since the rate was rather high from the very beginning. The students of the second group have mastered some skills they have not had before (C.3, C.4). The number of students who have acquired competences that need long training and rich experience (C.5 – C.7) is from 1 to 20 % of them.



**Figure 1: The level of pedagogical competence mastery among postgraduates with and without teaching experience at the beginning and at the end of pedagogical training (source: own calculations)**

Alongside the data concerning the levels of pedagogical competence mastery among postgraduates the results of the SWOT-analysis contributed to searching the ways of intensifying pedagogical training (Table 2).

It is possible to fight with the external threats using the advantages of organization (S–T). These include: the stabilization of pedagogical training; enhanced educational part of pedagogical training; the introduction of all academic mobility programmes held in SUSU and in the Project 5-100. The Federal Project 5-100 aims to maximize the competitive position of a group of leading Russian universities including SUSU, on the global market of education and research in accordance with the criteria of world ratings, such as Quacquarelli Symonds (QS) World University Rankings.

The use of favorable opportunities of the external environment to fight the disadvantages (O–W) includes the following: involving postgraduates in governmental and international programmes and projects. The most forward-looking are the means of internal strengthening the weak points (S–W): the use of more effective educational methods and techniques, methods of contextual learning and case-studies should be the first priority; the convergence of educational and professional processes; rationalized using of resources; the concentration on the basic elements of content of education; time and space

organization of education process using e-learning; competent management of education process.

	Strengths	Weaknesses
Internal environment	S – strengths	W – weaknesses
	<p>The correspondence of goals, tasks, content of pedagogical training to the requirements of the professional standard and FSES 3+</p> <p>The correspondence of the tasks given to postgraduates with the number of competences</p> <p>Highly-qualified academic staff</p>	<p>Theory and practice of professional education in the form of lectures</p> <p>Impossibility of immediate application of some results in teaching</p> <p>Insufficient use of material and human resources (centers, laboratories and other university units)</p> <p>The discrepancy between out-of-date methodological and didactic materials and modern components of pedagogical training</p>
External environment	O – opportunities	T – threats
	<p>Teaching as one of the main opportunities</p> <p>Grants for postgraduates</p>	<p>Insufficient financing, bureaucracy problems</p> <p>Uncertain values</p> <p>Reforming the system of higher education in Russia</p> <p>Limited academic mobility</p>

**Table 2: SWOT-analysis of postgraduate pedagogical training**

## DISCUSSION

Taking into account that postgraduates are to master the pedagogical competences within a limited amount of time fairly well, the intensification of pedagogical training was chosen as a proper means of changing the education process. Intensification here means carrying out a greater amount of work of better quality due to the improving of resources and technologies used. The principles of educational process intensification were studied by Osipov N. (2012). Scholars suggested various ways of intensification. Baibakov, Lysenko and Podgorecki (2006), as well as Shevardina (2014) consider improving the components of distance-learning as a means of intensification. Fedoruk (2005) suggests the usage of intellectual agents for the intensification of educational process. Intensive methods of learning foreign languages are well developed in Russia and implemented in education (Kitaygorodskaya, 1982). There exists research of intensifying the educational process by means of improving educational and pedagogical interaction (Kotlyarova, Volchenkova and Lelekova, 2015; Wotherspoon, 2008). Many scholars connect the intensification of an educational process with the usage of modern pedagogical technologies (Asset et al., 2015; Kokovay, 2005; Mata, Lazar, G. and Lazar, I., 2016; Moraru, 2015). In the 21<sup>st</sup> century the mutual support of formal, informal and non formal learning (Kaposta, 2014) is considered to be highly effective.

All the above-mentioned studies suggest the intensification of the educational process by means of using a certain factor. In our opinion, the intensification is achieved on the base of complex implementation of numerous factors. Basing on the results of the SWOT-analysis we revealed the intensification directions which take into account the influence of various factors simultaneously on different components of educational process and correspond to the peculiarities of a certain educational process. The intensification of educational process is achieved by means of improving each component and their rational

interaction. The ways of intensifying the postgraduate educational process revealed in this study include the following:

1. to mainstream the goals, tasks and content of postgraduate pedagogical education, bringing them into line with a variety of international, Russian, federal and university requirements;
2. to increase the information density of the classroom studies, using methods and forms enhancing and contributing to it;
3. to create the electronic information environment, which provides the variability and abundance of information, the opportunity to choose the educational material and trajectories individually; transition to blended learning;
4. to synthesize educational and pedagogical processes.

## **CONCLUSION**

Postgraduates of non-pedagogical areas of research have no (or minimum) prior pedagogical training. At the same time, according to FSES 3+ they must demonstrate a relatively high level of pedagogical competence mastery as they are viewed as prospective academic staff members. However the share of pedagogical training in their academic plan does not allow to master the necessary competences. As far as it is impossible to deviate from the educational standard the solution to the problem can be found only in the intensification of pedagogical training.

The research defined the insufficient or ineffective pedagogical competences, strengths and weaknesses, threats and opportunities of postgraduate pedagogical training and has revealed the possible ways of its intensification. We suggested the main directions of intensification: mainstreaming the goals and content of pedagogical training according to the modern international and Russian requirements; the creation of saturated and available educational electronic environment for the courses “The theory and methodology of professional education” and “Pedagogical training” and their transition to blended learning; the highlighting of the core components of all modules and their presentation and discussion during classroom studies; the synthesis of educational process with the elements of professional pedagogical process.

The scientific supposition regarding the design and realization of educational process can serve the grounds for planning and implementing the next stage of the investigation: working out the model of intensive postgraduate pedagogical training and its approbation.

## **ACKNOWLEDGEMENTS**

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# TEXT MINING ANALYSIS OF FUTURE TEACHERS' SELF-REFLECTION: GENDER CLASSIFICATION

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## ABSTRACT

The paper deals with gender differences in the self-reflection of future teachers. The self-reflective essays of 67 students of a master degree program (52 females and 16 males) at Department of Economic Teaching Methodology (University of Economics in Prague) were analysed by way of classification and regression trees (CARTs). This text mining method was used to a determination whether the self-reflection was written by a male or a female. From this analysis, mainly expressions describing personality traits and characteristic were selected to derive information about gender particularity in the way of self-perception and self-presentation. On the basis of the results, the authors suggest recommendations for the professional and personal development in the education of future teachers.

## KEYWORDS

Classification and Regression Trees (CARTs), Personality of Prospective Teacher, Self-reflection, Social Skills, Teachers' Education, Term-document Matrix

## INTRODUCTION

The personality of a teacher is one of the crucial factors that significantly influences efficiency and moral dimension of education. Educational psychology offers a lot of approaches to the categorization of teachers' professional skills (Sternberg and Horvath, 1995; Kyriacou, 1998; Gillernová, 2008) as well as many diagnostic tools to assess teachers' personal traits and attitudes (Fontana, 1995). Despite differences of cited approaches to the categorization of teachers' professional skills, they have some united features. Apart from other similarities, all of the theories emphasise self-reflection as an important part of diagnostic skills (Gillernová, 2008) or evaluative processes (Kyriacou, 1998) of an expert teacher (Sternberg and Horvath, 1995).

The self-reflective or auto-diagnostic skills could be defined as the teachers' ability to understand their personalities, recognise their weaknesses as well as strengths that help them to develop a high level of self-awareness (Zeren, 2012). Moreover, 'teachers with a high degree of self-awareness are expected to be more understanding towards their students because understanding others requires one to understand herself first' (Zeren, 2012: 2445). Švarcová (2010) defines the self-reflection ability as a crucial part of social intelligence: 'The social intelligence might be divided into two types: interpersonal intelligence, which means the ability to act with others, to perceive the needs of others, to emphasize easily with others, and intrapersonal intelligence, which refers to the self-reflective capacities, understanding of the self and own behavior and the skill to take control of it' (Švarcová, 2010: 41). The ability of self-reflection is strongly connected

with self-perception (Hayes, 1993) and with the level of self-efficacy (Bandura, 1977) that influence level of goals that people set themselves and their persistence in face of obstacles and complications.

Many authors note that intentional and systematic self-reflection should be part of teachers' initial training (Caires, Almeida and Vieira, 2012; Furlong, 2013; Sternberg et al., 2014; Lamote and Engels, 2010) mainly because 'in terms of professional development, teachers' ability to understand themselves and to have awareness of their inner selves may affect their attitudes and behaviors towards their students' (Zeren, 2012: 2445). This tendency is in correspondence with contemporary emphasis on the enrichment of social skills in teachers' education and on social support of initial teachers (Caires, Almeida and Vieira, 2012; Meristo, Ljalikovab and Löfström, 2013; Gillernová, 2008). Self-reflection is also investigated by pupils and students in correspondence with a contemporary trend to develop these skills in educational processes (e.g. Freddano, Siri, 2012; Körpülü, 2012). Well-developed auto-diagnostic competencies by teachers represent an inevitable condition for mediation self-reflective processes to their students.

Incorporating of self-reflection into the pre-gradual preparation of teachers is subject to several studies (Mogonea and Mogonea, 2013; Majzub, 2013; Zeren, 2012). Mogonea and Mogonea (2013) investigated a role of metacognitive skills in the process of self-reflection. They found out that enrichment of those skills complete with frequent use of self-evaluation significantly improve self-reflective skills of future teachers. Majzub (2013) proves that writing of self-reflective reports significantly influences awareness of professional skills of initial teachers.

Self-reflective processes are inseparably connected with issues of professional and personal identity. According to research studies, the professional identity of an initial teacher is markedly influenced by the social environment on the workplace (Meristo, Ljalikovab and Löfström, 2013) and significantly develops with increasing length of teachers' career (Lamote and Engels, 2010). Teachers' perception of self in role of a teacher is determined by his/her practical theory of teaching and idealised identities in a role of a teacher, perceived as 'a teacher I wish to be' (Furlong, 2013; Sternberg et al., 2014). Sociocultural development of a country also plays an important role in forming of professional identity. Furlong (2013) proves the importance of the traditional concept of a teacher in idealised identities of student teachers in Ireland.

According to some studies, self-perception of teachers' identity is also influenced by a gender. Caires, Almeida and Vieira (2012) note better adjustment to the teaching practice by males than by females who suffered more sleeping and eating problems and generally demonstrated a higher level of stress than males. Lamote and Engels (2010) researched development of professional identity by teachers and noticed a difference in preferences. Male student teachers consider a discipline in the classroom as important, whereas female respondents focused more on the involvement of their students.

Self-reflection of teachers and students can be expressed in a text form. Nowadays text-mining and ancillary data mining techniques are very often used to analyse text documents (Lin, Hsieh and Chuang, 2009). There are even some pedagogical experiments, where text-mining techniques are used as an analytical tool (Horakova and Rydval, 2015; Poole, 2016). Text mining techniques are also used for example for mining sentiments of teaching evaluation (Leong, Lee, and Mak, 2012), to characterize patterns of teachers' narratives and value-added patterns (Cavicchiolo, Alivernini, and Manganelli, 2015), or for representations of study and students' academic motivation (Alivernini et al., 2015). Text and data mining techniques can be used as a tool for gender identity, e.g. Bamman,

Eisenstein, and Schnoebelen (2014) analyse gender identity based on young persons' textual expression on some social networks.

The paper follows up on the previous study (Krejčová, 2015) that marked possible gender differences in self-assessment of student teachers. The aim of the current paper is to specify this finding by using of quantitative methods and to conclude suggestions for an education of future teachers.

## **MATERIALS AND METHODS**

We applied the text mining method on essays of students who were asked to write an essay called 'Why am I supposed to be a good teacher' as a part of their assessment in a course of Educational Psychology. They were told to summarise their characteristic that would help them to manage the profession of a teacher. In correspondence with the theory of positive psychology (Seligman, 2004), the students should describe positive characteristic. They could mention their negative characteristics as well, but they should suggest some possibilities how to improve themselves in those areas (some kind of intervention, time-management, relaxation etc.).

A sample size was 67 students of a master degree program (52 females and 16 males). A desiderative length of the essay was two standard pages and students had approximately three months for writing this essay.

### **Statistical Analysis**

First, a text-mining analysis was used in the context of data mining techniques. Term document matrix (e.g. Lin, Hsieh and Chuang (2009)) for selected word classes that appeared in analysed documents was created. Term documents matrix consists of all nouns, adjectives, verbs and adverbs (as Tang and Cao, 2015). Further, the relevant terms were filtered in terms of significance for self-reflection in educational practice. At the same time, synonyms have been defined, it means that synonyms were considered as one term in the further classification analysis.

Subsequently, the CARTs were used (Rokach and Maimon, 2014). CARTs are included in the software Statistica as data mining tools. The goal was to determine whether self-reflection of future teachers was written by a male or a female. Several CARTs with a different number of terminal and non-terminal nodes were generated. For the purposes of this article, the CART with 13 terminal and 12 non-terminal nodes was chosen (see Figure 1). Moreover, the graph of term importance was created for this classification, which served as discriminatory variables (Rokach and Maimon, 2014). The classification accuracy and purity of each node were also observed (Du et al., 2011). Prediction of the text style based on the occurrence of words and assigning the text to gender or to a particular author is commonly used in stylometry (Kestemont et al., 2016). Even some authors have created an automatic software that with some degree of accuracy classifies whether the text was created by a male or a female (Tang and Cao, 2015).

## **RESULTS**

Decision classification tree (Figure 1) has 12 non-terminal and 13 terminal nodes. Based on the occurrence of terms in the self-reflection text of we can assign if the document was written by a female (f) or a male (m). We have to start from the first node. The first classification variable is the word *games* if it occurs more than 1.5 times in one document, so the document was written by a male (m). If a word *game* in the document occurs less than 1.5 times, then we have to observe another classification variable, ie. *feeling*. If the

word *feeling* occurs more than 2.5 times in the document, so the document was written by a male (m). Then another classification variable is word *negative*. If a word *negative* occurs less than 0.5 times, the document was written by a male; if it occurs more than 0.5 times, the document was written by a female (f). If the word *feeling* occurs less than 2.5 times in the document, then another classification variable is a word *listening*. If a word *listening* occurs more than 1.5 times, then we have to observe another classification variable, ie. *pedagogical*. If the word *pedagogical* occurs more than 0.5 times in the document, so the document was written by a female (f). If the word *pedagogical* occurs less than 0.5 times, so the document was written by a male (m). If a word *listening* occurs less than 1.5 times, then we have to observe another classification variable, ie. *faults*. This procedure is applied till the final terminal node. CART split classification variables are words: *games, feeling, negative, listening, pedagogical, faults, evaluation, aim, planning, feeling, be unable, shortcoming*.

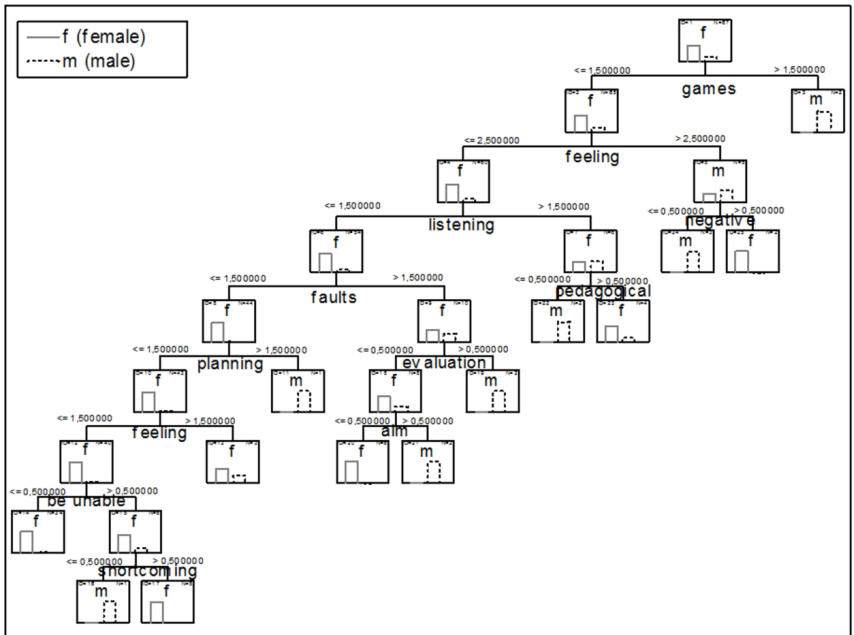


Figure 1: Tree graph for dependent variable: Gender

## DISCUSSION

Despite the small size of the sample and certain gender imbalance of our respondents (that approximately replicates real gender proportion of students at Department of Economic Teaching Methodology), we found out remarkable gender differences in self-reflective processes of future teachers. If we consider words that were determining for males (in combination with using of other expressions, see Figure 1), we find e.g. the words “games”, “planning” and “aim” (by expressions “planning” and “aim” we have to consider a constellation of other words in non-terminal nodes above these expressions), whereas expressions (“feeling”, “listening”) are more determining for females (see Figure 1). These finding could be related to personal traits that are typical for males and females.

In the study of Arif et al. (2012) that measured the Big five personality traits of future teachers at teacher education institutes of Punjab, Agreeableness (characterized as ‘Co-operative, worm caring, good-natured, Courteous trusting’ (Arif et al., 2012: 163) was significantly higher in females than in males.

Additionally, the classification tree shows the remarkable tendency of female-specific expressions. The adjective “negative” in combination with “feeling” is typical for females, as well as a combination of “shortcoming”, “be unable” with “feeling”. Despite this finding requires deeper analysis, it could be related to females tendency to underestimating of themselves, that is subject of many gender-related studies (e.g. Robins, Hendin and Trzesniewski, 2001).

## CONCLUSION

Responsible education of future teachers should include the development of professional skills, but also an enrichment of their personal growth. Despite our findings require further analysis, the study proved that there are specific gender differences in the way of self-perception that could be reflected in the professional training of future teachers. The education of male teachers should support their creativity and openness, but it should aim also at the development of their social skills (active listening, empathy etc.) because they are crucial for efficient work of a teacher (Gillernová, 2008). The education of female teachers should be orientated on work with their self-concept that would prevent underestimation. These tendencies would help to the more complex education of future teachers that would enrich not only their professional skills but their personalities as well.

## ACKNOWLEDGEMENTS

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# ACT AS A@: COULD THE STRUCTURE BEAT THE PITFALLS?

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## ABSTRACT

This contribution proposes a modification of a managerial game, Act As A, by introducing elements of project management, which is used within the Entrepreneurial Skills course at the Faculty of Economics and Management, CULS Prague. In the original version of the game, deficiencies in communication of players were observed that were reflected in the lack of analysis of the selected project from the perspective of the fundamental project limitations in terms of time, cost, performance/scope, as well as in the lack of attention paid to the selection of the project team. For this reason, the game was developed by introducing further gaming elements in the form of four playing cards, which should help structure better the communication in order for it to follow all kinds of basic constraints of the project. To create additional gaming elements, Project Management Triangle, Triple C Model, and 5-M Method were used.

## KEYWORDS

Communication, Experiential Exercise, Game, Project Management

## INTRODUCTION

Zulch (2014) mentions communication as the cornerstone of project management, which is necessary for successful project management and connection of all dimensions of the project in terms of cost, scope and time. Braun and Avital (2007) even state that it is one of the most critical skills of a project manager, which affects whether or not a project is to be successful. The importance of communication for successful project management is also confirmed by Andrew, Janardhanan and Kinslin (2016), Gillard and Johansen (2004), Ahimbisibwe and Nangoli (2012), PMI (2013) and many others.

Braun and Avital (2007) see the benefits of communication in good quality communication procedures within project management, which increase social accountability of the project team members and (communication) thus positively affects the results of the project. In contrast, Andrew, Janardhanan and Kinslin (2016) found that the conflicts caused by improper or inadequate communication affect the desired project objective in a negative way. The result of their study is the identified communication issues between various team members, which affect the level of achievement of the objectives in project management organization. At the same time, the authors also found that it is necessary to improve some of the communication skills of managers who believe that they are not supported by their team, are not understood, act authoritatively and trust their team less.

Communication skills of individuals are an integral part of a good communication plan in, which the framework for the project communication is set up. This plan includes communication methods and tools for successful communication in various stages of the project. As found by Samáková, Šujanová and Koltnerová (2013) 66% out of 85 evaluated



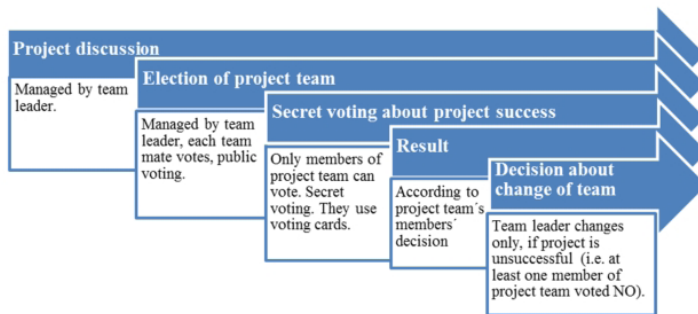
companies did not have available any methodology, document or procedural steps to manage project communication despite the fact that 74% of the issues in the project are caused by communication (Komi-Sirviö and Tihinen, 2005). The environment, where the framework for the project communication is set up and works, increases the likelihood of the exchange of information among individual team members, sharing of knowledge and increases the need for individual study (Braun and Avital, 2007).

An essential part of ensuring a successful achievement of the project objective is both a good communication plan and adequate communication skills of individual members of the project team. As reported by Kampf and Berggreen (2016) both communication and project management processes can be practised for example within the training courses or, as Silvius (2016) pointed out, even using project management smartphone apps, which, however, lack the possibility of communication/collaboration with the project sponsor or other stakeholders. This deficiency can be eliminated, according to Sullivan (1993), by using the role-play team-project approach when teaching project communication skills. Within the role-play team-project approach, students gain hands-on experience in project management, which leads to strengthening of communication skills (Sullivan, 1993). This approach to teaching is used also by Švec (2013) who teaches and trains ways of communicating with individual team members within the Act As A® (AAA) game. However, in its current form, the Act As A® game does not include the basic concept of the project from the perspective of all three most important aspects/limitations as cost, time, and performance (Švec, 2013).

Designing the appropriate use or, potentially, extension of the Act As A® game that would ensure that students both master communication and adopt the basic principles of project management is therefore the key objective of this contribution. The text is structured as follows: in the Materials and Methods is the description of game context, previous research's results, and methods used for the extension's proposal. There is descriptive output of our observation in the Result's part. The Discussion is divided to explanation of link between theory and suggestions, suggested changes, and their possible impact.

## **MATERIALS AND METHODS**

To fulfil the specified target, we identified, by observing the already played Act As A® (AAA) games, the pitfalls in the behaviour of individual participants. The AAA is the experiential exercise in which students play hidden roles. Twelve players (optimally) are in role of team mates who cooperate on management of several projects. Two basic types of team mates (hidden roles) are in the game: workhorses and loafers. The aim of the game is to successfully finish (for workhorses) or disrupt (for loafers) managing/finishing of three projects. (Švec, 2013) The gameplay is divided to roles' lottery (players obtain hidden roles), game rounds (where there might be from three to five rounds), and principals discovery (debate after game). (Švec, 2013) During each round there are phases as shown in the Figure 1.



**Figure 1: Phases repeated in each game round (Švec, 2013)**

What was used for observation were fifteen already played Act As A ® games in the total length of 22.5 hours. The games were played between 2014-2016 with the 5th grade students of the Faculty of Economics and Management of CULS Prague. Variable number of participant (from 6 to 12) were included in these games. In total, we observe 125 students whose games were analysed. The course of each game was recorded on video, so it was possible to identify individual repetitive errors even with hindsight. Using the methods of classification, we assigned the identified pitfalls to situations of key importance for further developments in the game (see Table 1). Then, using brainstorming, we suggested possible extensions of the game, potentially leading to improved performance in the context of the project management in the game. To achieve the desired state in the game, we used, as the basis for a potential extension, procedures and techniques of the Project Management Triangle, Triple C, Fishbone Diagram and 5-M Method.

## RESULTS

Based on our observations, we have identified pitfalls regarding five key situations. We can see the detailed summary of expected behaviour and pitfalls in Table 1.

Key situations one and two (in Table 1) are, in the original version of the game, left up to the students. However, in the practice of project management, they are, in most cases, stipulated for the project team by the company's management. Based on our observations of key situation one, in the moment of decision-making about future team leader students are clueless. In most observed cases, the constructive debate was completely missing or replaced by inadequate selection criteria. The main purpose of such evasive manoeuvres was to get rid of responsibility and fear of unfamiliar situations. As we found out later, during after each game debate, almost 90% of students have never been in the team leader position (we do not take in account school teams, where the team roles are not set up and responsibilities are not firmly specified). During key situation two (project proposal), we experienced students to show more creativity, decisiveness, and leadership than we expected according to previous key situation. On the other hand, there were groups which were unable to come up with its own idea and needed facilitator's help. But both approaches of projects' proposals proved to be too time-consuming as they took from 10 to 15 minutes each round (about 80% of the whole time for one game round).

The third key situation is the most important situation in the game. Students have the possibility for comparison with others in very specific situation and from many points of view via communication. They can compare how they react, speak, present themselves, think, make decisions, lead the others, manipulate, or make results about each other,

follow the decisions made by colleagues, and most importantly to make results about their own behavior and quality of own decision-making. ‘The most important result of the game lies in the possibility of student to take a lesson and to improve himself/herself to his/her desired result’ (Švec, 2013: 608). Unfortunately, students often miss the aim of communication and if not they lack the structure of communication. The role of team leader in such moment is to bring the discussion back on topic. According to our observations team leaders fail in this activity. Also, as we see this situation as the most important in the game, the time students spent in this phase of game very differ (from 3 to 10 minutes each round). But when they lose aim and structure, just the effort (or time spent) is not enough to understand the game and reveal who the loafer is.

No.	Key situation	Students expected behaviour	Pitfall
1	<b>Team leader election</b>	Students will vote the most suitable candidate after the short discussion.	Students resolve the situation as soon as they can. The first reason why to choose anyone as leader is the ‘proper’ one. Students do not show any skill. They are not used to discuss about issues, to show publicly any skill they possess. Students do not want to take the responsibility for the process. Students fear the unknown situation.
2	<b>Project proposal</b>	Team leader proposes interesting project.	Students propose projects interesting only for them. Students are not able to propose any project at all.
3	<b>Project discussion</b>	Team leader will manage discussion; stick the topic within the aim to find the members for project team. Team mates will try to present themselves as optimal candidates for project team.	Students were confronted with a new situation – discussion among students in front of teacher. Students do not debate, think critically, present their opinions, and make decisions. Students lack any communication plan or structure, they communicate randomly. Students do not focus on project’s priorities (objectives, resources, etc.).
4	<b>Project team members election</b>	Team leader calls vote. All team mates vote according to his/her role and intentions in the game.	Some students do not engage in the debate. Some students vote just without any specific reason, as there was no proper discussion before. Students do not realize the project management resources’ aspect.
5	<b>Result</b>	Team leader announces results. Each team mate makes its own conclusions.	Students do not follow the development of the game, the arguments of the others, and the results of projects. Therefore, they are not able to evaluate resources and make proper decision. Students are not able to take the basic principles of activity, assertiveness, and awareness away on their own from the game.

**Table 1: Students’ pitfalls in the game**

The fourth and fifth key project situations are included in the game for didactic and gaming purposes and both are dependent on the previous key situation. The fourth key situation

has its own direct impact on the game and decision making of players and there are only two states, which may occur via secret voting: win or lose (depending on team members' voting). During the observations in the fifth key situation, we identified following rule: the more time and effort students put to the communication in the third key situation, the better were they able to gain the experience in and information about the game principals. But in the moment, the imperfections appear in the third key situation, the fifth key situation is corrupted, and the students' take away effect of the game is in the danger.

## **DISCUSSION**

The common element of pitfalls in all key situations is the absence or insufficient level of communication. Therefore, there is a visible effect of failure of projects due to poor communication, in the same way as indicated for example by Andrew, Janardhanan and Kinslin (2016), Braun and Avital (2007) and Zulch (2014). Based on the analysis of played AAA games, communication among the participants in the game is not sufficiently structured and ignores the principles of project management. It is also clear, see Figure 1, that in its current form, the Act As A® game does not include the basic concept of the project from the perspective of all three most important aspects/limitations (cost, time and performance).

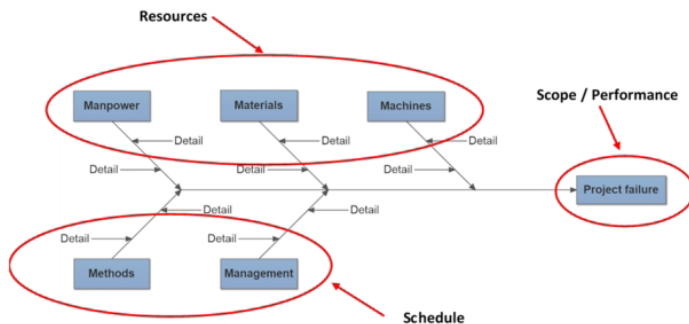
Also from the pitfalls in the third key situation (in Table 1), it is evident that, in the case of a discussion over the project solution, it would be practical to use preformed structure, which is logically related to the solved project. Nevertheless, we expect that the change set out in key situation 3 will stimulate a greater number of associations given by the deeper structure of communication about the project. This should also positively affect the involvement of students in the project/game during the fourth and fifth key situations.

### **The Link between Theory and Suggestions**

From the observations, it ensues, that the participants in the game may have difficulty with following the fulfilment of the project's structure or rather with what and how to ask. To deal with the preformed structure of communication in team we first follow the concept of project management in terms of the 5-M method. According to Andersen and Fagerhaug (2006) 5-M method is a simple method of analysing the causes and consequences (problems) based on five causes: Manpower, Machines, Materials, Methods, and Management. Unfortunately, this approach, even structured, would be still inappropriate for the experience level the game is played on and would lead to the possible confusion of the players. The same opinion shares Dale et al. (2007), who says that for the use of 5-M method is recommended that the appropriate graphical tool 1) to be effective in management, 2) to structure communication well, and 3) does not forget any key aspect. As Ishikawa's Fishbone diagram is suitable for analysing, identifying, sorting and displaying possible causes of a problem or quality characteristics (Ishikawa, 1991), we group possible causes of project failure based on pitfalls identified in Table 1. Using this diagram (in Figure 2) allows us to construct and structure a pictorial display of a list of causes and their relationship to a specific effect (Dobruskin, 2016; Liu et al., 2016; Sarazen, 1990).

We also seek to ensure students to understand the logic of resource use while working in a team. Therefore, the proposed extension of the AAA game will aim at the identification of problematic parts of the project (costs, performance, time). These parts of the project often deal with the Project Management Triangle. It is a graphic tool where the three main parameters (attributes) are displayed on the corners of the triangle to show the mutual

opposition of these three project’s attributes. Traditionally, these constraints have been listed as “scope” or “performance” (features and quality of the project), “time” and “cost” (Turner, 2016; Dobson, 2004, Lock, 2007). The triangle form of these three attributes expresses their interdependency. Changing one of the parameters leads to a change of at least one other (for more see Kerzner, 2013: 5, 8 or Doležal et al., 2012: 66). If we want to use the project management triangle’s point of view in project communication and for project communication improvement it is appropriate to extend the view by a Triple C model. According to Badiru (2008) the Triple C model is an effective project planning and control tool. The model enables enhancement of the project management triangle by implementing and integrating functions summarized as: Cooperation, Coordination, Communication (Badiru, 2008). Since the AAA game is significantly built on communication and the set goal to achieve success within the project, it is important to mention that the Project Management Triangle and the Triple C model are closely related to each other. Individual project constraints: time, cost and performance can be properly managed only by effective communication, cooperation and coordination. Figure 2 shows grouped causes of project failures in the game Act As A® in the mutual form of 5-M method and Project Management Triangle with Triple C model.



**Figure 2: Fishbone Diagram with 5-M mapped over triple constraints**

We propose to extend the game with the elements of the project approach, taking into account individual aspects of the Triple Constraints model from, which it is possible to acquire the structure of the communication framework, which would make it possible for the participants to be more consistent in solving the assigned project. The didactic impact would improve analytical skills and practical adoption of the Project Triple Constraints Focus – thinking about the objective, required resources, time constraints, manners of utilization, alternative solutions, decisions, etc. Game participants should thus gain a basic idea about what they should focus on in communication concerning the project.

### Suggested Changes

The proposal, based on a combination of approaches to project management and, at the same time, respectful to the course, time demands and complexity of the existing Act As A® game, consists in four cards that will assist the team leader during communication – see Figure 3.

	CARD 1	CARD 2	CARD 3	CARD 4
	What do we need to the project realization?	How to realize the project?	When will we complete the project?	Who will be on the project team?
Do you know?	Advice	Advice	Advice	Advice
<b>YES:</b> Move to the next card. <b>NO:</b> Use gradually pieces of advice 1, 2 and 3.	1 Ask the team.	1 Ask the team.	1 Ask the team.	1 Ask the team.
	2 Ask the members who have been silent.	2 Ask the members who have been silent.	2 Ask the members who have been silent.	2 Ask the members who have been silent.
	3 Take responsibility for yourself and decide what to do next.	3 Take responsibility for yourself and decide what to do next.	3 Take responsibility for yourself and decide what to do next.	3 Take responsibility for yourself and decide what to do next.

**Figure 3: A proposed card for structured communication of the team leader**

All cards will be separated, designed only to be used by the player in the role of the team leader. The player (team leader) will browse through them gradually and decide by himself what response or rather what advice to choose. Along with this extension it would be possible to monitor more profoundly the players' ability to communicate and make independent decisions.

### Presumed Impact of Suggested Changes

We assume individual cards will guide the team leader, in a simple way, through the basic structure of the debate on the project in terms of:

- resources – see the question (Figure 2, Card 1): “What do we need to implement the project?” after which we expect a debate on the resources necessary to achieve the project objectives.
- activities – see the question (Figure 2, Card 2): “By what activities do we implement the project?” after which we expect a debate on project activities and their links to resources.
- time – see the question (Figure 2, Card 3): “When will we complete the project?” in which we assume the estimate of the period and the possible connections with the previous questions.
- people – see the question (Figure 2, Card 4): “Who will be on the project team?” after which we expect a discussion to develop on the composition of the project team (part of the existing version of the game).

Questions in the header of the cards refer to a simplified structure of the project, which aims at showing students in practical situations that it is necessary to know the general structure/break-down of the project to be able to properly assign individual resources and activities. Each card also includes a set of the same pieces of advice that the team leader can use in the case the response is not known (see Figure 3):

- “Ask the team.” – By this question, we teach students that the work on the project is the work of a team and not individual work. The responsibility for the project is transferred to all team members, it is not only the team leader who is responsible.
- “Ask members who have been silent.” – In the game, not always all students get involved in the debate. Mostly it helps if they are directly invited to do so by the team leader. Getting involve in the debate we get three benefits 1) the responsibility

is transferred to the whole team, 2) fair environment it set up and 3) students learn, based on an example, to gain information also from their silent colleagues.

- “Take responsibility for yourself and decide what to do next.” – In the game, it may happen that despite the involvement of the team, the team leader will not have a clear viewpoint or 100% of the information in order to make decision based on conditions close to the certainty. In this case, it is necessary to learn to distinguish when it is appropriate to transfer the responsibility to the team and when to take the responsibility yourself.

## CONCLUSION

The Act As A® game is an experiential exercise aimed at the development of three basic team competencies: activity, assertiveness and awareness (Švec, 2013). When incorporating the proposed extension of the game (in the form of 4 cards) basic principles of project management will be used and the opportunity to follow more profoundly in the players with the roles of team leaders their ability to communicate and make independent decisions. Following up on the proposal to extend the game, despite all the considerations using theoretical approaches to project management, the next logical step is a test of the extension of the game in practice, including subsequent evaluation and, if necessary, modifications.

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# OPEN DATA, LINKED DATA AND THE SEMANTIC WEB IN EDUCATION AT THE FIS UEP

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## ABSTRACT

Open Data refers to machine-readable data shared on the Web for re-use. Due to its open nature Open Data could act as an educational resource that is accessible to teachers and students without unnecessary barriers and that can be freely redistributed or modified to fit the purposes of the educational process. In this paper we discuss how an open dataset was re-used as Open Educational Resource in the SPARQLab application and we also present results of an analysis of the final theses dealing with Open Data, Linked Data and the Semantic Web defended at the Faculty of Informatics and Statistics of the University of Economics, Prague.

## KEYWORDS

Linked Open Data, Open Educational Resource, SPARQLab, University of Economics Prague

## INTRODUCTION

According to Open Knowledge (n.d. b) Open Data could be defined as “*data that can be freely used, re-used and redistributed by anyone - subject only, at most, to the requirement to attribute and sharealike*”. There are two important dimensions of openness in Open Data – legal openness and technical openness (Open Knowledge, n.d. a). Legal openness refers to the open licencing of data which ensures that users of the data are allowed to re-use it and redistribute it. Technical openness aims at reducing the technical barriers to re-use of the data. Therefore Open Data should be available for download in a machine-readable format and preferably in bulk (Open Knowledge, n.d. a).

Berners-Lee (2006) suggested a 5-star deployment scheme for Open Data which classifies open datasets into five levels according to the type of the data format. The topmost level of this scheme is represented by Linked Open Data, i.e. data that not only conforms to the definition of Open Data but that also follows the Linked Data principles. According to Bizer at al. (2009) Linked Data is a set of practices for publishing structured data on the Web that enables connecting related data with typed links and it is seen as a way to develop the Semantic Web. The principles of Linked Data are following (Berners-Lee, 2006):

1. Use URIs as names for things.
2. Use HTTP URIs so that people can look up those names.
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL).

4. Include links to other URIs so that they can discover more things.

Re-use of Open Data could bring various benefits such as economic value, increased transparency or stimulation of innovations (Janssen et al., 2012; Jetzek et al., 2014). Data transparency is considered as a key aspect of Open Government (Lee and Kwak, 2011) and therefore Open Data is seen as one of the enablers of this movement (Bauer and Kaltenböck, 2012). In the European Union re-use of data held by public sector bodies is harmonized by the PSI (public sector information) directive (European Commission, 2003). Janssen (2011) pointed out that despite the fact that Open Data and PSI are different concepts, Open Data could contribute to the reduction of barriers to the re-use of the public sector information.

Manyika et al. (2013) argue that in the domain of education use of Open Data could help to improve the effectiveness of teaching because it can help to identify tools and strategies for effective teaching of specific knowledge and skills. Data about performance of schools could also help students and teachers to make more informed decisions.

According to Atkins et al. (2007) Open Educational Resources (OER) are “*teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others*”. Even broader definition of OER was proposed by Tuomi (2013) who defines OER as “*accumulated assets that are available in a non-discriminatory way to educators, students and self-learners for learning and education*”. With regards to the relationship between Open Data and OER Atenas and Havemann (2015) point out that Open Data is not always OER, but that it becomes OER when used within pedagogical context and they present a set of case studies that illustrate how Open Data could be used as OER. Atenas and Havemann (2015) also argue that this use of Open Data appears to be “*under-discussed*”.

Faculty of Informatics and Statistics of the University of Economics, Prague (FIS UEP) has been conducting research in the domains of Open Data, Linked Data and the Semantic Web and it has been involved in several related research projects such as LOD2<sup>1</sup>, Share-PSI 2.0<sup>2</sup> or OpenBudgets.eu<sup>3</sup>. FIS UEP has also been collaborating with the Czech public sector organizations on Open Data related activities. For example it helped the Czech Telecommunication Office<sup>4</sup> to launch its Open Data initiative (Czech Telecommunication Office, 2013) or it supported the Czech Social Security Administration (CSSA)<sup>5</sup> in publishing of its data as Linked Open Data (University of Economics, Prague, 2016).

In this paper we would like to show that the FIS UEP is not only involved in research and practical activities in the domains of Open Data, Linked Data and the Semantic Web but that these topic are also present in the education at FIS UEP. Therefore we present results of an analysis of the final theses defended at the FIS UEP that dealt with these topics. We would also like to contribute to the discussion about use of Open Data as OER by introducing SPARQLab<sup>6</sup>, a SPARQL training application developed at the FIS UEP which utilizes one of the open datasets published by the Czech Social Security Administration.

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1 <http://lod2.eu>  
2 <https://www.w3.org/2013/share-psi/>  
3 <http://openbudgets.eu/>  
4 <https://www.ctu.eu/>  
5 <http://www.cssz.cz/en/about-cssa/>  
6 <http://doc.lmcloud.vse.cz/sparqlab>

## MATERIALS AND METHODS

Analysis of the final theses defended at the FIS UEP is based on the data obtained from the Integrated Study Information System (InSIS) of the UEP<sup>7</sup>. InSIS provides access to the electronic archive of the final theses. This archive was searched for final theses related to Open Data, Linked Data or the Semantic Web. Full-text search was utilized with the terms “Open Data”, “Linked Data” and “Semantic Web” as the keywords. Czech equivalents of these keywords were used as well.

Due to the limited functionality of the full-text search provided by the InSIS the archive was searched individually with each of the keywords. Results obtained from the individual searches were then combined into a single dataset. Because some of the theses were retrieved multiple times as results corresponding to multiple keywords, duplicate records were removed as a subsequent step. Resulting list of the final theses was verified by checking abstracts and keywords of the theses. As a result of this verification some of the theses were considered as not relevant and therefore they were excluded from the analysis. The analysis was limited to the successfully defended theses. Theses that are currently being written as well as theses of the students with an improperly completed study, e.g. students that were not able to meet all of the obligations of the study curricula, were also excluded from the analysis.

## RESULTS

### Open Data, Linked Data and the Semantic Web as topics of the final theses

Between the years 2006 and 2016 a total number of 51 final theses were successfully defended at the FIS UEP that were supervised by 19 members of three FIS UEP departments, namely the Department of Information Technologies, the Department of Information and Knowledge Engineering and the Department of Systems Analysis. Table 1 summarizes number of final theses by category (bachelor thesis, master thesis, dissertation thesis) and year.

Thesis category / Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Bachelor thesis	0	0	2	3	1	2	0	1	1	5	5	20
Master thesis	0	0	0	1	2	2	3	3	7	8	2	28
Dissertation thesis	1	0	0	0	0	1	0	0	1	0	0	3
Total	1	0	2	4	3	5	3	4	9	13	7	51

**Table 1: Successfully defended final theses by category and year**

Distribution of topics of the successfully defended final theses by year is presented in table 2. One thesis could correspond to more than one topic. Therefore the presented values should be interpreted as occurrences of the topics and not as number of theses. Final theses were classified with the topics according to the search results, i.e. a thesis was classified with a topic if it was retrieved as a results of search with the corresponding key word.

Topic / Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Open Data	0	0	0	0	0	0	1	1	7	9	4	22
Linked Data	0	0	0	0	1	1	0	1	7	7	2	19
Semantic Web	1	0	2	4	2	4	2	2	0	3	3	23

**Table 2: Distribution of topics of the successfully defended final theses by year**

## **SPARQLab – a SPARQL training application**

HTTP Uniform Resource Identifiers (URIs) and the Resource Description Framework (RDF) are the core technical standards of Linked Data (Bizer, 2009; Heath, 2011). RDF is a framework for representing information about resources in a form of subject-predicate-object statements (Schreiber and Raimond, 2014). SPARQL is a query language for data in RDF (Harris and Seaborne, 2013).

4IZ440 – Linked data on the web<sup>8</sup> is a course at the FIS UEP that is dedicated to the semantic technologies, Linked Data and the related concepts including RDF and SPARQL. In order to help the students of this course, the SPARQLab application has been developed. SPARQLab is a web-based SPARQL training application that lets its users to test and improve their SPARQL skills by completing a set of exercises. SPARQL queries entered by the users as solutions to the exercises are automatically evaluated and users could also opt to have the correct answer displayed. Access to the application is not restricted to the students of the abovementioned course and therefore anyone interested in learning SPARQL can use this application.

Czech Social Security Administration has been publishing its data as Linked Open Data in RDF via its Open Data portal<sup>9</sup> since November 2015 (Czech Social Security Administration, 2015). This provided an opportunity to use a real-world dataset for the exercises in SPARQLab. It was decided to use a dataset about number of pensioners distributed according to gender, average amount of pension and average age<sup>10</sup> as it is one of the largest datasets provided by the CSSA with a geographical breakdown of the data down to the level of districts and thus it allowed a wide range of exercises to be prepared. In 2016 SPARQLab was awarded with the Red Hat Award for the best student application in the Czech Open Data challenge ‘Opening up data together’ (Otakar Motejl Fund, 2016).

## **DISCUSSION**

### **Open Data, Linked Data and the Semantic Web as topics of the final theses**

Berners-Lee et al. (1994) proposed an evolution of the Web from human-readable documents towards machine-readable semantic information back in the first half of the 1990s. The Semantic Web has been discussed since 2001 (Calaresu and Shiri, 2015). Berners-Lee proposed the Linked Data principles in 2006 (Berners-Lee, 2006). According to Bauer and Kaltenböck (2012) Open Data started to gain momentum after the Open Government initiative was launched in the USA in 2009.

Collected data about the final theses successfully defended at the FIS UEP shows that the first final thesis (a dissertation thesis) related to the Semantic Web was defended in 2006, the first thesis related to Linked Data was defended in 2010 and the first thesis related to Open Data was defended in 2012. In case of each of these topics there is a gap between

8 <https://insis.vse.cz/katalog/syllabus.pl?predmet=121729>

9 <https://data.cssz.cz/>

10 <https://data.cssz.cz/web/otevrena-data/-/duchodci-v-cr-krajich-okresech>

the important years in the history of these topics and the years when the first thesis on the particular topic was defended at the FIS UEP. This gap might be explained with time needed to fully reflect these topics in education. Gaining interest of students in a particular topic might also lack behind the moment when the topic is reflected in the educational process.

In 2007 there was no thesis related to the topics of interest defended at the FIS UEP. Number of theses related to these topics significantly increased between the years 2013 and 2015 reaching its peak in 2015. The collected data also shows a drop in number of theses between the years 2015 and 2016. Explaining this decrease in interest of the students in the analysed topics would require a study aimed at motivation of the students for selecting topics of their final theses.

### **Open Data as OER at the FIS UEP**

Use of the dataset published by the CSSA for the SPARQLab application could be classified as a use of Open Data as an Open Educational Resource. Availability of the CSSA's data as Linked Open Data allowed to develop training exercises based on a real-world dataset. CSSA is one of the first public sector organizations in the Czech Republic that has decided to publish its data as Linked Open Data. Even though availability of government data in the Czech Republic in the form of Linked Open Data is still less frequent than availability of data in other formats, use of the real-world linked dataset is nevertheless an evidence that students are being prepared for real-world scenarios. If the demand for Linked (Open) Data increases in the future, students familiar with the semantic technologies will have a comparative advantage on the labour market.

Teaching students the semantic technologies might also have another important impact. Lack of competencies related to Linked Open Data is perceived as one of the barriers to its adoption (Archer et al., 2013). Therefore teaching students RDF, SPARQL and other technologies related to Linked Data and the Semantic Web could help to increase availability of the competent personnel and thus it could help to overcome this barrier in the adoption of Linked Open Data. Public availability of SPARQLab could only add to this benefit because anyone interested in learning SPARQL could train his or her skills with this application.

### **CONCLUSION**

Open Data is one of the current trends in data sharing, especially in the domain of government data. Faculty of Informatics and Statistics of the University of Economics, Prague has been involved in various research and practical projects and activities related to Open Data, Linked Data and the Semantic Web. An analysis of data about the final theses successfully defended at the FIS UEP shows that these topics are also present in education at the FIS UEP. These topics have been steadily appearing as topics of the final theses since 2008. Total number of 51 final theses related to these topics have been successfully defended at the FIS UEP by 2016.

Open Educational Resources are educational resources that could be freely re-used (Atkins et al., 2007) or assets that are available in a non-discriminatory way for learning and education (Tuomi, 2013). Even though not every open dataset is an Open Educational Resource, it becomes an Open Educational Resource when used within pedagogical context (Atenas and Havemann, 2015). In order to help students and other people learning the SPARQL query language the SPARQLab application has been developed at the FIS UEP. This application provides its users with a set of exercises to train their SPARQL

skills. A real-world dataset published by the Czech Social Security Administration was used for the training exercises of the SPARQLab application. This use of a linked open dataset could be classified as a use of Open Data as OER.

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# HIERARCHICAL CLUSTERING OF M.SC. STUDENTS: AN IMPROVEMENT TO DIVISIVE ANALYSIS

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## ABSTRACT

As Bachelor degree becomes more common, postgraduate qualifications are sought after. Universities and institutes which offer postgraduate qualifications are now in competition to attract these potential students. Therefore, setting up postgraduate programmes that meet the demand and suitable to the nature of workforce is advantageous. This research has two main objectives. The first is an attempt to split students in Master Degree in Information Technology programme into a suitable number of clusters, this is carried out by means of applying Hierarchical Clustering technique, known as DIvisive ANALysis (DIANA) to the student dataset. The second objective is to improve DIANA further by considering indecisive samples whether they should belong to the main or the splinter cluster. The improvement results in better clustering performance. The research can aid administration to set up suitable tracks and courses for the Master Degree in Information Technology programme at King Mongkut's University of Technology Thonburi (KMUTT).

## KEYWORDS

Clustering, DIvisive ANALysis (DIANA), Hierarchical Clustering, Information Technology, King Mongkut's University of Technology Thonburi (KMUTT), Master Degree

## INTRODUCTION

There is no denial that good educational system provides the foundation necessary for the development of a country. It can be argued that prosperity is not possible without well-qualified workforce. As individual employee also wishes to advance his/her career, 1st degree is no longer sufficient and postgraduate qualification become much sought after. On the other hand, universities and educational institutes are in competition among themselves for good postgraduate students. Good management of postgraduate programmes is essential for survival of any university which offer such programmes. In 2013, the Thai's office of the Higher Education Commission reported that there were almost 200,000 students in Master Degree programmes (Thai's office of the Higher Education Commission, 2016) and this trend is likely to increase.

This research is concerned with administration of Master Programme (M.Sc.) in Information Technology at School of Information Technology (SIT), King Mongkut's University of Technology Thonburi (KMUTT), Bangkok, Thailand. It is the largest School of Information Technology in Thailand in terms of number of students. While the School is offering other M.Sc. programmes, M.Sc. (IT) is of concerned here as it has the largest number of students. Classes are conducted during evening and weekend to allow employees, especially in IT related fields, to further their qualification whilst employment.

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The programme also attracts full-time and unemployed applicants too. While students may be seeking further knowledge and are reasonably aware of current trend in IT, they may not know what courses are suitable for their needs and circumstances. In short, they rely the School to offer the best courses and programme tracks for them. Therefore, if possible, tailored made programme tracks ought to be offered according to characteristics of different groups. Issues of concerns in quality within a large number of students in such programmes was discussed in (Lavangnanada, K., 2000).

Knowledge Discovery, especially the clustering technique known as Divisive ANAalysis (DIANA), was applied to the student dataset in order to identify number of groups (i.e. clusters) among all students. This research also improves DIANA further for better clustering. Once this is known, further analysis can be carried out to determine characteristics of each group. This knowledge will then allow the School to set up different tracks and major courses within these tracks in the overall M.Sc. Programme. Administration of such programme will be more efficient and, in turn, the School can remain reputable and competitive in this era of demand driven education.

## CLUSTERING

Clustering is one of the well-known techniques in Knowledge Discovery (Everitt, B. S., et.al., 2011), it can be briefly described as the process of arranging a dataset into groups whereby intra-similarity is maximized while inter-similarity is minimized. Unlike classification, clustering is unsupervised, hence samples in the dataset are unlabeled. Applications of clustering ranges from finance (such as determining different types of investors) to bioinformatics (such as finding number of suitable groups for DNS sequences). Clustering can be categorized from various perspectives, a simple way is to categorize it into three types, Partitioning Clustering, Overlapping Clustering and Hierarchical Clustering.

As hierarchical clustering is adopted in this work, it merits a little description. Hierarchical clustering can be seen from two perspectives as below:

**Agglomerative:** This is an approach when each sample is individually categorized into sub group, then the most similar sub-groups are grouped repeatedly until the last two sub groups is categorized into one group.

**Divisive:** This is the reverse approach to agglomerative, when the group of samples are categorized into sub-groups in each hierarchical level, the most different group of samples is firstly divided into sub-groups. This process is repeated until every last sub-groups is an individual sample. Figure 1 depicts these two scenarios.

This work adopts the Divisive approach as it is suitable to the nature of the task since a dataset is to be split into a known number of clusters. Among hierarchical clustering techniques, the Divisive ANAlysis (DIANA) (Jain, A.K., and Dubes, R.C., 1988) is probably the best known, and it is the basis of for further improvement in this work. Hence, it is briefly described below.

## Divisive ANALYSIS (DIANA)

In DIANA, an individual which is different from others splits out to form a new group and some others may follow. First, a distance matrix (also known as dissimilarity matrix) of a kind is constructed, the one which average distance from other individuals is highest initiates the splinter group. Next, the average distance of each individual in the main group to the individual(s) in the splinter group is determined, this value ranges from -1 to +1 which is an indicator whether the individual(s) should be placed in splinter or main

```

Set the number of desired clusters (N).
Initialize the number of cluster (i) to 1.
Repeat
  Create distance matrix of data set.
  Repeat
    Select individual with highest average 'distance by comparing to each and every individual in
    main group' and move to splinter group.
    Calculate the 'difference of average distance of main group and splinter group of each
    individual in main group' (D).
  Until (D <= 0). -----*
  Calculate 'Intra distance' of each cluster.
  Select cluster with maximum of 'Intra distance' for next data set.
  Increment the number of cluster (i) by 1.
Until (The desired number of clusters is attained (i.e. i = N)).

```

**Figure 1: A brief description of DIANA**

## **RELATED WORK**

Applications of Knowledge Discovery are plentiful. This Section, therefore, introduces some previous research which are related to Hierarchical Clustering and those which applied Knowledge Discovery techniques in education. Recent examples of these works include the application of DIANA in classifying urban road networks into number of street classes to support traveller (Patnaik, A.K., Bhuyan, P.K. and Rao, K. (2016). Divisive clustering was also used to reduce energy consumption in wireless network (Ye, M., et.al. (2005). Hierarchical Clustering, divisive correlation clustering in particular, had been applied to biological data to organize group type of genes (Nugent, R. and Meila, M. (2009). Knowledge Discovery had also been applied to the field of education too. Machine Learning has been compared with statistical method classification of student's performance using qualitative attributes in (Phrueksanant, J. and Lavangnanada, K., 2002). Prediction of student's performance by means of Evolutionary Computation was carried out by (Lavangnanada, 2001; 2006). Partitioning Clustering of Master degree students was also carried out in (Lavangnananda, K. and Poolphol, R., 2014). Analysis of learning behaviour in on-line problem solving activity utilized hierarchical clustering (Psaromiligkos, et.al. 2011).

To date, there has not been a report in literature of an application of hierarchical clustering in administration of undergraduate or postgraduate degree programmes. Hence, this work is the first of its kind and also the first to further improve the performance of DIANA.

## **HIERARCHICAL CLUSTERING OBJECTIVE AND DATA PREPARATION**

As stated in Introduction, one of the two objectives is to appropriately cluster students into groups which allow efficient and effective administration of each group, this is elaborated here. In order to satisfy different needs of the students, the M.Sc. IT programme ought to comprise more than 1 tracks and different options ought to be offered with in each track. It was considered attractive and feasible if the programme offers two main tracks. Any more than two will become problematic from administrative perspectives. Further variation can be offered within each track by means of selecting one of the two majors within each track. Therefore, from hierarchical clustering perspective, this is translated into two levels of hierarchy, where two clusters are determined from overall students in the first level of hierarchy. Each cluster is then further divided into 2 smaller clusters in the second level. The dataset used in this research is the past and present student dataset (from 2005 to 2015) at the School of Information Technology (SIT), King Mongkut's University of

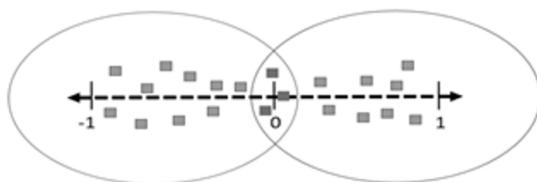
Technology Thonburi (KMUTT). It comprises around 1,250 student records. Prior to do any knowledge discovery (i.e. data mining), an essential process is ‘data preparation’ in order to ensure that dataset is clean, contains no error and in a proper format (Aggarwal, C. C. 2015). Incomplete records were removed. As each record contains a lot of information (i.e. several attributes) about a single student, not all information is useful or needed for hierarchical clustering.. For example, intuitively, telephone number and citizen ID number should be disregarded. Careful analysis was carried out to determine relevant attributes for the process. This revealed five important attributes that may affect students’ choice of courses they wish to undertake. The data preparation resulted in 1,208 usable records where by five attributes in each record were considered relevant. Table 1 shows these relevant five attributes in the 1,208 records in the dataset used.

Name	Data Type	Value
IT Related in 1 <sup>st</sup> Degree	Categorical	Yes, No
1 <sup>st</sup> Degree’s major	Categorical	7 different categories
GPA in 1 <sup>st</sup> Degree	Real	From 2.00 to 4.00
Type of Institutes in 1 <sup>st</sup> Degree	Categorical	6 different categories
Employment	Categorical	Employed, Unemployed

**Table 1: Relevant attributes in the student dataset**

## METHOD AND IMPROVEMENT TO DIANNA

Once data preparation was carried out, the dataset was ready for hierarchical clustering. DIANA was applied to the dataset to determine suitable clusters in both levels as described in previous Section. As stated in Divisive ANAalysis Section, the value (i.e. average distance) from -1 to +1 is used to determine whether an individual should be in the main or splinter group. Nevertheless, individuals with value of close to 0 indicate that they are at the borderline between either groups. Figure 2 depicts this circumstance.



**Figure 2: Individuals with average distance close to zero in overlapped area**

Improvement can be made to DIANA by reconsidering these individuals in overlapped area whether which cluster they really ought to be in. Referring Figure 1, this process is incorporated in DIANA algorithm at the point marked ‘\*’. A summary of the Pseudo Code for this improvement is described in Figure 3.

Sort individuals in *descending* order in the *main* group by using their 'difference average distances between main and splinter group ( $D_m$ )'.

Sort individuals in *ascending* order in the *splinter* group by using their 'difference average distances between main and splinter group ( $D_s$ )'.

Calculate the measure of cluster quality (i.e. Inter-Intra).

Repeat

- Move the individual with *highest* of  $D_m$  value from *main group to splinter group*.
- Calculate the measure of cluster quality (i.e. Inter-Intra).
- Calculate the difference between the new and old measure of cluster quality ( $D_c$ ).

Until ( $D_c < 0$ ).

Move the last individual with *highest* of  $D_m$  value back from *splinter group to main group*.

Repeat

- Move the individual with *lowest* of  $D_s$  value from *splinter group to main group*.
- Calculate the measure of cluster quality (i.e. Inter-Intra).
- Calculate the difference between the new and old measure of cluster quality ( $D_c$ ).

Until ( $D_c < 0$ ).

Move the last individual with *highest* of  $D_s$  value back from *main group to splinter group*.

Figure 3: A brief description of the improvement to DIANA

## RESULTS

Results from both DIANA and the DIANA improved version can be seen as a tree with 2 levels of hierarchy. Figure 4 illustrates the results of both DIANA and the DIANA improved version of the 1,208 students.

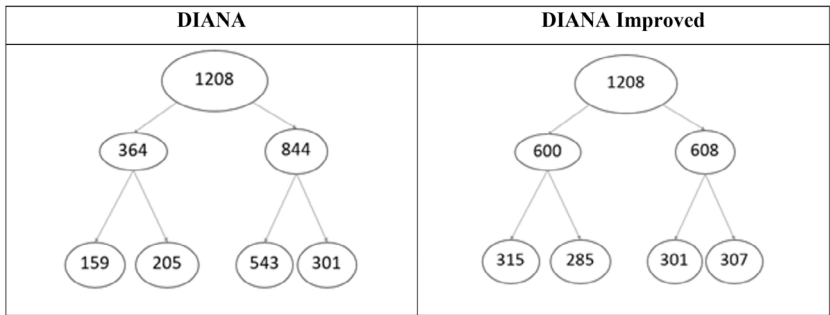


Figure 4: Results of hierarchical clustering from DIANA and DIANA Improve

There are several 'Measure of Quality's in clustering (Liu, Y., et.al, 2010). Among them, the 'Inter-Intra' is the most popular and is used in DIANA too. This work also adopts another index, the 'Divisive Coefficient' index as measure of quality it was invented later specifically for hierarchical clustering. Table 2 reveals comparison of performance between DIANA and DIANA improved version by these two indices.

Measure of Quality	DIANA	DIANA Improved	Improvement (%)
Divisive Coefficient	0.44	0.57	29.52
Inter-Intra	194,345.83	237,797.02	22.36

Table 2: Comparison of Performance between DIANA and DIANA Improved

## DISCUSSION

Referring to results in Figure 4, it can be seen that DIANA improved version distributes students into clusters at both levels more evenly. Table 2 also suggests that DIANA improved version yields a significant improvement to DIANA using the commonly known measure of cluster quality indices.

From administration perspective, the reasonably well balanced of the two clusters at the first level in the result from DIANA improved version at first level can be used to guide the School to offer two appropriate tracks in the M.Sc. IT programme by extracting characteristics of students in the two clusters. Similarly, further extraction can be done to reasonably well balanced clusters at the second level, this ought to reveal suitable courses that may be offered within each programme track. This can be in the form of offering two majors within each programme track in the first level. From students' perspective, such implementation will enable them to select the track and courses that are suitable for their background and needs, and hence fulfill their initial intended purposes in pursuing the M.Sc. IT program at SIT, KMUTT. In turn, it will allow the School to efficiently administrate the M.Sc. IT programme and to remain competitive in this fast pacing education era where many universities are also offer similar programmes.

## CONCLUSION

In order for a university or an educational institute to remain reputable and competitive in this modern age, it is imperative to take students' needs and their nature into consideration in providing the right programme to the right group of students. Therefore, understanding characteristics of students from multifarious backgrounds is essential. This research is the first attempt to apply hierarchical clustering technique, DIANA in particular, to aid administration of postgraduate degree programme in order to identify different clusters of students and to allow characteristics of each cluster to be further extracted. The research also improves DIANA further resulting in better clustering performance. It is yet another affirmation of the application of knowledge discovery, especially in clustering, in the field of education.

Future work can be carried out in several perspectives. Statistical analysis or data mining may be applied to the result from hierarchical clustering to discover characteristics of each cluster. DIANA improved version can also be applied to student datasets in other programmes or to datasets in other fields. Such future attempts may result in a new paradigm in administration of education at postgraduate level and in advancement in the field of knowledge discovery in general.

## ACKNOWLEDGEMENTS

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# SECESSION AS THE BATTLE OVER HUMAN CAPITAL

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## ABSTRACT

New wave of the current separatist movements in Europe is analysed with respect to the human capital building in the secessionist regions. The aim of our paper is to analyse human capital building in the secessionist regions in comparison to the non-secessionist regions in their respective countries. For our study four traditional secessionist countries were chosen: Belgium, Italy, Spain and the United Kingdom. We use results of the Programme for International Student Assessment of the OECD to approximate quality of the human capital stock. PISA results in the secessionist regions are significantly better in comparison to the non-secessionist regions despite the fact that the total level of the formal human capital stock does not differ significantly. Moreover, the secessionist regions invest in the education 12% above their respective country average. We prove that the secessionist regions in four European countries put more emphasis on the human capital building than rest of their countries. Quality of human capital is influenced by the existing stock of the human capital, efficiency of using the human capital as well as by the secessionist tendency of the region.

## KEYWORDS

Autonomy, Human Capital, PISA, Secession

## INTRODUCTION

Again and again the European countries fall into the trap of secession. As many times before, even in the 21<sup>st</sup> century numerous nations seek to be recognized by the international community, invoking the right of self-determination. Ukraine war, Catalanian and Scottish referendums as well as elections in Corsica or Åland just reflects the new wave of devolutions, separatist and secessionist movements and irredentism in the current Europe (e.g. Fischer, Lipovská and Šedová 2017).

There are numerous factors, which can accelerate the secessionist movements. While the modern approach highlights the socio-economic aspects of secession, the traditional studies dealt with the *romantic secession* (Rodríguez-Pose and Stermšek 2014), which recognizes secession as the result of different history, language, religion and culture (Lipovská 2016). These factors play a key rule on the crucial battlefield of secession – in education. As Boyle and Englebert (2008) noticed, separatist regions are “usually believed to be different from the rest of the country in terms of wealth, physical or human capital, or natural resources endowment.”

Firstly, it must be mentioned that the secessionist movements can be identified with the individual nations characteristic with own language. For example, there is *Gaelic* and *Scots* language besides English in Scotland, *Welsh* in Wales, *Dutch* in Flanders in Belgium, *Valdotain* and *French* in Aosta Valley in the northern Italy, *Sardu* in Sardegna, *Germany* and *Ladin* in South Tyrol, *Basque* in the Basque Country, *Aragonese* in Aragón

or *Catalan* in Catalonia and Balearic Islands, Spain. Language stays for an important part of the human capital (compare Breton 1998 or Pendakur and Pendakur 1998). Language was used to define the national culture especially in the 19<sup>th</sup> century (Zwet 2015), in the Czech independence movement was the nation identify with the mother tongue already by Jungmann (Patočka 1969).

However, the language knowledge is developed in schools where the substantial part of the individual's as well as national human capital is built up. And it is just the field of education, which is of the highest importance for the secessionist movements and secessionist political parties. While in the typical European country the education ministry is offloaded to the minor coalition parties (see Cabada 2006), the secessionist parties in the regional and local governments consider the education ministry as the key portfolio. For example, according to the Basque government's minister of education Cristina Uriarte, "the commitment to education is strongly linked to the national identity" as education is the key to keeping Basque culture (Coughlan 2016). Similarly, Hauk and Ortega (2015) mention that schooling is used to create a common identity.

Secondly, most of the secessionist movements need elite and well-educated leaders, who would be able to take the lead in international negotiations on their country recognition. Baranyai (2013) mentioned, that the regionalism in Upper Silesia suffered from the lack of own regional elites as the local political leaders always came from different Polish regions. Similarly, Deacon (2003) reminds that the leaders of the Cornish secessionist movements were mostly the teachers and the lower civil servants. Independence movement on the Faroe Islands was formed in 1888 by the young well educated elites and university students (Adler-Nissen 2014), Flanders independence movement was leaded by priests and other intellectuals (Vos 2002). Hroch (1999) recognizes three basic stages of the national movements: A. *scholar interest* – in this phase was the language, culture, history as well as the habits studied by the enlightened scholars; B. *national agitation* that was promoted by the well-educated patriots; and finally phase C. *mass movement*, in which thousands of citizens were mobilised. Regions with the successful secessionist movements have often given to their countries numerous prime ministers. For example 15 Belgian prime ministers in 1946–2016 were born in Flanders and 11 Italian Prime ministers were born in one of the main secessionist regions. On the other hand, none of the Finnish prime ministers in 1917–2016 came from Åland and none of the Polish prime ministers in 1989–2016 came from Upper Silesia.

For the success of the secessionist movements the regions should also have well-developed infrastructure, including the universities (compare Deacon 2003 or Mises 2004). From the economic point of view, the high level of the human capital is of great importance for the secessionist region which needs highly qualified workers to achieve high pace of the economic growth and economic level. Dorronsoro considers education to be a long term-investment, which needs feeling of the identity. That is why is the accumulation of the human capital supported in such regions as Basque country, where, due to the former suppression under Franco's dictatorship, enjoys the regional education strong public support (Coughlan 2016).

Effort to obtain autonomy in education policy might be also motivated by the interregional migration in the countries with secessionist movements. If the secessionist region lacked high quality education, the citizens moved to other part of country. Moreover, many of the secessionist regions in Europe promote teaching in their own language using their own curricula. Pupils therefore obtained stock of specific human capital, which has lower risk of depreciation because it lowers the risk of their migration to different region (compare



with the concept of returns to the firm investment in human capital as developed e. g. by Almeida and Carneiro 2006).

The aim of this paper is to analyse human capital building in the secessionist regions in comparison to the non-secessionist regions in their respective countries. Four traditional secessionist countries were chosen: Belgium, Italy, Spain and the United Kingdom. These countries are most often used for the aim of secessionist studies; moreover, the complete data are available. The rest of the paper is organized as follows. Firstly, the data and regions are introduced. In the next part the results are presented. We discuss the regional investment to the education. Further its impact on the school achievements is studied in terms of economic conditions of the regions. Finally, the quality of human capital stock in the secessionist regions is analysed.

## MATERIALS AND METHODS

For Belgium, Italy, Spain and the United Kingdom data for 41 NUTS 2 regions are available. All regions were divided on i. *secessionist regions* (Flanders in Belgium, Scotland in the United Kingdom, Aosta Valley, Sardinia, Venetia, Lombardy, Trentino-Alto Adige/South Tyrol and Bolzano in Italy and Basque Country, Aragon, Catalonia, Balearic Islands, Andalusia and Galicia in Spain) and ii. *other regions* (see Fig. 1).



**Figure 1: Map of the secessionist and non-secessionist regions in four European countries (black are the secessionist regions, grey the non-secessionist regions).**

List of data and data sources (including the year for which were data available) is summarized by Table 1. Eurostat Database was used as the source of the economic statistics on the regional level. Human capital quality was approximated by the results of the *Programme for International Student Assessment (PISA)* of the OECD (PISA 2012) which is the triennial international survey testing skills and knowledge of the 15 years old pupils (OECD 2016)<sup>1</sup>.

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<sup>1</sup> Detailed results of the PISA 2015 on the level of NUTS 2 were not available in time of our analyses was being prepared.

Eurostat Regional Statistics	Unemployment rate	15 years and over	2015
		From 15 to 24 years	2015
	Gross Domestic Product	current market prices, per inhabitant	2014
	Tertiary Education (ISCED 5-8)	From 25 to 64 years (%)	2015
<b>OECD PISA 2012</b>	Mathematics	Mean score	2012
	Reading	Mean score	2012
	Science	Mean score	2012
<b>Education expenditure</b>	Spain	Fundación BBVA-Ivive	2013
	United Kingdom	HM Treasury/Office for National Statistics	2015
	Italy	ImpresaLavoro	2013
	Belgium	Ruano and Profirou (2016)	2015

**Table 1: List of used data and data sources.**

Based on the education expenditure data the index variable  $EEI$  was calculated: expenditures on education by the  $s$ -th secessionist region ( $EE_s$ ) were divided by the average expenditures on education by the whole country ( $R$  regions):

$$EEI = \frac{EE_s}{\frac{1}{2} \sum_r EE_r} \times 100 \quad (1)$$

For testing the difference between secessionist regions and their non-secessionist counterparts the independent sample t-test was used. The null hypothesis that the means are for both regions equal  $H_0: \mu_r = \mu_s$  is tested against the alternative that the means differ significantly (on a significance level  $\alpha = 0.1$ ).

To explain the relationship between the level of human capital (approximated by the variable  $PISA\ COMPOSED$ ), the standard linear regression model estimated by the Ordinary Least Squares with Robust standard errors was used. Variable  $PISA\ COMPOSED$ , approximating the quality of human capital, was calculated for each region as the sum of PISA results in Mathematics, Reading and Science. Dummy variable  $Secession$  takes value 1 if the region is secessionist and value 0 in other cases. Efficiency of the existing human capital usage is approximated by the unemployment rate  $U$ . Finally, the existing stock of the higher human capital is reflected by the share of tertiary educated inhabitants (variable  $Education$ ):

$$PISA\ COMPOSED_i = \beta_0 + \beta_1 Secession_i + \beta_2 U_i + \beta_3 Education_i + \varepsilon_i \quad (2)$$

Furthermore, the standard methods of the mathematical descriptive statistic (especially arithmetic means and Pearson correlation coefficient) were used. The statistical and econometric results were computed using econometric software Gretl 1.9.14 and statistical software Dell Statistica, version 13.

## RESULTS AND DISCUSSION

In this section our findings are introduced. Firstly, we discuss the main differences between the secessionist and non-secessionist regions in terms of the basic educational statistics, than the OLS model is estimated and explained.

### Human capital in the secessionist regions

Economic level measured by the GDP per capita is significantly higher in the secessionist

regions in comparison to the non-secessionist regions (Table 2). The higher economic level is connected with two different ways. On the one hand, the higher the economic level is, the more the region in the human capital can invest (e.g. the Pearson correlation coefficient between GDP p.c. and Education expenditures index is  $\rho = 0.3$ ). Backwards, the higher the level of the human capital is, the higher economic level the region has. Correlation coefficient between GDP p.c. and PISA Composed is very high as it reaches  $\rho = 0.7$ .

Unemployment rate mirrors the efficiency of using the stock of labour, which the country has available. If the unemployment rate is high (especially in the cohort of young inhabitants in the age of 15–24), it suggests wasting the human capital. If the secessionist region behaves responsibly in terms of the future use of the labour resources, it should invest in the education which is needed in the labour market. Table 2 shows, that the unemployment rates in the secessionist regions are lower in comparison to the other reasons, however, this difference is not of the statistical significance.

	Regions		diff	p-value
	Secessionist	Non-secessionist		
GDP p.c. [€]	28 886	23 909	4 976	0.017
Unemployment 15-24 [%]	34.1	40.2	-6.1	0.178
Unemployment 15+ [%]	12.9	14.3	-1.4	0.544
Education expenditures index	111.8	93.9	17.9	0.029
Tertiary educated [%]	28.3	26.1	2.2	0.544
PISA Math	498.5	484.3	14.2	0.054
PISA Reading	499.6	486.8	12.8	0.048
PISA Science	507.6	493.6	14.0	0.060

**Table 2: Results of the independent sample t-test including the means.**

Nevertheless, the results suggest that the secessionist regions invest in the education 12% above their respective country average. Substantially higher investments to the education reflect the emphasis which the secessionists put on the human capital. However, they are partly also the result of the necessity to finance bilingual or even trilingual schooling system and to ensure different types of education in one, usually not very large, region.<sup>2</sup> This can be illustrated e.g. by the three models of language schooling in Basque (so called A, B and D models is described in Cenoz and Etxague 2011).

PISA results in the secessionist regions are significantly better in comparison to the non-secessionist regions despite the fact, that the total level of the formal human capital stock (approximated by the ratio of the tertiary educated inhabitants) does not differ significantly among the regions. The most striking difference is observed in the Math and in the Science.

### **Effect of the secession on the quality of human capital**

Results of the OLS model (Table 3) confirm that the quality of human capital (approximated by the PISA COMPOSED) is influenced by the existing stock of the human capital, efficiency of using the human capital as well as by the secessionist tendency of the region. In the secessionist regions the PISA COMPOSED index is nearly 20 points higher than in the non-secessionist regions. Simultaneously, the lower the unemployment rate (and so the higher the efficiency of the human capital usage), the higher the PISA COMPOSED

<sup>2</sup> Authors thank for this useful comment to Ing. Lucie Coufalová, Ph.D. (Faculty of Economics and Administration at Masaryk University).

is. Finally, the positive effect of the ratio of the tertiary educated inhabitants is in line with the recent studies on the intergenerational transmission mechanism (e.g. Fischer and Lipovská 2013). This model explains more than half of the variability of PISA COMPOSED variable (53%).

PISA COMPOSED			
	Coefficient	Standard Error	p-value
Constanta	1560.80	33.96	<0.0001
Secession	19.96	14.97	0.1907
Unemployment	-3.02	0.67	0.2038
Education	0.97	0.75	<0.0001
R <sup>2</sup>	0.53		

**Table 3: OLS Results**

## CONCLUSION

In this paper we proved that the secessionist regions in four European countries put more emphasis on the human capital building than rest of their countries. Education and schooling is public provided good which is key instrument for the secessionist region. Proper management of education allows the region preparation of the suitable condition either for the secession or for the negotiations on the autonomy.

Apparently, leaders of the secessionist regions are aware of the fact that potential new countries would need highly educated elites (to avoid the fate of the African countries after the secessionist wave in the 60's). They invest in the human capital to ensure higher competitiveness and economic level as well as to prevent the intraregional emigration from the secessionist region.

Our results are also in contradiction with the Bird idea that “the secession is more likely to occur where the level of education is low, because politicians are better able to manipulate the population through the identity policy” (Bird 2014: 390). Conversely, the secessionist regions seem to have higher sense of the responsibility in education than the central governments. Underestimating education and schooling can therefore even accelerate the secessionist pressures in the recent turbulent Europe.

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# SNT PETRI NETS THEORY APPLIED AT AUTOMATION OF RICH-MEDIA RECORDS PRODUCTION

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## ABSTRACT

Authorized training center within the Apple Authorised Training Centres for Education (AATCE) worldwide program with the current statutes of Media Focused AATCE and IT Focused AATCE carried at the Faculty of Economics VŠB-Technical University of Ostrava prepares the students and teachers to become internationally valid certified experts in the areas of multimedia technologies, operating systems and development of the programming systems. An integral part of the implementation of the educational process in the AATCE training center is also recording of the lectures and their publication on-line or on-demand with using of the rich-media and AirPlay Mirroring technologies in the frame of the MERLINGO project (*Media-rich Repository of LearnING Objects*). Rich-media describes a broad range of digital interactive media. The SNT Petri nets theory was applied at the design, verification and implementation of the software support that provides the AATCE lecture room functionalities and that enables automated recordings of the presentations.

## KEYWORDS

SNT Petri nets, AATCE, Rich-media, MERLINGO, AirPlay Mirroring

## INTRODUCTION

VŠB-Technical University of Ostrava completed successfully the gradual introduction of a quality management system according to the international standard ISO 9001 in 2007. One of the main aims of the quality policy of the university implemented within the quality management system is also increasing the employability of their graduates in the labor market. The practical realization of this objective also includes preparing students to become internationally valid certified experts in the several field of IT technologies. One of the important activities in this area is also operating an authorized training center within an Apple Authorised Training Centres for Education (AATCE, 2017) worldwide program with the current statutes of Media Focused AATCE and IT Focused AATCE. The AATCE training center has a non-commercial character with the whole university scope of operation and its mission is the education and preparation of the top-class certified professionals primarily in the areas of multimedia technologies, operating systems and development of the programming systems and the educational process in the chosen bachelor and master study programmes. An integral part of the implementation of the educational process in the AATCE training center is then also recording of the lectures and exercises with using of the rich-media (EduArt, 2017) and AirPlay (AirPlay, 2017) technologies.

The term *rich-media* is a synonym for the digital interactive multimedia accessible on-line or on-demand supporting synchronous and asynchronous bidirectional communication, through which it is possible to share and transfer information and communicate in various ways. An example can be online streaming video reporting, which is updated during

broadcast and can elicit user response in the real time, or a record teachers' presentation placed on a web site jointly with the synchronized slide show, which the user can interactively work with. The issue of key aspects of implementing the central repository of learning objects based on the rich-media technologies is dealt with in the MERLINGO Project (*MEDIA-rich Repository of Learning Objects*) (MERLINGO, 2017).

A long term key objective of the MERLINGO project is the development and practical use of methodologies for the automated production and publication of recordings of presentations on-line or on-demand. The design and implementation of the hardware and software support of the AATCE lecture room enabling automated central recordings of the presentations including their automated editing was the most significant problem solved in the frame of fulfilment of the above objectives. It was necessary to design and implement the single-purpose programming support determined for the distributed computing environment with the stated properties (i.e., especially with the absence of the programming deadlock possibility). It was necessary to apply the Petri nets formal mathematical theory (Balogh et al, 2012) for that reasons. The class of high-level Petri nets (Diaz, 2009) named SNT Petri nets (Martinik, 2015) was chosen for these requirements and it has been significantly applied at the design, verification, simulation and implementation phases of the mentioned software support.

## MATERIALS AND METHODS

### Mathematical preliminaries

Let  $\mathbf{N}$  denotes the set of all natural numbers,  $\mathbf{N} := \{1, 2, \dots\}$ ,  $\mathbf{N}_0$  the set of all non-negative integer numbers,  $\mathbf{N}_0 := \{0, 1, 2, \dots\}$ ,  $\mathbf{Z}$  the set of all integer numbers,  $\mathbf{Z} := \{\dots, -2, -1, 0, 1, 2, \dots\}$ ,  $\emptyset$  the empty set,  $|A|$  the cardinality of a given set  $A$ ,  $\neg$  the logical negation operator, **IDENT** the set of all the identifiers. **Multiset**  $M$  over a non-empty set  $S$  is a function  $M: S \rightarrow \mathbf{N}_0$ . The non-negative integer number  $M(a) \in \mathbf{N}_0$ , where  $a \in S$ , denotes the number of occurrences of the element  $a$  in the multiset  $M$ . The multiset  $M$  over a non-empty set  $S$  will be represented by the notation  $M := [a^{M(a)}, b^{M(b)}, c^{M(c)}, \dots]$ , where  $S := \{a, b, c, \dots\}$ . Notation  $S_{MS}$  then denotes the class of all the multisets over the set  $S$ . If  $K, L \in S_{MS}$ , then  $K \oplus L := [s^{K(s)+L(s)} \mid s \in S]$ ;  $K \neq L \Leftrightarrow \exists s \in S: K(s) \neq L(s)$ ;  $K \leq L \Leftrightarrow \forall s \in S: K(s) \leq L(s)$ ; if  $K \leq L$ , then  $L \setminus K := [s^{L(s)-K(s)} \mid s \in S]$ ;  $|K| := \sum_{s \in S} K(s)$ .

### SNT Petri nets and their static properties

SNT (*single-number token*) Petri net (SNTPN) is an ordered 6-tuple  $SNTPN := (P, T, A, AF, TP, M_0)$ , where  $P$  is a finite non-empty set of places;  $T$  is a finite set of transitions disjoint from  $P$  (i.e.,  $P \cap T = \emptyset$ );  $A$  is a finite set of arcs (flow relation),  $A \subseteq (P \times T) \cup (T \times P)$ ;  $AF$  is the arc function,  $AF: ((P \times T) \cup (T \times P)) \rightarrow \mathbf{IDENT} \cup \mathbf{Z}$ , such that  $(AF(x, y) \in \mathbf{IDENT} \cup \mathbf{N}_0) \Leftrightarrow ((x, y) \in A)$ ,  $(AF(x, y) := -1) \Leftrightarrow ((x, y) \notin A)$ , where  $x, y \in P \cup T$ , and  $\forall t \in T \forall q \in t \bullet: (AF(t, q) \in \mathbf{IDENT}) \Rightarrow (\exists p \in \bullet t: AF(p, t) = AF(t, q))$ ;  $TP$  is the transition priority function (with the default value of 1),  $TP: T \rightarrow \mathbf{N}$ ;  $M_0$  is the initial marking,  $M_0: P \rightarrow (\mathbf{N}_0)_{MS}$ .

SNTPNs represent a popular formalism connecting advantages of the graphic representation of a modeled system with the possibilities of its simulation and the formal analyzability. The system is then described with a bipartite graph containing a finite non-empty set of places  $P$  used for expressing of the conditions of a modeled system (we usually use circles for their representation); a finite set of transitions  $T$  describing changes in the system (we usually draw them in the form of rectangles); a finite set of arcs  $A$  being principally oriented while connecting the place with the transition or the transition with

the place and we usually draw them as lines with arrows; the arc function  $AF$  assigning each arc with a identifier or non-negative integer number expressing the kind of removed or added token from or to the place associated with that arc when firing a particular transition; priority function  $TP$  value of each transition (such priority has the default value of 1, if not explicitly indicated in the net diagram); the initial marking  $M_0$  then expresses the initial status of the modeled system with so called **tokens** and it assigns each place with the (possible empty) multiset over the set  $N_0$  of these tokens (i.e., every token is then represented by a single non-negative integer number in a particular place  $p \in P$ ).

Some commonly used notations for SNTPNs are  $\bullet y := \{x \mid (y, x) \in A\}$  for the **preset** and  $y \bullet := \{x \mid (y, x) \in A\}$  for the **postset** of a net element  $y$  (i.e., place or transition). **Marking**  $M$  of the SNTPN  $SNTPN$  is a mapping  $M: P \rightarrow (N_0)_{MS}$ . Marking  $M$  then express the current status of the modeled system. If  $P := \{P1, P2, \dots, Pn\}$ , where  $n = |P|$ , marking  $M$  can then be written as a vector  $M := (M(P1), M(P2), \dots, M(Pn))$ .

## Dynamics of SNT Petri nets

As it has been stated, with SNTPNs not only the current status of the modeled system can be detected, but dynamics of transitions between its individual states, too. Transition  $t \in T$  is **enabled** in the marking  $M$  of the SNTPN  $SNTPN := (P, T, A, AF, TP, M_0)$  iff for every place  $p$  in the preset of the transition  $t$  there exists **input binding function**  $i_p$  of the tokens in the actual marking  $M$  of the place  $p$ , i.e.,  $\forall p \in \bullet t \exists i_p: \{AF(p, t)\} \rightarrow M(p)$  such that:

- $AF(p, t) \in N_0 \Rightarrow i_p(AF(p, t)) := AF(p, t)$ , where  $AF(p, t) \in M(p)$ ,
- $\forall p \in \bullet t \forall q \in \bullet t: AF(p, t) = AF(q, t) \Rightarrow i_p(AF(p, t)) = i_q(AF(q, t))$ .

If the transition  $t$  is enabled in the marking  $M$  of the SNTPN  $SNTPN$ , we denote that fact symbolically in the form of  $t \text{ en } M$ . If the transition  $t$  is enabled in the marking  $M$  of the SNTPN  $SNTPN$  then for every place  $p$  in the postset of the transition  $t$  there exists **output binding function**  $o_p$ , i.e.,  $\forall p \in t \bullet \exists o_p: \{AF(t, p)\} \rightarrow N_0$  such that:

- $o_p(AF(t, p)) := i_q(AF(q, t))$ , if  $((AF(t, p) \in \mathbf{IDENT}) \wedge (AF(t, p) = AF(q, t)) \wedge (q \in \bullet t))$ ,
- $o_p(AF(t, p)) := AF(t, p)$ , if  $AF(t, p) \in N_0$ ,
- $o_p(AF(t, p)) := \emptyset$ , otherwise.

**Firing of the transition**  $t \in T$  itself consists in the removal of one token from each preset place  $p$  of the transition  $t$  as required by the value of the input binding function  $i_p$  of the particular place  $p$ , and adding of one token into each of the postset place  $p$  of the transition  $t$  as required by the value of output binding function  $o_p$  of the particular place  $p$ , i.e., it results in changing the marking  $M$  into the marking  $M'$ , where  $\forall p \in P: M'(p) = M(p) \setminus [i_p(AF(p, t))] \oplus [o_p(AF(t, p))]$ , that is denoted by  $M[t]M'$ . The set of all markings reachable from the marking  $M$  we will denote by the symbol  $[M]$ .

Fig. 1, illustrates the SNTPN  $CON := (P, T, A, AF, TP, M_0)$ , where  $P := \{P1, P2, P3\}$ ,  $T := \{T1, T2\}$ ,  $A := \{(P1, T1), (P1, T2), (P2, T2), (T1, P3), (T2, P3)\}$ ,  $AF := \{((P1, T1), 2), ((P1, T2), x), ((P2, T2), x), ((T1, P3), 3), ((T2, P3), x)\}$ ,  $TP := \{(T1, 1), (T2, 2)\}$ ,  $M_0 := (M_0(P1), M_0(P2), M_0(P3)) = ([2^1], [2^1], \emptyset)$ . The transition T1 is enabled in the initial marking  $M_0$ , because  $\bullet T1 = \{P1\}$ ;  $\exists i_{p1}: \{AF(P1, T1)\} \rightarrow M_0(P1)$ , i.e.,  $\exists i_{p1}: \{2\} \rightarrow [2^1]$ , such that:  $AF(P1, T1) \in N_0 \Rightarrow i_{p1}(AF(P1, T1)) = i_{p1}(2) := 2 = AF(P1, T1)$ , where  $AF(P1, T1) = 2 \in [2^1] = M_0(P1)$ . The transition T2 is also enabled in the initial marking  $M_0$ , because  $\bullet T2 = \{P1, P2\}$ ;  $\exists i_{p1}: \{AF(P1, T2)\} \rightarrow M_0(P1)$ , i.e.,  $\exists i_{p1}: \{x\} \rightarrow [2^1]$ ;  $\exists i_{p2}: \{AF(P2, T2)\} \rightarrow M_0(P2)$ , i.e.,  $\exists i_{p2}: \{x\} \rightarrow [2^1]$ ; such that:  $AF(P1, T2) = AF(P2, T2) \Rightarrow i_{p1}(AF(P1, T2)) = i_{p1}(x) = 2 = i_{p2}(x) = i_{p2}(AF(P2, T2))$ .



## Conflicts and their solving in SNT Petri nets

When enabling individual transitions of a given SNTPN so called **conflicts** can originate in its certain markings (or **conflict transitions**). At the enabling of the transitions  $t_1$  and  $t_2$  of the given net in its marking  $M$  the conflict occurs, if both the transitions  $t_1$  and  $t_2$  have at least one input place, each of the transitions  $t_1$  and  $t_2$  is individually enabled in the marking  $M$ , but the transitions  $t_1$  and  $t_2$  are not in the marking  $M$  enabled in parallel and enabling of one of them will prevent enabling the other, i.e.,  $(\bullet t_1 \cap \bullet t_2 \neq \emptyset) \wedge (t_1 \text{ en } M) \wedge (t_2 \text{ en } M) \wedge \neg(\{t_1, t_2\} \text{ en } M)$ . The term of conflict transitions can be obviously easily generalized for the case of the finite set  $t_1, t_2, \dots, t_n, n \in N$ , of the transitions of a given SNTPN.

A typical example of the conflict transitions in the initial marking  $M_0$  of the SNTPN *CON* is shown in Fig. 1, where the transitions T1 and T2 have the common input place P1, both are enabled, but not enabled in parallel. When solving such transitions conflicts we will therefore follow the rule which determines, informally said, that from the set of conflict transitions the one will be enabled, whose value of transition priority function *TP* is the highest. If such transition from the set of conflict transitions does not exist, the given conflict would have to be solved by other means. In our studied example will be then on the basis of that rule the transition T2 enabled (because  $TP(T1) = 1$  and  $TP(T2) = 2$ ). Firing of the transition T2 changes the initial marking  $M_0$  of the SNTPN *CON* into its marking  $M'$  that can be shown in Fig. 1, where:

- $M'(P1) = M_0(P1) \setminus [i_{p_1}(AF(P1, T2))]^1 = [2^1] \setminus [2^1] = \emptyset$ ,
- $M'(P2) = M_0(P2) \setminus [i_{p_2}(AF(P2, T2))]^1 = [2^1] \setminus [2^1] = \emptyset$ ,
- $M'(P3) = M_0(P3) \oplus [o_{p_3}(AF(T2, P3))]^1 = \emptyset \oplus [2^1] = [2^1]$  ( $o_{p_3}(AF(T2, P3)) = i_{p_1}(AF(P1, T2)) = 2$ , because  $(AF(P1, T2) = x \in \text{IDENT}) \wedge (AF(T2, P3) = AF(P1, T2) = x) \wedge (P1 \in \bullet T2)$ ).

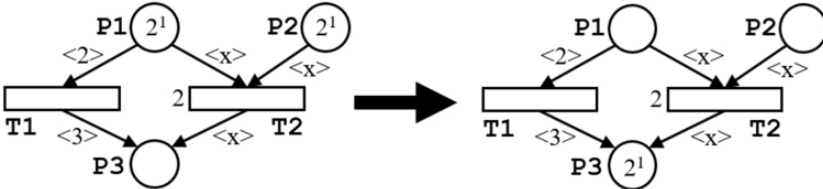


Figure 1: Firing of transition T2 in SNTPN *CON*

Let SNTPN  $SNTPN := (P, T, A, AF, TP, M_0)$ . We will denote that SNTPN  $SNTPN$  is:

- **live** iff  $\forall M \in [M_0] \forall t \in T \exists M' \in [M]: t \text{ en } M'$ ,
- **deadlock-free** iff  $\forall M \in [M_0] \exists t \in T: t \text{ en } M$ ,
- **k-bounded** iff  $\exists k \in N_0 \forall p \in P \forall M \in [M_0]: M(p) \leq k$ .

## AirPlay technology installed in AATCE training center

**AirPlay** (AirPlay, 2017) is a technology based on the proprietary protocol stack/suite developed by Apple Inc. that allows wireless streaming of the audiovisual content among AirPlay devices. AirPlay protocol stack uses UDP network protocol for streaming audio and it is based on the RTSP network protocol. The stream is buffered for approximately 2 seconds before playback begins resulting in small delay before audio output after starting an AirPlay stream. There are two types of AirPlay devices, those that send audiovisual content, i.e., senders, and those capable of receiving the content and rendering it on displays or speakers, i.e., receivers. AirPlay senders include iMacs, Mac minis, MacBooks, iPods, iPhones, iPads, Android phones and other third party devices, AirPlay

receivers include AirPort Express, Apple TV and selected third party speakers. With the open source implementation of the AirPlay protocol any computer can be turned into an AirPlay receiver. **AirPlay Mirroring** is a technology that allows broadcasting of the audiovisual content from a variety of Apple devices to a second generation of Apple TV. AATCE training center is equipped with the **iMac** and **Mac mini** computers, large format multi-touch display **65" NEC MultiSync V651 TM**, **Apple TV** and **AirPort Express** devices (see Fig. 2). AirPlay Mirroring technology is then intensively used during the teaching process to wirelessly mirror screen content of desktops or mobile devices of students and teacher (all these devices then play the role of the AirPlay senders) on the NEC V651 HDTV with a large screen or on the teacher's iMac computer (Apple TV equipment connected to these devices then play the role of the AirPlay receiver), for content sharing to other students, or checking the work of students by the teacher. It is also possible to make a real-time recording of a mirrored screen content by the rich-media technology recorder software **EduArt** (EduArt, 2017) and to publish it on-line or on-demand. It is necessary for the proper functioning of the AirPlay Mirroring technology that all the devices of the AATCE training center are connected to the same internal WiFi internal network. The AirPort Express WiFi router is used for this purpose in the AATCE training center classroom.



Figure 2: AATCE training center equipment

## RESULTS AND DISCUSSION

The main research goal of the MERLINGO project team was to design, verify and implement the software support of the AATCE training center enabling automated recordings of the mirrored audiovisual content of all the installed desktops and mobile devices of students and teacher with the support of the AirPlay Mirroring Technology. Design and verification of the generally parallel algorithm with the deadlock-free property which realizes the automatic switching and the automatic editing functionality during recordings of presentations in the training center involved the use of SNTPN formal theory. It was necessary to design the ***k*-bounded and deadlock-free SNTPN** (and in the best case the live SNTPN) then. This research goal was achieved and the simplified SNTPN model of the given algorithm is shown in the Fig. 3 (a more detailed model

is much more complicated and for its design was used the theory of timed Petri nets (Popova-Zeugmann, 2013)).

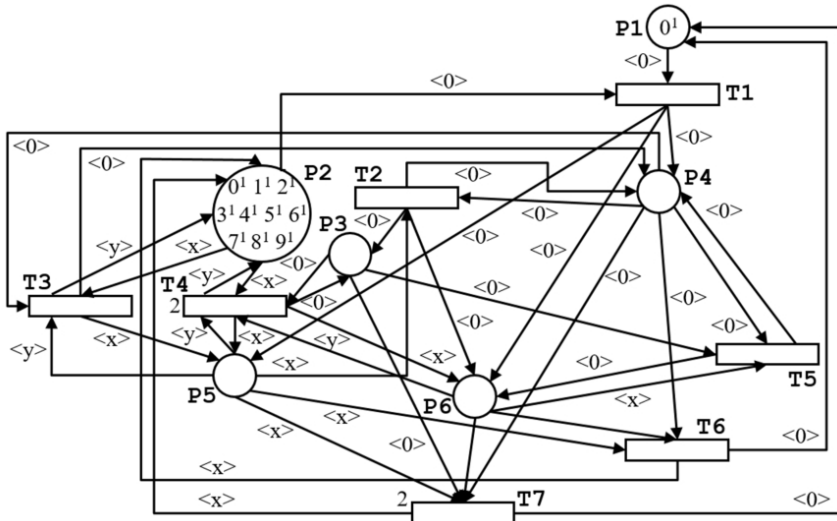


Figure 3: SNTPN representing AATCE training center functionalities in its initial marking  $M_0$

The token 0 in the place P1 of the SNTPN initial marking  $M_0$  (i.e.,  $M_0(P1) := [0^1]$ ) represents the teacher that is prepared for the lecture. The token 0 in the place P2 of the SNTPN initial marking  $M_0$  (i.e.,  $M_0(P2) := [0^1, 1^1, 2^1, 3^1, 4^1, 5^1, 6^1, 7^1, 8^1, 9^1]$ ) represents the teacher's computer (i.e., typically iMac) and the tokens 1, 2, ..., 9 then represent the student's computers (i.e., iPads or iMacs). The place P5 represents the NEC V651 HDTV installed in the training center and the place P6 the computer with the installed rich-media recording programming system (i.e., typically *EduArt*) that realizes the real time recording of the selected teacher's or student's device screen and its on-line or on-demand publication. Firing of the (in the initial marking  $M_0$ ) enabled transition T1 represents the starting of the lecture presentation and recording. The token 0 will be simultaneously removed from the places P1 and P2 and the token 0 will then be added into the places P5 (i.e., the screen of the teacher's device will be wirelessly mirrored on the NEC V651 HDTV), P6 (i.e., the screen of the teacher's device will be recorded and published by the rich-media recording system) and P4 (i.e., the teacher will present) during the firing of the transition T1. Firing of the transition T3 allows any student or the teacher wirelessly project the screen of his device on the NEC V651 HDTV at any time (i.e., the token actually presented in the place P5 will be returned back into the place P2 during the firing of the transition T3). Firing of the transition T2 will cause the placement of the token 0 in the place P3 that allows the firing the transition T4 instead of the transition T3 (because  $TP(T4) = 2 > 1 = TP(T3)$ ). Firing of the transition T4 then allows any student or the teacher project the screen of his device on the NEC V651 HDTV (i.e., the token in the place P5) and also simultaneous realization of the recording of his device screen content by the rich-media recording system (i.e., the token in the place P6). Such state of the SNTPN modeling the lecture room functionalities can be seen in Fig. 4, where the student with the device represented by the token 5 in the places P5 and P6 simultaneously project the screen of his

device on the NEC V651 HDTV and he also realizes the recording of the device screen content. Firing of the transition T5 will disallow the possibility of simultaneous projection of screen of any device and its recording by the rich-media programming system (i.e., the token 0 will be removed from the place P3, the token that is actually present in the place P6 will be removed and the token 0 representing the recording of the teacher's device screen will be added into the place P6) and the rich-media recording system will start to record the teacher's device screen again. Firing of the transition T6, resp. T7, will then finish the lecture (i.e., screen projection on the NEC V651 HDTV and the recording of the lecture) and the SNTPN will then return into its initial marking  $M_0$ .

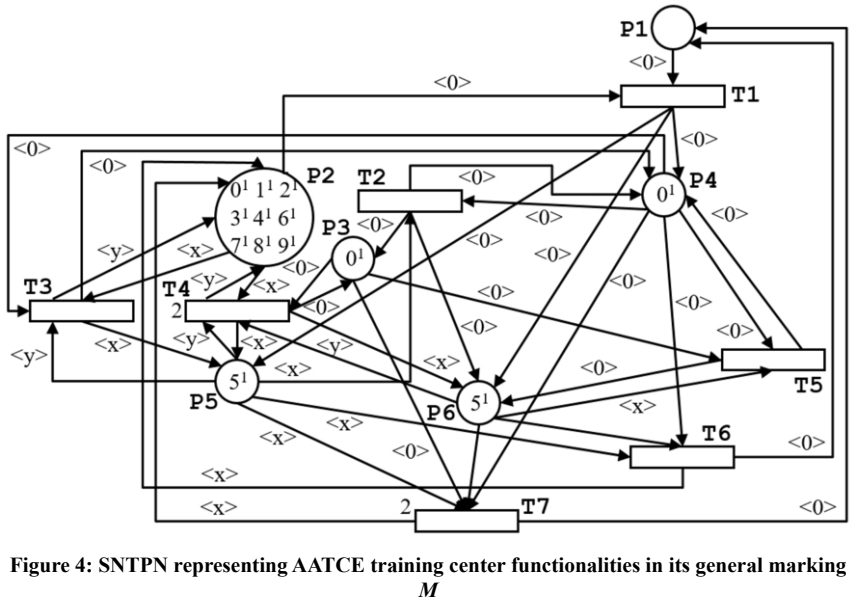


Figure 4: SNTPN representing AATCE training center functionalities in its general marking  $M$

It can be shown that the presented SNTPN in Fig. 3, is  $k$ -bounded (where  $k = 10$ ), deadlock-free and also live.

## CONCLUSION

At the Faculty of Economics, VŠB-Technical University of Ostrava, over 100 recordings of presentations were realized with the support of AATCE training center equipment and the comprehensive collections of the following subjects are available: Introduction to Programming (2<sup>nd</sup> year of Bachelor studies of Informatics in Economics), Dynamic Web Pages Creation (2<sup>nd</sup> year of Bachelor studies of Informatics in Economics), Programming of Internet Applications (3<sup>rd</sup> year of Bachelor studies of Informatics in Economics) and Artificial Intelligence and Expert Systems (2<sup>nd</sup> year of Master studies of Informatics in Economics). The rich-media recordings were published through the *EduArt Server* programming system that is also integrated with the LMS system *Moodle* in the present time. All the recordings are available in the on-demand mode as the part of the study materials for more than 70 students of relevant subjects who can go over the topic they did not fully comprehend again.

There is also verifiable improvement of the study results of the students (and particularly of

the students with special needs) in the context of the on-line or on-demand availability of the presentation recordings. Additionally, various forms of asynchronous communication of teachers with students were initiated and used in the so called pre-learning process, whereby the students have records of the selected topics presentations of the taught subjects for their disposal in advance. Hence, they can study them in detail coming to the particular lesson already equipped with information about the given topic. Presentation recordings becomes an excellent instrument for the support of education as it enables access to the educational process from multiple points, various time and any number of repetition.

## ACKNOWLEDGEMENTS

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# DO PRACTICE ENTRANCE EXAMS INCREASE THE PROBABILITY OF ACCEPTANCE TO A UNIVERSITY?

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## ABSTRACT

Since the number of potential applicants to universities is dropping, universities are looking for new ways of acquiring applicants and supporting their successful studies. One of the ways are practice entrance exams where the potential applicants can not only take practice entrance exams but can also see the environment where standard entrance exams are taken. University of Economics, Prague tried this in the 2016/2017 summer semester. The data that we had collected were analyzed using standard statistical functions. Our analyses looked for answers to four Research Questions. Overall, our analyses showed a slightly positive impact of practice entrance exams on regular entrance exam results at University of Economics, Prague. The positive impact is higher in English:

## KEYWORDS

Applicants, Examination, University, Mathematics, English

## INTRODUCTION

Current demographic trends confirm that we have not yet reached the lowest number of students leaving high schools (Doucek, 2010). We should reach this bottom in the following two years, and the number of potential applicants to universities should then gradually go up (Svátková, and Maryska, 2016; Doucek, Maryska, Nedomova and Novotny, 2011).

Although the number of potential applicants to universities shall soon go up (Kuncová, Bíza Bisová and Mulač 2015), universities consider it necessary to increase not only the number of applicants but also the number of accepted students, while maintaining their quality, of course. The University of Economics, Prague (UEP) also decided to implement practice entrance exams. These exams are to allow potential applicants to test their actual knowledge and to compare it with UEP's expectations - more detail for example in (Doucek and Maryska 2015). UEP makes it possible for applicants to take practice entrance exams in the main subjects of standard entrance exams, i.e. mathematics and English, as well as potentially in other languages (German, Russian, French and Italian). The number of practice entrance exams is not limited; these exams can be taken repeatedly on the days announced by UEP. However, the number of days of practice entrance exams is limited. Organization of the practice exams simulates the processes of real entrance exams and gives chance to participants to get experience for it by this way.

The goal of practice entrance exams is not only to allow the applicants to test their

knowledge but also to get acquainted with the university environment and the atmosphere of entrance exams. This should reduce their stress during standard entrance exams taken in an unknown environment, which – more often than lack of knowledge - is the cause of failing standard entrance exams.

Nowadays, practice entrance exams are a very popular trend not only at universities but also at elementary and high schools (Na necisto, 2017).

## **Problem Formulation**

The ever-dropping number of students is forcing universities to find ways to motivate applicants to study a certain study program and to increase the success rate in standard entrance exams, regular exams and state exams. Practice entrance exams are one of the ways to prepare students for standard entrance exams.

The analysis of the applicants' practice entrance exam results and standard entrance exam results and, in the long run, also the analysis of the study results of the applicants who passed the entrance exam, provide very interesting material for researching the correlation between practice entrance exam results and their impact on the success rate in standard entrance exams and studies as a whole. Systematic research of this matter brings out many research questions and work hypotheses (Maryska, Doucek, Mikovcová, and Nedomova, 2013; Doucek, Maryska and Novotny, 2013). For this article, we chose the following Research Questions (RQ):

- RQ1: Do at least 50% of applicants pass practice entrance exams?
- RQ2: Shall a student who passed a practice entrance exam also pass the standard entrance exam?
- RQ3: Do students who obtained a higher number of points in a mathematics practice entrance exam have a higher number of points in the mathematics standard entrance exam?
- RQ4: Do students who obtained a higher number of points in an English practice entrance exam have a higher number of points in the English standard entrance exam?

## **MATERIAL AND METHODS (DATA COLLECTION)**

The study information system of the University of Economics, Prague, includes a huge volume of data about study results, entrance exam results and, starting in the 2015/2016 summer semester, also practice entrance exam results. This system contains data about all applicants and students who filed a practice entrance exam application, filed a standard application or were accepted to UEP. In addition, the system contains data about passed exams and the number of points that an applicant or student obtained. This article does not include regular exam results (the data for the 2016/2017 winter semester, which has not yet ended, represent a very small data sample for performing an extensive analysis and making conclusions) and focuses only on practice entrance exam results and standard entrance exam results and their correlation.

Practice entrance exams are currently offered only for the bachelor program and at UEP's two faculties:

- Faculty of International Relations (FIR)
- Faculty of Informatics and Statistics (FIS)

Standard entrance exams are central entrance exams that all applicants must take, provided that they are not accepted to UEP in some other way, e.g. without taking the entrance exam, based on SCIO exams or based on their high school grades. The data collected for

our research were anonymized in compliance with the provisions of Act No. 101/2000 of Coll., on the protection of personal data.

## **Methodology**

We used filters and/or SQL questions to select data for a data sample for each analysis performed in order to find answers to the Research Questions. We calculated probability based on the entire data sample of all records, which was not necessary to adjust.

We used a correlation analysis for data samples concerning RQ3 and RQ4. For the purposes of the correlation analysis (Hebák, Hustopecký and Malá, 2005), it was necessary to adjust the data sample. For the correlation analysis concerning the “Mathematics” subject, we excluded all records with no mathematics entrance exam result or no mathematics practice entrance exam result. This situation occurred if the student was accepted without taking the entrance exam or did not come to take the entrance exam. The correlation analysis concerning English was adjusted similarly. We excluded all records with no English entrance exam result or no English practice entrance exam result.

## **General Data Characteristics**

UEP currently has 156,492 records about entrance exams. These records have been kept since 2009. Each record contains information about the faculty to which a student applied, information about the student’s entrance exam result, information about whether the student was accepted, information about which high school the student came from, information about the student’s nationality and other information.

UEP has 482 records about practice entrance exams from 397 applicants that have been monitored since 2016. UEP monitors practice entrance exam results (number of points obtained) and the date of a taken practice entrance exam. Practice entrance exams are linked through a unique identifier to a group of standard entrance exams. If a practice entrance exam record does not contain this identifier, it means that the applicant who took the practice entrance exam did not file an application to UEP. Our analyzed data sample did not show such a case.

With respect to the 482 practice entrance exam records, a total of 669 applications were filed in 2016/2017 to all faculties of UEP. This means that the applicants often file more than one application. Since more than one application can be filed and more than one practice entrance exam can be taken, we ended up with 847 records about entrance exam results in combination with practice entrance exams.

## **RESULTS AND DISCUSSION**

### **General Overview**

As part of UEP’s research, 482 records about practice entrance exams from 397 applicants were identified. Practice entrance exams are offered at two faculties – FIR and FIS - on several different days (in 2016, four different dates for each faculty), and every applicant can sign up for one or several exam dates. The details about the sample structure are provided in Table 1, including the number of exams taken in mathematics (MAT), English (ENG), German (GER), Italian (IT), Russian (RU) and French (FR).



Test in Certain Day	Number of Participants	MAT	ENG	GER	IT	RU	FR
FIR-01	35	35	35	21	0	1	3
FIR-02	50	50	49	26	2	4	14
FIR-03	34	34	34	14	0	7	6
FIR-04	53	53	53	22	1	9	7
<b>Total FIR</b>	<b>172</b>	<b>172</b>	<b>171</b>	<b>83</b>	<b>3</b>	<b>21</b>	<b>30</b>
FIS-01	49	46	49	0	0	0	0
FIS-02	101	94	101	0	0	0	0
FIS-03	68	63	68	0	0	0	0
FIS-04	92	88	91	0	0	0	0
<b>Total FIS</b>	<b>310</b>	<b>291</b>	<b>309</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

**Table 1: Number of Participants in Tests – Practice Entrance Exams (source: authors)**

Table 1 shows that, overall, more applicants were interested in practice entrance exams offered at FIS. Their number is almost twice as big in comparison to FIR. When comparing the number of applicants and the actual number of participants, we can see that many applicants take several practice entrance exams.

Out of the 397 applicants, 73 took a practice entrance exam more than once (18.39%). 13 applicants took a practice entrance exam three times (3.28%) and 3 applicants took a practice entrance exam four times (0.76%). Out of all these applicants, 13 applicants (3.28%) took an exam at both FIR and FIS.

### Practice Entrance Exam Results

When analyzing practice entrance exam results, we reached the conclusions that are shown in the following tables.

One of the requirements for passing the standard entrance exam at UEP is to obtain a sufficient number of points in MAT and in the selected language (or languages). The standard limit is 50 points. Table 2 shows the percentage of practice entrance exams with 50 and more points.

Test	MAT	ENG	GER	IT	RU	FR
FIR-01	29%	100%	67%		100%	67%
FIR-02	48%	92%	69%	0%	75%	29%
FIR-03	47%	91%	71%		57%	100%
FIR-04	60%	94%	82%	0%	100%	43%
<b>Total FIR</b>	<b>48%</b>	<b>94%</b>	<b>72%</b>	<b>0%</b>	<b>81%</b>	<b>50%</b>
FIS-01	43%	82%				
FIS-02	56%	86%				
FIS-03	48%	87%				
FIS-04	61%	86%				
<b>Total FIS</b>	<b>54%</b>	<b>85%</b>				
<b>Total</b>	<b>52%</b>	<b>89%</b>	<b>72%</b>	<b>0%</b>	<b>81%</b>	<b>50%</b>

**Table 2: Percentage of Tests With 50+ Points (source: authors)**

Table 2 shows the following:

- The success rate in mathematics was higher at FIS. The lowest success rate at FIR-01 was only 29%, while the lowest success rate at FIS was 43%; the highest success rate was also achieved at FIS.
- As expected, the situation in English was different. Better results were achieved at FIR, where the success rate in all cases exceeded 90%. Interestingly, the success rate in the Italian language was 0%, but on a very small sample, and the success rate in the French language was 29% in 14 applicants at FIR-02.
- When analyzing the data samples separately for FIR and FIS, we can see that the success rate in mathematics was lower at FIR than at FIS and was less than 50%, and the same is true about the Italian language. (RQ1) **In this case**, at least 50% of applicants do not pass practice entrance exams. **In all other cases**, at least 50% of applicants pass practice entrance exams, **and also in the case of aggregate data for FIR and FIS** at least 50% of applicants pass practice entrance exams.

Table 3 provides a similar analysis as Table 2, but shows the percentage of tests with 40 and more points.

Test	MAT	ENG	GER	IT	RU	FR
FIR-01	40%	100%	90%		100%	67%
FIR-02	60%	98%	73%	0%	75%	29%
FIR-03	59%	100%	93%		86%	100%
FIR-04	72%	98%	95%	0%	100%	57%
<b>Total FIR</b>	<b>58%</b>	<b>99%</b>	<b>88%</b>	<b>0%</b>	<b>90%</b>	<b>63%</b>
FIS-01	53%	93%				
FIS-02	70%	98%				
FIS-03	71%	100%				
FIS-04	73%	99%				
<b>Total FIS</b>	<b>67%</b>	<b>98%</b>				
<b>Total</b>	<b>65%</b>	<b>98%</b>	<b>72%</b>	<b>0%</b>	<b>81%</b>	<b>50%</b>

**Table 3: Percentage of Tests With 40+ Points (source: authors)**

Of course, the achieved success rate went up, except for FIR-01 where the success rate in the first mathematics practice entrance exam was only 40%. The English practice entrance exam results at FIS show an interesting change; the success rate was over 90% and over 98% in three out of four cases.

## Success Rate in Entrance Exams

The purpose of practice entrance exams is to help students to identify their weaknesses and to reduce their potential stress from the entrance exam. The tables below focus on the results of the applicants who took a practice entrance exam and applied to UEP.

Table 4 shows the entrance exam results of the applicants who obtained 50+ points (category 50+) in a practice entrance exam or obtained less than 50 points in at least one subject of a practice entrance exam. “Accepted,” “Not Accepted” and “Did Not Take the Entrance Exam” represent the entrance exam result. The values 50+ and 50- represent the practice entrance exam result.

Faculty	Accepted		Not Accepted		Did Not Take the Entrance Exam	
	50+	50-	50+	50-	50+	50-
FFA	55	27	40	38	10	17
FIR	83	70	9	25	7	12
FBA	85	62	32	61	8	15
FIS	29	11	16	18	6	5
FE	1	9	37	38		
FM	2	15			2	2
Total	255	194	134	180	33	51

**Table 4: Standard Entrance Exam Results of Applicants (source: authors)**

**Legend:** FFA – Faculty of Finance and Accounting, FIR - Faculty of International Relations, FBA – Faculty of Business Administration, FIS - Faculty of Informatics and Statistics, FE – Faculty of Economics, FM – Faculty of Management.

**Based on Table 4, we conclude the following:**

Out of 847 applicants, 422 passed a practice entrance exam, which is about 49% (the percentage is lower in Table 2 because in this case we require the applicants to pass both the math exam and the English exam). However, out of the 422 applicants who passed a practice entrance exam, only 255 applicants were accepted, i.e. 60.43%. Therefore, for RQ2 we can say that student who passed a practice entrance exam also pass the standard entrance exam, but only with a 0.6 probability.

In analyzing this outcome in detail, we can say that out of the 82 applicants accepted to FFA, 55 applicants passed a practice entrance exam while 27 failed. The situation is different in the case that they were not accepted. In this case, 40 applicants out of 78 passed a practice entrance exam, but were not accepted, and 39 applicants failed a practice entrance exam. The category “Did Not Take the Entrance Exam” provides the most interesting finding: 10 applicants who passed a practice entrance exam did not take the entrance exam.

Other faculties also show similar results in the category “Accepted,” except for FE and FM. Nine students were accepted to FE and 15 students were accepted to FM, although they failed a practice entrance exam.

In the search for answers to other research questions, we shall focus only on two key subjects of the entrance exam, i.e. mathematics and English.

Table 5 describes the statistical sample used for the correlation analysis of mathematics practice entrance exam results and standard entrance exam results.

The Table 5 and 6 are based on set of data from students which participates both practice entrance exams (mathematics and English) and both standard entrance exams (mathematics and English). From this reason, we have the same amount of observations (n=648) for both subjects (mathematics and English).

Based on 648 records, we found out that the mean of the mathematics standard entrance exam result was higher by 13 points as compared to that of the practice entrance exam result and that the median was actually higher by 18 points. In terms of Skewness and Kurtosis, the data in the entrance exam sample are slightly right-skewed and their distribution is flatter. They are not as flat as the data in the practice entrance exam sample; however, they are still below the normal distribution, and the distribution is left-skewed. There were identified outliers records in this data set. The share of 5 % of it were between 0 -10 obtained points either from standard entrance exams or for practice entrance exams.

Measure	Mat - Practice	Mathematics - Standard Exam
Mean	51.860	64.938
Standard Error	0.954	1.053
Median	50	68
Standard Deviation	24.272	26.808
Sample Variance	589.138	718.682
Count (N)	648	648
Confidence Level (95.0%)	1.872	2.068

**Table 5: Descriptive Statistics – Mathematics Entrance Exams (source: authors)**

Our correlation analysis of the mathematics practice entrance exam result and the standard entrance exam result under the mentioned assumptions identified a 0.5375 correlation, which is a slightly positive correlation, i.e. if an applicant has a better practice entrance exam result in mathematics, he/she shall have a better result in the standard entrance exam. The answer to RQ3 is that students who obtained a higher number of points in a mathematics practice entrance exam have a higher number of points in the mathematics standard entrance exam.

Measure	ENG – Practice	English Standard Exam
Mean	69.858	73.323
Standard Error	0.595	0.656
Median	71	76
Standard Deviation	15.152	16.687
Sample Variance	229.590	278.463
Count (N)	648	648
Confidence Level (95.0%)	1.169	1.287

**Table 6: Descriptive Statistics – English Entrance Exams (source: authors)**

Based on 648 records about English, we found out that the mean of the English standard entrance exam result was higher by only 3.5 points (the median was higher by 5 points) as compared to that of the practice entrance exam result, i.e. English results are much more even. In terms of Skewness and Kurtosis, the data in the entrance exam sample are left-skewed and their distribution is sharper. The normal distribution curve is sharper and left-skewed as compared to that of the English practice entrance exam result. There were no identified outliers records in this data file

Our correlation analysis of the English practice entrance exam result and the standard entrance exam result identified a 0.6746 correlation, which is a moderate positive correlation, i.e. if an applicant has a better practice entrance exam result in English, he/she shall have a better result in the standard entrance exam. **The answer (RQ4)** is that students who obtained a higher number of points in an English practice entrance exam have a higher number of points in the English standard entrance exam

## CONCLUSION

Based on the performed analysis, we reached the following several conclusions: The goal of RQ1 was to find out whether at least 50% of applicants pass practice entrance exams. By analyzing the data sample separately for FIR and FIS, we found out that the success rate in mathematics was lower at FIR than at FIS and was less than 50%. The success rate in the Italian practice entrance exam was also less than 50%. In this case, at least 50% of applicants do not pass practice entrance exams. In all other cases, at

least 50% of applicants pass practice entrance exams and this is also true in the case of aggregate data for FIR and FIS.

We found out that out of the 422 applicants who passed a practice entrance exam, only 255 applicants were accepted, i.e. 60.43%. Therefore, a student who passed a practice entrance exam shall also pass the standard entrance exam, but only with a 0.6 probability. Only 60% of applicants who passed a practice entrance exam shall pass the standard entrance exam.

Our correlation analysis of the mathematics practice entrance exam result and the standard entrance exam result identified a 0.5375 correlation, which is a slightly positive correlation, i.e. if an applicant has a better practice entrance exam result in mathematics, he/she shall have a better result in the standard entrance exam. RQ3 - Students who obtained a higher number of points in a mathematics practice entrance exam have a higher number of points in the mathematics standard entrance exam.

Our correlation analysis of the English practice entrance exam result and the standard entrance exam result identified a 0.6746 correlation, which is a moderate positive correlation, i.e. if an applicant has a better practice entrance exam result in English, he/she shall have a better result in the standard entrance exam (for different conditions also analyzed in Lee and Lee, 2016; Zaif, Karapinar and Eksi, 2017). Students who obtained a higher number of points in an English practice entrance exam have a higher number of points in the English standard entrance exam.

The results between the individual practice entrance exam rounds significantly differ, in particular in mathematics.

The data sample of practice entrance exams shows a moderate positive impact of practice entrance exams on entrance exam results at UEP.

In comparison to other approaches to practice exams mentioned e.g. in (Plotr, 2016). Their indisputable advantage is that they can considerably help to reduce procrastination. *“Research suggests that 75% of students consider themselves to be procrastinators, with 50% doing so regularly and to a level that is considered a problem”* (Plotr, 2016). Steel (2007) also states that *“the further away an event is, the less impact it has on people’s decisions.”* Further positive impact of practice entrance exams are mentioned in (Guardian, 2015): *„Mock exams are important because they’re a chance to improve your knowledge, confidence and confidence in yourself. Find out why they really do matter. Teachers will use your mock exam grades to figure out realistic targets for your grades. Doing mock exams is important because it helps you look at your revision timetable“*. Further positive experience with practice exam are for example presented in (ShuangYing, 2015) for English and in (Rodriguez-Muniz, Diaz, Mier and Alonso, 2016) for mathematics.

We think that students’ entrance exam results can improve if practice exams are posted on the Internet where students can take them before taking them at the university. In our opinion, personal participation cannot be replaced by remote access because it allows students to get used to taking real exams.

In spite of a relatively small sample of analyzed data and so-far weak proven correlation between practice entrance exam results and regular exam results, we recommend implementing these exams.

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# ERROR ANALYSIS OF UNDERGRADUATE STUDENTS' SOLUTIONS OF GRAPH ALGORITHM PROBLEMS

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## ABSTRACT

Graph algorithms are a common part of undergraduate courses in discrete mathematics. Even though they were successfully implemented in secondary curricula, there is only little research dedicated to the analysis of students' work. Mistakes that occurred in solutions of three problems (the Chinese postman problem, the shortest path problem and the minimum spanning tree problem) of 127 students were categorised and compared. The categories of errors varied regardless the problem types. The Chinese postman problem was identified as the most problematic for students. The possible sources of this difficulty are discussed in more detail.

## KEYWORDS

Mathematics Education, Discrete Mathematics, Graph Theory, Graph Algorithms, Error Pattern Analysis

## INTRODUCTION

In recent years, the research of mathematics taught within other disciplines has been attracting as close attention as the research of tertiary mathematics education and it is related to the relevance of mathematics for particular science field (Biza et al., 2016). The community of computer scientists has discussed the necessity of discrete mathematics course in computer science undergraduate programs for several decades (Marion, 1989, Li et al., 2008). Since the Marion's paper (1991) the graph theory has been embedded in nearly all courses in discrete mathematics for computer science in Slovakia and worldwide (Turčáni and Kuna, 2013). Various approaches to discrete mathematics courses have been piloted (Gries and Schneider, 1995, Paterson and Sneddon, 2011, Li et al., 2008) mostly based on computer support (Milková, 2009), particularly by e-learning courses (Vidermanová et al., 2007, Karagiannis et al., 2006).

Despite Niman's idea (Niman, 1975) that graph theory "could constitute a plausible and exciting alternative in mathematics education" as early as on primary level, it permeates school curricula very leisurely (Fest and Kortenkamp, 2009). Several authors (Yanagimoto et al., 2004, Geschke et al., 2005) described their experience in education of graph theory algorithms at secondary level; yet, it often happens that students encounter this topic not earlier than in undergraduate discrete mathematics courses. According to (Gries and Schneider, 1995) discrete mathematics courses should motivate students to use rigorous mathematical approach in solving problems in computer science. Other researchers (Lodder, 2014, Cigas and Hsin, 2005) describe empirical experience with unconventionally designed lessons, but only few of these papers include analyses of

students' thinking (Paterson and Sneddon, 2011, Vidermanová and Melušová, 2011) or possible misconceptions (Alstrum, et al., 2006).

One way to diagnose the misconceptions is error analysis (or error pattern analysis) as errors offer a picture of students' mind in some sense (Brodie, 2014). An error analysis focuses on weaknesses in procedural knowledge (Ketterlin-Geller and Yovanoff, 2009). It can be dated back to Borasí (1987). It is a process of reviewing students' item responses in order to identify a pattern of misunderstandings (Ketterlin-Geller and Yovanoff, 2009). An analysis of mistakes can localize mistake sources and provide students with valuable feedback (Hejný, 1989). On the other hand, an error analysis is not a satisfactory tool to analyse mathematical thinking of students from the cognitive point of view.

The main aim of this study is to identify types of students' mistakes that occur in problems related to graph algorithms and to compare the occurrence of the mistakes based on the kind of the problem.

## **MATERIALS AND METHODS**

### **Description of the settings**

The study was conducted during the discrete mathematics course for students of applied computer science and future informatics teachers. It is a compulsory course which is usually taken in the second semester of the study. Altogether 135 students were enrolled in the course, 127 out of whom took the course. Only the solutions of the latter were subjected to the error analysis.

The discrete mathematics course is spread over two consecutive semesters. In the first semester topics such as basic logic; sets, relations and functions; and introduction to number theory are covered. In the spring semester the basic counting and graph theory are introduced. The graph theory part of the course is oriented towards graph algorithms. The minimum spanning tree (MST) problem was introduced to students via its very first application. In 1920s the electrification of northern part of Moravia was planned. Otakar Borůvka was asked for help. He designed the optimal network and generalized his approach. Students were provided with the unweighted graph. Its vertices represented the towns and its edges represented the possibility to build a direct electric connection between the towns. The task was to find the minimum amount of edges needed for connecting all the towns. Students found several non-isomorphic solutions. Afterwards, the tree and spanning tree were defined and characterization theorem for trees was proved by the lecturer. Students then solved the same problem on a weighted graph; they were asked to find the cheapest spanning tree. Some of the students managed to come up with Kruskal's algorithm or some of its variants. The procedure is described in more detail in (Vidermanová and Melušová, 2011). After solving the problem, three algorithms were introduced and proved: Kruskal's algorithm, the reverse-delete algorithm (which is dual to Kruskal's one), and Jarník-Prim's algorithm. After the problem-solving activity the algorithms were formally described and proved by means of mathematical induction.

All the three algorithms belong to greedy algorithms and the Jarník-Prim's one is a typical demonstration of dynamical programming. A more detailed description of all the three algorithms can be found e.g. in (Chartrand and Oellermann, 1992).

Kruskal's algorithm starts with all vertices of the graph and no edges. The cheapest edges are added to the graph, while every added edge is required not to create a circle in the constructed subgraph. The reverse-delete algorithm starts with the full graph and



deletes the most expensive edges. The deleted edge is required not to be a bridge, i.e. the constructed subgraph has to remain connected.

Jarník-Prim's algorithm is sometimes referred to as Prim's algorithm, though it was published by Jarník first. The algorithm uses the idea of dynamical programming. Starting by single vertex, the cheapest edge connecting already constructed subgraph with not-yet-connected vertices is added. In each step the constructed subgraph is a minimum spanning tree of the graph induced by vertices already used. This subgraph is called the optimal substructure in algorithmization.

The second problem covered in the course is the shortest path problem. Similarly to the MST problem, this problem was introduced to students through its application. The lecturer presented how to find the shortest connection between two chosen train stops in the graph representing a part of Slovak railway network. After the solution on an unweighted graph, the weighted alternative was solved. Afterwards, the algorithm was formalized and proved by means of mathematical induction.

Dijkstra's algorithm is another greedy algorithm using dynamical programming. It consists of two stages. Firstly, the distance from one vertex to all other vertices is computed. Secondly, the shortest path is described. In the course the two possibilities to find the path were introduced. The first one is based on tracing the computation; the second possibility draws on differences between the values of the vertices.

The third problem is the Chinese postman problem. The aim of the algorithm is to find the optimal route for the postman. We used the solution introduced by Edmonds and Johnson. In the first part of the computation the streets (edges) where the postman is required to walk twice are estimated, and then the Eulerian circle is found. Students worked in groups on designing the algorithms for constructing Eulerian circle and Eulerian trail before solving the Chinese postman problem. The Eulerian circle can be found by two algorithms. The Euler-Hierholzer's algorithm is based on Hierholzer's addition to proof of the Euler's theorem stating the necessary condition for a graph to be Eulerian. The second possibility was the Fleury's algorithm, another greedy algorithm using dynamical programming.

## **Data**

At the end of the course, as a part of the final assessment, students took a paper-and-pencil test that contained 14 problems: four problems in combinatorics, nine problems in graph theory, and one enumeration problem where the base set are graph edges and vertices. In this paper we analyse three problems which measured the comprehension (the second level of Bloom's taxonomy) of the above mentioned algorithms. If several algorithms for solving one problem were presented, students could decide for any of them. They could even use their own approaches providing that they able to prove the correctness of their solution.

The students' solutions were coded 1 (correct) and 0 (not correct). Mistakes identified in incorrect solutions were categorised and further analysed.

## **Statistical analysis**

The statistical analysis of the obtained data was performed in the software environment R, packages RVAideMemoire and DescTools. The success-rates in the three problems were compared by Cochran Q test which is the generalisation of McNemar test for two independent samples. The three problems were considered as three independent samples.

Subsequently, the post-hoc analysis comparing each pair of problems was performed by McNemar test.

The occurrence and distribution of students' mistakes in the three problems was compared by  $\chi^2$  test of independence. The  $p$ -value was estimated by the Monte Carlo method.

## RESULTS AND DISCUSSION

In more than one third of the tests, all the three solutions were correct. There were only three tests with a mistake in each algorithm (Tab. 1). The success-rates of the problems are summarised in Table 2. The results obtained from Cochran's Q test ( $Q(2) = 24.76$ ;  $p < 0.001$ ) imply that the three problems were not equally demanding. The Chinese postman problem was significantly more problematic in comparison with the remaining two problems. It may be caused by higher complexity of the algorithm which demands more calculations, therefore, students have more chances to make a mistake.

Number of correctly solved problems	Frequency	Relative frequency
3 correct solutions	50	39.4 %
2 correct solutions	62	48.8 %
1 correct solution	12	9.4 %
0 correct solutions	3	2.4 %
Total	127	100.0 %

**Table 1: Frequencies of correctly solved problems in one test (source: own calculation)**

Problem	Number of students who attempted to solve the problem	Number of correct solutions
Minimum spanning tree problem	122	110 <sup>a</sup>
Shortest path problem	112	100 <sup>a</sup>
Chinese postman problem	117	76 <sup>b</sup>

*Values signed by the same letter do not differ significantly according to McNemar test ( $p = 0.01$ )*

**Table 2: Success-rates of analysed problems (source: own calculation)**

The two problems (MST, SP) demanding only knowledge and comprehension (Bloom, 1956) did not differ significantly ( $p = 0.121$ ), although MST problem was introduced by a problem-solving activity, unlike the shortest path problem. This is in contradiction with the opinion of Kirschner et al. (2006) who claim that problem-based and inquiry-based teaching are not efficient ways to teach mathematics.

### Problem 1: Minimum spanning tree problem

The first problem had the highest success-rate among the three analysed problems. The students were allowed to choose from three algorithms described above: Jarník-Prim's, Kruskal's and reverse-delete algorithm. Surprisingly, the latter was not used at all. We considered it equivalent to Kruskal's algorithm that was used by 115 students. All the six solutions by Jarník-Prim's algorithm were correct. It may be caused by the nature of the algorithm. It requires higher insight into the idea of dynamical programming and higher level of recursive thinking comparing to Kruskal's algorithm. Recursive thinking is characterised as an ability to recognise "that the smaller case to which a problem is reduced must have the same... structure as the original problem" (Almstrum et al., 2006). When using Kruskal's algorithm, the following mistakes occurred (Tab. 3).

Category	Description of mistake	Frequency
A	Wrong approach. Student tried to list all the spanning trees and compare their values (3 spanning trees listed)	1
B	Wrong order of selection of edges (caused by omitting to sort the list of weights of edges)	5
	Creating a circle (continuing the computation after the computations should have been stopped according to the algorithm)	2
C	Assigning a wrong edge to the weight in the list	1
D	Numerical mistake when estimating the value of the spanning tree	3
Total		12

**Table 3: Frequencies of mistakes in students' solutions of the minimum spanning tree problem (source: own calculation)**

### Problem 2: Shortest path problem

This problem was solved by 112 students; 100 students solved the problem correctly. The solution consists of two stages. Firstly, the vertices of the graph are given weight according their distance from chosen vertex. Secondly, the shortest path is determined. In the second stage students were allowed to choose from two methods. Tracing table was used by 90 students; method using differences between weights of vertices was used by 12 students. Two students used their own modifications of the difference method. The second stage of the algorithm was not performed by three students (Tab. 4). Students who used wrong approach to determine the weight of vertices (category A mistake) shown low level of recursive thinking in sense of (Almstrum et al., 2006).

Category	Description of mistake	Frequency
A	Wrong approach to determine the weight of vertices	5
B	Skipping the determination of the path	3
D	Numerical mistake in determination of the weight of vertices	1
	Numerical mistake when using the difference method for determination of the path	2
	Graphical mistake when using the tracing table for determination of the path (confusion of vertices labels C and G)	1
Total		12

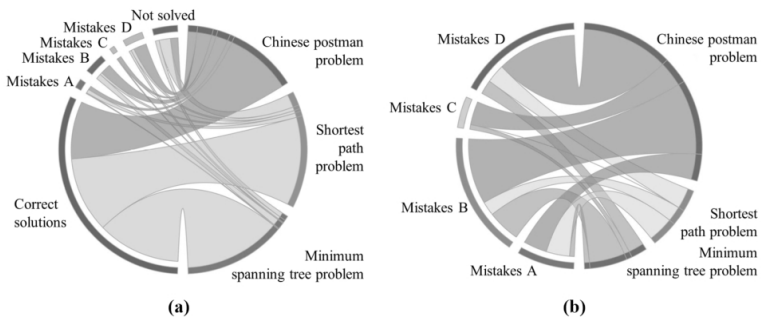
**Table 4: Frequencies of mistakes in students' solutions of the shortest path problem (source: own calculation)**

### Problem 3: Chinese postman problem

Out of 127 students who took the test as many as 117 attempted to solve the problem and only 76 came up with a correct solution. The mistakes and their frequency are shown in Table 5. The most problematic part of the solution was to identify which edges should be covered twice. Most problems occurred in determination of the distances between the pairs of vertices with odd degree (there were only three pairs of odd-degree vertices). In some cases the shortest path was obvious, but there were pairs where use of Dijkstra's algorithm was very advantageous. The students could choose the way how to construct Eulerian circle in the modified graph with added edges. Out of 95 students who reached this point in their solutions five students did not solve it at all, 89 used Euler-Hierholzer's algorithm, and one student used his own modification of this algorithm. Fleury's algorithm was not used by any student.

Category	Description of mistake	Frequency
A	Wrong approach	5
B	Wrong estimation of distance between vertices in three and more cases	7
	Wrong pairing of odd-degree vertices	3
	Skipping the determination of Eulerian circle	4
C	Wrong estimation of distance between vertices in one case	2
	Wrong estimation of distance between vertices in two cases	3
D	Numerical mistake in the sum of the distances	12
	Graphical mistake in determination of Eulerian circle	5
Total		41

**Table 5: Frequencies of mistakes in students' solutions of the Chinese postman problem (source: own calculation)**



**Figure 1: Circular graphs representing the relation between problems and results (a) and between problems and mistakes (b) (source: own visualisation)**

## Analysis

The mistakes described in the previous section were assigned to one of the following categories. Category A contains solutions where students started to solve the problem, performed some calculations which, however, were neither based on the algorithm presented within the course, nor led to a correct solution. These kinds of errors are called *helplessness and wanderings* by (Hejný, 1989). Category B comprises solutions where students knew how to start but they were not able to solve a part of the solution (e.g. to determine the path after assigning the values to the vertices in shortest-path problem) or did not solve it correctly, i.e. *operational errors*. The category C covers mistakes arising from the students' instantaneous inattention which are not based on single numerical or graphical error, they are usually caused by so-called *big steps* and/or omitting written recording of the calculation process. They are typically made by students in a hurry or by students overestimating their abilities. In order to overcome these types of errors it is necessary to establish the way how to trace the calculations. Category D includes solutions with a single numerical or graphical mistake (e.g. confusion of numbers 4 and 7). There are two main sources of these errors: (1) insufficient automatization of lower operations which demonstrates when the student is focused on solving problems requiring higher processes; (2) underestimating the clarity of their written recordings of the solution. Some authors (Ketterlin-Geller and Yovanoff, 2009) refer to such mistakes as *slips*.

The overview of the mistakes according to the defined categories is presented by means of circular graphs (Fig. 1). The categories B (operational errors) and D (slips) seem to be

larger than the other two. Mistakes of both of these types can be remedied by more practice resulting in deeper automatization of mental operations. The category of mistake is not in relation with the problem type ( $\chi^2(6) = 9.69$ ; Monte-Carlo estimation of  $p = 0.131$ ). In other words, the relative frequency of each mistake category is similar for each analysed problem.

## CONCLUSIONS

Eight out of 41 mistakes in solving the Chinese postman problem were caused by a wrong estimation of the distance (the length of the shortest path) between correctly stated pairs of odd-degree vertices. On the other hand, the same students managed to solve the shortest path problem within the same test. This may indicate that correct application of the Dijkstra's algorithm in context of other problems requires higher cognitive skills (Bloom, 1956) comparing to simple parroting of the algorithm to a given graph.

In this paper we tried to bring some insights about students' work when solving problems by direct use of graph algorithms. We are aware that a mere look at students' mistakes is insufficient in defining the sources of students' difficulties related to higher cognitive skills and should be accomplished by diagnostic interview. Deeper analysis of students' recursive reasoning and inductive thinking employed in solving more demanding problems in discrete mathematics is subject for further research.

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# PARENT-TEACHER RELATIONS IN RUSSIAN EARLY CHILDHOOD EDUCATION AND CARE

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## ABSTRACT

The present paper investigates key issues involved in the process of interaction between the parents of pre-school children and specialists working with these children in Russian nursery education organisations. It is shown that the new Federal Early Education Standard introduced in Russia in 2013 requires both parties to undertake coordinated efforts in order to provide favourable conditions for every child's moral, practical ("labour"), intellectual and ethical development. The results of an empirical study show that parents and early childhood education specialists currently lack a shared understanding of which qualities should be primarily formed in 2-3 year-old children. It is noted that the majority of parents are in need of assistance from education professionals regarding such questions as how to develop a child's ability to self-organize and to independently solve problems that arise both in their individual cognitive and play activities as well as in their interaction with peers. However, the qualification level of such professionals turns out to be insufficient for facilitating, in cooperation with parents, the development of a set of qualities such that children can fully realize their talents and form appropriate cultural communication patterns.

## KEYWORDS

Childhood, Early Childhood Education and Care, Educators, Parents, Parent-teacher Relations, Teachers

## INTRODUCTION

Early childhood education is a constitutive element of the Russian education system, which is aimed at the education and development of a child's personality. This can be seen in terms of a society, whose centre is formed by children of pre-school age. State nursery education organizations are intended in principle for children aged from 2 months to 7 years old; although, in practice, they are usually attended by children above the age of 2-3. According to the data provided by the Federal State Statistics Service of the Russian Federation, the number of kindergartens amounted to 50.1 thousand in 2015, with 7151.6 thousand children or 66.2% of all children attending them (Federal State Statistics Service of RF, 2015).

Based on the requirements that contemporary society impose on the system of education and upbringing, the main function of pre-school education becomes the socialization of the younger generation (Nance, 2009) as a process of familiarizing the child with the culture by nurturing the need for constant self-improvement and self-development.

Today's dynamically changing world requires people to undergo continuous change in terms of a willingness to keep on socializing under varying conditions that underpin all human activities – from everyday life, education and family to creativity in the work place. Thus, both family members and pre-school education teachers should be focused on

raising a self-developing personality starting from a child's early years. Previous research shows that pre-school teachers are not satisfied with the teacher-parent relationship, as well as with the role that parents play in the process of child education (Baum, and McMurray-Schwarz, 2004). However, the involvement of the parent community in this process is certain to facilitate a child's assimilation of social norms and values, as well as the formation of the desire to constantly develop by acquiring new knowledge and skills (Eldridge, 2001; Buell, Hallam, and Beck, 2001).

Although families and society have naturally differing requirements and possibilities, as well as a diverging understanding of what education should include, parents and pre-school teachers need to seek a common ground that would alleviate the personal developmental conflicts typical of an early age child. Extensive scientific research has revealed key mechanisms of how children acquire important social skills and competencies (Gallagher and Mayer, 2006; Lynch and Simpson, 2010; McClelland and Morrison, 2003) and of how to raise honest, kind and responsible human beings; however, very few parents know and apply these approaches. Hence, parents should be trained in applying modern educational methods; this then becomes a key function of early child education professionals. The realization of this function is likely to promote the professional development of the teacher community, which constitutes an essential human resource under the conditions of contemporary society.

In the context of the abovementioned, this paper sets out to investigate the problematic zones of interaction between nursery educators working in Russian state organizations and parents whose children attend them. Possible directions for establishing parent-teacher partnerships are outlined. On the basis of the conducted sociological survey, the following research objectives have been realized: (1) definition of the priority directions for pre-school education practices; (2) identification of parents' and teachers' perceptions, particularly with regard to the problem of which personal qualities should be developed in children within the family and which are the responsibility of pre-school education; (3) investigation of the specific features of the pedagogical assistance that parents need to receive from education organizations.

## **MATERIALS AND METHODS**

The activity of early childhood education teachers is regulated by a number of normative documents. Russia's National Framework for the Development of Education up to 2025 posits that "the development of a highly ethical personality sharing Russian cultural values, possessing relevant knowledge and skills, capable of realizing their potential under the conditions of contemporary society, prepared for peaceful creativity and the defense of the motherland" is a top priority of the Russian Federation in the field of education (Russia's National Framework for the Development of Education, 2015). Following this objective, educators working with pre-school children should focus on the development of moral norms that regulate child-parent, child-peer and child-other people relationships. In addition, it is necessary to provide a connection between traditional values and those arising in the modern, polycultural world, as well as to help every child to realize his or her talents in cognitive, play and creative activities.

In 2013, the Russian Federal State Standard of Early Childhood Education, which sets out the key priorities for the development of pre-school education, was adopted. These priorities are "social and normative characteristics of a child's potential achievements at the level of completion of the pre-school education stage" (The Federal State Standard of Early Childhood Education, 2013). This Directive states the need for a permanent



collaboration between educators working with children of different ages and their parents in the process of “forming the general culture of a child’s personality, including the values of a healthy lifestyle, the development of their social, moral, ethical, intellectual and physical qualities, as well as of proactivity, independence, responsibility and preparedness for further education” (The Federal State Standard of Early Childhood Education, 2013). Every pre-school education organization is given the right to independently determine how to achieve these abovementioned goals. It is considered that educators are capable of specifying the content of moral, labour and aesthetic orientations to be formed in children, as well as selecting adequate methods for their formation. In addition, teachers should coordinate their individual understandings of educational goals with those of the children’s parents.

Hence, the realization of the Standard’s requirements is to a large extent determined by whether parents and pre-school teachers have adequately developed orientations towards active and on-going cooperation, which 1) facilitates a child’s assimilation of both those norms and rules that will help him or her to comprehensively develop in the process of communication with peers, as well as of those cultural orientations that education specialists aim at; 2) provides an opportunity for professionals to apply the principles of individualized education on the basis of the information obtained from a child’s parents concerning his or her particular physiological and physical features; 3) provides a basis for the development of those moral, aesthetic, labour and intellectual qualities that constitute the aim of pre-school education practices.

In order to determine typical problems arising in the process of interaction between families and pre-school education organizations under the conditions of the new Federal Standard, we carried out a sociological survey in the major industrial city of Ekaterinburg in 2016, using questionnaires developed specifically for this project. Using the questionnaire method, 260 parents, whose 3-6 year-old children attended pre-school organizations, were asked a series of questions about difficulties that they experience when developing a child’s moral, labour and intellectual qualities, and to what extent education specialists are prepared for a collaborative work with parents when seeking optimal means for increasing the quality of their pupils’ education. The parent sample was selected as follows. On the basis of expert recommendations (specialists working in the Department of Education, Ekaterinburg), 10 typical pre-school organizations situated in different parts of the city were selected. In each organization, 26 parents, chosen on a random basis from various age groups, were questioned. In total, 87 parents (55 women and 32 men) having 3 year-old children, 87 parents (59 women and 28 men) having 4 year-old children and 86 parents (61 women and 25 men) having 5 year-old children were surveyed. All the respondents had 1-2 children and were married at the time of the study. The questionnaire offered to the respondents comprised 25 questions, 5 out of which were of open type. In addition, 115 pre-school teachers were questioned in order to elicit information regarding to what extents parents are oriented at the teacher’s assistance in the process of developing a child at all age stages and how parents react to specialists’ recommendations for developing a child’s particular qualities. The sample of pre-school education specialists was gathered using the convenience sampling technique, which meant that all teachers present at the time of the survey in 10 selected organizations were surveyed. The respondents’ work experience comprised: under 3 years – 15 teachers; from 3-10 years – 28 teachers; from 10-20 years – 37 teachers, and above 20 years – 35 teachers. The questionnaire offered to the pre-school education specialists consisted of 15 questions, 3 out of which were of open type.

## **RESULTS**

### **Parents' awareness of the Federal Early Childhood Education Standard**

Our research has shown that the majority of parents are not familiar with the requirements concerning the work of early childhood education specialists formulated in the new Federal Early Childhood Education Standard. Of all the respondents, 35% mentioned hearing from the pre-school administration that the work of education specialists is regulated by the aims and objectives set out in this directive. About 12% of the respondents said that they have a very general idea of the Standard's content. Therefore, it seems unlikely that parents would refer to the Standard's requirements when discussing specific educational approaches and directions with pre-school specialists.

### **Key objectives for the pedagogical activity of early childhood educators**

It has been found that parents and teachers have diverging understandings of key education priorities. Thus, children's legal guardians are convinced that early childhood education professionals should, first of all, develop their pupils through play, cognitive and artistic activities. In aiming at this development, teachers and assistants are expected to provide 1) children with every opportunity to reveal their creative inclinations; 2) conditions for children to constantly master acquired skills in the course of specific, purpose-built lessons. Pre-school education specialists are shown to be unprepared to meet these expectations. Interestingly, the teachers ranked the abovementioned objective as the third most important, with the goal of improving and securing children's health being given the top priority. Undeniably, the latter requirement is obligatory for all education specialists; however, in ranking it as most important, teachers reproduce traditional perceptions of the role of an education organization as an institution whose main function is to guarantee the safety of children during the time when their guardians are busy at work.

Where the opinions of the teachers and parents coincided was the objective relating to the development of those knowledge and skills that are essential in a child's everyday life. Both parties noted the significance of skills regulating moral behaviour in the process of communication with various people. In addition, the teacher and parent respondents shared similar viewpoints concerning the objectives of preparing a child for further successful education on the basis of the formation of a need to explore the world.

### **Children's social qualities formed within the family and within the early childhood education organization**

Our research has identified parents' attitudes towards which social qualities should be formed within the family, and which are the responsibility of pre-school educators (Table 1).

This data points to a clear distinction that parents draw between the responsibilities borne by families and pre-school organizations. Such an understanding significantly limits the possibility for productive collaboration between these two parties in the process of developing a child's aesthetic, moral, labour and intellectual qualities.

On the one hand, it is indeed difficult to develop a child's skills of helping close people within an education organisation, since such abilities are normally formed when taking care of parents and other relatives in home settings. On the other, children should be taught how to control their emotions – in particular negative ones – not only at home, but also in communication with peers. Although this ability can be considered as an indicator of a highly developed communication culture, only 9% of the parents believed it to be

the goal of pre-school education specialists. Another hard-to-interpret opinion is the parents' belief that discipline and self-control should be trained by teachers rather than within the family. Clearly, for such qualities to be formed, parents need to make efforts to effectively organize a child's everyday activities by assigning feasible housework responsibilities and stimulating the independent development of new competencies. It is under these conditions when willpower, patience and self-control – all qualities that constitute discipline – are developed rather naturally.

Which qualities should be formed within the family, and which are the responsibility of pre-school educators?	Family	Pre-school education organization
Skills of helping other people	74%	10%
Ability to control emotions	43%	12%
Quality of compassion	34%	14%
Culture of communication	31%	21%
Independence	18%	26%
Discipline	15%	49%
Self-control	11%	31%
Logical thinking skills	10%	67%

**Table 1: Children's qualities formed within the family and within the early childhood education organization, according to their parents, 2016 (source: own calculation)**

Our results indicate that pre-school teachers have different viewpoints concerning how educational responsibilities should be divided between the family and the pre-school organization. 67% of the respondents stated that parents should systematically develop a child's independence, which level is frequently rather low because of the absence of feasible housework responsibilities assigned by parents to their offspring. The high technologization of everyday life has significantly reduced the number of practical tasks that can be performed by a child, with the adult family members doing all the necessary housework. However, only 11% of the parents believe that they should actively participate in the development of a child's independence.

43% of the pre-school specialist respondents said that mothers and fathers should be more active in developing their children's discipline. In the modern, frequently one-parent, family, a child is given a great deal of freedom that is not restricted by the need to perform responsibilities by a certain deadline. As a result, the majority of 5-6 year-old children lack the trained ability of subordinating themselves to adults, which quality guarantees a child's safety and health, as well as the possibility to explore the world safely using various technological devices. Despite this, only 20% of the parents considered the development of a child's discipline to be their responsibility.

35% of the teachers opined that it was important for the family to develop skills that can help children to control their negative emotions and periodically arising aggressive intentions. They noted that many parents do not understand that children demonstrate different behaviour at home and with peers; therefore, common methods for forming a child's patterns of controlling emotions, feelings and actions are needed.

It should be highlighted that 67% of the parents said that they only turn to information concerning which qualities the family should help the child to develop, at which age and by which methods, when facing difficulties in forming a child's particular skills. Parents are shown to lack basic knowledge concerning, e.g. when children normally start to experience such feelings as pride in their achievements, shame for their wrongdoings, compassion, tact, honesty, as well as to demonstrate other moral, labour and intellectual

qualities. One of the reasons for this situation lies in the fact that early childhood education specialists do not provide parents with any information about the child's age-specific psychical and psychological peculiarities. Therefore, 23% of the parents turn to their own parents when they fail to find an effective way of solving a particular educational problem. Only 9% of the respondents reported reading specialized education literature.

23% of the parents having 4-5 year-old children mentioned experiencing difficulties when developing a child's obedience; 17% pointed to the lack of knowledge about when they should start developing a child's particular moral, labour and intellectual skills. About 15% of the survey participants reported a lack of time to educate their children, with the majority of them being fathers. In the survey, 12% of the respondents said that they experienced difficulties in finding specialized literature that could explain the basics of a child's upbringing and education in a simple and practical way.

### **Pedagogical assistance provided to parents**

Naturally, when parents face a serious deficit of knowledge about various problems in a child's upbringing, they are likely to appreciate the help provided by early school education specialists. Our research has revealed a number of problems that make parents turn to professionals for consultation. 25% of the parents reported that they would like specialists to provide them with information about how to arouse a 4-6 year-old child's interest in acquiring new knowledge. The parents noted that their children are mainly interested in watching TV and playing computer games, with the desire to learn something new from books and talks with adults about nature, animals and reasons triggering certain human behaviours being expressed rather rarely.

Of all the parent respondents, 17% would like to receive help when developing a child's independence in such everyday activities as games and interactions with peers. On the one hand, parents use different methods for encouraging their children to independently solve problems that arise in their cognitive and everyday activities. On the other, these methods do not always produce a desirable effect: conflicts frequently occur when parents attempt to develop this quality in children that are to go to school in one or two years' time. 14% of the parents reported that they need a specialist's help in developing a child's self-organization skills, as well as the ability to overcome laziness. These qualities are closely linked with a person's independence and are normally formed when a child is taught to set goals, train willpower and patience when facing difficulties, as well as to apply self-control. Parents need to be advised how to form these skills in the process of a child's housework, play and interaction with peers and adults.

According to 58% of the parent respondents, they do not receive any kind of pedagogical support from pre-school educators. 28% of the parents reported that they are only informed when pre-school teachers experience difficulties in the development of a child's particular skills: in such cases, parents are advised to pay attention to the problem because specialists' efforts have failed to produce the expected effect. 14% of the parents said that educators claim a complete absence of some moral and labour skills in their children; however, their development is considered to be the duty of the family. Only 5% of the pre-school teachers tend to explain which methods should be applied when forming these skills in children, with 12% of the educators insisting on the concerted efforts of the family and the pre-school education organization.

A reason for the low activity of pre-school teachers in providing a qualified assistance to parents lies in the fact that educators do not possess the necessary information themselves. As much as 79% of the pre-school teachers admitted they need more knowledge about

typical problems arising in the education process of today's generation; 66% would like to advance their understanding about the specifics of early childhood psychology; 56% are interested in information about innovative early-age education technologies.

## **DISCUSSION**

Our study has revealed a number of problems in the system of teacher-parent interaction. Although previous studies have demonstrated a positive effect of teacher-parent partnership on the child's development and future performance (Knopf and Swick, 2007), pre-school education specialists seem to possess minimal knowledge and skills essential for working with parents. The reason for this situation is likely to be the system of nursery teacher training (Hiatt-Michael, 2001). Therefore, it is essential to determine and investigate typical problems that should be included in the curricula of training pre-school teachers and teacher assistants (Baum and Swick, 2008), taking into consideration the cultural specifics of the particular education system.

The interaction between the education organization and the family should not be limited to the involvement of parents in the education process. Rather, it should involve the targeted construction of an integrated system capable of supporting the teacher-parent partnership on the basis of shared knowledge about the child's physical and psychological abilities, as well as the specifics of their socialization at the pre-school stage. In this connection, there is an acute need for the development of specialized programmes aimed at facilitating the parent-teacher communication process (Powell, 1989), which the Russian pre-school education system currently lacks. These programmes should meet the requirements of all involved parties, i.e. parents, the nursery education system and society. Such initiatives can contribute to an increased level of parental competence and active cooperation between pre-school specialists and parents in the process of a child's upbringing and education (Fischer and Lipovska, 2013).

In addition, the motivation for teachers to work in the system of early childhood education and their job satisfaction depend to a large extent on the perceived social prestige of their profession. Since working with children requires only a vocational degree, the professional status of pre-school specialists is currently not high. As a result, parents both in Russia and other countries frequently express a less respectful attitude towards such professionals compared to secondary and high school teachers (Moloney, 2010). A feasible solution is seen in the constant professional development of early childhood education specialists, which takes the central position in the formation of their professional identity (Gomes, Ferreira, Pereira and Batista, 2013).

## **CONCLUSION**

Our research has shown that a system of effective pre-school teacher-parent interaction, which constitutes a requirement of the new Federal State Early Childhood Education Standard, has not been formed in Russia yet. This results from the fact that, in the process of socialization, children are not being prepared to perform the function of educator with regard to their own future offspring. Over the past few decades, the previously existing system of upbringing, which was based on the child's personal observation of educational processes in larger families, has declined. Today's adults, who have typically been brought up in families having only 1 or 2 children, tend to lack 'stored-in-mind' patterns of how to develop a child's moral, labour and intellectual qualities. A specialized education for young people planning families in "schools for future parents" could provide them with

the knowledge and skills that allow for the pedagogically appropriate development of children with regard to their individual capabilities.

Another urgent goal is to enhance the competencies of early childhood education specialists in terms of methods for collaborative work with families in the process of developing a 2-7 year-old child's skills and talents, thus facilitating their preparation for school. In this connection, professional communities should be involved in order to solve the problems of interacting with parents (Shartrand, Weiss, Kreider and Lopez, 1997), exchanging experiences and developing collaborative approaches towards specialized partnership programmes.

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# WHAT CAN WE LEARN FROM STUDENTS' TESTS RESULTS IN SUBJECT MANAGEMENT?

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## ABSTRACT

The main objective of this paper is to find the problems in the current process of evaluation of student performance. This article deals with the students' results, using mainly descriptive statistics and Pearson's chi-square test. The paper confirmed that there are questions in the tests which have not been answered correctly by any student so far. This situation will be discussed with subject teachers, concerning both - changes in the educational process and different formulation of these questions. Another result of this paper is that several students received grade 1 (excellent, or "A") after some (sometimes several) failed attempts. Discussion about changing evaluation rules will be held across the University.

## KEYWORDS

Analysis, Education, Evaluation, Management, Results

## INTRODUCTION

Universities are affected by various external factors (e.g. changes in laws, demographics, the change of number of students who are finishing high schools and are applying to universities, which results in a shift in funding, etc.). Another type of influence is represented by internal factors like organizational rules of each faculty, quality of tools helping the students communicate with teachers or diversity of particular study fields. One of the key internal factors could be seen from the feedback of the current students as well as from using available data, in which possible weaknesses in educational process and evaluation can be traced.

Number of universities is trying to learn more about their current or future students on the basis of available data.

Multiple-choice tests have been widely used to test easily a large number of students in works of Premadasa (1993), Kaspříková (2012) and Klůfa (2012).

Klůfa (2016) focused on differences in math tests of various formats. He discovered statistically significant differences in average scores in some variations of math tests. Concerning these results, it is clear that some variants of examined tests were more difficult for an average student and that some tests, on the contrary, could be easily passed by an unprepared one.

Doucek and Maryška (2015) detected that the score in Mathematics achieved by applicants of the University of Economics in Prague had been dropping over the time (from 2010 to 2014), however the score in English remained constant.

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Kučera, Svatošová and Pelikán (2015) described the relation between results of admission proceedings and the success in university studies. They traced one of the causes of failure in one particular course, which was taught in the first year of the university studies, and that is that the students are not fully adapted to the university study style yet. In addition to that, admission exam results could predict the level of success in university studies. Zhao (2006) studied the probability of pure guessing in multiple-choice tests. He found out that the optimum number of given choices for multiple-choice question test is four. When the number of questions in a four-choice question test is increased from 8 to 18, the probability of scoring above 40 points by pure guessing is reduced from approximately 5% to less than 1%, the probability with 48 questions goes down to 0.01%. Brožová and Rydval (2014) studied scores in subject called 'Applied Mathematics for Informatics' at the University of Life Sciences Prague, which were collected during a period of 13 years. Among other results, they found out that the high number of the tests with less than 50 points indicates that the students use their first exam attempt only to become familiar with form of the test and the nature of the exam itself. Pavlović et al (2014) introduced the idea to use the Lean Six Sigma method in the educational process. Modular-competence approach described Vaganova et al (2016) to assess results of higher school student training. The students of the Jan Evangelista Purkyně University in Ústí nad Labem usually need several attempts to pass the subject Management, on average it takes them, including the students repeating the course, more than 2.5 attempts to succeed in the test. This subject is of a great importance as it plays a significant role in the final bachelor exam. The main objective of this paper is to find the problems in the current process of evaluation of student performance.

## **MATERIALS AND METHODS**

To conduct this study, multiple-choice tests and their results were used. The final test of the subject Management was conducted from academic year 2015/2016 until the winter semester of academic year 2016/2017 at the Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem. Each test consisted of 18 questions, with each question having five statements including the option that none of the listed choices was correct. These tests were designed according to the last two academic years (mainly because of changes in accreditation and method of testing) and the students could choose to join the class of teacher A or teacher B.

There were 169 students (69 male and 100 female, 134 full-time students and 35 combined students) and 17 variants of the tests over two years.

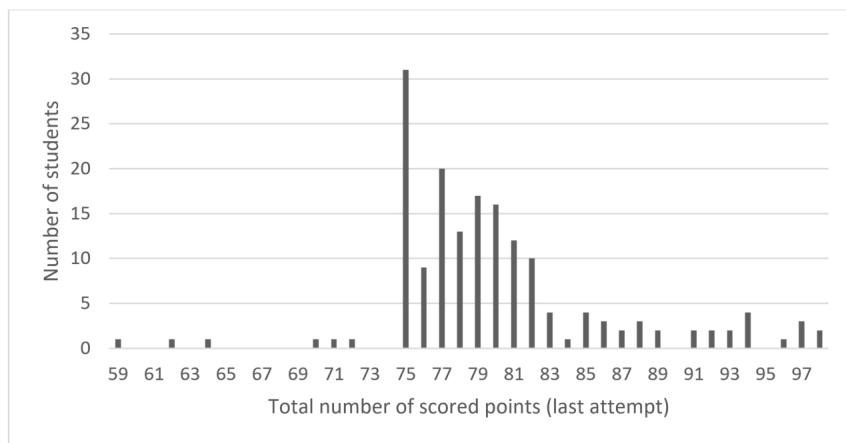
Test sheets were gathered and the answers were copied into MS Excel then the data were exported to simple text data files at format CSV. After that, by using C++ programming language, was created a program in order to prevent making obvious typos or mistakes during the data gathering (by setting the rules e.g. wrong dates format or test being held on Sunday, etc.) (Stroustrup, 2000).

Then C++ language was used again to create a set of programs (Stroustrup, 2000). Methods of those programs matched the answers of each student with the right test variation and solution and calculated the number of scored points, gathered overall results of a test variant etc. Statistic methods were used to describe and test our hypothesis by descriptive statistics and Pearson's chi-square test ( $H_0$ : Students success rate of teacher A is the same as teacher B.  $H_1$ : Students success rate of teacher A differs from teacher B.), so if the

$p$ -value calculated by means of the  $\chi^2$  test was lower than the selected level of significance  $\alpha = 0.05$ , null hypothesis was rejected (Anděl, 2005).

## RESULTS

First of all, the descriptive statistics was used to find out more about the results of the tests. Figure 1 shows the final number of students' scored points as the function of total scored points at their last attempt. Most of the students were able to achieve between 75 and 83 points.



**Figure 1: Number of students by their final test score (source: own calculation)**

At first attempt 52 students passed the test (their first attempt to pass this subject), 43 students had to repeat the subject the following year after they failed the first year. Table 1 shows the number of attempts to achieve the final grade.

Attempt	1	2	3	4	5	6
Number of students	52	52	22	16	13	14

**Table 1: Number of attempts to achieve final grade (source: own calculation)**

Some questions were never successfully answered (i.e. there is no exact match between the answer to a particular question and the correct test answer). There were 18 questions never answered correctly. Eight of them were present in one variant (the worst one). Table 2 shows test variants, number of tests and number of questions never successfully answered. There are 10 out of 17 tests, which contain at least one question which was not correctly answered by any of the students.

Test variant	22	23	26	25	24	1	6	3	8	21
Number of tests	5	4	3	5	4	26	31	27	25	4
Number of wrong answers out of 18	8	7	6	5	4	2	1	1	1	1

**Table 2: List of test variants with number of tests and number of wrong answers (source: own calculation)**

On the other hand, five questions were correctly answered in 90% or more of the tests. Table 3 shows an average number of scored points in specific academic years, standard

deviation, and the minimum and maximum number of scored points. The number of scored points increased in the academic year 2016/2017 by one point, the worst test result improved from 51 to 59 scored points. The best score dropped from 98 to 87 scored points.

Year	Average number of points	Standard deviation	Minimum	Maximum
2015/2016	73.1	8.8	51	98
2016/2017	74	6.9	59	87

**Table 3: Statistics of tests for given academic years (source: own calculation)**

The most successful variant of the test was the variant 11 with the average number of scored points 77.2 (31 tests), the second one was the variant 7 with 76.6 scored points (40 tests). The least successful variant of the tests was the variant 22 with an average number of 61.4 scored points (5 tests), the second least successful was the variant 5 with 67.5 scored points (29 tests). The rest of the results is shown in Table 4.

Variant	1	2	3	4	5	6	7	8	9
Average	72.8	75.9	71.1	75.9	67.5	70	76.6	73.5	70.9
Standard deviation	7.4	7	8.3	10.1	7.2	5.4	11	6.9	6.6
Median	74.5	75	73	74.5	67	70	76	75	71
Minimum	55	55	51	55	54	60	55	59	55
Maximum	82	94	86	98	86	79	97	83	80
Variant	10	11	21	22	23	24	25	26	
Average	75.1	77.2	72.3	61.4	68.3	71.5	72.4	69.3	
Standard deviation	7.4	6	12.1	5.6	5.4	9.2	6.7	0.9	
Median	73.5	77	70.5	60	69	71	72	70	
Minimum	62	62	60	56	60	59	62	68	
Maximum	93	93	88	71	75	85	81	70	

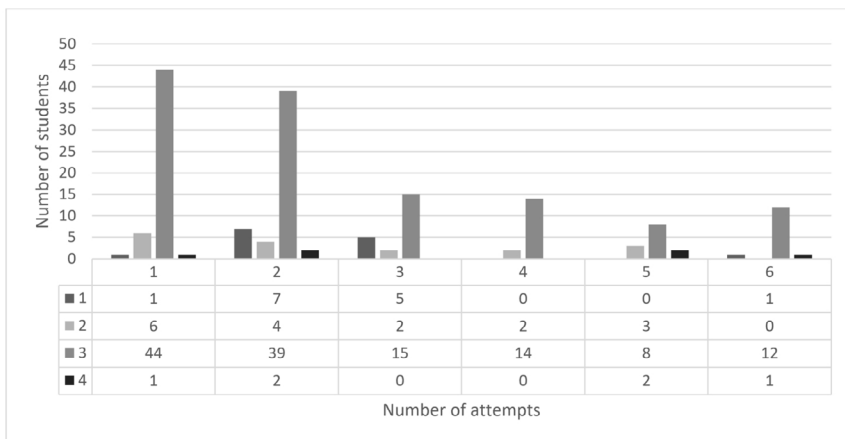
**Table 4: List of test variants with statistics of points (source: own calculation)**

Final results of the tests are shown in Table 5. Majority of the students ended up with grade 3.

Grade	1 (best grade, like A)	2 (like B or C)	3 (like D or E)	4 (like F)
Number of students	14	17	132	6

**Table 5: Number of students achieving final grade (source: own calculation)**

The number of attempts needed to pass the subject is shown in Figure 2 (i.e. to achieve a better grade than a grade 4; in a case of failure, grade 4 is displayed in the final attempt). Data indicated that students who failed several times may achieve grade 1 or 2. Altogether, there were 13 students who failed at least once but finally received grade 1 (five of them gained grade 1 in the third attempt and one of them even achieved grade 1 in his or hers sixth attempt).



**Figure 2: Number of attempts and final grade (source: own calculation)**

In the next section one hypothesis will be tested.

Is the success rate of student's dependent on their teacher?

H0: Students success rate of teacher A is the same as teacher B.

H1: Students success rate of teacher A differs from teacher B.

The Pearson's chi-square test was used to find out whether the success rate of the students was dependent on their teacher. There were just three test variants used by both teachers. Table 6 sums up the successful and unsuccessful students' attempts in the test variant number 2.

Teacher		Failed	Passed	Total
A	Students number	8	11	19
	%	42.1053	57.8947	100
B	Students number	8	10	18
	%	44.4444	55.5556	100
Total		16	21	37
Total %		43.2432	56.7568	100

**Table 6: Results of variant 2 used by both teachers (source: own calculation)**

For variant 2 the Pearson's chi-square statistic is 0.0206, the  $p$ -value is 0.885855 therefore this result is not significant at  $p < 0.05$ .

Table 7 sums up the successful and unsuccessful students' attempts in the test variant number 4.

Teacher		Failed	Passed	Total
A	Students number	7	8	15
	%	46.6667	53.3333	100
B	Students number	11	10	21
	%	52.381	47.619	100
Total		18	18	36
Total %		50	50	100

**Table 7: Results of variant 4 used by both teachers (source: own calculation)**

For variant 4 the Pearson's chi-square statistic is 0.1143, the  $p$ -value is 0.735317 therefore this result is not significant at  $p < 0.05$ .

Table 8 sums up the successful and unsuccessful students' attempts in the test variant number 7.

Teacher		Failed	Passed	Total
A	Students number	12	6	18
	%	66.6667	33.3333	100
B	Students number	6	16	22
	%	27.2727	72.7273	100
Total		18	22	40
Total %		45	55	100

**Table 8: Results of variant 7 used by both teachers (source: own calculation)**

For variant 7 the Pearson's chi-square test is 6.2075. The  $p$ -value is 0.012721. This result is significant at  $p < 0.05$ .

In the case of the test variant number 7, there is significant difference between results of the students of teacher A and teacher B.

In the case of the test variant number 2 and 4, there is no significant difference.

## DISCUSSION

This paper is based on the sample of 169 students. The test results showed that 52 students passed the test at their first attempt. This means that 31% of students can pass the test with no significant difficulties. On the other hand, an average student needs 2.5 attempts to pass the test (including 43 students from previous year and therefore more than 3 attempts in total), 14 students used all six possible attempts and one of them received final grade 1. As Brožová and Rydval (2014) found out it is not rare that students use their first attempt just to find out more about the test structure, type of questions etc., which generates unnecessary and undesired costs if the number of students is high.

The interesting finding is that 10 out of 17 tests had at least one question which was not answered correctly by any student. Some test variants (e.g. 22 and 23) had more than 6 such questions. However, with the increasing samples of the tests, the fewer questions without answers were found. It can be assumed that this situation is caused by a small sample of tests and therefore a smaller chance for somebody to know or guess the right answer, as discussed by Klůfa (2012) and Zhao (2006). Another explanation could be that students became gradually aware of some test variants used several times (or set of questions used to generate variants of tests) and took in account their possible recurrence, for that reason they prepared for these particular questions in advance. Therefore, these questions should be checked. In case that the questions' formulation is not sufficient, the formulation should be revised or the question should be removed. Nevertheless, five questions were correctly answered in more than 90 % of the tests.

Majority of the students passed the subject with grade 3 and a total number of 75 scored points or higher, 13 students failed at least once, despite this, they received a final grade 1, one of them received grade 1 after five failed attempts. This shows that the current system of evaluation should be altered in order to reduce the number of test attempts as well as to prevent the situation of students failing the test intentionally to make sure next attempt would bring them successful results. However, some students could be discouraged by reduction of test attempts.

Another significant discovery was that the difference between the results of students of

teacher A and B was only in one test variant, which could be caused by standardization and synchronization of educational process. Teachers of the same subjects often communicate and share necessary information about lectures since the exchange of information and knowledge also helps them with the successful explanation of topics to their students.

The second important discovery was that there were 13 students, which failed the test at least once and finally received grade 1. This sends an undesired message to other students, that they can simply visit the test without any real intention to pass the test and based on their experience they can prepare for the 'real' attempt and achieve a better score.

## CONCLUSION

This paper summarized data from multiple-choice tests and interpreted them accordingly. There was no evidence found to support the idea that the students attending one teacher's class would score more points in their final test than those who attend the second teacher's class, which can be seen as a good result, as this could indicate that weaker students prefer one teacher or that the teacher fails to explain problems in a way students are able to understand and remember.

Major discoveries are connected with the questions which were not correctly answered by the students and a revelation that a student can receive the best grade after failing the test at least once. In some variants were found several questions, which were not answered correctly by any student. These questions will be further examined, which should lead to discovery of a list of misconceptions connected to these questions. After discussion with teachers of this subject, these questions can be rearranged, their formulation can be altered or the teachers can stress problematic topics during the lectures and help students to better understand the problematic areas.

Second major discovery was connected with the way how the evaluation at the Jan Evangelista Purkyně University in Ústí nad Labem works. There are students who failed several times and then achieved grade 1 (excellent, or "A"). That of course puts an excessive pressure on teachers (in one case, student took six attempts to receive the grade 1).

Some other universities (e.g. the University of Economics in Prague) chose a different approach, giving their students only one attempt to pass the exam. In a case that a student fails, there is a possibility of another attempt however the student is not able to receive a better grade than grade 3. An open debate should take place about the possibility of adaptation of this rule. The main subjects (like Management) should implement this rule to prevent the undesired state of things concerning the discussed problematics.

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# GENERATION Z IN THE LITERATURE

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## ABSTRACT

The paper discusses the results of the theoretical study on generation Z. Generation Z is perceived to be a specific generation, especially due to its relation to modern technologies. This generation is called the digital or Facebook generation, also the global generation. It is a generation of university students these days, but soon they will become the leading workforce. The objective of the theoretical study was to answer three research questions: What is generation Z? What are features and specifics of generation Z? Which researches have been done about generation Z in the field of learning, knowledge sharing and pedagogy?

## KEYWORDS

Digital Generation, Generation Z, Researches on Generation Z, Specifics of Generation Z

## INTRODUCTION

The objective of this paper is to discuss various approaches and ideas on generation Z. Generation Z is a specific generation due to their specific relationship to modern information and communication technology. It is the first generation that grew up surrounded by ICT and it is called the first digital generation. Modern ICT means are natural tools for this group of young people and shape the way how they understand world, how they learn, communicate and also influence their values and priorities. Generation Z is not worse than any other generation that historically proceeded. But it is different.

Up till now we published results of three surveys on generation Z. Our respondents were generation Z students from the University of Economics Prague. First survey focused on learning habits of generation Z students and showed that they prefer various materials shared through electronic and social media to obligatory literature; Facebook was preferred. The survey verified our presumption that economy of time and well structured materials are important for students of generation Z (Mládková, 2015).

Second survey explored how generation Z students work with knowledge and which knowledge creation processes they use. The survey showed that our respondents prefer to create new knowledge by codification and externalization. As for knowledge sharing, interviewed students preferred externalization and internalization and codification got the lowest evaluation. Socialization turned out to be unpopular process of both knowledge creation and sharing. As for the preference of knowledge dimensions, our respondents prefer create new knowledge using explicit dimension and share knowledge using tacit knowledge. VARK analysis focused on knowledge acquisition identified that majority of interviewed students were kinaesthetic or aural (Mládková, 2016b).

The third survey focused on how students of generation Z understand academic environment showed that interviewed students are more practically than theoretically oriented, want to work in good atmosphere together with teachers and other students. They are very sensitive about fairness (Mládková, 2016b).

Our surveys brought interesting results. To be able to answer other questions concerning



generation Z and to compare our findings with findings of other authors we decided to do the theoretical study.

The objective of the study was to collect and compare literature on generation Z and find out what authors think about this generation; how they see these young people, how they classify them and what type of researches have already been done about them in the field of learning, knowledge sharing and pedagogy. The study focuses on three questions: What is generation Z? What are features and specifics of generation Z? Which researches have been done about generation Z in the field of learning, knowledge sharing and pedagogy?

## **MATERIALS AND METHODS**

The methodology typical for theoretical study was used. Scientific journals, conferences and research reports were examined. The data for theoretical study were mostly collected in electronic form databasis. Electronic information resources of University of Economics Prague and scholar.google.com provided majority of data used in the study.

We collected, described and evaluated different approaches and different ideas on relevant topics, e.g. generation Z, specifics of generation Z and researches on generation Z. Methods used for the theoretical study include typical methods of theoretical work that allow identification and interlinking separate pieces of knowledge; e.g. analysis, synthesis, comparison, induction and generalisation and critical thinking.

Analysis was used to separate and abstract individual ideas on generation Z. Synthesis helped us to combine together specific ideas of individual authors. Comparison was used to find similarities and differences of different author's ideas and approaches. Induction and generalisation were used to generalise our findings. Critical thinking was employed to give all ideas the same priority regardless of ideas and previous experience of study authors.

## **RESULTS**

### **Who are People of Generation Z - Timing of Generation Z**

The first part of the theoretical study mapped and compared ideas on who are people of generation Z – how this generation is defined, e.g. to which period it is dated. The results show that there is no agreement on this topic (Jaleniauskiene and Juceviciene, 2015). Some authors date start of generation Z to the beginning of the 90s, other much later. The first group is represented by Geck (2006) who sees generation Z as people born in or after 1990, Posnick-Goodwin (2010) who dates generation Z to 1990s and the early 2000s, Glass (2007) who puts start of generation Z to the year 1992, and Rowlands et.al. (2008) who see them as a generation of people born after 1993. On the other hand Vallone et al. (2016), Gupta and Gulati (2014), Adecco (2015) understand generation Z as people born after 1995. Zemke, Raines and Filipczak (2000) put generation Z between 1995 – 2010, Williams (2010) puts their birth between 1995-2009, Schroer (2015) between 1995-2012 and Wood (2013) from the mid-1990's to the early 2000's. Bencsik and Machova (2016) see generation Z as people born after 1996. Bennett, Pitt and Price (2012), Hernaus, 2014 put beginning of generation Z to the year 2000.

### **Specifics of Generation Z**

The second part of the theoretical study focuses on features and specifics of generation Z.

## *Generation Z and Digital World*

For many authors, relation of generation Z to ICT technologies turns out to be very important characteristic. Generation Z is called a digital generation or Facebook generation. “Some authors think that generation Z people are specific as they grew in a world influenced by ICT technologies dominated by the Internet. From infancy, these people grew up in an environment surrounded by and using graphical web browsers, laptops, cell phones, instant messenger services, broadband, wireless, video games.” (Geck, 2006). Generation Z are ‘digital natives’– the first generation born into an already-digital world (Gross, 2008:8). Gupta and Gulati (2014) call generation Z “digital natives which are bombarded with digital technologies and are considered to be tech-savvy”; Ozkan and Solmaz (2015) call generation Z “internet generation and the first mobile mavens”. Addor (2011) calls them the “Net Generation or digital natives”. Zacks investment research (2016) even defines generation Z as cloud natives rather than their previous cohort who went by the name of digital natives. Varied names have been suggested to be associated with this generational group, including Generation Z, Gen Z, Zs, Gen Z’ers, iGeneration, Gen Tech, Gen Wii, Net Gen, Digital Natives, Gen Next, Post Gen, and Plurals (Wiedmer, 2015). Some authors highlighted the fact that ICT technologies shape behaviour of their users. By Taylor et al. (2014) generation Z students spend an average 9 hours per day on their cell phones. This reliance on mobile technology affects not only how this generation learns, it also drastically affects how instructors should be delivering instructional material (Shatto, Erwin, 2016). Gupta and Gulati (2014) write that “major impact of technology on their behaviour make them dissimilar from preceding generations”.

On the other hand some authors argue that specifics of generation Z are not caused by their exposition to digital world (Rowlands et. al., 2008). But these ideas are scare.

## *Learning Specifics of Generation Z*

Some authors argue that generation Z require different teaching and management approaches. More than any of the current generations, Generation Z students learn by observation and practice, not by reading and listening to PowerPoint® presentations (Taylor et al., 2014). Their affinity to Google™ information is remarkable; however, their ability to fully critique the validity of this information may be lacking (Shatto, Erwin, 2016). Taylor et al. (2014) also write that the average Generation Z individual has an 8-second attention span, down from 12 seconds for Millennials. Their brains have become wired to understand complex visual imagery, making visual approaches to teaching more effective than other approaches (Hallowell and Ratey, 2011).

## *Other Specifics of Generation Z*

Adecco (2015) writes that generation Z people are extremely self-confident, have an optimistic view on their future professional life. Compared to the prior generation (Y), whose ability to multi-task is already acknowledged, generation Z has an even greater ability to work on several tasks at the same time, while being more productive (Addor, 2011; Adecco, 2015; Ozkan and Solmaz, 2015; Iorgulescu, 2016). Generation Z tends not to resist authority relationships, as the representatives of this cohort report a strong need for human connection. (Tulgan, 2013). Igel and Urquhart (2012) see generation Z as “smarter, more self-directed, and more able to quickly process information than previous generations; but there is one thing they may not be-team players”. Generation Z tend to value more the importance of “soft skills”, in the detriment of “hard skills” (Adecco, 2015), which may seem surprising, as another study (Tulgan, 2013) indicates that the

members of this generation tend not to have soft skills as they begin their professional life (Iorgulescu, 2016). They could become loyal to their employer if the organization offers them the opportunity to grow, to experience new things and to achieve leading positions (Adecco, 2015). McCrindle (2013) even defines generation Z as “the most materially endowed, technological saturated, formally educated generation ever seen”. Glass (2007) points at certain selfishness of generation Z and calls them “generation me”. Taylor et al. (2014) mention that generation Z is uniquely diverse than any previous group of college students. Wood (2013), Tulgan (2013) and Iorgulescu (2016) highlight generation Z need for security.

Summing it all together, “unlike other generation ever seen before, it is the first truly global generation” (Bolser and Gosciej, 2015). High-tech is in their blood, they have grown up in uncertain and complex environment which determines their viewpoint about work, studying and the world. Arising from their habit, they have different expectations in their workplaces. We can speak about a careerist, professionally ambitious generation, but their technical- and language knowledge are on a high level (Dill, 2015, Bencsik et al., 2016).

### *Researches on generation Z in the field of learning, knowledge sharing and pedagogy*

The third part of the theoretical study focuses on researches on learning, knowledge sharing and pedagogy concerning generation Z. Only few such researches were found. Pérez-Escoda, Castro-Zubizarreta and Fandos-Igado (2016) made research on primary school children of generation Z concerning their digital skills. They refer to fallacy of the digital native. From their perspective the child may have access and coexist with ICT but does not know how to use digital technologies for education and work. Igel and Urquhart (2012) oriented their paper on cooperative learning of generation Z. They conclude that not all young people are capable of using this method. Shatto, Erwin (2016) recommend change of teaching style with generation Z. Resources must be devoted to acquiring new technologies as well as faculty development on its use. Biró (2014) in his theoretical paper discusses different learning theories and the way how they influence the learner. Ding, Guan, and Yu (2017) investigate the effectiveness of game-based learning as an instructional strategy for tertiary education. According to a Northeastern University Survey (2014) university students are highly self-directed, demonstrated by a strong desire to work for themselves, study entrepreneurship, and design their own programs of study in college. Contrary to the prevailing narrative about today’s teenagers, the survey revealed somewhat modest enthusiasm for technology, particularly its use within higher education. Similarly, in their personal lives, technology hasn’t supplanted in-person interaction. Bencsik and Machova (2016) researched main problems among different generations at a workplace from the view of knowledge sharing. Their findings show that generation Z hesitate to work in teams. If forced to do so, they prefer virtual communication. On the other hand they do not mind knowledge sharing; of course virtually. (Bencsik and Machova, 2016).

## **DISCUSSION**

Our theoretical study answered our three research questions and provided us with following picture of people of generation Z. There is no agreement on definition of generation Z. Timing of this generation varies from 1990 (Geck, 2006) to 2012 (Schroer, 2015). We do not understand these differences as a problem as boundaries between generations

are both fuzzy and questionable (Lawler, 2011). Different authors time beginning of generation Z differently because they understand differently development of advanced ICT technologies, important factor that causes specifics of generation Z. The fact that our country was connected to the Internet on 13. 2. 1992 allows us to date generation Z to the beginning of the 90s and adopt the approach of Geck (2006).

As for specifics of generation Z, many authors think that generation Z is influenced by digital world they grew in (for example Gupta and Gulati, 2014, Ozkan and Solmaz, 2015, Iorgulescu, 2016, Wiedmer, 2015, Zacks investment research, 2016, Shatto and Erwin, 2016). Still some argue that relation to digital world is problem of other generations, too (Rowlands et. al., 2008). Pérez-Escoda, Castro-Zubizarreta and Fandos-Igado (2016) research indicates that relation of generation Z to ICT technologies may not be as strong as many perceive.

Some authors point out that relation between digital world and generation Z influence their learning habits (Taylor et al., 2014, Shatto, Erwin, 2016, Hallowell and Ratey, 2011). Our research on learning habits of generation Z (Mládková, 2015) indicates same conclusions. Results of our research on how generation Z students work with knowledge and which knowledge creation processes they use (Mládková, 2016b) are compatible with conclusions of Taylor et al. (2014) who think that generation Z students learn by observation and practice.

Our theoretical study identified also other specifics of generation Z, for example self-confidence and optimism (Adecco, 2015), multitasking (Addor, 2011; Adecco, 2015; Ozkan and Solmaz, 2015; Iorgulescu, 2016), globalism, (Addor, 2011; Adecco, 2015; Ozkan and Solmaz, 2015; Iorgulescu, 2016), high ambitions (Dill, 2015, Bencsik et al., 2016).

We found out that thought widely discussed in the literature, generation Z has not been researched properly yet and requires deeper researches in future.

## CONCLUSION

The objective of the paper was to provide results of theoretical study on generation Z. We were interested in three questions: What is generation Z? What are features and specifics of generation Z? Which researches have been done about generation Z in the field of learning, knowledge sharing and pedagogy? The study shows that generation Z is not unanimously defined; different authors put generation Z to different time intervals. Generation Z is perceived as a digital, global and self-confident generation with high expectations about their carriers. On the other hand they may have the problem to work in teams, and some may lack deeper digital skills. The researches in the field of learning, knowledge sharing and pedagogy are surprisingly not many. Their results indicate certain specifics of generation Z and the whole field requires deeper research attention in future.

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# HOW DO PRE-SERVICE TEACHERS OF MATHEMATICS PLAN THEIR CLIL MATHEMATICS LESSONS?

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## ABSTRACT

The paper focuses on skills of future teachers of mathematics when planning CLIL lessons (Content and Language Integrated Learning, i.e. partly in a non-mother tongue) on primary and lower secondary school levels. The paper is based on a detailed analysis of pre-service teachers' mathematics lesson plans developed within the frame of an undergraduate course at Faculty of Education, Charles University. The authors of the paper look at the selection of topics the students find appropriate for a CLIL lesson, for the scope of activities they include, on how they cope with tackling both the language and mathematics goals of the lesson, to how much attention they pay to the 4 Cs of CLIL (communication, cognition, content, culture) etc. The findings from this analysis are of interest to teacher educators in general, to researchers interested in CLIL as well as to practicing teachers.

## KEYWORDS

Analysis a priori, CLIL, Language and Content Goals, Lesson Planning

## INTRODUCTION

Support of language education is one of the priorities of EU, as policy makers are fully aware of the need of EU citizens to be able to communicate across borders, to be functionally bilingual, i. e. to be able to switch between languages according to the situation easily. CLIL (Content and language integrated learning) may be seen as one of the tools of supporting pupils' competence in a non-mother language. CLIL refers to the teaching of a non-linguistic subject such as mathematics through a foreign language. It suggests an equilibrium between content and language learning. In CLIL, the subject understanding and thinking manifested by the language of the subject are developed through a foreign language (L2). Conversely, the L2 is developed through the non-language content, such as mathematics. CLIL provides plenty of opportunities for incidental language learning, which has been shown to be effective, deep and long-lasting (Pavesi et al., 2001).

A CLIL lesson has two objectives – the goal is not only learning the subject but also learning the language itself. Theories (Teaching Knowledge Test. Content and Language, 2009) distinguish between soft CLIL and hard CLIL, where in the first case 30% of communication in L2 is sufficient. The latter case asks for at least 70% of communication in L2. The advantage of CLIL thus is that it does not disqualify its learner from sitting various national exams in mother tongue. The possibility to combine mother tongue and foreign language also allows development of mathematical reasoning in case of A1 or A2 learners of the foreign language according to European Framework of Reference for Languages. Moraová and Novotná (2015) show that already very young learners with very basic knowledge of L2 can cope in a CLIL lesson as long as the demands on their

language production are limited. However, mathematical reasoning and its development need a very elaborate level of language and thus can only be achieved in L1.

The here presented paper looks at the quality of lesson plans future teachers of mathematics are able to produce after an undergraduate course in teaching mathematics in CLIL. It builds on other research in CLIL area presented on ERIE conferences (Procházková, 2014; Moraová, 2015).

The research questions of the here presented study is the following: How do pre-service teachers respond to the special requirements of lesson planning in CLIL? How well are they able to integrate all four Cs' into their lesson plans?

Before we present the materials and methods as well as results and findings, let us look at the key underlying concepts.

#### **4 Cs in CLIL**

As presented in (Moraová, 2015), there are certain underlying principles in a CLIL lesson that must be paid due attention to. When planning CLIL lessons, the teacher should always bear in mind that there are some areas the lessons must not fail to address. One of the possible underlying structures to bear in mind when planning a CLIL lesson is Coyle's (Coyle, 1999) 4 Cs. The 4 Cs framework includes Content (Progression in knowledge, skills and understanding related to specific elements of a defined curriculum), Communication (Using language to learn whilst learning to use language), Cognition (Developing thinking skills which link concept formation, abstract and concrete, understanding and language) and Culture (Exposure to alternative perspectives and shared understandings). Culture deepens awareness of otherness and self. The 4 Cs correspond to basic principles described by 21st century skills and defined as key competencies (FEP, 2010).

#### **Lesson planning**

As Nováková (2013) states, there is not much research on lesson planning, although it is undoubtedly one of the key elements in education. Only a teacher who is able to plan their lessons well in a way that gives them the needed support in the lesson as well as the flexibility to react to unexpected situations can be successful in their lessons.

The key question a teacher planning a lesson should ask is according to Harmer (1992) the following: „What is it that my students will feel, know or be able to do at the end of the class (or classes) that they did not feel or know or were not able to do at the beginning of the class (classes)? (Harmer, 1992, p. 259) To answer these questions, the teacher defines the goal of the lesson. A good lesson plan according to Harmer (1992) builds on two principles: variability and flexibility. Variability comes out of a wide range of various activities and teaching materials. Flexibility is in the hands of the teacher – it is their ability to adapt their lesson plan to the classroom situation.

According to Divíšek (1989) there are two risks in lesson planning: a teacher may pay too much attention to methodology without deeper understanding of the subject matter, or may focus only on the subject matter and have the lesson plan very formal, not giving the learners the space for development of thinking processes. According to Obst (2002) a lesson plan usually has a written form although form is not prescribed by the law.

Lesson planning is paid attention in the Theory of Didactical Situations in Mathematics. Brousseau (1997) in his Theory of Didactical Situations in Mathematics (TDSM) introduces the concept of analysis a priori. According to Brousseau analysis a priori is one of the tools available to a teacher when planning a lesson. Its objective is to predict as accurately as possible the course of the relevant teaching unit. A special attention is paid to



the division of this unit into different phases, to potential pupils' reactions and attitudes and the teacher's reactions (obstacles, misconceptions and mistakes, correction of and further work with these mistakes), possible solving strategies (correct and incorrect), knowledge prerequisite for the use of the different solving strategies. (Nováková and Novotná, 2014) Thus analysis a priori provides the teacher with a lot of valuable information and gives them the chance to predict possible obstacles in a lesson and to be ready to react to these.

### **Lesson planning in CLIL**

When teaching a lesson or a part of it in L2 teachers face an additional burden: They have to focus not only on mathematics content and its methodological elaboration but also on the language they will use for communication with their pupils, for explanations and also how and in what stages of lessons language and communication skills will be developed. A good CLIL lesson plan should have clearly defined mathematics and language goals and the activities leading to their achievement should predict obstacles in both mathematics and the language – where pupils might struggle to understand, what key words they have to be taught, how to react in situations a pupil fails to understand or communicate).

### **MATERIALS AND METHODS**

The design of this study is qualitative. The authors of the paper analyse 16 lesson plans written by pre-service teachers within the frame of their work in the undergraduate course *Integrovaná výuka matematiky a angličtiny* (Integrated Teaching of Mathematics and English) at Faculty of Education, Charles University. The course is compulsory for pre-service teachers of only mathematics and optional for pre-service teachers studying mathematics in combination with another subject. The course is run at the Department of Mathematics and Didactics of Mathematics in the cycle of masters studies, i.e. its participants have also other courses of didactics of mathematics.

Within the course the students are introduced to CLIL, its principles and obstacles a CLIL teacher faces. As part of their studies they micro teach one activity and write a lesson plan. The students, before writing the plan, are introduced to the concept of 4 Cs (Coyle, 1999) and higher order thinking skills (Bloom, Krathwohl and Masia, 1984), the concepts of soft CLIL and hard CLIL. They know that a CLIL lesson has two objectives – mathematics and language. Their task is to choose the mathematical content and the target group and plan a lesson for this specific target group with respect to the pupils' language skills. While planning the lesson they should try to target all four Cs and pay attention to development of higher order thinking skills.

To answer the research question formulated for this study, the authors of the paper focused on the following in their analysis of the lesson plans:

- a. definition of mathematical and language goals of the lesson,
- b. age of target group,
- c. adequacy of language difficulty for the target group,
- d. focus on formulation of instruction in L2, presence of key vocabulary items in L2,
- e. attention to development in all 4 Cs.

The findings from this analysis are presented in the following section results.

## RESULTS AND DISCUSSION

### The content of the plans

Out of the 16 pre-service teachers, 13 created their lesson plans for a lesson conducted in English, one in Russian, one in German and one in Italian.

As far as goals in mathematics are concerned, 5 lesson plans focus on arithmetic – conversion of units, working with fractions, basic arithmetical operations with a calculator, basic arithmetical operations with large numbers, one on rules of divisibility of numbers. 11 lesson on geometry – 2 focused on angles, 4 on symmetry, 2 on perimeter and area of planar shapes, 1 on basic properties of planar shapes and their names, 1 on circle and its properties and 1 on median and centroid of a triangle. These goals were most often formulated in the title of the lesson plan.

It may be seen as surprising that the students preferred geometry to arithmetic. Since the lesson plans were handed it after the end of the seminar the authors of this paper did not have a chance to ask the students about their preference of geometry. It would be interesting to find out whether their preference of geometry is anyhow language conditioned or whether the selection was based on their preferences in mathematics as such.

Language goals were clearly defined in fourteen of the lesson plans (although in majority of cases in a mathematics oriented way, e.g. to name basic arithmetical operations in English, to describe where and how to find the median and the centroid in a triangle in English, to learn the terminology for description of planar shapes, area, perimeter). Two students did not define the language goals for the lesson at all, which is a problem and the lesson plan does not meet the criteria of a CLIL lesson plan.

On the other hand three of the pre-service teachers define a real language goal of the lesson – If clauses, relative clauses, asking questions in English, formulating sentences in the 3<sup>rd</sup> person in the present tense, uncountable nouns). These students show that CLIL opens space to more language development than just acquisition of the basic terminology in L2. Each teaching unit of mathematics does not only use specific terminology but a number of language structures that are used in everyday life. It is crucially important that the teacher be aware of the specific structures that their pupils will be practicing and developing. Then it is easier to predict possible mistakes (e.g. no -s in the 3<sup>rd</sup> person singular) and to correct possible mistakes covertly.

### Age of the target group

A vast majority of the lesson plans was created for 6<sup>th</sup> grade pupils. 2 students failed to define the target group in their lesson plan, one student planned a lesson for the 3<sup>rd</sup> grade (basic unit conversions), one for 5<sup>th</sup> grade (arithmetical operations on large numbers), one for 7<sup>th</sup> grade (perimeter and area) and one for 8<sup>th</sup> grade (circle and its properties). The selected goals in mathematics correspond to Framework Education Programme for Elementary Education and the commonly used textbooks for the level.

Only one of the students defined the level of pupils' knowledge of English according to the European Framework of Reference for Languages (6<sup>th</sup> grade, A1 level, which corresponds to objectives for Foreign Language where A2 level is expected in the 9<sup>th</sup> grade).

Similarly as in case of the mathematical topic, the authors of the paper have no information about selection of the target group. However, the choice of lower secondary school pupils is very likely to be caused by the fact that the seminar is not part of pre-service primary teachers' curricula and attendees at the seminar were future secondary school teachers

with the exception of two pre-service primary school teachers who enrolled in the course as a selective course. Another aspect of this selection might have been the feeling that very young learners with very basic level of English will not be able to follow a lesson in L2. Research (e.g. Moraová and Novotná, 2015) shows that some episodes in L2 are possible with beginners.

### **Adequacy of use of L2 for the target group**

Analysis of the lesson plans shows that the students were able to select some mathematical activities suitable for CLIL as far as their language is concerned. Unlike narrative subjects such as history, the language needed for communicating some things in mathematics is relatively simple. The learners must understand the key words and instructions from the teacher, the rest of the time they are doing something. This is the case of lesson plans focusing on geometry – if the pupils understand the key words, the terms describing different objects, they will be able to follow the lesson.

Most English as such is probably used in the lesson plan focusing on division of the whole into part and fractions in the context of a story from Ancient Egypt, which exposes pupils to the past simple and a story in English. Introductory stories may be considered a very good element in CLIL lessons. They increase motivation, allow exposure to more than mathematical language and provide space for communication.

Another example of good use of English appropriate exactly for the target group (6<sup>th</sup> grade) is the lesson plan working with area and perimeter in the environment of a house and the floor plan. Although the student does not define it in the language goals in the lesson plan, the pupils are exposed to a lot of practice of the structure *There is... There are*, the comparative and superlative of adjectives and vocabulary connected to flats, houses, rooms and furniture. Thus the plan well meets the criteria for a CLIL lesson as it really well combines mathematics and everyday English.

### **“Formulations in English” in the lesson plan, list of key words**

There are big differences in the extent of the use of L2 in the lesson plans. The lesson plan of 3 students is only in Czech. 4 students created a lesson plan in Czech with key words in L2. 3 students have the instructions given by the teacher (the exact formulations) in L2. 4 students have the worksheets with the assignments ready in L2, 1 student only has the name of activities in L2, the rest of the lesson plan is in Czech. Two lesson plans are written in English (however, one of them is more in the form of a worksheet, a sequence of activities to be done in the lesson, then a lesson plan in the sense of description of methods, activities, possible obstacles etc.)

This is another topic that will need more inquiry in the future. However, it seems that those students who are not very confident in L2 prefer to have the instructions written in L2 to make sure they do not make mistakes when explaining to the pupils in the lesson and to make sure the explanations are clear. If the pre-service teacher lacks the self-confidence in L2, pre-formulated instructions and explanations that they can read to the pupils might give them the needed self-confidence.

The plans that are written in L2 are obviously (with respect to the quality of language used) plans of those pre-service teachers who are proficient in L2 and do not find it difficult to write their seminar work in L2. These lesson plans do not have the formulations of explanations by the teacher written explicitly as the students have the self-confidence and know they will be able to formulate the instructions on the fly.

The lesson plans that are written in L1 without key words seem to be giving little support to the teacher who would be using them. One of these lesson plans has the information about which activity will be carried out in L1 and L2, however, it could become really difficult for the teacher to use it with no support of at least the key words written. Moreover, the pupils will need to be introduced to the key words, which will be difficult for the teacher to achieve without having specified the list of key words in the lesson plan.

### **Attention to development of 4 Cs and higher order thinking skills**

As stated above, a CLIL teacher should always bear in mind the 4 Cs' of CLIL, i.e. content, cognition, culture and communication. As stated in the subsection Content of the plans, mathematical content was a priority for all the pre-service teachers and was paid due attention. More attention should be paid to the language and communication in the language, which is another key aspect of a CLIL lesson.

Analysis of the lesson plans shows that there are some communicative activities in the sense of real, everyday communication, not just repeating the key words or instructions. Pupils would be communicating in English when thinking about division of loaves of bread in Ancient Egypt, when talking about houses or flats. An interesting communication activity is also part of a lesson plan on planar shapes. The lesson is concluded by a pair work communicative activity when one pupil describes their shape (*I have four sides. Two of them are longer...*). This is a perfect CLIL activity that at the same time develops communication skills and makes mathematical thinking more precise as only precise description will allow the classmate to make the correct guess. Another example of a communicative activity to be used in a CLIL lesson is the discussion with pupils about the importance of centroid in real life. The question here is if this discussion would be possible in English, if the language level of 6<sup>th</sup> grade pupils would allow it. Another example is use of word problems in the lesson plan on conversion of units. Word problems are a rich source of everyday language, they develop reading skills in L2 and also writing skills if the learners are expected to answer using the whole sentence (however, production of sentences might be an obstacle in the 3<sup>rd</sup> grade, which is the target group of this lesson plan).

As far as development of Cognition is concerned, many of the lesson plans have activities that allow individual discovery, require analysis and synthesis. Only lower order thinking skills (knowledge, comprehension and application of a learned procedure) are in 6 out of the 16 lesson plans, which means majority of the students were able to include development of higher order thinking skills in their lesson plans. 2 of the lesson plans describe explicitly which thinking skills each of the activities targets.

Less attention was paid to the last of the 4 Cs, to Culture. This may be partially caused by the fact that a lot of the lesson plans were very mathematical, focusing primarily on mathematics, basic concepts and procedures (e.g. how to construct the centroid). Pure mathematics does not give the space for developing culture awareness. Culture awareness is developed through its applications. In case of symmetries this may be done on Ornaments (Moraová and Novotná, 2016).

### **CONCLUSIONS**

The analysis of the 16 lesson plans by pre-service mathematics teachers shows that in general future teachers are able to plan a lesson that could be efficiently taught in L2. There are some weaknesses in the plans. One of the important shortcomings is that the majority of the lesson plans do not have real language goals. It is good that students are aware of

the need to define both mathematics and language goals, however, most of the language goals focus on acquisition of terminology and key words, on being able to understand and use the terms. Lesson plans of three of the students show that more is possible. If a teacher thinks about the language that is used when doing specific mathematical topic, they are able to define it. Having defined it then allows them to focus on accuracy of the learners in these specific structures. Also language goal of a lesson such as: *Pupils are able to describe where and how we find the medians and the centroid of a circle.* seems not to be fulfilling the general objectives of CLIL. The learners are not expected to learn definitions in L2 but to use it in natural communication situations. It is more important that a learner is able to find the centroid than that they are able to explain it in words.

It was interesting to see that majority of the lesson plans focused on geometry and were designed for 6<sup>th</sup> grade pupils. In the next academic year the authors of the paper will ask the students to explain their selection of the topic. Then it will be possible to see whether this selection comes out of the students' preferences in mathematics or whether it is a deliberate decision. The students know from the seminar that in soft CLIL lessons, the teacher should think about suitability of different topics for being taught in L1 or L2. The question is if their selection of the mathematical topic is influenced by this knowledge or is influenced by other factors. The use of language in the lesson plans was another interesting aspect to analyse. The scope of use of L1 and L2 was wide – with no use L2 in the lesson plan to lesson plans entirely in L2. The implication for the future, however, is to have the students make a list of key words as it is essential both for their learners and for themselves. All considerations about the needed key words will make the teacher think about the language structures that will be used and practiced in the particular CLIL lesson. One of the very positive results of the analysis is the finding that ten out of sixteen students have in their lesson plans activities that develop higher order thinking skills. Many try to include some communicative activity in the lesson plan as well. The findings from the analysis show that the form and the quality of the lesson plans differs significantly. While some of the students planned the lesson very carefully with a lot of attention to all aspects of a good CLIL lesson, others ignored some of the important aspects entirely. The here presented study shows that many future teachers have the potential to become good CLIL teacher. It should help teacher educators to realize what must be stressed in a course for prospective CLIL teachers, what areas need to be paid more attention to. The study will be developed in the next academic year when the authors will also interview the students to find out the motivation for certain choices in the lesson plan.

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# RETRIEVING KNOWLEDGE FROM TEXTS: DESIGN OF AN EXPERIMENT WITH HUMAN USERS

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## ABSTRACT

Within the learning process, educational texts play an important role in transferring the procedural explicit knowledge from the experts or teachers to the students. As more studies carried out in past evidenced, the style of the educational texts is one of the significant parameters directly influencing the efficiency of the knowledge transfer. On the other hand, the way of perception connected with the processing the written text could be tightly connected with the personality of a particular reader (student). Thus the paper aims at designing an experiment mapping the differences in processing the texts written in different styles by human users. We suggest the research procedure, indicators and other parameters of the experiment to investigate, whether the students process the texts written in a different style by a different way. If so, another argument for spending resources to write the textbooks in a special style could be propounded to enhance the efficiency of the learning process.

## KEYWORDS

Educational Texts, Explicit Knowledge, Eye-Tracking, Human Behavioural Research Unit, Knowledge Unit, Usability Lab

## INTRODUCTION

Technical differences among data, information and knowledge are well known. They are also being reflected in education; the nowadays trend is to move from memorizing data related to a branch to applying knowledge to solve particular problems. Thus study materials and namely textbooks should support this trend. The feedback from the students shows that the ability of the teacher to provide the textbooks of good quality is one of the most important teacher's competences (Brozova, 2012). The importance of these issue just increases as soon as a new subject is developed or its important part is redesigned (Krejci, Kvasnicka and Domeova, 2011). On the other hand, the issue of efficiency cannot be omitted, when an innovative form of the study materials are developed (Turcani and Magdin, 2014). In case of educational texts, other questions are induced: how to understand the efficiency and how to measure it.

In literature, two approaches to solving this task are the most used. The first one is a learning outcomes based approach (e.g. Brozova, Rydval and Horakova, 2014), which supposed that the educational innovation is efficient, if induces a measurable contribution to enhancing the learning outcomes, usually measured by didactic tests.

To reach the validity of the research and the correct interpretation of the results, it is necessary to separate individual factors influencing the learning outcomes and quantify their contribution to the complete outcome as well. This is not a trivial issue, sometimes infeasible due to the lack of the data.

The other approach could be entitled as a questionnaire based approach and work with the feedback from the students using the questionnaire survey (e.g. Abersek, 2016). Two main problems are connected with this approach. Usually, a limited sample of the students is not representative and does not allow the researchers to generalize the results. Furthermore, it is not simple to develop a questionnaire ensuring both validity and reliability of the survey.

Thus our intention is to use another approach to distinguish among data, information and knowledge and their contribution to the efficiency to the transfer of knowledge. To develop an experiment based on the objective measurement of the brain activity of the students within working with the text of different styling is a promising way (Horakova and Houska, 2016), but subject to the conditions of the measurement using the fMRI technology, the students' activity is more or less limited to a passive reception of information. To support the students within active working with educational text, an eye-tracking technology is another way how to objectively measure the differences among the visual processing the text based on data and information only and the text based on explicit knowledge.

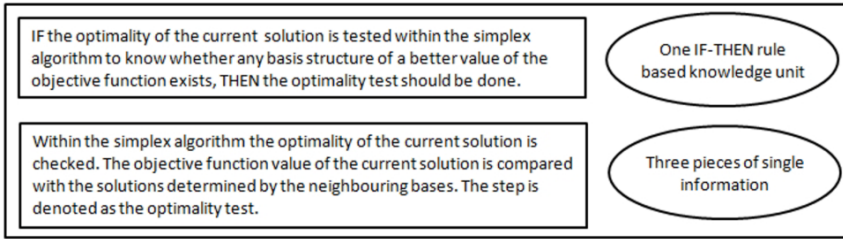
The aim of this conceptual paper is to develop and set up an experiment leading to the determination of differences in studying the various kinds of educational texts by human users. In particular, we will observe, whether the users read and study knowledge-style designed educational texts in different way in comparison with general (common) educational texts free of purposeful aim to transfer explicit knowledge. The experiment is designed for the Usability Lab in the research centre Human Behavioral Research Unit (HUBRU) using the eye-tracking technology. For this purpose we determine an efficient layout of the text samples presented to the students including the definition of the Areas of Interests (AOI) key for the description of the eye path within reading the texts. We also analyze the set of the indicators used for the quantitative representation of the eye path to determine the system of the measures for statistical analysis (analysis of variance – ANOVA methods will be used) in order to distinguish the typical patterns of eye paths in case of knowledge-style designed texts and common educational texts.

## **MATERIALS AND METHODS**

### **Knowledge-based design of an educational text**

For the purpose of this paper we characterize the knowledge-based text (knowledge text) as the text based on the enhanced production rule (so called knowledge unit, further KU, see Domeova, Houska and Houskova Berankova, 2008 for the definition) accompanied with additional information. In contrast with the knowledge text, we further use the term “common text” for a piece of the educational text of no special design, based on the set of information. See Figure 1 to distinguish the knowledge style and common style of the educational text (an example from Operations Research is used).





**Figure 1: Differences between knowledge and common styles of text (redesigned based on Domeova, Houska and Houskova Berankova, 2008)**

## **Tobii Eye Tracker**

In our pilot experiment we performed a pilot study using Tobii Eye Tracker (further TET) in the HUBRU. The TET's field is 160° (horizontally), with minimal vision loss during extreme eye movements. The system was calibrated separately for each participant to fit its personal characteristics. Each experiment was supervised by an investigator, who provided complete information on the testing to the participant and managed the run of the experiment procedure. The investigator observed the participant's activities with his macular vision represented by a red circle generated with a delay up to 5 ms (Sánchez-Ferrer et al, 2017).

The pilot experiment was organized as follows. First, the respondents received a presentation with the texts to study. The presentation contained 30 pieces texts in total. Half of them were written in a common style with no KU, half of them were written in the KU form. Typical length was around 5 rows of text, one piece of text was presented on one slide. After the study part, the testing part followed. The test contained 30 questions in total. It was not allowed to go back to study materials. A test question had a form of a statement and the respondent had to accept it or denied. We had 5 participants involved in the pilot experiment. Their success rate was high, all of them reached more than 75% right answers, even if the subject of the study was not familiar to anyone of them.

### *Eye movement parameters*

Selected AOIs were classified as the area on the each slide of presentation/test presented to the participants with LMS Moodle. Eye movement events such as fixations, saccades and blinks were calculated by metrics implemented in the TET. One of the characteristics which were interesting for authors was the overall time that subjects looked at a specific slide, group of slides or whole presentation/test. Dwell time was in this experiment as the dependent variable. Dwell time is described as the duration how much time one spent to look at a stimulus (Armstrong and Olatunji, 2012).

### *Eye measuring self-efficacy*

There is still not a rich enough eye tracking literature for successful measurement of self-efficacy levels. Mouse movements are one few metrics which can be used for this purpose. But it is quite complicated as mentioned in many research studies (e.g. Navalpakkam et al, 2013; Huang, White and Buscher, 2012; and many others). Many of those researchers have founded self efficacy levels can be determined by that the direct mouse movements. These direct mouse movements can be characterized by a pause before a direct movement towards a target. This use of mouse defines direct movements that occur once the user has decided which action to take (Tzafilkou and Protogeros, 2017).

### *Eye measuring risk perception*

In the case of knowledge texts in comparison with normal texts, there are few research studies as Bojko (2013) whose research is pointing on pupils who get larger workload diameter with high processing demands. Bojko (2013) thinks that the higher pupils' workload is, the more highly their performance will suffer. Also other authors as Tevel and Burns (2000) think that perceived-risk may be one of the most important factors which contribute to mental workload. Those authors also showed in their research a relationship between subjective risk assessment and mental workload in fields such as Human-Computer Interaction (HCI) (Tzafilkou and Protogeris, 2017).

### *Eye measuring perceived ease of use*

The average fixation duration is one of the most important metrics of cognitive processing. As Tzafilkou and Protogeris (2017) mentioned in their study, such as longer fixations mean such a more effort to extract information and also more difficulty in general. There are many possible measures of eye-tracking, about 120, they can be organized into the following groups (Holmquist et al, 2011):

1. Movements measures are concerned with whole variety of eye-movements through space, and the properties of these movements.
2. Position measures deal only with where a participant has or has not been looking, and the properties of eye-movements at spatial locations.
3. Frequency measures pertain to the number, proportion, or rate of any countable eye-movement event.
4. Latency and distance measures express the duration from the onset of one event to the onset of a second event. Measures of this type also appear in the form of spatial distances.

### *Areas of Interest (AOI)*

Areas of Interest are defined as regions in the stimulus where a researcher focuses his/her attention to examine eye movement pattern, e. g. words, sentences, and images (Holmquist et al, 2011).

AOIs can be static or dynamic. Static AOIs are drawn by the user and collect data throughout the entire display time of the media. Dynamic AOIs – the shapes and behaviours of dynamic AOIs are defined by so called Keyframes. Each Keyframe is a user defined shape and position of the AOI that corresponds to a certain point on the timeline of the media. Dynamic media containing dynamic AOIs, typically have numerous Keyframes for each AOI.

### *Fixation vs. Visit*

As described in Figure 2, fixation and visit are slightly different. Duration of fixation within an AOI is the sum of the duration of all of the individual fixations in the corresponding AOI, while the duration of visit comprises all of the fixations that occurred in one visit within the AOI as well as the saccadic duration among those fixations within that AOI until fixation is placed outside of the AOI. We also could examine the interaction between the participants and the attributes with eye-tracker data based on AOIs (Kim, et al, 2012).

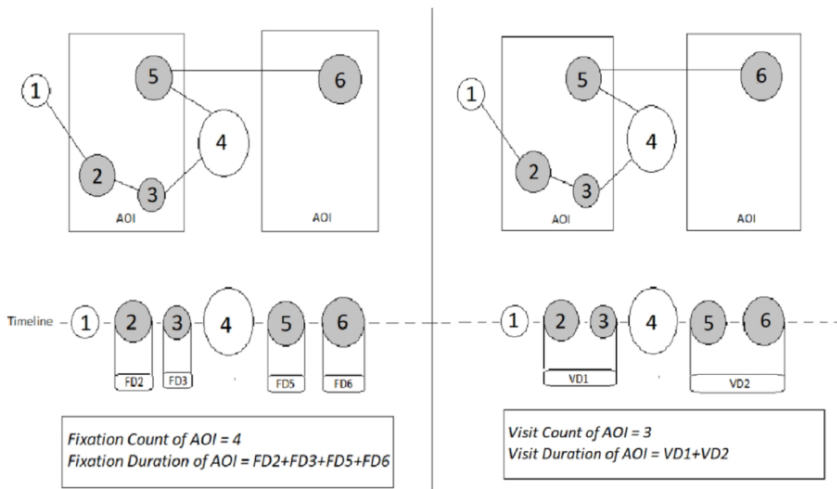


Figure 2: Difference between Fixation and Visit (source: Kim et al, 2012)

## RESULTS AND DISCUSSION

### Experiment procedure

The pilot experiment was analyzed and according to the acquired experiences the following steps for the full research procedure were established.

*Step 1: Preparing the educational texts in the knowledge and common styles, and the TRUE/FALSE didactic test*

The text of a selected style for the learning phase is accompanied with the question for the didactic test in one screen. See Figure 3 for the layout proposed for this purpose. The main attention is put on the unity of presented text to filter all other factors influencing the quality of the transfer of knowledge (such as graphical elements, highlighted words, etc.).

*Step 2: Creating the screens in the LSM Moodle*

To hold the attention of the participants on within the complete experiment, no more than 25 screens should be used.

*Step 3: Defining the Areas of Interest*

The static AOIs are used for our purposes. In total, seven AOIs are defined for each screen as follows:

- AOI 1 - elementary problem (part Y of the knowledge unit);
- AOI 2 - problem situation (part X of the knowledge unit);
- AOI 3 - objectives of the elementary problem to solve (part Z of the knowledge unit);
- AOI 4 - solution of the elementary problem (part Q of the knowledge unit);
- AOI 5 - complete question of the didactic TRUE/FALSE test;
- AOI 6 - answer button for the choice "TRUE";
- AOI 7 - answer button for the choice "FALSE".

See Figure 3 for the specification of AOIs' layout.

#### Step 4: Experiment with the users

The key parameters of the experiment are as follows:

- participants: homogeneous group of 24 students of neither diseases nor injuries in their mental, cognitive and perceptive functions;
- supervision: introductory information and explanation of the experiment by the supervisor, management of the experiment by the participant;
- time: unlimited, each participant can receive time up to him/her;
- screen: full screen mode without any annoying elements;
- making the record: in one frame, video track and data from the TET are separately stored in databases and are assigned to the particular participant.

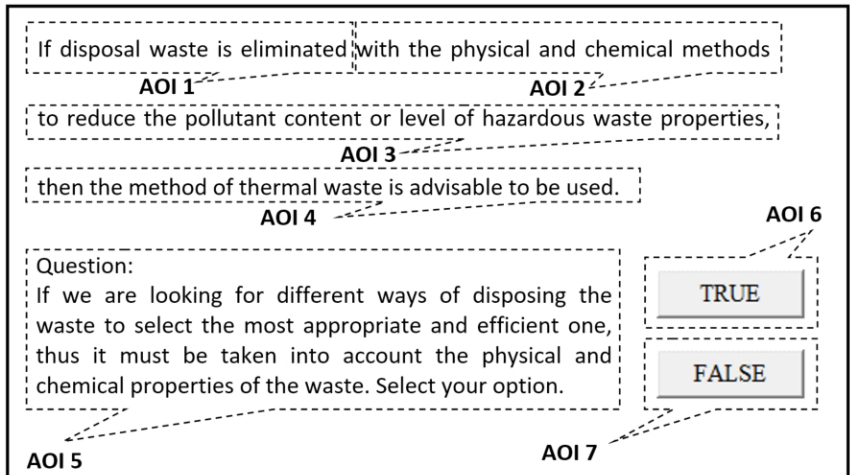


Figure 3: Experiment design - one screen (source: own processing)

#### Step 5: Evaluation

For the evaluation of the experiment, the following measures are used (Holmquist et al, 2011):

The Fixation Duration (s): measures the duration of each individual fixation within an AOI.

Total Fixation Duration (s) and Total Fixation Duration (zeros) (s): these metrics measure the sum of the duration for all fixations within an AOI. Zero metric: if at the end of the recording the participant has not fixated on the AOI, the Total Fixation Duration will be registered as zero and the recording will be included in the descriptive statistics calculations.

Fixation Count (a number of occurrences) and Fixation Count (zeros) (a number of occurrences): these metrics measure the number of times the participant fixates on an AOI. Zero metric: if at the end of the recording the participant has not fixated on the AOI, the Fixation Count will be registered as zero and the recording will be included in the description statistic calculations.

The Percentage Fixated (-): metrics measures the number of recordings in which participants have fixated at least once within an AOI and expresses it as a fraction of the total number of recordings. It is calculated by dividing the total number of recordings in which participant has fixated within the AOI by the total number of recordings in the test.

Visit Duration (s): metric measures the duration of each individual visit within an AOI. This visit is defined as the interval of time between the first fixation on that AOI and the next fixation outside the AOI.

Total Visit Duration (s) and Total Visit Duration (zeros) (s): these metrics measure the total duration of all visits within an active AOI. Zeros metric is quite similar with the exception that if the participant at the end of the recording has not fixated on the AOI, the Total Visit Duration value should be scored as zero and this recording should be included in the descriptive statistics calculations.

The Time from First Fixation to Next Mouse Click (s): metric measures the time from the first fixation within an active AOI or AOI group until the participant left-clicks within the same active AOI or AOI group.

The methods of analysis of variance – ANOVA – will be used to determine the differences among the values of indicators measured for knowledge texts and common texts. The samples of the knowledge texts and the common texts could not be considered as independent, because they represent the same piece of practical knowledge and differ in the form of the representation only. Thus the pair t-test will be employed as the main method for the analysis of the hypotheses. The hypotheses are formulated as usual, i.e. the zero hypotheses suppose that the difference between the mean values of the above-mentioned parameters is not statistically significant, otherwise the alternative hypotheses are valid.

Let us compare the above-presented design with the studies, which have been already carried out successfully. Liu (2014) employed over 40 participants to explore the differences in the learning strategy within the learning with the text accompanied a concept map and the text without any map. The research supports our decision to present the text and the test item in one screen; it allows comparing fixation and reading paths within the working with different kinds of the text. The only parameter used in Liu's study (fixation time) seems to be sufficient for evidencing the differences between the learning strategies. A higher number of participants involved in his experiment is substituted by a higher number of text pieces in our experiment; the total number of stimulus as an input for the statistical analysis (ANOVA) remains similarly the same.

Also the study on comparing the learning strategies for simple and illustrated texts is of a similar design (Mason, Tornaora and Pluchino, 2013). Besides the fixation time connected with individual areas of interests, she uses other indicators, such as first-pass fixation time on text/picture, look-from text to text fixation time, integrative transitions, look-from text to picture fixation time and look-from picture to text fixation time. We also thought about this approach, but we rejected it because of relatively small ranges of our AOIs; in combination with the measurement error presented by the TET producer, it could provide rather confusing than accurate results.

## **CONCLUSION**

In this study, we reflected our experiences from a pilot experiment on the perception of different text styles by human users to determine a relevant and reliable testing procedure and its parameters such as a number of participants, management of the experiment, design of individual screens and measures for quantitative analysis. The future research enhances the results of our previous studies on identification of the differences among the styles of the educational text carried out by both subjective approaches (questionnaire survey among the students) and objective approaches (semantic and syntactic characteristics of the texts). In case of receiving positive results (i.e. the differences are measurable

and significantly influences the efficiency of knowledge transfer) allow us to develop a calculation scheme to employ the break-even point analysis to allocate an appropriate amount of resources to ensure the educational quality of the textbooks on one hand and their economic efficiency on the other hand. But this is the issue for the further research.

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# PUPILS' STRATEGIES FOR MISSING VALUE PROPORTIONAL PROBLEMS

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## ABSTRACT

The article investigates what strategies pupils use when solving two missing value word problems with the same mathematical model but different contexts. Both are examples of direct proportional problems. The sample consists of 238 Grade 8 pupils and 175 Grade 9 pupils. Their written solutions were analysed in terms of their correctness and strategies used. It was found out that the unit strategy, that is a pre-formal strategy, was by far the most frequent one. The context of the word problem influenced the choice of the strategy for nearly half of the pupils. These pupils saw the two problems with the same mathematical model as belonging to two different classes of problems for which they had available different procedures. The use of formal procedures is less frequent as Grade 8 and 9 pupils do not have them fresh in mind.

## KEYWORDS

Cross-multiplication Method, Mathematics, Proportion, Unit Method, Word Problems

## INTRODUCTION

Proportional problems involve situations in which mathematical relationships are multiplicative and which allow for the formation of two equal ratios between them. The ability to solve them indicates the existence of proportional reasoning (Ben-Chaim, Keret and Ilany, 2012). Proportional reasoning is assessed by three types of tasks (Ben-Chaim et al., 1998): numerical comparison problems (two ratios are given and they are to be compared), qualitative prediction and comparison problems requiring comparisons not dependent on specific numerical values, and missing value problems in which three pieces of information are given and the task is to find the fourth. In this contribution, we will restrict ourselves to the latter.

Missing value problems can be solved in different ways. One of them is through the equality between two ratios which Ben-Chaim, Keret and Ilany (2012) include among formal strategies. This strategy is in Czech textbooks often written in a shorthand way called 'the rule of three' (in English also 'cross-multiplication method'). To capture the essence of the equality between the two ratios, two arrows are depicted, either in the same direction for the direct proportion (as in the third strategy for Problem 1 and 2 below), or in the opposite direction for the inverse proportion. In older textbooks in the Czech Republic and abroad (see da Ponte and Marques, 2007), this rule is also represented as a 'cross product': If  $a$  is for  $b$  such as  $c$  is for  $d$ , we represent this as



$$\begin{array}{ccc} a & \dots & b \\ & \times & \\ c & \dots & d \end{array}$$

and we say that  $a$ ,  $b$ ,  $c$  and  $d$  are in proportion and  $ad = bc$ .

The rule of three is a standard procedure taught by most Czech teachers. Some argue that its use in teaching is counterproductive to reasoning in mathematics as pupils tend to rely on it even in situations when it is not appropriate, e.g., in ‘pseudo-proportionality problems’. This phenomenon has been lately called ‘illusion of linearity’ (de Bock et al., 2002).

Percent is a particular type of ratio. Textbooks usually present the solving strategy of finding 1% first but later, as problems on percent belong among proportional word problems, the rule of three is often introduced, too. In older textbooks, so called percent formulas are presented, i.e., one formula for each of the three types of problems on percent (depending on whether we look for the total, percent value or percentage).

Besides standard procedures suggested by textbooks and materials for teachers, heuristic strategies can be used for solving proportional problems (see e.g., a comprehensive list of such strategies in Novotná et al., 2014, Novotná, 2016). These strategies are not of an algorithmic nature.

Czech pupils usually meet with proportional problems during the topic of direct and indirect proportions and percent in Grade 7. However, naturally, the basis for proportional reasoning is laid already in the elementary school. The core of the topic is taught in the form of word problems.

Contexts play an important role in pupils’ understanding of and success in word problems. However, the evidence of their influence is rather anecdotal and speculative (Beswick, 2011). An example is Martin and Bassok’s research (2005) in which they found that semantic relations between the objects in word problems affected pupils’ sense-making activity of mathematical modelling and influenced the frequency of correct answers in one type of task and the structure of errors in another. Another example is Palm’s research (2008) which showed an impact of authenticity on both the presence of ‘real life’ considerations in the solution process and on the proportion of pupils’ written solutions that were really affected by these considerations.

The article answers two research questions: What strategies do lower secondary pupils use for proportional missing value word problems? How does the change of context influence their choice of solving strategies for two word problems with the same mathematical model?

## **MATERIALS AND METHODS**

The pupils participating in our research are from four primary schools (here A, B, J, S) which were purposefully sampled within GAČR project (Grant Agency of the Czech Republic, the project aims at investigating parameters influencing the difficulty of word problems). We selected the schools according to Reports by the Czech School Inspection and websites of schools in order to get schools with no specialisation, of a medium size, attended by children from their immediate surroundings, with a varied socio-economic background, with the percentage of children from abroad not exceeding the average for the whole Czech Republic, not aimed for children with special needs and placed in the area of

outer Prague. An important condition for the inclusion of the school in the GACR project was that the whole school would participate. The *sample* used in the part of research presented here consists of 238 Grade 8 pupils and 175 Grade 9 pupils. No selection of pupils was made; all the classes from the four schools of the same grade participated.

The pupils were given initial tests in mathematics and the Czech language to divide them into equally abled groups which will later be given different versions of the same word problem differing in one parameter only. For the purpose of this text and based on our research questions, two *word problems* were selected from the initial mathematics test. Both are inspired by TIMSS (Trends in International Mathematics and Science Study) 2007 for Grade 8. They are missing value proportional problems, have the same mathematical model but differ in context. Both are examples of direct proportion and allow for several solving strategies, including the rule of three. Their brief analysis *a priori* in terms of solving strategies is given below. We identified 9 strategies for each problem, however, only those which appeared in pupils' solutions are given here.

**Problem 1:** A bus travels at a constant speed. If the bus travels 225 km in 3 hours, how many kilometres does it travel in 5 hours?

*Unit strategy:* In 3 hours... 225 km

In 1 hour...  $225 \div 3 \text{ km} = 75 \text{ km}$

In 5 hours.....  $5 \times 75 \text{ km} = \underline{375 \text{ km}}$  (or  $225 \text{ km} + 2 \times 75 \text{ km} = \underline{375 \text{ km}}$ )

*Ratio:*  $5 \div 3 = x \div 225, x = \underline{375}$

*Rule of three:*  $\begin{array}{ccc} \uparrow & 3 \text{ hours... } 225 \text{ km} & \uparrow \\ & 5 \text{ hours... } x \text{ km} & \uparrow \end{array}$

$5/3 = x/225, x = \underline{375}$  (or  $x \div 225 = 5 \div 3$ )

**Problem 2:** A coat normally costs 1 200 CZK. Alan bought the coat when the price was reduced by 30%. How much did Alan save?

*Unit strategy:* 100% ... 1 200 CZK

1% ...  $1\ 200 \text{ CZK} \div 100 = 12 \text{ CZK}$

30% ...  $30 \times 12 \text{ CZK} = \underline{360 \text{ CZK}}$

*Ratio:*  $30 \div 100 = x \div 1\ 200, x = 360$

*Rule of three:*  $\begin{array}{ccc} \uparrow & 100\% \dots 1\ 200 \text{ CZK} & \uparrow \\ & 30\% \dots x \text{ CZK} & \uparrow \end{array}$

$30/100 = x/1\ 200, x = 360$  (or  $x = (5 \times 225)/3$ )

*Formula:*  $c = (pz)/100 = (30 \times 1\ 200)/100 = 360$

Both problems were part of the initial test assigned in Grade 8 (there was one more word problem placed between Problem 1 and 2), while Problem 1 was also part of the test in Grade 9.

Pupils' written solutions were *analysed* in terms of correctness. Each solution was assigned 0 point if there was nothing written or if the solution was totally wrong, 1 or 2 points were given to partial solutions, 2 points also to a correct solution with a numerical mistake and 3 points to a complete solution. Next, only those solutions were selected (regardless of their correctness) in which we could identify the type of strategy used. From among Grade 8 tests, only those were selected in which the strategy could be identified for both problems. In this way, we got the work of 180 Grade 8 pupils and 142 Grade 9 pupils which we analysed in a qualitative way to determine the type of solving strategy used.

Finally, statistical tests were conducted to see whether there was a statistically significant difference in the success rate of Grade 8 pupils for Problem 1 and 2, resp. Grade 8 and 9 pupils for Problem 1. The results of the Shapiro-Wilk test were significant,  $W = 0.15$ ,  $p < .001$ , resp.  $W = 0.61$ ,  $p < .001$ . This suggests that difference is unlikely to have been

produced by a normal distribution; normality cannot be assumed. Thus, the Wilcoxon signed rank test, resp. the Mann-Whitney U test was conducted.

## RESULTS AND DISCUSSION

### Success rate

Table 1 shows results for all the pupils. The results of the Wilcoxon signed rank test for the difference in the success rate for Problem 1 and 2 for Grade 8 pupils were not significant ( $V = 2619.00, p = .138$ ). This indicates that their difficulty level for pupils was the same. There was no statistical difference in the success rate for Grade 8 and 9 pupils solving Problem 1 (the results of the Mann-Whitney U test were not significant,  $U = 22236.5, z = -1.43, p = .152$ ). The difference of one year in schooling did not add any knowledge which would significantly improve Grade 9 pupils' results. It is probably not surprising as the direct proportional problems are formally taught in Grade 7. Still, Problem 1 and Problem 2 are quite straightforward. They have a clear structure, the direct proportion is obvious in the two situations, the contexts of the problems are well known to pupils and the sentences used in them are short and uncomplicated (thus, reading skills should not be a hindrance). We would have expected a bigger success rate. In the next paragraph we hint at a possible cause of why Problem 1 was not more successful.

Points	0	1	2	3
Problem 1 (Grade 8)	20.17%	2.94%	11.76%	65.13%
Problem 1 (Grade 9)	17.14%	0.57%	10.29%	72.00%
Problem 2 (Grade 8)	25.63%	2.10%	9.66%	62.61%

**Table 1: Success rate for the two problems ( $n = 238$  Grade 8,  $n = 175$  Grade 9)**

As already stated, both problems were variants of problems used in TIMSS 2007 for Grade 8 pupils (Tomášek et al., 2009). Problem 1 had different numbers (5 hours instead of 3 as was our case, 120 km instead of 225 and the question concerned 8 hours instead of 5 hours) but more importantly, it included the sentence “so that the distance travelled is directly proportional to the time spent travelling” and it was assigned as a multiple-choice problem. The success rate of Czech pupils was 80% which is better than in our case. Of course, our sample is not a random sample and thus cannot be directly compared to the results of TIMSS. However, our previous research with TIMSS problems (Vondrová, 2015) showed that for pupils selected in Prague, the results are better than for the whole TIMSS population (see also results for Problem 2 below). Seeing that the results from Table 1 are the opposite, that is worse than in TIMSS, we can hypothesise that the reason lies both in the fact that the problem was used as a multiple-choice one but probably more in the fact that the key words “directly proportional” were included. They indicate to pupils that the problem belongs to a certain class of word problems for which they have a standard procedure.

The fact that pupils often look for key words in word problems and choose a procedure accordingly is well documented in research (e.g., Martin and Bassok, 2005). Moreover, teachers in our interviews (Vondrová and Žalská, 2013) claimed that word problems which belong to a class of problems (such as proportional, on movement, on common work, etc.) are the easiest for pupils if they recognise that they belong to this class. Thus, if there is a direct hint at the class which the problem belongs to in its assignment (as was the case with the TIMSS problem), it simplifies the solution for pupils.

The TIMSS 2007 variant of Problem 2 included the price of ‘60 zeds’ instead of ‘1 200

CZK' (Tomášek et al., 2009). The success rate of Czech pupils was 56.2% which is less than in our case. The reason might lie in the above consideration about the choice of pupils from Prague rather than the whole republic and also the presence of a hypothetical currency. (The hypothesis of the influence of an imaginary currency on the difficulty of the problem is being tested in the above GAČR project.)

### Solving strategies

Next, we will investigate the solving strategies the pupils used. Novotná (2016) described eight heuristic strategies (e.g., the strategy of analogy, guess – check – revise) which are used when the solver does not have the required procedure at hand. However, we were only able to find one solution with a heuristic strategy – one pupil from school B used the guess – check – revise one. If the other pupils in our sample started solving the problems at all, they all used what Novotná calls ‘straight way’ (see *a priori* analysis above). Table 2 presents the types of strategy used for the two problems. Note that here, we only deal with solutions for which we can determine the solving strategy based on the written work, not solutions of all the pupils in our sample.

School	Rule of three		Unit strategy		Formula
	Problem 1	Problem 2	Problem 1	Problem 2	Problem 2
A	60.00%	10.00%	40.00%	85.00%	5.00%
J	26.42%	7.55%	67.92%	52.83%	39.62%
S	27.59%	13.79%	65.52%	79.31%	0.00%
B	55.26%	39.47%	44.74%	52.63%	5.26%
All schools	43.89%	16.11%	53.33%	67.78%	14.44%

**Table 2: The use of the rule of three, unit strategy and the formula (Grade 8)**

By far the most frequent strategy was the unit one: 53% for Problem 1, resp. 68% for Problem 2 of Grade 8 pupils used it. Namely, 72 Grade 8 pupils used it in both problems and other 74 pupils used it in one (more often in Problem 2 than in Problem 1). This is even more true for Grade 9 pupils as 91% of them used the unit strategy for Problem 1. This is not surprising as it is the intuitive strategy based on understanding the text without any need to use a prescribed algorithm; Ben-Chaim, Keret and Ilany (2012) counts the unit strategy among *pre-formal* strategies. This strategy is considered as the most natural one by other authors (e.g., Cramer and Post, 1993). We can confirm it when we realise that the problems were solved by pupils one or two years after they had been taught proportion (and the rule of three) at school and they did not have it fresh in mind. Moreover, research of Ben-Chaim and colleagues (1998) confirmed the above in a different way. They found out that the unit strategy was the most frequent one for missing value problems for 12 year-old pupils who were taught in a specific way: they were not shown any standard procedures for solving proportional problems but had to develop their own by solving contextual problems. The conclusion was that the unit strategy is more natural (intuitive) for pupils (as they develop it themselves). We can find a certain parallel in one of the classes in school B which was taught in a specific way different from other classes, in which no procedures are demonstrated to pupils by the teacher (and certainly not the rule of three). Of the 30 solutions from this class in which a strategy in one or two problems can be determined, 25 used the unit strategy.

There are two standard *formal procedures* to be used in the solution to the missing value proportional problems: the rule of three for both Problem 1 and 2 and the percent formula for Problem 2.

Except for the class in school B mentioned above, the teachers in the other three schools introduce the rule of three to their pupils. When asked, they all claim that they teach different methods for solving missing value proportional problems. Teachers in school J stress that for their pupils, as they are weak, the rule of three is a preferable method and thus they cover it in depth (by that, they mean that they explain the procedure step by step). The other teachers explicitly stress that pupils can choose which method they want to use. Table 2 depicts the use of the rule of three in all the schools. It appears that for school A and B, the rule of three is the preferable method (even though from what the teachers say, we would have expected this for school J). Overall, the pupils used the rule of three more in Problem 1 which, in fact, resembles the type of word problems which they meet when learning the rule. On the contrary, even though the teachers also mention this rule at the topic of percent, which follows the topic of direct and inverse proportions, the pupils prefer other methods for the problem on percent, the ones they met as the first ones.

Nowadays, it is very rare that teachers introduce percent formulas (modern textbooks do not present it) and thus it is rather surprising that the formula was by far the most used method for problem 2 in school J (Table 2). This tentatively confirms that teachers in this school indeed tend to favour standard procedures in teaching mathematics (as they claim for the rule of three).

<b>Strategy for Problem 1/Strategy for Problem 2 (<math>n = 83</math>, Grade 8)</b>								
Strate-gies	Unit/ Formula	Unit/ Trial	Unit/ Rule	Rule/ Unit	Rule/ Formula	Ratio/ Unit	Ratio/ Formula	Unit/ Ratio
Pupils	16	1	6	48	8	2	1	1
<b>Same strategy used for both problems (<math>n = 97</math>, Grade 8)</b>								
Strat.	Unit	Rule	Ratio					
Pupils	72	23	2					

**Table 3: Changes (or not) in Grade 8 pupils' strategies for Problem 1 and 2 ( $n = 180$ )**

As the two problems were solved by the same Grade 8 pupils, it is reasonable to investigate whether they used the same strategy or not. Table 3 presents the results. Slightly more Grade 8 pupils used the same strategy for both problems, the unit one being the most frequent one (see above). One reason might be that when they are successful with the strategy for one problem, they use it again for other problems (from this point of view it might be interesting to find out whether these pupils attempted to use this strategy for the problem which was included in between Problem 1 and 2 in the test; we have not done that). The pupils may have recognised the structural similarity of the two problems and this might have led them to the use of the same strategy. Interviews with the pupils are needed to investigate this in more detail.

On the other hand, different contexts of the problem led 83 pupils to the use of different strategy. They either did not notice the same mathematical model of the problems or, and it is more probable, they categorize them into different classes of problems ('proportional problems' for Problem 1 and 'percent problems' for Problem 2) for which they have available different procedures. Two groups of pupils stand out. 16 pupils used the unit strategy for Problem 1 and the formula for Problem 2. The percent formula is indeed an algorithmic procedure – to solve word problems on percent, one must remember three formulas and choose the one which applies. However, the unit strategy is not an algorithmic one, it is based on understanding the situation described in the word problem. It appears that for these pupils, Problem 1 is not a typical example of proportional problems. It

remains to be seen whether they would have used the algorithmic solution (i.e., the rule of three) for Problem 1 if it had been formulated in the above TIMSS 2007 (Tomášek et al., 2009) way in which ‘directionally proportional’ appeared. The second group of pupils worth mentioning are 48 pupils who used the algorithmic way for Problem 1 but the unit strategy for Problem 2. It shows that they understood Problem 1 as belonging to proportional problems for which they had an algorithm available, while Problem 2 was not understood as a proportional problem.

Considering that the two word problems were rather straightforward, the success rate of pupils nearly at the end of their primary school attendance is not satisfactory. Our study has tentatively showed that some pupils tend to be less successful in solving the word problem when it is not immediately clear which class of word problems it belongs to. A possible implication for teaching would be that pupils should not be taught in such a way that they rely on standard procedures only (as the rule of three) as they tend to forget it after some time and if they do not have a pre-formal solving strategy to rely on they are unsuccessful. Literature such as (Ben-Chaim, Keret and Ilany, 2012, Cramer and Post, 1993) suggests that pupils should meet with ample opportunities to create their own strategies in a variety of proportional contexts and only afterwards be introduced to formal procedures.

## **CONCLUSION**

In our study, we investigated the influence of the context on the used solving strategies for lower secondary pupils. The sample was not a random one, however, it consists of the whole population of pupils of the same age in four primary schools purposefully selected and thus, we can make some conclusions. The context influenced the choice of the strategy for nearly half of the pupils. These pupils saw the two problems with the same mathematical model as belonging to two different classes of problems for which they had available different procedures. The rest of the pupils used the same strategy, recognising that the two problems have the same mathematical model and thus warrant the use of the same strategy.

The most frequent strategy was the informal one – the unit strategy. It is based on understanding the substance of the situation. The formal strategies of the rule of three and the percent formula were used in minority of cases which shows that with growing time distance from the time when it was covered in school, pupils stop using it and resort to pre-formal strategies.

Our study has its limitations. The choice of the sample was already mentioned above; its size is another one. Moreover, we base our considerations on the written solutions only. By using interviews with pupils, we could get a more plastic picture. But then the sample could not be as big as it is now.

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# COMPUTER APPLICATION FOR DEVELOPMENT OF INNOVATIVE EDUCATIONAL PROGRAMS

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## ABSTRACT

In view of the increasing demand for knowledge of multidisciplinary endeavours under digitalization of society, there is an increasing need for development of flexible innovative educational programs. For this purpose, we offer a computer application for development of the educational program content. This computer application is implemented on the basis of the topological sorting algorithm. The efficiency of this algorithm compared to others is obvious because it promotes the course of learning, which avoids duplication of modules (theme) and keeps the logical sequence of the educational material learning. The computer application presented allows to create an individual learning course, taking into account the prerequisites and postrequisites of elective disciplines and multi-disciplines.

## KEYWORDS

Computer Application, Topological Sorting, Elective Disciplines, Innovative Educational Program

## INTRODUCTION

Under digitization of society, including intellectualization of the educational system, creation and management of educational programs should be implemented with application of modern information technologies. When developing innovative educational programs we should take into account the timely trends of modernization of the educational programs content. Creation of innovative educational programs of multidisciplinary endeavours is one of these trends. It is known that novelty is often referred to «as “innovation”. ‘In most cases, new – it is an integration of old components in the whole that did not exist before’» (Trump, 2009). This article discusses an innovative approach used in development of the interdisciplinary educational programs. Currently, there are different approaches, methods and means of carrying out formation of the learning course of a student. Many considered views and approaches were taken as the basis for development of the proposed computer application.

At developing electronic educational means, it is reasonable to use fundamental knowledge in mathematics and informatics, such as theories and methods of algorithms, mathematical bases of informatics. Study of the results of modern scientific works for



example, such as «in the work (Dominikov and Belous, 2014:201). In this paper, the ‘problem of rational ordering of the modules of the training course is proposed. A graph (an acyclic graph) is used for the solution methods. The problem of rational ordering of the modules of the electronic course is formulated as the problem of finding the best approximation of the initial structure of preferences in the class of all order relations on a given set of objects’». The classical algorithms have been successfully used everywhere for designing means of educational digitalization. Topological sorting algorithm has been used for decades as a tool for planning educational process. It is demonstrated by a tool, «which is based on topological sorting and ‘used both for planning forty-minute lecture and sequence of courses for the entire period of studies’» (Meinke, 1976: 60).

Also, algorithm of topological sorting «has been used for creating Optimum Learning Path (OLP) generator, ‘based on personalized knowledge of structural graph (KSG). This generator realizes the student model and personalized decision-making rules, which are updated in real time and monitor the status of students in educational process’» (Liu and Huang 2012: 406).

Personalized adaptive system is represented «in the work by Limongelli et al (2010, 1015) ‘based on personalized needs of trainees’. In their approach, the authors use the ‘sequencing algorithm, i.e. to help the trainees to find optimal path through the education material’». Brief «review of ‘adaptive systems’, used in educational process is stated» in the work by (Brusilovsky, 1999: 20).

Among various electronic means of systematizing content of educational material, from the point of view of our research, «the most interesting is CmapTools software ‘for creating representative maps’, by Canas et al (2001:50) at IHMC (Institute for Human and Machine Cognition)». These tools are represented in the form of software product for modeling new knowledge, and creation of concept maps, the software support review of map space and search.

There are also works for managing knowledge, «based on thesaurus method, such as ‘ALTER-NATIVA, a system for supporting different elements of e-learning’ J. Sarraipa et al (2016: 85)». The formal requirements, «which must be accounted during development of thesaurus system of programming concepts, are highlighted in the work by Kuvaldina (2003: 5) ‘1) systemacy; 2) hierarchical pattern– each concept has its own level, being the main element for the above level; 3) axiomativity (thesaurus, as a knowledge system, includes concepts, which cannot be defined within the limits of a given system, their definitions are accepted as axioms’. With that, the system of concepts (thesaurus) is viewed as a systems of elements, consisting of two types – concepts and links between them».

The approach, stated «in the work by Baldoni et al (2007:45) ‘lies in creating RDF document out of received metadata (existing database of curricula), which contains title of curriculum, catalogue identifier, semester’». Unlike this research, «the article by Carchiolo et al (2007: 267), ‘development of curriculum and learning materials was based on providing the students by set of concepts. All the curriculum items, each of them represented as a logical unit, are characterized by a set of extractable concepts’». The curricula are located in the form of oriented graph, consisting of nodes, connected by arcs. Developing content of learning material is based on main concepts, represented by nodes and their linkage characteristics in the form of arcs of the graph.

In the context of rapidly changing educational environment, «quite new methods of developing content of curricula are emerging (Baldomero, Salmeryn and Lypez, 2015: 133), for example, ‘the tool for evaluating MOOCs: Standard UNE 6681:2012 for

managing quality in virtual education and the tool for analyzing qualification in training models and strategies of on-line curricula in higher educational institutions ADECUR'». Also, well-known environment for developing curricula, «Moodle (Monica Inec Monsivais et al, 2014: 94), 'is not out of date and is still being used by many vocational higher education institutions'».

Based on review and analysis of the above and many other researches in developing curriculum content, it should be noted that application of topological sorting algorithm is scientifically justified and evolution of computer applications and platforms does not diminish its advantages in designing content of educational programs for more advanced systems. In this connection, in our project we used «a formal description of the 'topological sorting algorithm' for computer-based realization, listed in work by Virt (1986)».

Analysis of educational programs, currently implemented in higher education institutions is based on modular approach and consists of variant and invariant components. Invariant component includes discipline modules, mandatory for all students. Assimilation of different (usually four) variant educational modules provide students with knowledge on the individual learning paths.

Proposed computer application for designing inter-disciplinary educational programs, provides flexibility in forming student's individual learning path, which takes into account invariant and variant links between different courses. The practical importance of our project is also determined by the social aspect of modernization of the educational programs content. An interdisciplinary study of complex systems in physical and social sciences over the last quarter of a century «has led to the development of new important 'conceptual perspectives and methodologies that are relevant for research in these areas', as well as for experts, politicians, and citizens who have to deal with complex social and global problems in the 21st century as states Jacobson and Wilensky (2006: 11)». Padek et al (2015) and Shankararaman and Ducrot (2015: 5) «observe that realization of 'interdisciplinary links assists in achieving better result in overall development of a student, harmonic evolution of all the regions in his intellectual activity, takes into account different competences of learners by their discipline'».

The aim of our study is to verify the impact of interdisciplinary curricula constructed by using topological sorting algorithm on learning outcomes.

## **MATERIALS AND METHODS**

The information model, which lies in the basis of computer application of the multidisciplinary educational programs, has a flow of information on the input, in the form of a list of subjects on the output of multidisciplinary educational program. An analyzer unit carries out data processing based on apparatus of matrix theory, graph theory and topological sorting of the input information. Li, Wang and Leung (2015:5) argue «that the graph theory and 'topological sorting is used in different scientific areas: technical, social, mathematics, physics etc. Let us consider general idea of topological sorting'». Given directed graph  $G(V,E)$ , it is necessary to conduct topological sorting, i.e. establish linear order. Demonstrate that each arc of the graph leads from smaller to bigger node.

Proposed computer application realizes the following algorithm:

*1 step:* build graph for curriculum content. Graph edges are:

- 1) direction of a sector, showing sequence of disciplines in the learning path;
- 2) non-directed weighed section, showing presence of links between learning elements.

*2 step:* build matrix  $B$ , which defines logical links of the graph:

$$\beta_{ij} = \begin{cases} 1, & \text{if there is a relation between nodes } X_{ij} \\ 0, & \text{if there is a relation between nodes } X_{ij} \end{cases}$$

Where  $i, j$  take values from 1 to  $N$  the nodes may be:

Curricula or sections, comprising these disciplines;

Objects– storages of resources.

3 step: define coupling degree matrix  $K$ , where:

$$K = \begin{cases} Z(Z = \overline{1, N}), & \text{if } B \neq 0 \\ K - 1, & \text{if } B = 0 \end{cases} \quad (1)$$

4 step: define sequence of learning elements.

Ordering content is done in the following sequence:

Define integral skill elements of the curriculum;

Given elements are placed in certain sequence;

Develop coupling matrix of learning elements.

If necessary, conduct correction of couplings

Modified algorithm of topological sorting:

While Graph not free do

begin

Define predecessor nodes.

Lead out graph nodes

Identify graph edges

end

The tested and implemented computer application of educational programs based on topological sorting comprises 10 interconnected modules, each of which is programmed to perform specific functions.

Program module

About.ddp

Module for building matrix of learning elements

W2kMain.

Module for sorting courses, identification of nodes, building edges.

CourseTopologicalApp.dpr

CourseTopologicalApp.dproj

CourseTopologicalApp.dproj.local

CourseTopologicalApp.exe

CourseTopologicalApp.identcache

CourseTopologicalApp.res

W2kStrs.rc

W2kStrs.res

Thus, if topic B includes content part of topic A, let us note that A contains B. The practical significance of the topological sorting of our work lies in the fact that no topic subject will be studied before the one, to which it is a prerequisite, and topological sorting is not possible if there is a duplication of educational material.

Building content-based educational program starts with filling logical-meaning coupling

matrix. After forming the matrix, we build the graph, which is represented by a sequence of studying disciplines. The dialogue window produces one of two messages:

“No cycles in the graph. It is possible to proceed to next step”.

“Cycles in the graph. It is not possible to calculate further!” - in this case, it is necessary to revise learning elements coupling matrix. If there are cycles in this graph, the program will produce relevant message. The graph will be presented, but the logical sequence of studying disciplines will not be shown.

In the process of the computer application development for designing of educational program, we used SCORM specification standard.

Functionally, this computer application allows to manage and track content to the level of learning objects, manage learning content and track learning outcomes.

## **RESULTS**

In order to determine the content of the disciplines which were used in a computer application for designing the content of the educational program, empirical methods such as observation, interviews and questionnaires were used.

The first experiment version was tested by the experts from the number of professors - teaching staff, who were coordinators of the educational program. Studies have been conducted on the correctness of drawing up of educational programs for avoiding duplication of educational material, the correct sequence of courses that are prerequisites and postrequisites. Computer application has been used for interdisciplinary educational programs as a process of double-diploma education on the basis of combined educational programs and is bilateral symmetrical. The results of the application of computer applications have been tested together with the Omsk State Pedagogical University in the educational program direction “Education and pedagogical sciences” profile “Information technologies in education”. The aim which is to ensure the formation of information and communication competence as part of the professional competence of the future masters of education in accordance with their profile and characteristics of the future professional work in the field of education. Graduate training in the disciplines combined programs carried out with the use of e-learning and distance learning technologies. Inclusion in «the educational programs of these courses provide a complete interactive content posted on educational websites of universities, ‘it contributes to solving the problem of preparation of masters of education for the introduction of e-learning Lapchik et al (2015: 35)’». At the moment, we are checking the content of the interdisciplinary educational program for the specialty 6M011100 - Informatics jointly with the University of Texas Rio Grande Valley (UTRGV), USA, Computer Science in Astronomy direction.

Second experiment results of the application of computer application have been tested at the beginning of academic year from 2015 to 2016 together with the Omsk State Pedagogical University in the educational program direction “Education and pedagogical sciences” profile “Information technologies in education”. 90 students from 2 specialties participated in the experiment. The purpose of the educational program was to ensure the formation of information and communication competence as part of the professional competence of the future masters of education in accordance with their profile and characteristics of the future professional work in the field of education. During the study, 2 groups of 14 people were selected. For the experimental group, the trajectory of training is constructed using a computer application based on topological sorting, and the control group chose the modules for training without taking into account any criteria, only on their own. After selecting the trajectory of learning, the results were determined by a testing

method to determine the impact of interdisciplinary curricula built using a topological sorting algorithm. Empirical values were calculated using the Cramer-Welch criterion for two samples, so that the characteristics of the samples compared coincide at the significance level of 0.05.

As a result of calculations on the sample of the experimental and control groups, the value of the empirical Cramer-Welch criterion equal to 0.07 was obtained prior to the start of the experiment.

$$T_{эм} = \frac{\sqrt{4 \cdot 14} |59.86 - 60.5|}{\sqrt{4 \cdot 542.59 + 14 \cdot 494.73}} = 0.07 \quad (2)$$

The obtained value is less than the critical value of 1.96, therefore, the hypothesis on the coincidence of the characteristics of the control and experimental groups before the experiment is taken is at the level of 0.05. Comparison of the characteristics of the control and experimental groups after the experiment.

$$T_{эм} = \frac{\sqrt{4 \cdot 14} |40.86 - 22.07|}{\sqrt{4 \cdot 259.82 + 14 \cdot 26.38}} = 4.15 \quad (3)$$

As a result  $T_{эм} = 4.15 > 1.96$ . It follows that the reliability of differences in the characteristics of the control and experimental groups after the end of the experiment is 95%. This result shows that the changes in the groups are due to the application of a computer application based on topological sorting.

The experts also noted that based on the principles of inductances and deductive presentation of the content of disciplines, students are allowed, on the one hand, to go into more details and, on the other hand, systematically work through the content of the educational program.

Coordinators of the educational program noted that based on the principles of inductances and deductive presentation of the content of disciplines, allowing on the one hand in more detail, on the other hand systematically work through the content of the educational program.

## DISCUSSION

The article is aimed at demonstrating efficiency of interdisciplinary educational programs. Science and technologies «are developing rapidly, and as a result, 'the content of modern distant education is also changing dynamically, highlighting the need to find ways and mechanisms to promote and provide learning information' Chia-I-Chang (2004:60), Stacey (2007:3)». Computer application as a tool helps exploring curriculum using a multidisciplinary approach. The software may serve not only as a tool for designing curricula, but also for use by teachers, psychologists, managers, whose main objectives are to examine quality of curricula contents. The content is updated dynamically. Advance of digital revolution requires from the society proper training of persons, in accordance with modern conditions, where great attention is paid to knowledge on the interdisciplinary level. All the above listed works of scientists are aimed at improving learning process.

## CONCLUSION

The implemented computer application of multidisciplinary educational programs solves the technology problem of intellectual forming of the content for the learning process. The

application assists the issue of rendering structured and systematic knowledge to a student, construction of a logical sequence of necessary information from its large amount. Thus, we believe that we solved one of the problems of rational design of the learning disciplines content for the educational process development. The implemented computer application enables the efficient development of academic knowledge of students. Computer application on the basis of topological sorting creates the learning course in compliance with the logical sequence of the educational material learning and avoids duplication of modules (themes).

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# THE DIFFERENCES IN RESULTS AMONG STUDENTS ADMITTED IN DIFFERENT WAYS

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## ABSTRACT

The paper presents results of the analysis of results from the course of Mathematics for Economists at the University of Economics, Prague. Results of 1848 students were used to verify whether the way in which students were admitted could predict results in mathematics or students' performance in general.

The sum of scores from the mid-term and the final test were analysed by using Kruskal-Wallis test and grades were analysed by using ordinal logistic regression. Both methods concluded that the way of admission did not have any effect on student's performance. Analysis of variance was used to study the effect of way of admission separately for each combination of student's faculty and semester during which the student took the course. The conclusion was that there was a significant effect of way of admission on the scores and this effect was different for each faculty.

## KEYWORDS

Analysis of Variance, Entrance Examination, Kruskal-Wallis Test, Ordinal Logistic Regression, Test in Mathematics

## INTRODUCTION

Each university and faculty gives admission to new incoming students based on different criteria and in different ways. Faculties of the University of Economics, Prague admit students by using in-house made entrance examinations, which usually consist of mathematics test and foreign language tests. However, some students may get admission based on SCIO test scores or based on other criteria, such as average grade in secondary school or grades in certain subjects.

Each student of the Faculty of Finance and Accounting, the Faculty of International Relations, the Faculty of Business Administration and the Faculty of Informatics and Statistics at the University of Economics, Prague is obliged to take the course of Mathematics for Economists, offered by the Department of Mathematics of the Faculty of Informatics and Statistics, during their undergraduate studies. The students of the Faculty of Economics can take this course as optional as they have a different mathematics course offered by their faculty. During the course, each student has to write a mid-term test that is worth 20 points, a final test worth 40 points, and take an oral exam worth 40 points. The final grades are then determined according to the rules of the University of Economics, Prague, which can be found in the Appendix. The content of the course is identical with the content of the book by Klůfa (2013b).

The scores from the two tests have been analysed in several papers, e.g. Kaspříková (2012) analysed whether demographic and behavioural traits influenced student results,



Otavová and Sýkorová (2015; 2016) showed that the score of students depended on the faculty at which the student was enrolled and the semester in which he/she took the course. The scores were also analysed by different approaches, e.g. Klůfa (2012) analysed the scores from the probability point of view, while Kaspříková (2013) used latent variable framework to analyse the scores. Otavová and Sýkorová (2014) showed that there was an association between the mid-term test score and the final test score by using contingency table.

Klůfa (2013a; 2015a; 2015b; 2015c) analysed the results of entrance examinations, namely whether the result of the entrance examination depends on the variant of the test. He also verified whether the results of students depended on the way the students were admitted to the university by using Kruskal-Wallis test and analysis of variance (Klůfa 2015a; 2015b).

The purpose of this paper was to analyse whether the results of students in the course of Mathematics for Economists depend on the way students were admitted to the university. Therefore, this paper is an extension of the research conducted by Otavová and Sýkorová (2015; 2016) and Klůfa (2015a; 2015b). At first, we verified whether the way of admission had any effect on the scores and grades. In the second part, we conducted the analysis of variance and included faculty and semester as independent variables, so that the dependence on the way of admission could be studied for each faculty and semester separately. All the analyses were performed in the statistical packages R and IBM SPSS.

## **MATERIALS AND METHODS**

### **Data description**

The dataset contains information about 1981 students who took the course of Mathematics for Economists in the academic year 2014/2015. It provides information about each student's score in the mid-term test (0-20 points), score in the final test (0-40 points), grade (see Appendix), faculty (Faculty of Finance and Accounting – F1, Faculty of International Relations – F2, Faculty of Business Administration – F3, Faculty of Informatics and Statistics – F4, and Faculty of Economics – F5), semester in which he/she took the course (winter, summer), and the way in which the student was admitted to the university (Entrance Exam, SCIO test, Other).

Students from the Faculty of Economics were not included in the analysis, as there were only few of them and due to fact that the course was not obligatory for them. Some students forgot to fill in the question about the way in which they were given admission, so some missing values were present in the dataset. Hence, the scores and grades of 1848 students at their first attempt to the exam were used for analysis.

Table 1 shows the number of students in each treatment, or combination of the three categorical factors mentioned above (faculty, semester, and way of admission). We can see that majority of the students were admitted by entrance exams and only a few students were admitted by SCIO tests or in other ways.

Admission	Semester	Faculty				Total
		F1	F2	F3	F4	
Entrance Exam	Winter	226	242	213	275	956
	Summer	218	271	176	35	700
	Total	444	513	389	310	1656
SCIO test	Winter	0	2	2	55	59
	Summer	5	0	2	10	17
	Total	5	2	4	65	76
Other	Winter	0	2	0	104	106
	Summer	1	0	0	9	10
	Total	1	2	0	113	116
Total		450	517	393	488	1848

**Table 1: Contingency table of number of students in each treatment**

Table 2 shows the contingency table of grades by the way of admission. It can be seen that most of the students were classified by the “good” grade, while only small proportion of students was given a second chance to take the final and oral exams.

Grade	Admission			
	Entrance Exam	SCIO test	Other	Total
Excellent	227	8	30	265
Very good	396	14	21	431
Good	687	34	32	753
Failed, eligible for retake	126	6	5	137
Failed	220	14	28	262
Total	1656	76	116	1848

**Table 2: Contingency table of grade by admission**

## Statistical methods

Firstly, we verified if the results of students were different for students admitted in different ways, i.e., we did not take semester and faculty into account. For this purpose, two statistical methods were used: Kruskal-Wallis test and ordinal logistic regression.

Kruskal-Wallis test was used to compare whether the sum of scores from both tests was different for students admitted in different ways. The method tested the hypothesis that the three groups of students had the same distribution of scores. This nonparametric alternative to one-way analysis of variance was used due to fact that distributional assumptions for scores and heteroscedasticity assumptions were not fulfilled. More details about Kruskal-Wallis test can be found, e.g., in (Pecáková, 2011).

Ordinal logistic regression was used to check whether the grades of students depend on the way of admission. Both variables were categorical: grades were ordinal with 5 levels and way of admission was nominal with 3 levels. Hence, ordinal logistic regression was applied to fit a model with grade as a dependent ordinal variable and the way of admission as an independent factor. The significance of the way of admission was then tested by the likelihood ratio test. For more details about ordinal logistic regression, see (Agresti, 2010).

Secondly, we analysed whether the score of a student depends on the way of admission and we controlled for faculty and semester. We used three-way analysis of variance and included all possible interactions. By doing so, we analysed the dependency for each

combination of faculty and semester separately. Since the number of students in each combination of semester, faculty, and way of admission was not equal, we used linear regression approach to the analysis of variance. Weighted least squares were used due to fact that homoscedasticity assumption was violated. The final model was then chosen by using backward elimination of the factors and their interactions. More details about analysis of variance and linear regression can be found in (Kutner et al, 2005).

## RESULTS

### Descriptive Statistics

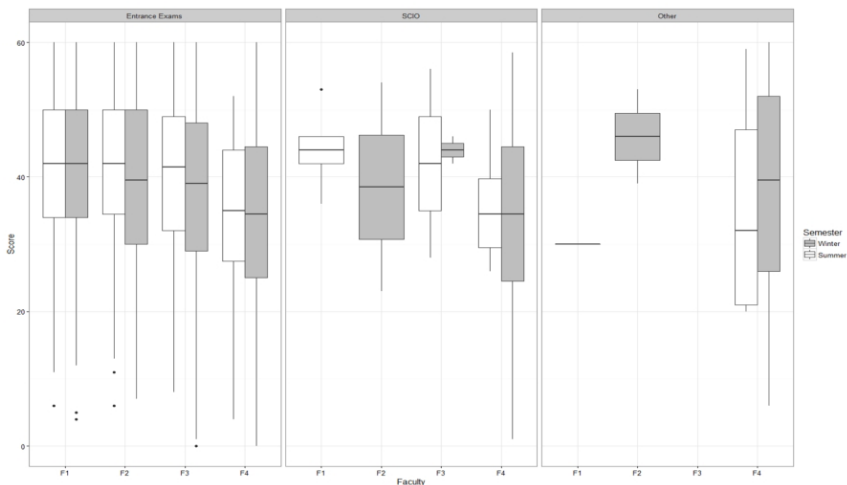
For analysing the scores of students, the scores from both tests (mid-term test and final test) were summed. Table 3 shows the descriptive statistics for this variable. It can be observed that scores were negatively skewed. Table 4 shows the treatment means, i.e., average score for each combination of faculty, semester and way of admission. The distribution of scores in each treatment can be seen on the boxplots on Figure 1. From these boxplots it can be observed that the variance was different in each treatment as the interquartile range, which corresponds to the height of the box, was different each treatment.

N	1848
Mean	38,797
Median	40
Std. Deviation	12,693
Skewness	-0,505
Minimum	0
Maximum	60

**Table 3: Descriptive statistics for score**

Admission	Semester	Faculty				Total
		F1	F2	F3	F4	
Entrance Exam	Winter	41,04	39,27	37,41	34,25	37,83
	Summer	41,21	41,20	40,01	35,00	40,60
	Total	41,12	40,29	38,59	34,33	39,00
SCIO test	Winter	-	38,50	44,00	33,64	34,15
	Summer	44,20	-	42,00	35,20	38,65
	Total	44,20	38,50	43,00	33,88	35,16
Other	Winter	-	46,00	-	38,43	38,57
	Summer	30,00	-	-	36,11	35,50
	Total	30,00	46,00	-	38,24	38,31
Total		41,13	40,31	38,63	35,18	38,80

**Table 4: Average score in each treatment**



**Figure 1: Boxplots for each treatment**

### Kruskal-Wallis Test

Table 5 shows the results of the Kruskal-Wallis test. As the p-value was greater than 0.05, we failed to reject the null hypothesis. Hence, it can be concluded that there are no differences in the results for students who were admitted in different ways.

	Df	Chi-squared value	P-value
Kruskal-Wallis	2	5.3293	0.06962

**Table 5: Kruskal-Wallis test for admission**

### Ordinal logistic regression

Table 6 shows the result of the likelihood ratio test which tests whether way of admission could act as a predictor for the final grades. As the p-value was greater than 0.05, we failed to reject the null hypothesis. Hence, the way of admission did not have any effect on grades.

Model	Log likelihood	Df	LR stat	P-value
Only intercept	-2686.41	4	3.0277	0.2201
Admission	-2684.90	6		

**Table 6: Likelihood ratio test for admission**

### Analysis of Variance

Before conducting the analysis of variance, the Brown-Forsythe test for the equality of variances was performed and its results are provided in table 7. As the p-value was lower than 0.05, we rejected the null hypothesis of equality of variances (homoscedasticity) in each treatment and weighted least squares had to be used.

	Df	F-value	P-value
Treatments	17	2.9891	0.0000
	1830		

**Table 7: Brown–Forsythe test for the homogeneity of variances**

Table 8 shows the analysis of variance table with the final model of the backward elimination. The three-way analysis of variance allowed analysing whether the way of admission acts as a predictor for the scores of students for each faculty and semester separately. From the table 8 it could be concluded that score in mathematics depended on the way of admission and this effect was different for each faculty as the interaction between the faculty and the way of admission turned out to be significant.

Source of variation	Df	Sum of squares	F-value	P-value
Faculty	3	39.03		0.0000
Semester	1	7.82		0.0231
Admission	2	471.49		0.0000
Faculty*Admission	5	145.19		0.0000
Errors	2778.51	1836		

**Table 8: ANOVA table (Type II sum of squares)**

## DISCUSSION

Our findings coincide with the findings of Klůfa (2015b), but he tested the independence of score on the way of admission only for the Faculty of Informatics and Statistics, while we used data from four faculties. Moreover, we have shown that the same conclusion held for the final grades, i.e., that the grades did not depend on way of admission.

Similar studies, which studied the relationship between score in the entrance examination and score in mathematics courses, were conducted in the past. Linda and Kubanová (2013) found that the score in mathematics depended on the score at the entrance examination, but this did not hold for students which were admitted by the SCIO tests. Similarly, Kučera, Svatošová and Pelikán (2015) showed that the performance of students in two mathematics courses could be predicted from the score in the entrance exam.

## CONCLUSION

In the paper we verified whether scores and grades of the students of the University of Economics in the Mathematics for Economists course depend on the way students were admitted to the university. When all students were included in the analysis without taking semester and faculty into consideration, the way of admission did not influence the scores of the students. However, when faculty and semester were taken into consideration, the score of a student depended on the way of admission.

These results may be used to verify whether the faculties give admission in correct ways. In the future research, we would like to study the long-term evolution of this dependence and we would like to analyse the differences between faculties in more details. However, we are still in process of collecting such data.

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## APPENDIX

Grade		Points
Excellent	1	90-100
Very good	2	75-89
Good	3	60-74
Failed, eligible for retake	4+	50-59
Failed	4	0-49

# DRIVING THE “BUS” BEYOND THE BOUNDARIES OF CZECH REPUBLIC

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## ABSTRACT

Efforts in the Czech Republic to build youngest learners’ calculation skills on the understanding of concepts, relationships and processes, instead of drilling large quantities of “columns” of similar problems, resulted in the development of innovative mathematics textbooks at the primary school level that are based on the idea of schema-construction. Mathematics is embedded into a number of mathematics-didactical environments. One of the key environments, the Bus, was used as an object of an experiment in Thessaloniki, Greece, in 2013. The research findings indicate that no matter the cultural setting, the Bus environment can empower both the early conceptualization of natural numbers and the development of important mathematical skills such as the mental operations and the meaningful organization of arithmetical data.

## KEYWORDS

Additive Operations, Conceptualization of Natural Numbers, Didactical Environment, Record of Process, Schema Construction

## INTRODUCTION

While searching for effective mathematics teaching methods for youngest pupils in Greece, we became acquainted with the method of schema-building, developed by Hejný (Charles University in Prague, the Czech Republic) and first introduced in Greece in 2011 (Hejný, 2011; Jirotková, 2011). Put in simple terms, this method rests upon two pillars: a constructivist teaching style of a teacher who rather provides problems to the students instead of turnkey knowledge. Solving problems enables them to acquire new knowledge through autonomous work on one hand, and a thoroughly elaborated system of problems that guide pupils through a variety of mathematical environments on the other. While pupils solve problems in various contexts that they enjoy and feel comfortable with because these contexts build on their experience, and while they solve problems at various levels of difficulty that are amenable to individual approaches, the pupils build quality mental schemata of mathematical concepts, relationships and processes. In the recent years, there has been an extensive experience of using such approaches (i.e. based on schema-oriented education) in Czech schools.<sup>1</sup> However, the Greek setting is quite different. There are differences in the adopted approaches as well as in the curriculum content. For the latter case perhaps the most significant difference is that in Greece, during their first grade, pupils are dealing with numbers from 1-100 whereas in the Czech

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<sup>1</sup> According to the survey of Ministry of Education of ČR from 2016, the textbooks (Hejný et. al., 2007-2011) are currently being used in about 20% of Czech schools.



Republic the corresponding range of numbers is from 1-20. This means that the students in Greece deal with the numbers 1-20 almost during their first month of schooling. Thus our research question is: Could the usage of an environment like the Bus one influence young students' (a) conceptualization of natural numbers, and (b) problem solving behavior?

The concept of schema is frequently used in various scientific areas (Herschkowitz, 2009) and, obviously, its different definitions have different connotations. It was adopted in the field of mathematical education from cognitive psychologists, such as Piaget (1928) and Gerrig (1991). Both the Action-Process-Objects-Schema (APOS) theory of learning process (Dubinsky and McDonald, 1999) and the theory of procept (Gray and Tall, 1994) make extensive use of this concept. We adopt Hejný's (2014) approach who compares the two conceptions in detail and he grounds his definition of the schema concept on the definition given by the American psychologist Gerrig (1991), but he limits it only to mathematical schemata. He defines schema as a mental construct that includes clusters of information relevant to understanding. Moreover, he claims that in order for a schema to come to existence, there must first exist isolated models that act as cluster-forming information. A schema comes to being only through the existence of a first generic model. According to Hejný, the schema should be understood as a dynamic organization of heterogeneous elements which gradually changes into a mathematical structure. An additional key concept is that of the mathematics-didactical environment. It is based on the concept of Wittmann's (2001) substantial learning environment and endowed with further characteristics by Hejný (2014). By mathematics-didactical environment we will here understand a set of mutually interrelated concepts, relationships, processes and situations where the problems that are formed have the following qualities:

- they are motivating and attractive for pupils,
- they bring deep mathematical ideas (Semadeni, 2002),
- they are long-term applicable (developing from simple problems suitable for primary pupils to difficult ones at a higher level, e.g. the lower secondary level),
- their levels of difficulty are adaptable for both weaker and stronger pupils.

One of such key environments is the Bus environment which is an arithmetical semantic one. "Bus" capitalizes on pupils' experience of travelling with public transport. The process of people getting on and getting off and the recording of the number of passengers in a table constitutes a rich set of data and numerical relationships which in turn can be the origin for creating a lot of problems. This environment can be implemented as early as the first grade of primary school and is also highly effective in lower secondary grades. In the first stage the Bus environment contributes to the development of five pupils' needs and competences: a) to quantify phenomena from everyday life, b) to hold attention during the whole performance, c) to mathematize real situation, d) to practice short-term procedural memory, e) to create a language suitable for grasping the process.

Conceptualization of natural numbers and additive numerical operations is developed within this environment. In fact, there are four arithmetical elements connected to each bus-stop, i.e., the number of passengers who (i) arrive to the specific stop (A), (ii) get on (N), (iii) get off (F) and, (iv) depart from this stop (D). These elements are interrelated according to the equality:  $D = A + N - F$ . The central idea is the discovery of this relationship between the four elements that facilitates further problem solving and the development of an effective record of a process. The process is thus conceptualized. The environment is didactically developed in the textbooks (Hejný et. al., 2007-2011). The Bus environment is described in detail in Hejný and Jirotková (2009). Let us only briefly introduce the environment.

The game simulates travelling by bus on a line connecting several bus stops. The bus is represented for instance by a cardboard box and the passengers could be represented by objects like plastic bottles. The bus stops are set up around the classroom and pupils can give them their own names. The bus driver takes the bus from the initial stop to the terminal stop. At each stop some passengers may get off (except at the initial stop) and get on (except at the terminal stop). The getting on and off at each stop is happening at the command of a dispatcher. Pupils can see passengers getting on and off but they cannot see inside the bus (the box). The pupils' task is to remember, or to record in some way, the whole process of the journey. After the performance, the teacher asks questions about the journey. For example: How many passengers arrived at the terminal stop? How many got on at the stop X? Where did most passengers get off?

Jirotková, Kloboučková and Hejný (2013) and Jirotková and Slezaková (2013) report on experiments with primary pupils and preschoolers in Czech schools. They demonstrate the emergence of the pupils' need to record the process and how this recording is gradually improved by ignoring information that is useless for solving the problem, leading thus to the more organized form of a table. This paper intends among others to make a short comparison between the significant results of the above experiments in Czech schools with the experiments conducted in a culturally distinct environment, namely, in a primary school in Thessaloniki, Greece, in 2013.

## **MATERIALS AND METHODS**

The participants were 15 pupils (9 female and 6 male, 7 years old) in a primary school in Thessaloniki, Greece. The research took place during the first month of their school life. Because of the already existing curriculum, the "bus" game was played in parallel with the normal teaching of mathematics every 2-3 days. The set in the classroom included the Departure, the Terminal, and three intermediate stops. A specific color was assigned to each one of them so as to be easy for the pupils to refer to them (Brown, Green and Pink stop). They also chose the bus and the passengers from objects in the classroom. There were two stages of the experiment. During the first stage, the pupils were asked to find just the total number of passengers who got off at the Terminal stop. The numbers used for each stop varied from 1 to 5 and it was better to start with events where passengers got only on at the intermediate stops. Later, when the pupils felt comfortable with the rules of the game, the conditions became more complex with passengers both getting on and getting off, but still within the range 1-5.

The second stage was more demanding because the numbers were in the range 1-10 and mainly because the questions posed to the pupils required a continuous recording of how the total number of passengers evolved during the whole journey. Some examples of such questions are: How many passengers were on the bus between the Brown and Green stops? In which part of the bus journey was there the biggest number of passengers on the bus? On which stop did the largest number of passengers get off? etc. For each journey, a certain template was given to the pupils.

These templates were collected after each journey and examined so as to be utilized for the design of the next journey. The final two sessions were audio-recorded and then transcribed for the purpose of the research. These protocols, in conjunction with the collected templates as well as with the notes of the observer-researcher, constituted our data and they were examined in the context of qualitative content analysis (Mayring, 2014) in order to identify instances that give evidence about students' conceptualization

of numbers as well as of the changes in their problem-solving behavior (i.e., progress in the way they organize data so as to make them sense-making).

According to the curriculum, pupils were expected to progressively compare and estimate quantities from 1 to 5, to be able to count collections of the same size, to count verbally from 1 to 10. During their last lesson, before the final two sessions, they were introduced to the concept of addition given that the sum is always less than or equal to five. In relation to journeys that involve quantities from 6 to 10, the curriculum states that the pupils should have early preliminary knowledge about them.

## RESULTS AND DISCUSSION

The first stage of the project started with passengers simply getting on. Initially, there was one passenger per stop and later two passengers or zero passengers. Very quickly, the pupils felt comfortable and this is why their teacher started introducing also passengers who got off. She decided to avoid getting on and off at the same bus-stop at this time. For this part of the project, the pupils were given blank templates in case they were not able to calculate mentally the necessary results. Some of the pupils simply wrote the final number. Others used to keep records that would help them to do their final calculations (fig. 1). In the following passage, we will comment on the pupils' record-keeping.

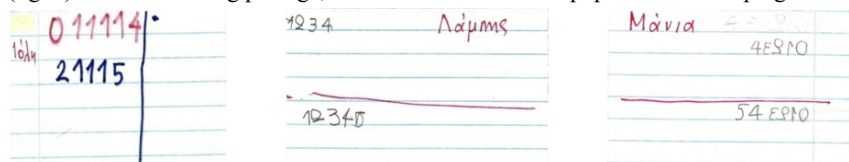


Figure 1: Pupils' first attempts

The zero in the first template corresponds to the very first moment of showing the empty box to the students. The "1" that is next to the "0" refers to the first passenger who got on at the Departure stop, and then the next "1" for the passenger who got on at the first bus stop, and so on. Number "4" at the end corresponds to the total number of passengers who got off at the Terminal stop. This process was shortened for the second journey (first template). There is no zero. The pupil just ignored the moment the teacher showed the empty bus to the classroom. The whole series of numbers starts with the number of passengers who got on at the Departure stop. In the second template, the pupil counted and wrote down the total number of passengers at the moment the bus was leaving each stop. A similar strategy can be seen in the third template. Writing the numbers in reverse order is perhaps related to the actual movement of the bus in the classroom: the bus was in front of the pupils and it was moving from right to left and perhaps this was why the order of the numbers follows the same direction. The next step – as already mentioned earlier – was to include getting off at the intermediate bus stops. The pupils soon managed to handle the situation either by calculating mentally or crossing out the previous calculation after each passenger's getting on or off. Then, they could make the necessary calculation and write down the new number and continue to do so until the end of the journey.

However, the rules of the game changed during the second stage. The first difficulty the pupils encountered was that the total number of passengers was between 1 and 10. The second, and the most important one, occurred when the teacher started to ask questions that demanded a continuous recording of the process of the whole journey. In order to help the pupils, the teacher gave them templates including the whole series of the stops (see fig.

2), so that they could keep record of what was going on at each bus stop. Obviously, such a task is very demanding for such young pupils and this was why our focus was more on the process than on the result. Our effort was to detect how pupils recorded the continuing information, making – when possible – a connection with the recording methods of the first stage. The reason was to see whether they kept on using the very same strategy or whether they made a step further by improving it.

The number of the pupils who were able to find the correct result was significantly smaller in comparison to the first stage (as expected). However, almost all of them tried to find a way of organizing the gathered data that may prove helpful for answering the teacher's questions.

Initially, some pupils – influenced by the experience gained during the first stage – continued marking the passengers horizontally along a row, ignoring the different colors in their templates. They used 1's for passengers who get on and X's for the ones who get off. These X's were placed either next to the 1's or above them. In the former case, getting on and off was measured separately. The calculation then was complex since the pupils had to take account of additions and subtractions each time and, therefore, they were prone to committing errors. The latter was indicative of an advanced mathematical thinking since each pair (the '1' and the 'X' above it) in essence represents a pair of opposite numbers (+1, -1). The sum of these numbers is zero and therefore they do not contribute to the final result (fig. 2, left, fig. 2, right). This makes the calculation of the results easier since the pupil had to consider only the 1's that were left over. Even though this method was effective for the final number of passengers, it did not help with answering questions related to the intermediate stops.

The nature of the numbers and questions led pupils, gradually, to turn towards recording their data separately for each bus-stop. Deciding how this would be carried out was not an easy task. Some of them decided to write two numbers next to each color (bus-stop), denoting the number of passengers who got on and off. However, they were not able to handle all this accumulated information. Arguably, this was beyond their abilities (fig. 2, middle). There were also pupils who modified their horizontal way of writing to a vertical one using 1's and X's for each bus-stop (fig. 2, right).



**Figure 2: Pupils' attempts during the second stage**

In relation to the first stage, two aspects of the game's contribution in the classroom could be pointed out. On one hand, the bus environment responds to the need for quantification of events from the pupils' daily life (Hejný and Jirotková, 2009), and it lets pupils exercise the skill of following and recording an event that is in progress, as well as develop their ability to mathematize a situation. On the other hand, from the teaching point of view, it is important to see pupils in their first month of schooling handle mentally numbers (Threlfall, 2009) and basic arithmetical facts (the increase and decrease of the number of passengers) while, according to the curriculum, they are expected to operate on a less

demanding level. Thus, in the common teaching practice and in order to respond to basic arithmetical facts, the pupils always have visual representations of the targeted numbers – either in the form of pictures in the textbooks or in the form of manipulatives – in front of them. Gradually, our pupils became able to calculate easily the final number of passengers through a series of intermediate calculations. For these intermediate calculations, the pupils could not see the content of the bus. They only could see passengers getting on or off. So, they had to somehow interpret this visual information in numbers. This was indeed difficult, if one took into account the fact that the pupils had not yet been taught the operation of subtraction. One thing is to count backwards from 5 (or 10) to 1, and it is quite a different thing to see two or three passengers getting off which must be translated in terms of the necessary operation so as to identify the number of the passengers who are still inside the bus. Given that subtraction is more difficult than addition, this skill becomes very significant.

Obviously, the second stage made the pupils feel confused and unable to answer. It was clear that the method they followed was not any more effective. This was why they were encouraged to use – in any way they considered helpful – the template with the colors. The pupils gradually realized that if their memory failed to support them then they had to work in an alternative way to continue recording the progress of the journey. Implicitly, the template suggested a double entry table with two variables: (1) the bus stop, and (2) the number of passengers who got on or off. This recording tool was used and was progressively improved on. The pupils organized their data across a continuous line initially, but their inability to utilize this data for the purpose of the intermediate questions led them, step-by-step, to the logic of using the two variables. Therefore, they began marking in a separate line the data for each bus-stop (according to the stops' respective colors). They also adapted the form of marking the 1's and X's so as to signal a specific meaning (for the specific pupil), making him/her able to manage the intermediate questions. This idea of using a table carrying a unique meaning for a specific "reader" constitutes a vital skill important for the school life of the pupil in the years to come.

## **CONCLUSION**

The acquaintance with the spirit of the new mathematical textbooks for primary school in the Czech Republic was presented at some conferences relevant to Mathematics Education, eg. (Hejný, 2011; Jirotková, 2011) and continued with personal communication with the authors of these textbooks (Hejný, 2007-2011). This became the starting point for deciding to 'drive' the 'Bus' beyond the boundaries of the Czech Republic.

The time dedicated to the usage of the Bus in the Greek classroom was limited and the reason was twofold. First, the teacher had to work with it during the first month so as to deal with the numbers from 1 to 20. Second, this would be done in parallel with the normal teaching which means that she had to finish the Greek official textbook and then to play with the Bus. However, the results gave positive evidence about the influence of this experience on students' early conceptualization of natural numbers. Perhaps the most interesting influence was the pupils' interplay between the visual and the mental modes of thinking. They had the chance to see only travelers getting on or off but never the interior of the Bus. So, there was a visual component to "mental arithmetic". Cuoco, Goldenberg and Mark (1996) refer to this as the "visualizing calculations". According to their "habits of Mind" the students should be in the habit of visualizing calculations, perhaps 'by seeing numbers flying around in some way'.

Additionally and given their age it is worthy to focus more on some other aspects of the results obtained. Perhaps the Bus environment is a way to talk about metacognition in Grade 1. The fact that the students realized that the recording method they followed during the first part could be transferred and applied (in an improved form) during the second part is in itself an instance of metacognitive behavior. But, for obtaining an effective version of their recording tool the students actually used a kind of systematic experimentation. This was done on the basis of understanding the role each symbol (i.e. '1's and 'X's) plays in the total or intermediate calculations. There are research findings that show how students are able to apply systematic experimentation during problem solving but they refer to older students (Papadopoulos and Iatridou, 2010). This may open a different view for considering these environments from the research point of view. Finally, as the comparison between Czech and Greek experience is concerned, it is safe to say that we did not find any significant differences between the work of Czech and Greek pupils. What needs to be emphasized is the fact that all pupils expressed their need to record a process, especially when they could not handle all the necessary information in their memory. Czech pupils tended to include a drawing of the bus route, most likely as a result of the enactment of the game. They also used other than numeric symbols to record the number of passengers, and they eventually managed to work their way towards creating a table even when not given a template. Therefore, the Bus environment achieves the didactical goals independently of the place where it is used. The only factor is the way in which the environment is used.

## ACKNOWLEDGEMENTS

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# EFFECTIVENESS OF OBTAINING THE STUDY INFORMATION BY STUDENTS

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## ABSTRACT

The aim of the paper is to assess how the students obtain the information about studies in the most convenient way and to find out what is the role of social media in this process. Primary survey asked 110 university students about their preferences. We focused on the role of social media. The results show that despite that the most often students find the information at official faculty's internet pages, the most convenient way of searching the information is on Facebook in students' groups of and sending the messages to official Facebook page of faculty. It can be recommended to the universities' study departments to foster the communication with students also via social media. Message there can reach broader public and help to mitigate the occurrence of misinformation, especially in Facebook students' groups.

## KEYWORDS

Communication, Convenience, Social Media, Study Information

## INTRODUCTION

The ways how the students obtain the information about the study requirements and other important matters changes together with the ways of communication. Whereas previous decades, students had to visit personally students' department or made a phone call, currently they rather communicate via e-mail. Students also gets more used to search for information on social media. "In today's society, social media have become an almost indispensable part of daily life, particularly among university students, who are generally heavy social media users." (Lau, 2012: 286) With increasing usage of social media, students use them not only to interact with their peers, but also to obtain study information. Social media can be further used "to share information with students, collect information when overseas or while conducting research, share personal academic interests with other people, engage students and understand what they think about during instruction, form student study groups, and enhance e-textbook functions by connecting students with social tools for collaborative purposes", (O'Brien, 2012: 1).

Social media foster communication among teachers, current and future students, various university departments and other possible interested stakeholders. For example, Pechrová, Lohr and Michal (2015) analysed the effectiveness of social media usage in the process of selection of study programme by prospective students and concluded that this tool has the power to help the students to decide for certain study programme. Similarly, Pechrová and Lohr (2016) assessed the efficiency of this communication with current or prospective students, employees, community etc. by universities and faculties via social media. They found out that universities were less efficient in communication on Facebook

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than individual faculties. They recommend to both enhancing the users' engagement by the interactions with the audience and creating the relevant content. "School officials, like their corporate and government counterparts, are learning that social media tools are exceedingly more powerful than they realized," (Cox and McLeod, 2014: 6). We can even proclaim that "social media use is an expectation; it's no longer optional." (Blankenship, 2012). With advances in technology, more information is made available via a wide variety of channels – and social media became one of the most important (Kim and Sin, 2016). Therefore, the aim of the paper is to analyse the ways how the students obtain the information about studies in the most convenient way and find out what is the role of social media in this process. A case study was held at Czech University of Life Sciences Prague (CULS) at Faculty of Economics and Management (FEM). The paper is structured as follows. Firstly, the social media channels that are available at a faculty are introduced. Then the primary survey construction, used data and methods of analysis are described. Results section presents the findings and discuss them. Last section concludes.

## **MATERIALS AND METHODS**

Primary survey took place between 14<sup>th</sup> November 2016 and 4<sup>th</sup> December 2016. The study was done on a sample of 110 students from three study programmes at the FEM at CULS. Sample consisted mostly of the 1<sup>st</sup> year master degree students (104 persons), others were 1<sup>st</sup> year undergraduates. They studied Business and administration (101), System engineering (8) and Management and economics (1).

Official information sources at FEM includes internet pages of study system [is.czu.cz](http://is.czu.cz), Moodle ([moodle.czu.cz](http://moodle.czu.cz)) that contains study materials, [student.czu.cz](http://student.czu.cz) (with information about important dates etc.), and study department or official Facebook (FB) pages of FEM. There are also unofficial ways, how the students can find information about studies that they need, such as other thematic web pages (e.g. [primat.cz](http://primat.cz)) or posting questions in the groups at FB. Official FB page of FEM was founded in 2011 and since that it gained 10 838 fans (beginning of February 2016). It is managed by the students and the employee of the faculty. Its posts are mostly informing about important dates of the academic years and interesting events taking place at the university. It is also possible to contact the administrators by direct message or by posting the question on the FB wall. The questions are answered based on official faculty information within 2 days. Traditional resource of study information is the study department, where each study programme has its own study officer. It is possible to contact her by e-mail (but the response might take time), phone or personally (where the answer is immediate, although office hours must be followed). Firstly, the students were asked what type of information they search the most. They were given the groups of information from which they could select appropriate ones. Consequently, it was surveyed where they obtain the general information about study (study conditions, study requirements, important dates, etc.). Following possibilities were given: internet pages of FEM, [student.czu.cz](http://student.czu.cz), [is.czu.cz](http://is.czu.cz), [moodle.czu.cz](http://moodle.czu.cz), others (non-official) internet pages, questions in the groups at FB, messages at official FB pages FEM, questions at official FB pages FEM, e-mail on study department, phone calls on study department, personal visit at study department. Statistical description of the results is done using contingent tables in Excel where can be seen the frequency of appearance of particular answers. Then students evaluated different types of obtaining information according to how they perceive their convenience: 1 – the most convenient, 2 – convenient, 3 – non-convenient and 4 – the less convenient. Average mark was calculated to see the most convenient way of obtaining the information.

Second part of the survey was focused on the communication of FEM through social media. Students were asked whether they use FEM's FB pages as a source of study information, and if they do, whether they received relevant answers for their questions in appropriate time. Consequently, it was assessed to what extent the student perceive the posts on FB of FEM as interesting, useful, entertaining and important. They could decide on the scale from 1 – the most to 5 – the less. Besides, it was surveyed if students are fans of FEM at other social media platforms than FB such as Twitter, Google+, Instagram, LinkedIn, YouTube or Swarm.

The results are compared and discussed with the findings of other researches aimed at social media usage by university students. The conclusions are made based on the synthesis of findings from primary survey.

## **RESULTS**

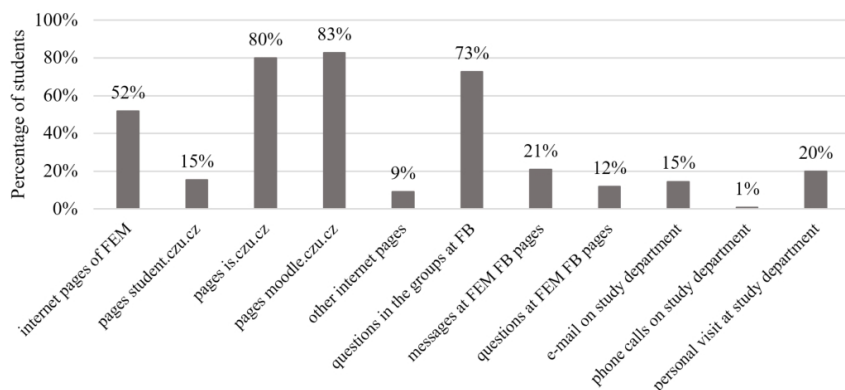
At first, it was asked what type of information students search. Mostly it was marked the answer that requirements for a semester, seminar and other works (bachelor or master theses). In 82 cases students try to find important dates of the academic year (the examination period, the Rector day, start / end of the semester etc.) and in 71 cases they search for contacts for teachers (their e-mails, telephones, office hours, etc.). Of course, that majority of students need time to time all type of information.

The general information about study (conditions, requirements and important dates) are mostly gained from multiple sources. Only in five cases they stated that they use only one source (internet pages FEM 2 times, is.czu.cz 2 times and other internet pages). The most frequented answer was that mostly they obtain the information from web pages moodle.czu.cz, then from information system is.czu.cz, followed by the questions in the FB groups. The most frequent combination (18 cases) was obtaining the information at web pages is.czu.cz, moodle.czu.cz, questions in groups at Facebook. Second most frequented answer was that internet pages of PEF, is.czu.cz, moodle.czu.cz, questions in FB groups. Hence, the social media have their stable place beside official sources of information. As expected, on-line resources overwhelmed the off-line ways of communication. Visit of the study department were important only for only 20% of students, probably where no other ways were possible or when the information required was not standard (such as specific study situations and problems). Approximately the same number of students rather writes the message on the official Facebook pages of the FEM and 12% of students also asked the questions directly at FB pages of FEM. The results are displayed at Figure 1.

The results of the survey about the convenience of obtaining the information about studies from the stated methods are displayed at Figure 2. The best average mark was given to pose the questions in specialized groups at FB. Asking peers or classmates was perceived as the most convenient way of obtaining desired information as it awarded with mark 1 by 56 students out of 110. Another useful resource of study information were messages sent at FEM's FB pages valued by average mark (1.91) and then official internet pages of FEM (1.93). Also posting a question on the FB pages of FEM was considered highly convenient (1.96). The less convenient is to make a phone call on study department or to personally visit it. Even writing an e-mail to the study officer is considered to be non-convenient.

In absolute terms, as convenient is perceived writing the messages at FEM FB pages that was given mark 1 by 36 students. It can be seen, that among comfortable methods of searching for the information are also social media. Ask and pose the questions about the subject about which the students are interested in is easier than finding the information

on internet pages (non-official or even of FEM CULS). This conclusion is in line with the results of study elaborated Roblyer et al. (2010). According to their findings students in higher education institutions preferred using Facebook and other similar technologies to supplement learning and preferred obtaining information and references via Facebook and e-mail to conventional face-to-face interaction. It is due to the fact, that social media are suitable for fast, easy and cheap interactions. (van Rooyen, 2015)



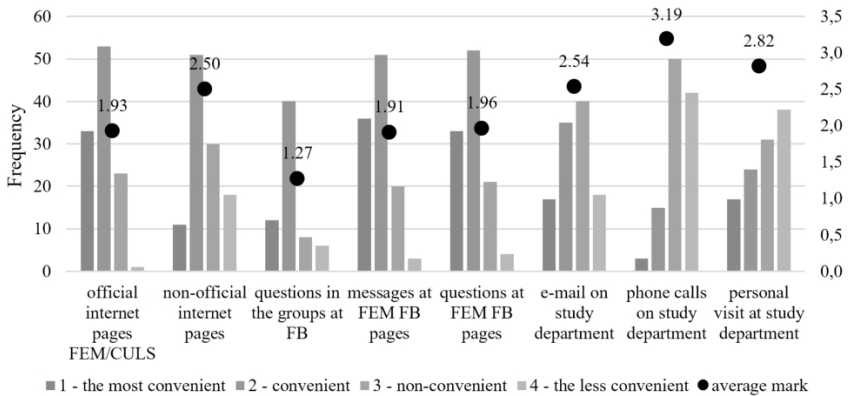
**Figure 1: Sources of obtaining the general information about study; source: own elaboration**

However, there is a certain risk of obtaining wrong information when asking only in the groups at FB. On one hand, the student can get quick answer on the question from the classmates, but the reliability might be lower as the question are usually not answered by employees of the university. It was proved in study of Chen et al. (2015) that college students sometimes share misinformation on social media. Despite that it is “often for non-informational reasons such as to share eye-catching messages or to interact with friends,” (Chen et al., 2015: 591). One must be caution before fully relying on the truth of the obtained information. Besides, as Kim and Sin (2016) warn, students are not always critically valuating the sources of information.

While the of communication among students in FB groups cannot be influenced by the faculty, it can use its own FB profile to foster the communication and provide important information by posting and answering the messages and questions.

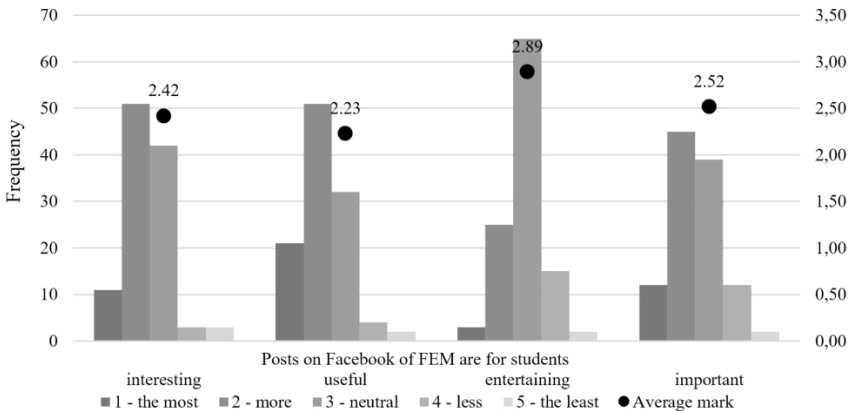
However, before we make a conclusion about usefulness of direct communication between faculty and the students, we must keep in mind that not all students are using social media for this purpose. Our survey revealed that 70% of students never send any message to FEM on Facebook. Let’s have a closer look on the relation of the students to the FB and other social media of FEM.

Majority of the students in the sample are fans of the FEM on Facebook (103). Moreover, 26 of these follow their faculty on other social media. They are fans of the faculty on its Instagram account (26 students) or follow the tweets on Twitter (7). Also 4 students are connected with FEM on LinkedIn. Only four people from the sample stated that they do not follow any social media of the FEM. According to the survey, 33 students out of 110 ever send a message to FB of FEM. From those 21 students always got the relevant answer quickly. 10 of them also got relevant answer, but not fast enough. Only 2 did not consider the answer relevant. It seems that answering the messages on FB by FEM works well in spite that there is still place for improvement.



**Figure 2: Convenience of the method of obtaining the information about study; source: own elaboration**

Regarding the posts on the FB pages of FEM, the students mostly consider them useful and interesting. They contain important information, and maybe this is the reason why they are not perceived as entertaining. Content of the posts is focused on telling important information and not primarily aimed at amusement of the users. Most of the students (65) have neutral meaning about the entertaining nature of the FEM’s posts on FB. Results are displayed at Figure 3.



**Figure 3: Evaluation of the posts of FEM on Facebook by students; source: own elaboration**

There was a space for other comments in the questionnaire. From the feedback of the students, it can be seen that the posts on the FB of FEM are relevant to their needs. “Posts contain the most current information, i. e. various deadlines, applications or invitations to events and interesting lectures”, student no. 35. “Very practical is the alert on actions – enrolment (in timetable), job fair etc. (from official FB page of FEM),” student no. 43. Contrary to that, student no. 63 stated that “Pedagogues could respond more to e-mails.” This suggest that teachers are not answering the e-mails on time. We must keep in mind that one-to-one communication with students is often demanding for the teachers as they

sometimes have to answer the same question many times. In this case, usage of social media could help to manage more questions at once and hence effectively.

Based on the reactions of the FEM students, we can recommend utilizing further, and maybe even more the social media to share important information with students. We may proclaim in general that all universities and faculties will have to focus more on the communication via social media in the future as it is a very convenient way for the students to obtain the information about studies. It is also a convenient way for the university teachers to share the information with more students at once. Besides, it helps to mitigate the occurrence of misinformation on the social media (and especially in FB groups of students) as the students are often advising each other without complete or accurate information.

Taking into account that the survey suggests that the most convenient way for the students how to obtain the information about studies is to post a question in specialized group of students on FB, the challenge is to manage the misleading information that often arise there. We can state the suggestions based on the Roblyer et al. (2010: 135) presumption that faculties “may be likely to adopt a technology if they perceive it as a way to facilitate communication with students” and recommend to the study departments of faculties to join the groups of students to monitor their questions. Answering them directly in these groups would be, however, too time demanding. More efficient way could be to create FB pages of the study department, where all important information can be posted.

## **CONCLUSION**

The aim of the paper was to assess the ways how the students obtain the information about studies in the most convenient way and find out what is the role of social media in this process. Primary survey asked 110 students of Faculty of Economics and Management at Czech University of Life Sciences Prague about their preferences. A lot of communication between students and study department or teachers about study requirements already goes on via email. However, students are increasingly preferring the communication via social media. Therefore, the focus of the survey was on the role of social media and especially of the Facebook pages of the faculty of which majority of respondents was the fans.

According to the students the most convenient way of obtaining the information about studies was asking the questions in the groups at Facebook, despite that the students are mostly searching for the information on official internet pages. However, the students must be aware that in the students' Facebook groups there is a certain risk of obtaining wrong information.

Majority of the respondents were the fans of the faculty's Facebook pages; 33 of them ever asked a question there and 21 got relevant answer. The information posted by the faculty can be considered as useful and interesting. Students appreciated the notices on important dates. It plays its role in the communication between students and faculty by informing them of events and other faculty's activities. Based on our results, it can be recommended to the universities' study departments to also foster the communication with students via social media. The posts and messages there can reach broader public and help to mitigate the occurrence of misinformation, especially in Facebook students' groups.

This survey was the first insight in the issue and shall be continued in the future on larger sample. There should be searched the determinants that influence the convenience of the way, how the students obtain the information about studies. A logit or probit models shall be constructed and assessed. From practical point of view, future survey shall examine the contents of students' FB pages from the point of view of search and shared information.

Based on the results, frequently asked questions can be formulated and answers can be shared with the students (see for example <http://www.smat.se/pruvodce-studenta>).

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# GAMIFICATION IN EDUCATION: SOCIAL NETWORK ANALYSIS

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## ABSTRACT

The aim of this paper is to identify the contents of posts on Twitter and Instagram in regards to gamification in education. Partially, the aim is to identify any disparity between various studies of the current status in the field of gamification in education based on journal analysis and social network analysis (Twitter and Instagram). The analysis includes data from Instagram (516 posts) and Twitter (3,549 posts) from a total of 2,409 users, and two literature reviews. The posts were recorded between 13/03/2016 and 19/02/2017. The results identified the 20 most-used hashtags, and were extrapolated into 5 crowds focusing on two major areas (1) learning and (2) business. In this study, the Business Sector is taken as the dominant area, unlike previous research, where there was much less emphasis on this field. In greater detail, this analysis of social networks identifies areas connected with business and gamification and education, these being (1) motivation, (2) startup success, and (3) finance.

## KEYWORDS

Gamification, Education, Social Network Analysis, Learning, Business

## INTRODUCTION

Dignan (2011) states that the term “gamification” is used widely and can take many forms. Deterding et al. (2011), Swan (2012), Sarangi and Shah (2015), and Tansley, Hafermalz and Dery (2016) identify gamification as an intersection of game elements and non-game activities. Conejo (2014) further states that gamification is a technique that uses elements of digital games to motivate people to act in a certain way in a non-game environment. Trees (2015) introduces gamification as an application of game mechanics and psychology to the management of employees. According to Harman, Koohang and Paliszkievicz (2014), gamification has been studied in many sectors- in marketing, psychology or education, and there has been an increased interest in gamification in recent years. For example, Bittner a Schipper (2014) examined what motivational suggestions of game design influence the purchase intentions of consumers (in product advertising). Harwood and Gary (2015) researched gamification’s access in online customer engagement and behaviour. Tansley, Hafermalz and Dery (2016) investigated the use of gamification (gaming tools) in the talent assessment process. Baptista and Oliveira (2017) examined the impact of the use of game mechanics and game design techniques in the acceptance of mobile banking services.

The use of gamification should also have potential in traditional education, for example when students need to be motivated to convert learning into action (Harman, Koohang and Paliszkievicz, 2014). The use of gamification in education is still considered to

be a rapidly developing area of research (Deterding et al., 2011; Dicheva et al., 2015). According to Simões, Redondo and Vilas (2013), the aim of gamification is to use game elements in the teaching processes. Holmes and Gee (2016) dealt with a framework for understanding and differentiating different forms of game-based teaching and learning. These authors suggest that one of the options of the use of gamification is to transform learning into a game format (by using the game elements). At the Czech University of Life Sciences in Prague, a game program has been created, which is used in the education in management course (Pavlíček et al., 2015). Pilař et al. (2016) presented a study which showed that the use of the term “gamification” in the educational context has been increasing over time, indicating that the topic is of current interest and has strong potential for further research.

### **Gamification in education: Current state studies**

Dichev and Dicheva (2017) examined by method of literature review selected papers (empirical and theoretical studies), and have identified studies reporting empirical evidence for the effectiveness of gamification in the educational context. They introduced in this context areas as motivational mechanisms: learning, improvement of attendance and participation. Martí-Parreño, Méndez-Ibáñez and Alonso-Arroyo (2016) analysed the use of gamification in education from published theoretical reviews and research papers. They examined a wide variety of constructs, which were grouped in four main themes - effectiveness, acceptance, engagement and social interactions. Pilař et al. (2016) and Surendeleg et al. (2014) researched, by method of literature review, the role of gamification in education and introduced in this context areas such as motivation, learning processes, game elements, enhanced learning and student engagement.

Literature reviews are valuable as an introduction to a topic, but focusing only on the scientific literature can be very limiting. In this research field, it is possible to use social networks for extending knowledge. A better understanding of social media is important because it will help to gain deeper insights into gamification in education via social, cultural and environmental issues about human activities (Hu, Manikonda and Kambhampati, 2014).

### **MATERIALS AND METHODS**

Data was collected by continuously following Instagram and Twitter between 13/03/2016 and 19/02/2017. During this period, 4,065 posts were recorded containing 2 hashtags at the same time: #gamification and #education. These posts were created by 2,409 unique users. There were 516 posts from Instagram and 3,549 posts from Twitter.

Data were filtered and all text not containing the hashtag sign was removed, so that a comparative analysis was possible against the results of a previous analysis of gamification in education, stored on the Scopus database (Pilař et al. 2016).

Data were inserted into the Gephi 0.9.1 program. The Excel/CSV converter plugin was used to facilitate the data import into the network. This application is commonly used for network creation on the basis of table data. Through this plugin it was possible to build the network on the basis of an algorithm that connected the single values in the row, and between the rows, based on the same value.

For a network analysis, the following factors were applied: The Average Degree and Modularity. As a graphical representation method, Force Atlas 2 was used. For the definition of network crowds and their types (polarisation and tight), methods based on the analysis of visual representation were used (Smith et al, 2014).



## RESULTS

819 keywords were analysed containing 12,180 edges. As for the statistical characteristics of the sample in question, the average degree was 29.744. This indicates a great degree of interconnectedness between the keywords. The modularity was 0.53, which can be considered an average value of interconnectedness of individual keywords in terms of crowds of a similar level and individual crowds, resulting in an assumption that one dominant crowd will be identified.

In a frequency analysis of individual hashtags, 20 most-used keywords were identified (see Table 1 below).

Keywords	Degree	Crowds	Keywords	Degree	Crowds
Gamification	783	2	student	158	3
education	783	2	videogames	158	3
learning	292	3	elearning	144	2
edtech	248	2	fun	137	8
gaming	225	3	university	132	3
motivation	186	0	students	132	7
school	176	2	innovation	128	2
game	174	8	teaching	128	2
games	165	8	entrepreneur	125	8
startup	161	8	teacher	120	3

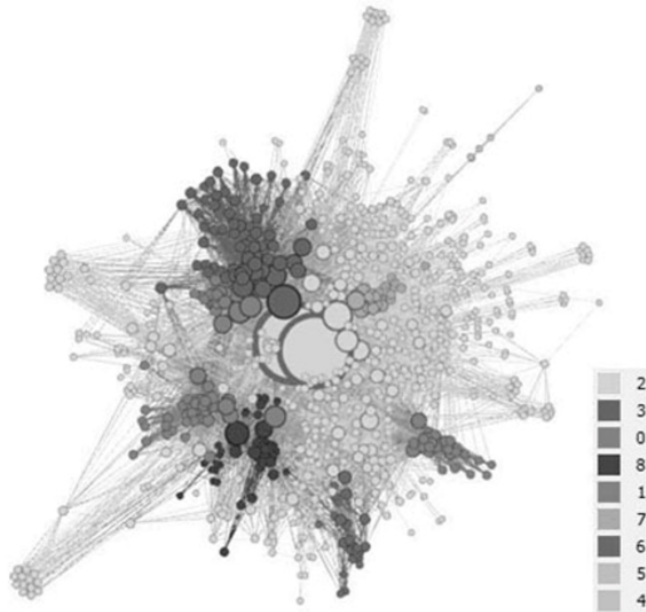
**Table 1: Hashtags sorted by frequency (source: own calculation)**

Based on a modularity analysis, a total of 9 crowds were extracted. The 5 most significant crowds accounted for 93.43% of keywords.

Crowds	Sample of Hahstags	%
2 - Learning (focused on action)	#gamification, #education, #edtech, #school, #elearning, #innovation, #teaching, #math, #learningthroughplay, #gamebasedlearnin	64.1
3 - Learning (Focus on things)	#learning, #gaming, #videogaming, #student, #university, #teacher, #highschool, #college, #teachers, #vr, #science	9.16
0 - Business - motivation	#motivation, #business, #coaching, #mindset, #report, #negocios	8.68
8 - Business - startup success	#game, #games, #startup, #fun, #gamer, #entrepreneur, #success, #crowdfunding,	6.23
1 - Business - finance	#entrepreneurlife, #finance, #stockmarket, #finnancefreedom, #passiveinvome, #income, Stock, #investing, #longinvestment	4.27

**Table 2: Crowds (source: own calculation)**

Visualisation of Social Networks is important to visual the complexity of organisational structure, and is necessary for visual representations of how an organisation functions (Dekker, 2005).



**Figure 1: Communities distribution - ForceAtlas2 Algorithm (source: own calculation)**

The results of the analysis confirmed the average value of modularity and that one major crowd that surrounds the other communities.

## DISCUSSION

Compared to other hashtag analyses in social networks, e.g. related to organic products (Pechrová, Lohr and Havlíček, 2015), communication related to gamification in education is at a very low level, which is related to the fact that gamification is a rather new term which has only gained in popularity since 2010 (Zichermann and Cunningham, 2011). These findings largely correspond to the results of the previous keyword analysis based on articles about gamification in education in the Scopus database (Pilař et al., 2016), as shown in Table 3 below. Moreover, the key hashtags “entrepreneur” and “startup” occurred, indicating a business focus.

Source	Keywords and Hashtags
Scopus (Pilař et al, 2016)	Gamification, Education, E-learning, Simulation, Motivation, Augment properties, Virtual words, 3D multi-user virtual environments, Natural interfaces, Engagement, Serious games, Learning, Game elements, Game-based learning, Higher education
Instagram, Twitter	Gamification, education, learning, edtech, gaming, motivation, school, game, games, startup, student, videogames, elearning, fun, university, students, innovation, teaching, entrepreneur, teacher

**Table 3: Comparison of hashtags at social networks with keywords from Scopus (Source: Pilař et al, 2016 and own calculation)**

A very interesting finding is that, when comparing the crowds to those in previously published research (Pilař et al., 2016), the same differences are apparent for other hashtags related to “entrepreneur”, “startup”, “business” and “coaching” (see Table 3).

This finding can be used in research, as one could focus on this area related to business and soft skills to identify the sharing of these hashtags on social networks.

However, it cannot be said that the business area does not deal with this at all. It is possible to find articles dealing with this topic (Arias Aranda, Bustinza Sánchez and Djundubaev, 2016; Kronnel, 2016); however, they only constitute a minority, and in analyses focusing on literature review, they only mention the business area very briefly (Pilař et al., 2016, Nah et al., 2014) see table 4.

Therefore, to increase the efficiency of these studies and gamification in education, social network analysis is an important addition to literature review, intensifying research in the specific areas.

Author	Areas (crowds)
Own calculation	Learning (focused on action), (2) Learning (Focus on things), (3) Business - motivation, (4) Business - startup success, (5) Business - finance
Pilař et al., 2016	Gamification, Game-based learning, (2) E-learning, education, motivation, student engagement (3) Virtual worlds, augmented reality, 3D multi-user virtual environments, simulation (4) Serious games, higher education, entrepreneurship education (5) Student engagement (6) Active-learning
Martí-Parreño, Méndez-Ibáñez, and Alonso-Arroyo (2016)	(1) effectiveness, (2) acceptance, (3) engagement, (4) social interactions

**Table 4: Comparison of hashtags at social networks with areas(crowds) from literature review (Source: Pilař et al, 2016 and own calculation)**

## CONCLUSION

Based on the analysis, and by comparison of the individual areas with previous research, it can be concluded that there is a disparity between the scientific area (Scopus database) and social networks (Instagram and Twitter). In the scientific area, business together with gamification in education is only treated as a very generic field, whereas on social networks, this area is very dominant, focusing on three main aspects (1) motivation (2) startup success (3) finance.

In analysing the individual areas focusing on keywords and hashtags, this research has identified the 20 most-used hashtags relating to gamification in education on the Instagram and Twitter social networks: “Gamification”, “education”, “learning”, “edtech”, “gaming”, “motivation”, “school”, “game”, “games”, “startup”, “student”, “videogames”, “elearning”, “fun”, “university”, “students”, “innovation”, “teaching”, “gamer”, “teacher”. By comparison with the previous study aimed at the analysis of articles from the Scopus database (Pilař et al., 2016), the difference in the communicated areas related to “entrepreneur”, “startup”, “business” and “coaching” can be found. In the everyday life (social network) context, where people communicate their activities through the Instagram or Twitter networks, gamification in education is published in compliance with the areas of “entrepreneur”, “startup”, “business”, “coaching” and “finance”. In contrast, the research shows the orientation more to the other areas than the

field of business (Pilař et al., 2016). However the results of the analysis of the modularity demonstrate that these areas are linked closely. The important findings of this presented study is the added value of identified clusters (areas of interest on social networks with a connection to gamification in education), that are aimed at the business, and which represent 19.18% of the sample.

For these reasons and according to the results of this study it is possible to recommend four main areas:

- 1) Continue research in gamification in education, because both areas are fields of interest to both sides (Scientists and social network users)
- 2) Focus the research on gamification in education which could be applied to the business area “entrepreneur”, “startup”, “business”, “coaching” and “finance”, to increase the efficiency of the joint business issues in the field of gamification in education through scientific research.
- 3) Exploit the social network analysis in comparison to the results of scientific databases for the following comparative analysis of overlapping areas and for the identification of the unique areas of interest.
- 4) From a wider perspective, augment other current-state studies (based only/mainly on literature review) with an analysis of the Social media, because these results can provide informal feedback from everyday users of social networks to interested workers in the scientific community.

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# EXPLORING THE STUDENTS' PREFERENCES OF EDUCATIONAL TOOLS IN REGIONAL STUDIES

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## ABSTRACT

The paper aims to elicit the students' preferences (weights, priorities) of the educational tools used in the EU Regional Policy course at Faculty of Economics, VŠB-Technical University of Ostrava. Priorities of the educational tools are found out by group decision making using the method of the Analytic Hierarchy Process. Students' preferences are also compared with tutors' priorities. Preferences' analysis showed that form of lessons plays the most important role in the educational process both for the students and their tutors. Results obtained from the analysis will be used to update the course with aim to increase quality of teaching, improve students' knowledge and support attractiveness of the lessons.

## KEYWORDS

Education, Preferences, EU Regional Policy Course, Pairwise Comparison

## INTRODUCTION

Nowadays, innovation of educational process is one of the important topics of academic research. Rapid economic and political changes, the dynamic development of information and communication technology, growth in information, knowledge, science and rapidly changing lifestyles influence the life preferences and attitudes of people (especially young population) to most of socioeconomic activities, including education, see e.g. (Kucera and Kucirkova, 2015; Kovarová, 2015; Vnouckova, Urbancova, Smolova and Smejkalova, 2016). In last few years, the Czech higher education has gone through changes in the field of universities' organization and function, new systems, technologies due to increase in number of students on the one hand and the demographic decline on the other hand as stated e.g. by Kovarova (2015), or Vahalík and Fojtíková (2015). Moreover, the different position of university students and their expectations has been evidenced. For these reasons, universities and their tutors should reflect the changes and needs of today's university students to improve the teaching process, develop and identify new stimuli that attracts students. Educational efficiency is influenced by many factors on both sides of students and tutors. Education quality, according to Cheng (2003) is character of input, process and output of education system that satisfy both internal and external stakeholders by meeting their explicit and implicit expectation. According to Jagadeesh (2000), education quality can be defined from the perspective of knowledge base and skill set of graduates. With the help of student satisfaction, institutions can identify their strength and areas of improvement (Borah, Pahari and Malaka, 2014: 88). Thus research can be also understood as the "action research" which refers to classroom investigation initiated by researchers – tutors who look critically at own practice with the purpose of improving

teaching and quality of education (Blázquez, 2007: 26). The students' priorities are examined in many areas of the educational process and fields. The students' preferences of teaching methods and learning styles in foreign languages lessons at universities are analysed by questionnaire survey by e.g. Smejkalová (2016), Jarkovska and Odstrcilova (2016) or in field of managerial education by Jarosova, Lorencova and Pupalova (2016). Results of these surveys generally showed that the respondents most valued the methods that activate them throughout the lessons (discussion, simulation).

*The aim of the paper is to explore the students' preferences (weights, priorities) of the educational tools used in the EU Regional Policy course.* Preferences of the educational tools are found out by group decision making using method of Analytic Hierarchy Process (AHP) which represents one of the multiple attribute decision making (MADM) techniques. Preferences are found out and compared by the full-time and combined students of bachelor degree attending the EU Regional Policy course whereas we suppose the different results between these two students' groups. Results of students' priorities are subsequently compared with tutors' ones. The paper also discusses the strengths and weakness of used quantitative research method.

## **MATERIALS AND METHODS**

The EU Regional Policy course (EU RP) at Department of European Integration, Faculty of Economics, VŠB-Technical University of Ostrava, has been taught within the study branch European Administration in Czech language since 2004 and in English language since 2008. The Czech course is the compulsory subject for full-time bachelor students of the European Administration study branch. Moreover, this course is the optional subject for full-time bachelor students of study branches Regional Development, Public Economics and Administration, Finance and National Economy and for the combined bachelor students of study branches Public Economics and Administration Business Economics. In terms of importance, this course belongs to one of the key subjects of the bachelor European Administration study branch. The aim of the course is to acquaint students with the development of a basic set-up of the EU Regional Policy its mechanisms and tools. After completing the course, students can explain functioning of mechanisms and instruments of the EU Regional Policy, methodology and use of the European Structural and Investment Funds and other instruments in regional development and their application in the Czech Republic. Students can apply gained knowledge and solve problems within the issues of socio-economic cohesion of the European Union and under the condition of the Czech Republic.

The EU RP course is divided into lectures and seminars. Length of the course is one semester. In winter semester 2016/2017, the course was attended by 17 students of full-time bachelor study programme and 29 students of combined bachelor study programme. In winter semester 2016/2017, compulsory version of the course was concluded by combined exam (test and oral exam). Optional version of the course was concluded by written test. All students passed the credit or exam successfully. Besides regular teaching of the course, both compulsory and optional courses are supported by electronic versions in Learning Management System (LMS) Moodle. In LMS Moodle, students can find all compulsory and recommended study materials and literature within lectures and seminars (tutor's presentations in the ppt/pdf versions, links on related literature sources). Moreover, LMS Moodle serves as: a space for loading of students' essays; space for an announcement of the important news in the field of regional issues; space of possible

discussion between tutors and students LMS Moodle is not currently used for any kind of the testing of students' knowledge.

Since January 2017, the tutors have realized institutional development project focusing on innovation of the EU RP course. The main aim of the project is to update the course, which will lead to better preparedness of the future graduates for practice in the area of regional development and regional policy, implementation of the EU Cohesion policy and application of the principles and standards of project management related with the EU subsidy's consultancy. To increase the quality of teaching, improve students' knowledge and support the attractiveness of the lessons it is necessary to analyse the needs of students in teaching process in terms of current requirements and trends in education.

Based on Slavík (2012), didactic tools used by teachers in education process can be divided into material and immaterial. *Material tools* include classrooms, equipment, technologies and teaching aids. *Immaterial tools* include teaching methods and techniques (Horakova and Rydval, 2015). In this context, we aim to identify the students' subjective preferences (weights) of the following educational tools: *study materials* (Printed textbooks to the course, Presentations (ppt/pdf) placed and downloadable from LMS Moodle, Presentations (ppt/pdf) placed and downloadable from Facebook or other social media, Books related to the study topic, Own notation from the lecture), *form of lessons* (Tutor's presentation of the lecture, Discussion at the lectures, Discussion on Facebook/LMS Moodle/Skype, Self-study, Excursion/lectures with experts from practice) and *form of course* (Form of course completion, Continuous tests during the lessons, Online self-tests in LMS Moodle, Only final exam (written test), Only final (oral) exam). In our opinion, these tools influence the educational process of the EU RP course and have been selected on based on the current state of the EU RP course teaching and new proposed educational tools within the course innovation. Educational tools representing the criteria and related sub-criteria in used methodology are shown in Figure 1 in methodological part of the paper.

## Methods

The multicriteria decision making is a discipline aimed at supporting decision makers who are faced with numerous and conflicting alternatives to make an optimal decision. The multicriteria decision methods (MCDM methods) have been successfully applied to the areas of business and management, marketing, consumer choice, product design, macroeconomic forecasting, portfolio selection, transportation, performance analysis etc. The high flexibility of this concept enables its further extension such as into socioeconomic research (e.g. education, medicine, environmental issues, and political candidacy). The multicriteria decision making problems can be classified into two main categories: multiple attribute decision making (MADM) and multiple objective decision making (MODM). One of the most popular MADM techniques in the real world are Analytic Hierarchy Process (AHP), Simple Additive Weighting (SAW), Technique for Order Preferences by Similarity to an Ideal Solution (TOPSIS), VlseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) or Data envelopment analysis (DEA), see e.g. (Kashi and Franek, 2014; Lin, Wang, Chen and Chang, 2008; Staničková, Melecký and Navrátil, 2013; Poledníková, 2013). In general the MADM methods deal with a range of decision problems, in which the finite number of variants is evaluated based on large number of criteria. In the MADM models the group of  $m$  alternatives is evaluated based on  $n$  criteria (Kashi and Franek, 2014: 417). This decision situation can be described with criteria matrix (1):



$$\begin{matrix}
 & C_1 & C_2 & \dots & C_n \\
 A_1 & \left[ \begin{matrix} y_{11} & y_{12} & \dots & y_{1n} \\
 A_2 & y_{21} & y_{22} & \dots & y_{2n} \\
 \vdots & \vdots & \vdots & \vdots & \vdots \\
 A_m & y_{m1} & y_{m2} & \dots & y_{mn} \end{matrix} \right]
 \end{matrix} \quad (1)$$

where  $y_{mn}$  represents evaluation of  $m$ -th alternative towards  $n$ -th criteria.

### Analytic Hierarchy Process

One of the most popular analytical techniques for complex decision-making problems is the analytical hierarchy process (AHP) developed by Saaty (e.g. Saaty, 2008). AHP enables to handle decision situations involving subjective judgments, multiple decision makers and to provide measures of consistency of preference. Designed to reflect the way people actually think, AHP continues to be the most highly regarded and widely used decision-making method. AHP can efficiently deal with tangible as well as non-tangible attributes, especially where the subjective judgments of different individuals constitute an important part of the decision process (Vyas, Gayatri and Misal, 2013: 10). The decomposition decision-making approach of AHP has the advantage of permitting a hierarchical structure of the criteria, which provides users with a better focus on specific criteria and sub-criteria when allocating the preferences (weights) (Kashi and Franek, 2014). The weights of criteria and sub-criteria can be determined by a number of weighting procedures (subjective and objective), see e.g. (Ginevičius and Podvezko, 2005). One of the most popular procedures is the pairwise comparison (Saaty's method) within AHP. Basic foundation for weight construction of considered criteria is pairwise comparison matrix  $S$  (2):

$$S = \begin{bmatrix} 1 & s_{12} & \dots & s_{1n} \\ 1/s_{12} & 1 & \dots & s_{2n} \\ \dots & \dots & \dots & \dots \\ 1/s_{1n} & 1/s_{2n} & \dots & 1 \end{bmatrix} \quad (2)$$

where diagonal elements are self-compared then  $s_{ij} = 1$ , where  $i = j$ ,  $i, j = 1, 2, \dots, n$ . The values on the left and right sides of the matrix diagonal represent the strength of the relative importance degree of the  $i$ -th criterion compared to the  $j$ -th criterion. Let  $s_{ij} = 1/s_{ji}$ , where  $s_{ij} > 0$ ,  $i \neq j$ . The strength of the relative importance of criterion can be judged by Saaty's scale. The intermediate levels of the 1–9 Saaty's scale is presented in Table 1 and indicates how many times one element is more important over another element with respect to property to which they are compared to. The more the decision maker considers the criteria as more significant, the more is criteria weight higher (Kashi and Franek, 2014), for detailed explanation, see e.g. (Saaty, 2008).

Intensity of importance	Definition	Explanation
1	equal importance	Criteria $i$ and $j$ are equal
3	moderate importance	Low preference of criteria $i$ before $j$
5	strong importance	Strong preference of criteria $i$ before $j$
7	very strong importance	Very strong preference of criteria $i$ before $j$
9	extreme importance	Absolute preference of criteria $i$ before $j$

**Table 1: Saaty's fundamental scale (source: Saaty, 2008, own processing, 2017)**

After pairwise comparisons, normalization of geometric mean is used to determine the importance of elements (3). Let  $w_i$  denote the importance degree for the  $i$ -th element:

$$w_i = \frac{\left(\prod_{j=1}^n s_{ij}\right)^{1/n}}{\sum_{i=1}^n \left(\prod_{j=1}^n s_{ij}\right)^{1/n}}, i, j = 1, 2, \dots, n \quad (3)$$

To ensure that evaluation of the pairwise comparison matrix is reasonable and acceptable, a consistency check is done (4). Let  $C$  denote an  $n$ -dimensional column vector describing the sum of the weighted values for the importance degrees of elements, then:

$$C = [c_i]_{n \times 1} = S \cdot W^T, i = 1, 2, \dots, n \quad (4)$$

where

$$S \cdot W^T = \begin{bmatrix} 1 & s_{12} & \dots & s_{1n} \\ s_{21} & 1 & \dots & s_{2n} \\ \dots & \dots & \dots & \dots \\ s_{n1} & s_{n2} & \dots & 1 \end{bmatrix} \cdot [w_1 w_2, \dots, w_n]^T = \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{bmatrix} \quad (5)$$

The consistency values can be represented by the vector  $CV = [cv_i]_{1 \times n}$ , with element  $cv_i$  (6):

$$cv_i = \frac{c_i}{w_i}, i = 1, 2, \dots, n \quad (6)$$

To avoid the inconsistency occur when using different measurement scales in evaluation process, we use the maximal eigenvalue  $\lambda_{\max}$  (7) to evaluate effectiveness of measurements (Lin, Wang, Chen, Chang, 2008: 20):

$$\lambda_{\max} = \frac{\sum_{i=1}^n cv_i}{n}, i = 1, 2, \dots, n \quad (7)$$

With the maximal eigenvalue  $\lambda_{\max}$  a consistency index (CI) can be determined by (8):

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (8)$$

If  $CI = 0$ , evaluation for the pairwise comparison matrix is implied to be completely consistent. Generally, consistency ratio (CR) can be used as guide to check for consistency (9):

$$CR = \frac{CI}{RI} \quad (9)$$

where RI denotes the average random index, see e.g. Saaty, 2008. If the value of CR is below than the threshold of 0.1, then evaluation of the criteria importance is reasonable.

### **Model of the educational tools evaluation**

Application of AHP to obtain preferences of the educational tools includes the following steps.

*Step 1: Define model of evaluation.* Model has three levels: goal, criteria and sub-criteria. We defined three groups of the educational tools (criteria) and each group was divided into several (4 to 5) individual educational tools (sub-criteria), which belong into the particular group. Proposal of model for utilization of AHP is shown in Figure 1. Decision makers (experts, assessors) are following three groups of respondents: full-time bachelor's students, combined bachelor's students and tutors of the EU RP course.

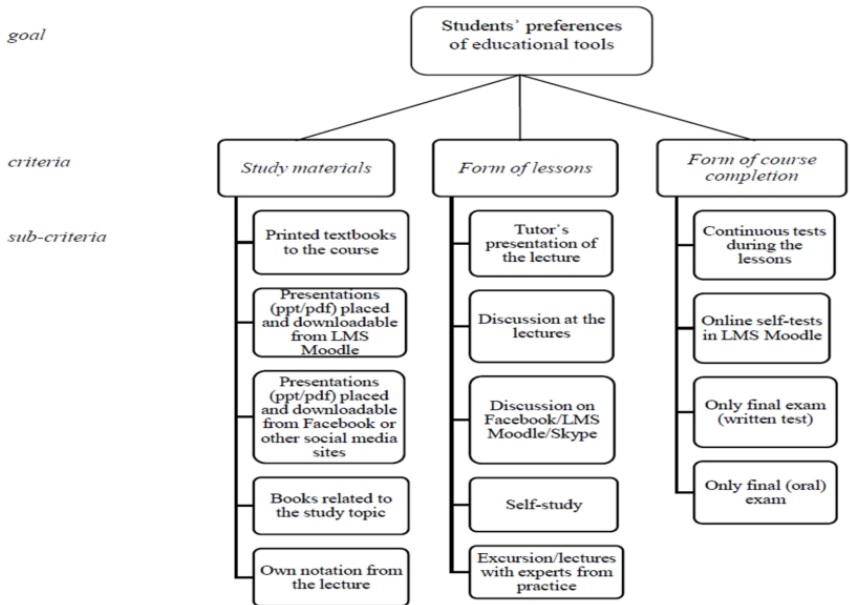
*Step 2: Obtain respondents' judgments for the educational tools and the individual educational tools displayed in the pairwise comparison matrices.* Evaluators are asked to fill-in the pairwise comparison tables and assigned values based on Table 1 if row was preferred before column. If column was preferred before row, reciprocal values were assigned, e.g. 1/5, 1/7. Results were put into Excel sheets.

*Step 3: Compute the educational tools priorities (local weights) and the individual educational tools priorities (global weights) of each respondent in particular group of respondent.* Normalized local weights are calculated by row geometric mean method. Normalized global weights are computed as product of the individual educational tools weights and weights of appropriate sets of the educational tools. After that matrices are checked for the consistency of respondents' judgments.

*Step 4: Compute local and global weights over particular group of respondents.* These results are derived from group of decision making (normalized global and local weights are calculated by row geometric mean method).

*Step 5: Rank the educational tools and the individual educational tools by their importance,* whereas the highest weight the better the educational tool and the individual educational tool achieves.

*Step 6: Compare the educational tools and the individual educational tools priorities and their ranking among particular groups of respondents.*



**Figure 1: Model of the educational tools evaluation – AHP decomposition**  
(source: own processing, 2017)

## RESULTS

Final tested data sample represents 10 full-time bachelor's students, 10 combined bachelor's students and 10 tutors of the EU RP course. The same minimal number of observations in the sample of full-time and combined bachelor's students and tutors ensures the comparability of results. After checking of consistency, from total 17 students of full-time bachelor study programme, 7 respondents were excluded. It means that judgements of some students were conflicting.

Table 2 shows allocation of priorities among educational tools (local weights). As it can be seen, the rank of criteria is the same in all three groups (full-time bachelor's students, combined bachelor's students and tutors). The highest weight and first position was assigned to tool "Form of teaching". It means, the method of the subject teaching is the most important for both full-time (51%) and combined bachelor's students (41%) as well for tutors themselves (64%). The second highest preference was assigned to "Study materials" whereas the highest value (39%) was shown by combined bachelor's students. It can result from combined study form in which the extent of lectures is lower and students are more dependent on self-study and thus quality and available study materials. Tool "Form of course completion" was preferred the less in terms of importance in educational process, whereas the lowest preference (14%) was naturally assigned by tutors.

Respondents	Full-time bachelor's students		Combined bachelor's students		Tutors	
	Weight (%)	Rank	Weight (%)	Rank	Weight (%)	Rank
Educational tools (criteria)						
Study materials	32	2	39	2	22	2
Form of teaching (lessons)	51	1	41	1	64	1
Form of course completion	17	3	19	3	14	3

**Table 2: Local weights (source: own calculation, 2017)**

Table 3 shows allocation of priorities among individual educational tools (global weights). As it can be seen, the rank of sub-criteria differs by three groups of respondents.

Respondents	Full-time bachelor's students		Combined bachelor's students		Tutors	
	Weight (%)	Rank	Weight (%)	Rank	Weight (%)	Rank
Individual educational tools (sub-criteria)						
Printed textbooks to the course	6.76	5	8.63	5	5.95	6
Presentations (ppt/pdf) placed and downloadable from LMS Moodle	11.02	4	15.65	2	5.28	7
Presentations (ppt/pdf) placed and downloadable from Facebook or other social media	2.51	14	2.96	11	3.42	11
Books related to the study topic	3.13	11	4.20	9	4.64	8
Own notation from the lecture	4.92	7	11.50	3	2.56	13
Tutor's presentation of the lecture	18.84	1	15.69	1	23.74	1
Discussion at the lectures	14.59	2	10.81	4	13.98	2
Discussion on Facebook/LMS Moodle/Skype	2.74	13	2.15	14	6.11	5
Self-study	5.37	6	4.99	8	6.98	4
Excursion/lectures with experts from practice	14.21	3	7.07	7	13.24	3
Continuous tests during the lessons	2.85	12	2.18	13	4.55	9
Online self-tests in LMS Moodle	4.01	10	2.96	12	4.50	10
Only final exam (written test)	4.62	8	7.08	6	2.08	14
Only final (oral) exam	4.44	9	4.14	10	2.97	12

**Table 3: Global weights (source: own calculation, 2017)**

The highest preference was given to individual educational tool "Tutor's presentation of the lecture" by three groups of respondents and it was ranked at the first position in educational tools (in category of full-time bachelor's students preference was 18.84%, in category of combined bachelor's students preference was 15.69% and in category of tutors preference was 23.74%). At the second position, educational tool "Discussion at the lectures" was ranked by full-time bachelor's students (preference of this sub-criterion was 14.59%) and tutors (preference of this sub-criterion was 13.98%), while combined bachelor's students assigned this tool as the fourth most important. The third position was given to educational tool "Excursion/lectures with experts from practise" by full-time bachelor's students (preference of this sub-criterion was 14.21%) and tutors (preference of this sub-criterion was 13.24%). By combined bachelor's students this tool was ranked at the seventh position (preference was 7.07%). The "Presentations (ppt/

pdf) placed and downloadable from LMS Moodle” was considered as the fourth most important tool in educational process by full-time bachelor’s students (sub-criterion’s preference was 11.02%) and as second important by combined bachelor’s students (sub-criterion’s preference was 15.65%) while tutors ranked this tool at the seven position (sub-criterion’s preference was 5.28%). On the contrary, the lowest preferences had the tools “Presentations (ppt/pdf) placed and downloadable from Facebook or other social media”, “Discussion on Facebook/LMS Moodle/Skype”, “Continuous tests during the lessons”, “Books related to the study topic”, “Online self-tests in LMS Moodle”. These tools were ranked at the last fourth positions. Preferences and the rank of these individual educational tools differed by students and also tutors. Full-time bachelor’s students assigned the lowest preferences to “Presentations (ppt/pdf) placed and downloadable from Facebook or other social media” (2.51%) and “Discussion on Facebook/LMS Moodle/Skype” (2.74%). Combined bachelor’s students assigned the lowest preferences to “Discussion on Facebook/LMS Moodle/Skype” (2.15%) and “Continuous tests during the lessons” (2.18%). Tutors assigned the lowest importance to tools “Only final exam (written test)” (2.08%) and “Own notation from the lecture”.

## **DISCUSSION**

Results confirm the assumption of different priorities of particular educational tools (sub-criteria) between the full-time bachelor’s students and combined bachelor’s students. Tutors’ preferences in using of given tools during lessons and expectations about students preferences mostly differed from students (if there were similar there were closer to preferences of full-time bachelor’s students).

Full-time bachelor’s students assigned the highest preferences to individual educational tools “Tutor’s presentation of the lecture”, “Discussion at the lectures” and “Excursion/lectures with experts from practise”. Results can indicate that these students are more interested in practical form of teaching and call for active involvement in the lessons. They also appreciate study materials – presentations (ppt/pdf) that they can download from LMS Moodle. On the other hand, and rather surprisingly than tutors expected, students are not interested in possibility to download presentations (ppt/pdf) from Facebook or other social media that are often more user-friendly to young students than university system LMS Moodle. Moreover, they do not prefer discussion on Facebook/LMS Moodle/Skype. One of the explanations can be that students do not prefer to use Facebook or other social media as educational tools but as leisure time activity and they prefer discussion face to face at the lecture which they attend. Students also do not give priority to pass tests continuously during the lessons or to use online self-tests in LMS Moodle as well as use the other specialist books related to regional problematic. These educational tools are considered by students as time consuming for their exam’s preparedness. Naturally, tutors give to these tools higher preferences than students.

In comparison with full-time bachelor’s students, combined students prefer the study material, especially own notation from the lecture and also possibility to download presentations (ppt/pdf) from LMS Moodle or printed textbook of the course. One explanation can be that these students do not attend the lectures every day, they are not in touch with their colleagues so often to share study materials and thus own notation from the lecture. Presentations (ppt/pdf) from LMS Moodle represent the easy way how to get the right study materials. Combined students do not give so high priority to excursion/lectures with experts from practice in educational process. One of reasons can be that these students are mostly employed and they have sufficient practice experiences. These

students also prefer written test as final exam and according their preferences this criterion is ranked at sixth position. Within this criterion, there is the most visible difference among the students' and tutors' preferences. Tutors considered the form of course's completion (especially written test and oral exam) as the least important in terms of educational process. The high difference is also visible by tools own notation from the lecture that is less preferred and discussion on Facebook/LMS Moodle/Skype which tutors give the higher priority probably in terms of current trends.

Results of students' preferences can be implemented to innovation of course, e.g. continuing in improvement of quality of teaching – tutors' presentations and increase time for discussion, maintaining and extending the course support in LMS Moodle, writing the EU RP textbooks. It is necessary to differ in preferences of full-time bachelor's students and combined students.

AHP method allows consistency cross checking between the different pairwise comparisons, although the perfect consistency is very difficult to be achieved. Disadvantage is that the method can be time consuming with many criteria. On the other hand, expert must think about all possible criteria' relations although method requires only two criteria to be considered at one time. Thus, it can be said that it makes the decision making more rigorous in comparison with traditional approach of questionnaire survey. Compared to questionnaire, AHP enables to determine the importance score of criteria and elicit respondent's opinion more precisely. In practice AHP could be done by several software applications (Super Decisions, Expert Choice, AHP Excel calculator) or using own prepared Excel spreadsheets, thus the strength of AHP method is easy mathematical calculation and clear interpretation of results. Exclusion of some comparison matrices confirmed the fact that decision makers sometimes make judgments inconsistently and transitivity is not always satisfied. In our study, inconsistency of judgements was caused in many cases by assigning average number to all comparisons. To eliminate this problem, the full 1–9 Saaty's scale (odd and even values) may be used or letter evaluation can be proposed. Then, letter scale (A, C, E, G, I) would correspond to odd values of Saaty's scale 1–9. Other possibility, how to lower inconsistent comparison matrix, is to ask at first respondents to rank all given criteria in comparison table from the most preferred to the least and then to let respondents to define the preferences.

## **CONCLUSION**

This paper reflects the real needs and priorities of the regional studies' lessons at Department of European Integration, Faculty of Economics, VŠB-TU Ostrava. Preferences' analysis showed that form of teaching plays the most important role in the lessons of the EU Regional Policy course both for the students and their tutors. The second highest weight is given to study materials followed by the form of course completion. Different preferences in three categories of respondents were found out within given educational tools. The tutor's presentation and explanation of the lecture plays the key role at the lessons and get the highest students' and tutors' priority. On the contrary, the full-time bachelor's students appreciate the less the possibility to download the presentations (ppt/pdf) from Facebook or other social media. For the combined bachelor's students the possibility of discussion on Facebook/LMS Moodle/Skype is the least interesting, while tutors consider the criterion only final exam (written test) as the least important. The results of preferences' analysis will be used to update the course with aim to increase the quality of teaching, improve students' knowledge and support the attractiveness of the lessons. We suggest to continue in the research topic and extent it in following academic year with

aim to compare the results between the full-time bachelor's students of the different study year after the course's updating, and to get the preferences of the students who study the English version of the EU RP course (mostly foreign students). In further research we propose to involve full samples of respondents because in the EU RP course participants current samples "inconsistent respondents" have appeared and therefore we suppose to compare results of "consistent" and "inconsistent" respondents.

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# PREVENTION OF RISK BEHAVIOR AT THE 1<sup>ST</sup> LEVEL OF ELEMENTARY SCHOOL

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## ABSTRACT

The aim of the paper is to introduce theoretical perspectives on the topic of school prevention and to present research results within this area. The text of this paper describes the influences on the risk behaviour of children, experience with risk behaviour prevention, the occurrence of risk behaviour and how these problems are perceived by teachers who are in the position of prevention methodologists. The paper is based on partial results of the project *Readiness of Students' and Fresh Graduates' from the Faculty of Education, University of South Bohemia, to Solve Educational Problems of Pupils*, and on the research aimed at the implementation of primary prevention at primary and lower secondary schools. The data were collected from 110 teachers, out of which 40 were primary school teachers, and 70 were in the position of the prevention methodologist in different primary and lower secondary schools in the South Bohemian region.

## KEYWORDS

Novice Teacher, Primary Prevention, Primary School Pupil, Risk Behaviour, Teacher

## INTRODUCTION

The environment of primary and lower secondary school has long been considered as an important area for the formation of children's values. At the same time, school is the place where a wide range of critical moments occur in the socialization and education process of children and teachers must be able to respond to manifestations of the related risk behaviour of their pupils. Mastering relationship crises and behavioural excesses are becoming a key condition for the functional educational process in school. The creation of a positive social environment which allows children as well as teachers to perceive everyday school as a positive experience is becoming fundamentally important (Daniels and Garner, 2000). Despite efforts to change the paradigm of school education, problems with behaviour and increasing indiscipline are a major barrier to the development of primary and lower secondary school. Teachers have long been warning that due to indiscipline in the classroom, they are unable to improve the quality of education (OECD, 2009), and that pupils with behavioural problems are regarded as the most important problem in a school (Meijer, 2001). Some preventive programs have been developed; they are aimed at reducing or preventing violent behaviour and are based on the identification of risk factors (Hahn et al., 2007; Eisenbraun, 2007). Vojtová (2010) has shown that one of the most difficult behavioural tasks of a school is motivating pupils for school work and related to its strengthening of their self-esteem and promotion of their horizontal and vertical social relationships with a school. The teacher's regular work thus gains a new

dimension, and the effective prevention of risk behaviour becomes one of the conditions for a successful functioning of a school.

The trend of introducing prevention into the school's educational program is typical for the Czech Republic as well as for the education system of the European Union. Most European countries specify a statutory responsibility to the schools to implement prevention, but each country deals with the question of how the teachers themselves should participate in the prevention in a different way. In the Czech Republic, for example, prevention is entrusted to a trained teacher, a 'methodologist of a school-based prevention', who is responsible for the implementation of the prevention program as well as the involvement of other teachers in this task. In Slovakia, the social educator is significantly involved in the implementation of school-based prevention. Their activities focus on the implementation of supportive and educational measures and, as such, they very positively complement the teacher's educational work (Dulovics, 2014; Hroncová and Emmerová et al., 2015).

It is very difficult to map the current concept of primary prevention in schools for several reasons. The first cause is the lack of uniformity of terms describing the purpose, content, and circumstances of the implementation of prevention. This is due to both, the multidisciplinary nature of the problems that should forego prevention, as well the wide spectrum of opinions on the nature of solving these problems. It is possible to talk about the conflict of concepts: psychological (prevention as the formation of social behaviour), sociological (prevention as a reaction to social reality), social and educational (prevention as a work with environmental influences) or medical (reaction to risks taken as a medical construct). The decision whether the impact of social 'phenomena' can be prevented, or whether it is possible to influence the future degree of risk 'behaviour' of children, is transmitted to the unclear relationship with the content of educational activities aimed at implementing prevention at school. Another problem preventing a simple clarification of the nature of primary prevention is its inter-sectional nature. The realm of primary prevention is naturally affected by the education sector when one speaks of a school prevention strategy (Ministry of Education, Youth and Sports, 2010), the health sector when one speaks of health prevention, and the interior sector where crime prevention is implemented (Ministry of Interior, 2011).

The nature of school environment creates a clear space for the implementation of primary prevention. As cautioned by Emmerová (2014), however, a growing number of children with risk behaviour and the need to resolve such manifestations in cooperation with the family and state administration are to bring secondary prevention to schools as well. The goal of primary prevention, in general, is to prevent risks before they become problems. Ministry of Education, Youth and Sports (2010) defines prevention in this sense as 'education to prevent and minimize risk manifestations, to support a healthy lifestyle, to develop positive social behaviour, and to develop psychosocial skills and cope with difficult personality situations'. Several authors have found other positions of prevention; Niklová (2013), for example, defines it as the creation of conditions for the development of a person as a bio-psycho-social being. The prevention strategies therefore also work well with the concept of health as it is understood in the universally accepted comprehensive definition of health by the World Health Organization (Kalina et al., 2003: 79) 'health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity'. Within this concept of primary prevention, it will be important that the child's health is not adversely affected in its physical, mental, or social sense (Kalina et al., 2003). The goal of primary prevention is indicated as the purposeful, systematic, and comprehensive strengthening of forms of a healthy lifestyle and the minimization of

the occurrence and consequences of socially pathological phenomena in a society. The second area of the goals of prevention is the effort aimed at reducing risk behaviour. The assumptions stated above allow us to express the conclusion which is also mentioned by Mioovsky et al. (2010) that prevention is rightly referred to as a non-homogeneous set of different regulations, strategies and approaches. The unclear theoretical definition of the issue of prevention as well as the ambiguity of its conceptual basis leads to problematic results of prevention work in school practice. This is one of the reasons why we consider research of the issue of prevention to be essential.

In the next part of the paper we present the research methodology, and the results providing answers to the following research questions: Who influences the children's risk behaviour in a negative and in a positive way? What experience do teachers have with risk behaviour prevention? What forms of pupils' risk behaviour exist according to teachers? And how are disciplinary problems perceived by teachers who are in the position of prevention methodologists? The aim of the paper is therefore, to introduce theoretical perspectives on the topic of school prevention and to present research results within this area. The paper describes the influences on the risk behaviour of children, experience with risk behaviour prevention, the occurrence of risk behaviour and how these problems are perceived by teachers who are in the position of prevention methodologists.

## **MATERIALS AND METHODS**

The presented results are part of the project *The Readiness of Students and Recent Graduates from Faculty of Education South Bohemian University, for Solving Educational Problems of Students (GAJU 154/2016/S)*. Several research surveys were carried out within this project. For the paper, the data obtained were selected from a research probe carried out by a questionnaire survey at 110 primary and lower secondary schools. In the first research file, there are data from 40 primary school teachers (the length of the respondents' teaching practice was from one year to 34 years). These respondents are not directly responsible for prevention, but their task is to incorporate preventive activities into regular education in cooperation with a prevention methodologist. In the second case, there were 70 teachers who work as school prevention methodologists (here the most numerous group of teachers were those ones with experience over 16 years - 63% of respondents). The task of these respondents, prevention methodologists, is initiating and managing the implementation of prevention in their schools; they are especially prepared for this work and should provide support to other teachers. The questionnaire survey was conducted in different schools with the direct participation of the authors of the text. The data for this paper were processed by SPSS software - it is a descriptive analysis. Results are presented using absolute and relative frequencies.

## **RESULTS**

In the first part, we present the results of the survey among the 40 primary school teachers. When asked whether the teachers met with a pupil who displayed risk behaviour during their practice, 33 respondents answered 'yes'. Risk was described to the respondents as the behaviour that leads to increased health, social, educational, and other risks, and behaviour in which the pupil endangered him/herself or others. Due to the ambiguity of terms, it was also mentioned that the concept of socially pathological phenomenon was formerly used to describe this category of behaviour.

Respondents were also encouraged to characterize the nature of the causes of risk behaviour. An interesting finding was that according to 25 teachers, education has

only a ‘partial’ influence on risk behaviour. In this context, one teacher responded with the term ‘unique’, thus indicating a skeptical view of the relationship of behaviour and education. The remaining 14 teachers see family influence as ‘complete, fundamental’. Child and its behaviour are influenced both by a family and its social environment. We wanted to determine how the teachers ( $n = 40$ ) perceive this influence by asking the questions: ‘Who can educationally influence behaviour of a child positively in relation to risks?’ and ‘Who can educationally influence behaviour of a child negatively in relation to risks?’. The results are presented in Table 1 and Table 2 (absolute and relative frequency, 1 – the most, 5 – the least).

If we created an imaginary sequence of those who, according to the respondents, have a positive influence on behaviour, then (based on the sum of the values 1 and 2) the greatest extent of influence on children have their parents, followed by friends and schoolmates. The data show that a teacher, prevention methodologist, plays the least important role here. Based on the collected data, family plays the biggest role according to the teachers. From this finding it may therefore be deduced that in the case of disciplinary problems, communicating and working with the family is the most important.

Positive impact	1	2	3	4	5
teacher	8 20 %	20 50 %	12 30 %	0	0
parent	31 77.5 %	6 15 %	2 5 %	0	1 2.5 %
sibling	10 25 %	20 50 %	8 20 %	2 5 %	0
friend	13 32.5 %	18 45 %	7 17.5 %	1 2.5 %	1 2.5 %
schoolmate	6 15 %	16 40 %	11 27.5 %	7 17.5 %	0
grandparents	4 10 %	8 20 %	13 32.5 %	14 35 %	1 2.5 %
another family member	2 5 %	5 12.5 %	14 35 %	17 42.5 %	2 5 %
prevention professional who leads a discussion on the topic (1 respondent did not answer)	0	5 12.5 %	14 35 %	10 25 %	10 25 %

**Table 1: People who in risk prevention have a positive impact on respondents, 2016 (source: own calculation)**

Regarding negative examples, the teachers note an important role of friends and classmates in addition to parents. It appears, therefore, that for the implementation of systematic support of risk behaviour prevention, the important strategy is to work with parents, involve them in communication with a school, and create mechanisms for consulting educational problems between teachers and parents. The opinion on the role of peers in the development of negative forms of behaviour is well founded, and shows how important it is for a school to work effectively with children’s collective. The basis for establishing and maintaining positive forms of behaviour will be how a teacher recognizes, influences, and evaluates social relations in a pupil’s collective. A positive classroom environment and clear structure of rules of behaviour in the classroom are an important prerequisite for an effective implementation of prevention at school.

Negative impact	1	2	3	4	5
teacher	2 5 %	8 20 %	8 20 %	5 12.5 %	17 42.5 %
parent	10 25 %	10 25 %	3 7.5 %	8 20 %	9 22.5 %
sibling	5 12.5 %	8 20 %	18 45 %	7 17.5 %	2 5 %
friend	8 20 %	25 62.5 %	7 17.5 %	0	0
schoolmate	4 10 %	18 45 %	14 35 %	4 10 %	0
grandparents	1 2.5 %	4 10 %	7 17.5 %	12 30 %	16 40 %
another family member	1 2.5 %	8 20 %	10 25 %	14 35 %	7 17.5 %
prevention professional who leads a discussion on the topic (1 respondent did not answer)	0	3 7.5 %	7 17.5 %	9 22.5 %	21 52.5 %

**Table 2: People who in risk prevention have a negative impact on respondents, 2016 (source: own calculation)**

In the following part of the research, it was mapped what methodological approaches, methods of working with pupils, and activities are effective in prevention according to the primary school teachers. The question is important for understanding what views teachers have on the form of prevention implementation. It is very important to determine whether educators envision methods and procedures that ensure interactivity as within the concept of preventive activities, and whether they engage substantive persons in cooperation – an external expert, teacher, or pupil. Previous research has shown that monologue and static methods still prevail in schools (cf. Procházka, Vítečková and Gadušová, 2016). If primary school teachers perceive these methods as inefficient, this is an important finding for influencing overall preventive strategies of a school.

The following list shows the order of the listed activities based on the respondents' answers:

1. cooperation with the school counselor and school psychologist;
2. interview with the individual;
3. cooperation with the family;
4. training mutual respect and self-esteem;
5. psychological guidance,
6. joint determination of rules of coexistence between pupils and teachers;
7. transmission of information by older pupils to younger;
8. meetings and discussions;
9. expert lectures.

The objectives, contents, and methods of preventive work in schools should correspond to the risks that occur at school. Monitoring the occurrences of negative behaviour is therefore an important part of preparing a preventive school strategy. This is why we were also curious as to what kinds of risk behaviour the primary school teachers encounter the most often.

In the questionnaire for evaluation, the teachers could choose out of a spectrum range of risk behaviours which the Ministry of Education presents in the 'Primary Prevention Strategy for 2013-2018' (Ministry of Education, Youth and Sports, 2013), but they also

had the opportunity to freely introduce other items of behaviour as they solve them in their practice. These additional items are indicated in italics in the survey table. The results are reported in absolute frequencies in Table 3, wherein 1 – often, 2 – usually, 3 – rarely, 4 – never.

Regarding the forms of problem behaviour at primary schools, the most often indicated was ‘forgetfulness’. The teachers also considered ‘lying’ and ‘endless discussions’ as problematic. As an important issue the teachers also see violations of agreed rules. All these aspects are an important part of discipline; they influence the climate of the classroom and dealing with them falls within the ‘normal’ educational work of a teacher. Special categories of behaviour that belong to socially risky manifestations of behaviour and to which the whole school should respond by comprehensive prevention, appear in the opinions of the primary school teachers in connection with child aggression and the threats of the Internet. They are aggression, rudeness, provocation and bullying.

In the second part, we present the results of the survey conducted by the questionnaire survey, in which the research group was the teachers of lower secondary schools at the position of the school prevention methodologist ( $n = 70$ ). The respondents expressed their opinion on an offered spectrum of socially pathological phenomena, the selection of which was made in connection with the list of phenomena identified in the above-mentioned strategic documents.

The task was to identify five acute manifestations of behaviour that are a priority for them when preparing a school preventive program. The respondents were asked to mark them with a number from 1 to 5 in the order of greatest urgency (1) to a smaller one (5) (Table 4).

From this comparison, we have further compiled the ranking of the evaluated phenomena. For the most common behavioural manifestation, that needs to be addressed in the preparation of the school prevention program, the methodologists marked was smoking. Quite frequently it also mentioned the issue of bullying and the rise in alcohol use even among children under the age of 15. Thus, teachers, the prevention methodologists are most concerned about the use of legal drugs by children and the growing bullying in peer-to-peer relations.

Thus, it is evident that teachers, the prevention methodologists, when preparing the content of prevention, focus on phenomena related to the various forms of drug abuse. The primary school teachers consider bullying and breaking rules of mutual coexistence (theft, truancy) to be the key problem.

<b>Risk behaviour in primary schools</b>	1	2	3	4
lying	16	16	8	0
cheating	5	7	24	4
theft	2	3	27	8
vandalism (one respondent did not answer)	1	2	21	15
aggression	8	13	17	2
truancy	3	7	15	15
cheekiness, provocation	9	18	13	0
bullying	7	8	19	6
escaping from school	2	0	16	22
endless discussions	11	16	11	2
forgetfulness	14	24	1	1
brawling	3	16	21	0
risk behaviour of children on the internet	1	10	21	8
risk behaviour in traffic, risky sports	1	4	14	21
extremism	0	1	8	31
-sexual behaviour (1 respondent did not answer)	0	2	4	33
addictive behaviour - drugs, alcohol, tobacco and other psychotropic substances, gambling, addiction to computers or other electronic devices	2	2	24	12
violating societal and agreed rules	7	23	9	1
eating disorders	0	1	14	25
self-harm	1	1	10	28
negative influence of sects	1	0	9	30
racism, xenophobia	0	2	18	20
criminality	1	0	10	29

**Table 3: Frequency of risk behaviour in primary schools, 2016 (source: own calculation)**

<b>Manifestations of risk behaviour</b>	1	2	3	4	5	Σ
experimenting with marijuana	9	5	5	15	13	47
experimenting with ,hard' drugs	0	2	0	1	1	4
smoking	37	12	3	3	4	59
alcohol use	3	21	17	10	4	55
bullying	7	10	14	14	12	57
thefts	4	6	10	11	14	45
truancy and neglecting school duties	6	7	10	10	9	42
vandalism	5	0	5	2	9	21
spraying	0	0	2	0	0	2
other, what?	0	0	0	0	2	2

**Table 4: Assessing the consequences of individual manifestations of risk behaviour, 2016 (source: own calculation)**

## DISCUSSION

The research results indicate the circumstances that accompany the implementation of prevention in schools and how much influence the microenvironment has on the behaviour of an individual. Working with a family who can positively influence pupils appears to be the most effective. Teachers rightly noted that behavioural problems stem from the family environment and that, at the same time, the family has by its nature a fundamental



influence on the transmission of positive or negative behaviour patterns. On the other hand, it is evident that teachers are seeking ways of influencing and involving parents in the schools' behaviour and prevention work. Respondents talk about cooperation with the family in general, but the research did not reveal what models to apply in this direction. Mapping out teachers' work strategies with parents will be the subject of further research. It will also be important to identify opportunities to preventively influence the family's lifestyle and attitudes of parents towards their children's health from the position of a school.

Another part of the research indicated how important educational work with the entire class collective is for prevention. This is educational work with classmates and friends, since in the case of risk behaviour; they may be a large negative model for others. From the areas of problem behaviour, the teachers chose or filled in categories such as 'lying', 'forgetting school duties', and 'endless discussions'. In their own way, they described the categories of behaviour that indicate resistance inside the children's collective, resistance to the rules of communication in the classroom, and low educational motivation of children. Creating a supportive environment is, to a large extent, however, based on teachers themselves and their ability to communicate with the class (Lašek, 2007). Teacher's ability to provide children with clear and unambiguous information, not to hide their own thoughts and feelings, and effectively listen to the children will be one of the conditions of motivation and satisfaction in a classroom.

The results also demonstrate the great task of the counselling department within a school. From the responses it is clear that teachers primarily tend to solve these problems with a psychologist, the school counsellor at a school. It is thus evident, that effective prevention will be conditional to the establishment of quality team relationships so that everyone clearly understands his/her role in the prevention program, so that individual workers provide support and mutually cooperate. It is a pity that the prevention methodologist, i.e. the teacher, who has a sole charge of the entire system of prevention, is not perceived by the respondents as the person with whom it would be good to consult behavioural problems in a classroom.

Conducting the survey on the risk behaviour opinions among the primary school teachers and school prevention methodologists, it suggests another interesting moment. Both groups of respondents perceive other areas of risk and therefore other topics for preventive activities. The primary school teachers view as most problematic disciplinary problems, which in turn lead to an increase in aggression and bullying. Furthermore, currently bullying appears also among pre-school children (Saracho, 2017). The teachers, who guarantee prevention throughout a school, are primarily concerned with addictive behaviours and bullying, which are typical for the adolescence age at the end of schooling. Significant mismatches can have a major impact on the effectiveness of prevention. Underestimating the importance of prevention of negative relationships in a classroom, and little focus on co-operation promotion, cooperation, and adherence to class rules is a potential cause of the increase in dangerous behaviour in subsequent years of schooling.

## **CONCLUSION**

The primary prevention of risk behaviour apparently does not affect primary school. Problems with discipline and negative behaviours would be more expected at lower and upper secondary school. Dramatic manifestations of indiscipline actually appear at higher levels of school education, but it is clear that the earlier prevention begins, the more effective the result. Indeed, personality focus, opinions, and a person's attitudes are

formed at the earliest age. It will therefore be important for prevention in primary and lower secondary schools to be supported by all teachers and that forms of actions are used which are tailored to the age and abilities of children. In this respect, the research suggests that teachers are able to identify adequate procedures and fields of prevention, but they lack more systematic support that would help them effectively implement the possibilities of prevention.

At the same time, it turns out that teachers, methodologists, are more likely to focus on the problems faced by teachers when working with older pupils when preparing a preventative strategy for the whole school. Similarly, as Hawkins et al. (1999) state that protection should be strengthened during childhood, we also see that the core of the problem arises in primary schools. If there is no work with a class of young learners, then, problems in school socialization arise that cannot be prevented or re-educated in the last grades of lower secondary school. Wider communication among primary school teachers and lower secondary school teachers and considering the challenges faced by primary school teachers will be an important step in the implementation of effective prevention.

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# ANALYSIS OF SELF-TEST IMPROVEMENT FOR INCREASING THE QUALITY OF EDUCATION PROCESS

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## ABSTRACT

The main goal of this paper is to analyse the impact of self-test improvement for the course Applied Mathematics for Informatics made in academic year 2015/2016 at the Czech University of Life Sciences. The impact of self-tests changes is measured by the students' results from the academic years 2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017. The improvement of self-tests was made by modification of passing condition and self-test questions. The self-tests' ability to evaluate students' knowledge and to differentiate successful and unsuccessful students has been improved.

## KEYWORDS

Difficulty Index, Discrimination Index, Education Process, Score, Self-test

## INTRODUCTION

The educational efficiency is influenced by many different factors, mainly whether the student has clearly clarified objectives of his study, whether he/she is able to motivate himself/herself and whether consultations and other support for studying is available, whether the student has the ability to classify himself, ability and opportunity to compare his study results and goals (Dewey, 1997).

One of the frequently used forms of study support at universities, which has improved the teaching-learning process, is the usage of the information and communication technology (ICT) in education (Escobar-Rodriguez and Monge-Lozano, 2012), e.g. learning management system – e-learning system (Poulová, 2010). E-learning system helps active student's participation in classes (Teasley and Lonn, 2011) and offers new teaching methods complementing traditional teaching methods (Novo-Corti, Varela-Candamio and Ramil-Díaz, 2013; Davis and Surajballi, 2014). Internet e-learning support allows students to access the necessary study support on the web which students use for both the study with teachers and for self-study (Clark and Mayer, 2011).

An important part of the e-learning support is a system of self-tests. It represents the kind of knowledge testing, which allows a simple and quick way to verify the students' knowledge by computer generated tests consisting of a few selected questions. Students receive the results immediately after the completion of the self-test. This quick mapping of students' knowledge is the main advantage. Students learn from their mistakes and can focus follow-up studies on the part they failed in. Self-tests are also very helpful for teachers because they can see where their students show a lack of knowledge and where they need to improve.

The self-test's ability to evaluate students' knowledge depends on the quality of the self-test and every implemented change must be analysed and its suitability verified. Self-tests

can be analysed in different ways and based on this analysis the state of knowledge of students can be determined and if needed education process or self-tests can be adapted. The aim of this paper is to analyse the improvement of self-tests used for the subject Applied Mathematics for Informatics (AMI) at the Czech University of Life Sciences (CULS) which was designed by Brožová and Rydval (2015). These proposed self-tests' changes were made in the academic year 2015/2016 and in this paper, their suitability will be proved and verified.

## **MATERIALS AND METHODS**

### **Description of the new formed self-tests**

The syllabus of AMI contains an introduction to Linear algebra and Vector space, Linear optimisation models, Transportation models, Decision theory and Game Theory models and Multi-criteria models. The main topics of the subject are covered in the lectures and seminars, model definitions and steps of algorithms are highlighted during the teaching. The subject AMI is organised in 2-hour lecture and 1-hour tutorial per week. It places great emphasis on individual preparation of students. During the course the students have to periodically fill out six self-tests covering the main subject topics:

- Self-test 1 - Linear algebra,
- Self-test 2 - Linear programming – Simplex algorithm,
- Self-test 3 - Linear programming – Post optimisation,
- Self-test 4 - Distribution problems,
- Self-test 5 - Decision-making theory and Game theory,
- Self-test 6 – Multi-criteria decision-making.

Brožová and Rydval (2015) focused in their previous research on the quality of the e-learning tests of the course Applied Mathematics for Informatics (AMI) at the Czech University of Life Sciences (CULS) using self-tests analysis by difficulty index and discrimination index. Self-tests were analysed according to the collected scores of self-tests from the Moodle.czu.cz system for 3 academic years (2012/2013, 2013/2014, 2014/2015). Based on these self-tests analysis the important changes were designed only in two tests – the Self-test 1 and the Self-test 6 and also some partial changes of credit obtaining conditions were made (Brožová and Rydval, 2015). The changes are as follows:

1. It is necessary to achieve at least 40 points (40%) from each self-test in order to be possible to include the result of the self-test to the total score.
2. Only three attempts to complete the self-test are allowed.
3. The Self-test 1 – Linear algebra was mainly containing a calculation of matrix operations and a solution of system of linear equations. In order to increase the quality of this self-test, new parts of Linear algebra were introduced and the theoretical questions were reformulated into more complex form. For instance, the theory of the vector space and of the basic vectors was covered. Accordingly, students see the possible application in examples.
4. The number of students who completed Self-test 6 – Multi-criteria decision-making especially was too low, over 40 % of student did not attempt to take the Self-test 6 (Brožová and Rydval, 2015). In order to increase the number of students who complete this self-test, the completion of the Self-test 6 as a condition for obtaining the credit has been set as obligatory. So students are required to fill out all six self-tests.

Students fill out self-tests in the learning management system Moodle.czu.cz, which

allows students to access not only self-tests themselves but also the necessary study materials which are available in the e-learning system and can be used for study. Self-tests have the form of multiple choice test. Each self-test is scored and the total possible score is 100 points. Students have 3 attempts to complete each self-test within a certain period of time. The best score is included in the final score. The maximum score from all self-tests is 600 points. The students have to receive at least 40 points (40%) from each self-test and at least 360 points (60%) total to get credit and be allowed to take the final exam. It is necessary to participate in each self-test including the sixth one.

### Analysed data

For the analysis of self-tests, the scores of self-tests have been collected from the Moodle. czu.cz system for the last 5 academic years (2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017) and from all students, regardless of the number of attempts. Together we have analysed results of 1406 students (220 students from the year 2012/2013, 242 students from the year 2013/2014, 285 students from the year 2014/2015, 341 students from the year 2015/2016 and 318 students from the year 2016/2017).

	Number of students	Number of attempts					
		Self-test 1	Self-test 2	Self-test 3	Self-test 4	Self-test 5	Self-test 6
2012/2013	220	283	406	488	363	323	177
2013/2014	242	348	476	566	341	349	191
2014/2015	285	336	507	521	398	385	313
2015/2016	341	630	576	654	415	350	351
2016/2017	318	470	403	447	333	310	314

**Table 1: Number of students and number of attempts of the self-tests in five years**

The self-test analysis is based on the average number of attempts and average self-test score, number of students and on the difficulty index and the discrimination index.

### The Difficulty Index

The difficulty index  $P$ -value of the test questions is one of the most useful and most frequently reported test analyses (Taib and Yusoff, 2014):

$$P = \frac{B_{sum}}{B_{max}} \quad (1)$$

where  $B_{sum}$  is a total number of obtained score of all students;  $B_{max}$  is maximal possible amount of score.

$P$ -value can range between 0.0 and 1.0 and  $P$ -value of a suitable question lies in the closed interval [20%, 80%] (Škoda, Doulík and Hajerová-Müllerová, 2006).

### The Discrimination Index

The discrimination index shows how the test distinguishes between the good and bad students:

$$ULI = \frac{N_U - N_L}{0.5N} \quad (2)$$

where  $N_U$  is the number of students from better group who answered the question properly;  
 $N_L$  is the number of students from poorer groups who answered properly;  
 $N$  is the total number of students.

The possible range of  $ULI$  is from -1.0 to 1.0; however, if a question has the discrimination index below 0.0, it suggests a problem. A negative discrimination index indicates that the question (test item) is measuring something other than the rest of the test is measuring. The values of the discrimination index and the difficulty index have to be interpreted together because there is a relationship between them. If an item has a very high (or very low)  $P$ -value, the potential value of  $ULI$  will be much smaller than if the item has a mid-range  $P$ -value. The test questions are suitable if  $P$ -value is from [0.3, 0.7] and  $ULI$  is greater than 0.25. If  $P$ -value lies in the intervals [0.2, 0.3] or [0.7, 0.8],  $ULI$  has to be greater than 0.15 (Škoda, Douřík and Hajerová-Müllerová, 2006).

## RESULTS AND DISCUSSION

### Analysis of self-tests results

Firstly, we analysed the impact of the first three above-mentioned conditions' changes and the number of students and number of attempts of answering self-tests. The number of attempts differs from the number of students because each student can repeat the self-test according to new conditions up to three times. Figure 1 shows the average number of self-test attempts during the analysed years. The Self-test 6 required the lowest number of attempts for completion, however from the academic years 2015/2016 and 2016/2017 the number of required attempts was significantly higher. This is due to the fact, that some students previously could receive the credit if they had enough points before taking this test (in years 2012/2013, 2013/2014 and 2014/2015). According to the new conditions for obtaining credit, this way is currently not possible. The significant increase in the number of attempts in the Self-test 1 in years 2015/2016 and 2016/2017 can be explained by the newly introduced questions from Linear algebra, especially from Vector space.

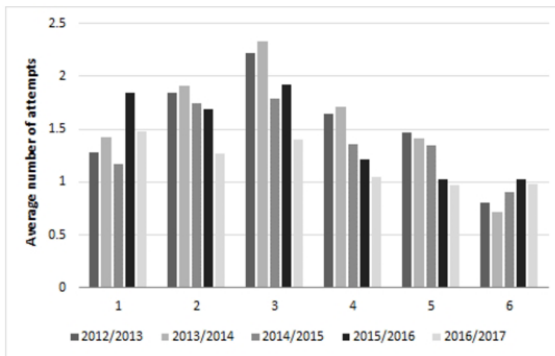
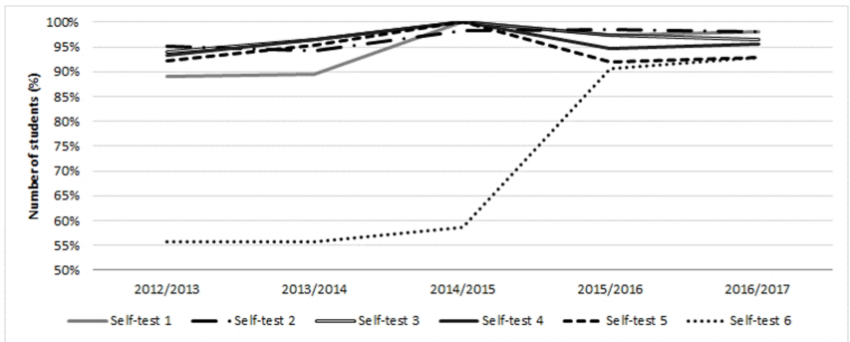


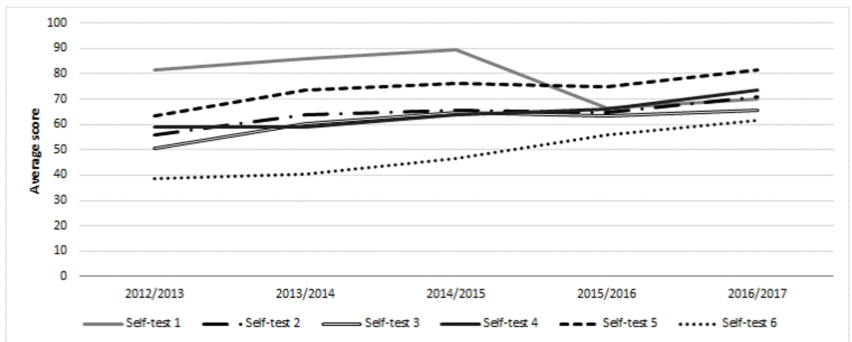
Figure 1: Average number of attempts of self-tests

Clear impact of the first condition is shown in Figure 2. It is quite evident that the percentage of students participating in the Self-test 6 was increased from less than 60% in the academic years 2012/2013, 2013/2014 and 2014/2015 to the level of over 90% in academic years 2015/2016 and 2016/2017. This made the Self-test 6 quite similar to the other self-tests.



**Figure 2: Number of students participating in self-test**

In the next step, the analysis of the impact of the self-test changes was made. The Figure 3 shows, that the average score of each self-test has been slightly increasing over the years, which is in contrast with final exam results (Brožová and Rydval, 2013, 2014).



**Figure 3: Average Score of Self-tests**

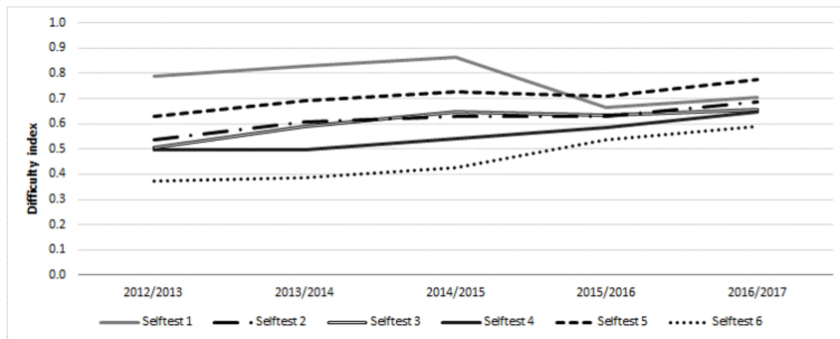
The main reason of the average score increase is in the refocusing of all self-tests on examples solved in the seminars. This increase can be also caused by computer use during the seminars, and therefore students are able to use computers when taking the self-test, and thus they get higher score.

The tendency, that students achieve a significantly higher average number of points from the Self-test 1, was corrected in academic years 2015/2016 and 2016/2017. The reason for that is that the Self-test 1 was changed, as mentioned above. The second tendency, that students achieve a significantly lower average score in the Self-test 6 in contrary to the Self-test 1 (Brožová and Rydval 2015), was corrected too and now the average score in the Self-test 6 is in the same range as the score of other self-tests, i.e. between 60 and 80 points. This is due to the obligatory participation in the Self-test 6. However, the average amount of points from this self-test is still the lowest one. This is largely due to the two facts. The last topic Multi-criteria decision-making is discussed in the last lecture and it is partly practised only during the last seminar and students know how many points they need to receive a credit.

The above-mentioned changes of self-test had significantly impact on the difficulty index



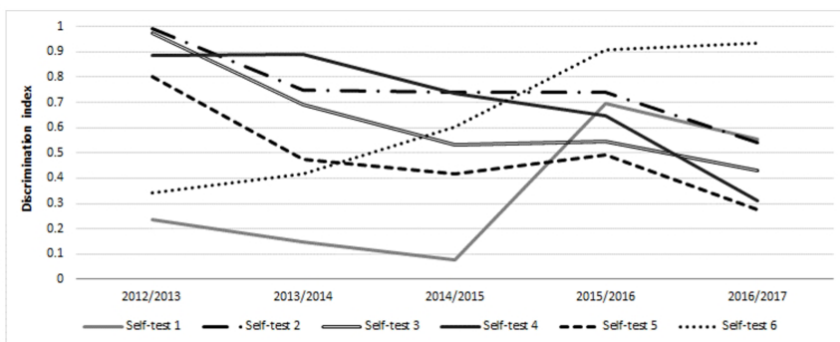
and the discrimination index too. The values of the difficulty index of all self-tests are from the academic year 2016/2017 in the interval [0.3, 0.8], so the difficulty of these tests is designed well (Figure 4).



**Figure 4: Difficulty Index of Self-tests**

The first self-test was much simpler, as already stated, the difficulty index was between the values of 0.8 and 0.9 until the academic year 2014/2015. After its modification difficulty index is 0.7 in the year 2016/2017. The Self-test 6 was seen conversely more difficult, but now its difficulty index is greater than 0.3, so this test is also adequately created. The value of the sixth self-test's difficulty index has been due to the obligatory participation increased to the value of 0.6 in the academic year 2016/2017.

The value of difficulty index replicates the average score achieved by students because the maximum number of points for each self-test is 100. The higher the value of this index is, the greater number of students achieved a higher score in this self-tests.



**Figure 5: Discrimination Index of Self-tests**

The discrimination index has been greater than 0.25 for all self-tests during the researched academic years (Figure 5). The only exception to this fact is the very low value of the discrimination index of the Self-test 1 in the academic years 2012/2013, 2013/2014 and 2014/2015. This was caused by the simplicity of the test. The difficulty of the test was improved and increased due to the test's changes made in academic year 2015/2016. From this academic year, the discrimination index value of the Self-test 1 has been significantly higher and the test can be described as well designed.

Due to the obligatory participation and relatively high difficulty of the Self-test 6, the discrimination index has been increased to the value 0.9 and thus distinguishes between the good and bad students very well.

The trend of increasing average score corresponds to a decreasing value of the discrimination index. The gradually decreasing value of the discrimination index indicates an increasing level of students' knowledge and understanding of areas and topics of AMI. However, this trend does not correspond with deteriorating students' performance in exams (Brožová and Rydval, 2014).

### **Discussion about the effect of self-tests on students' knowledge**

Students often base their choice of self-study and preparation strategy on their subjective judgements of learning or their estimate of how well they know their material especially the electronic material, and often underestimate how much they forget in a week. That is the reason why e-learning is so important. E-learning clearly promotes the participation of students (Chen et al, 2014), increases their motivation and improves their competence and thus their performance in terms of qualifications as Novo-Corti, Varela-Candamio and Ramil-Díaz (2013) show in their research. And self-tests are an integral part of e-learning, their results revealing students' knowledge are used to improve the material in e-learning. As Clark and Mayer, (2011) point out, e-learning and self-tests have a positive influence on students' knowledge.

According to Otter et al (2017), various users want to use test results for actions that support e-learning. Furthermore, they perform actions on different levels, thus indicating the need for tailored reports that fit the information needs of individual users. For this reason, it is important, that the highest amount of students participate in self-tests. Therefore, the condition of compulsory attendance of all self-tests for participants seem to be appropriate. Furthermore, Otter et al (2017) pointed out, that if the test results should be relevant, students must make more effort when taking the self-test. From this point of view, the higher difficulty of the self-test seems to be appropriate too.

### **CONCLUSION**

The paper is focused on the impact of improvement of the self-tests. It is necessary to include into the test not only practical calculations but also theoretical knowledge. The self-tests used for the course Applied Mathematics for Informatics at the Czech University of Life Sciences Prague has been analysed according to the collected scores of self-tests from the Moodle.czu.cz system for the last 5 academic years (2012/2013, 2013/2014, 2014/2015, 2015/2016 and 2016/2017). The impact of the improvement made from the academic year 2015/2016 has been analysed. The core of the improvements were the compulsory participation in all self-test and increased difficulty of the first self-test.

This analysis proves that the average score of each self-test has been slightly increasing over the years. The trend of increasing average score corresponds to an increasing value of difficulty index and to a decreasing value of the discrimination index.

The compulsory participation in all self-tests increased the percentage of students' participation in the Self-test 6 and it is quite similar to the participation in other self-tests. The increased difficulty of Self-test 1 cause the discrimination index of the Self-test 1 to go significantly higher and the test now can be described as well designed. The Self-test 6 was seen as very difficult, but now after introducing the compulsory participation, the difficulty indexes of all self-tests are in the interval [0.6, 0.8], so all of them are adequately designed.

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# EVALUATION OF STUDY SUPPORTS USED BY UNIVERSITY STUDENTS OF THE CULS PRAGUE

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## ABSTRACT

The article presents the results of research that was carried out among students of 5 faculties of the Czech University of Life Sciences Prague. The research was aimed at obtaining information on whether and how students actually use study supports. It maps their work with printed texts, study materials available at learning management system Moodle, it focuses on students' activities during lectures and at the extent and reasons behind using "unofficial" study materials. The gathered data significantly contribute to verifying the effectiveness of teaching methods, and, therefore, fulfill the requirements for internal evaluation of the learning process. Moreover, they provide the individual subjects' guarantors with information that can help them choose a strategy for creating study support systems.

## KEYWORDS

Effectiveness of Teaching, Evaluation of The Learning Process, Moodle - Learning Management System, Study Support

## INTRODUCTION

Continuous evaluation of the learning process is understood worldwide to be an important indicator of the quality of institutions providing tertiary education. Adhering to the Standards and Guidelines for Quality Assurance in the European Higher Education Area is highly emphasized since 2003. The Standards and Guidelines stress the necessity to create close ties between internal and external evaluation processes of higher education institutions and universities. Internal evaluation is focused on 1) monitoring the effectiveness of its own systems of quality assurance, as well as on (2) approving study programs, their regular evaluation and monitoring, (3) evaluating students, (4) ensuring high quality university teachers, (5) monitoring study sources, study support systems and learning support (in the sense of counseling), (6) evaluating information systems that also provide further study support and materials, and (7) on providing complete, correct and unbiased information regarding study programs to the public (ENQA, 2009). The evaluation process includes detecting and explaining data that characterize the state, quality and effectiveness of the educational system, learning processes, projects, results and books used. It plays an important role in correcting and innovating the educational system, and helps create a strategy for the planning of its development (Kolar et al., 2012). Investigations that are based on students' responses are (among other things) also an important source of information for internal evaluation. Surveys conducted among university students are often used on the level of evaluation of study subjects and their university teachers (Lakin, 2016), teaching methods (Mehta, Adwal and Chourishi, 2016), or learning systems, most often electronic ones (Klement, 2011; Kuncova and Vojackova, 2012).

One important requirement of course evaluations, which lead to ensuring a corresponding

standard level of the learning process, should be the implementation of such teaching methods and learning materials that support students' motivation to study. Here we find that next to the irreplaceable role of the university teacher's personality (Semradova and Hubackova, 2014), it is also necessary to adjust supporting learning materials or methods to the contemporary needs, abilities and preferences of students – their attachment to using modern communication technologies calls out for comparing students' access to traditional versus modern teaching methods (Hinke and Svoboda, 2014; Sirbu et al., 2015).

Although we may perceive students' evaluations as being highly subjective, they give teachers as well as the educational institution very important information. It is absolutely necessary to ensure that the respondents remain anonymous when evaluating the quality of teaching or the teacher's work. That way students do not need to worry about the effect their answers could have on their further studies (Hrbacek, 2017). If this condition is not met, students could turn to using tactics or giving "expected" or socially more acceptable answers. Therefore, electronically presented surveys seem to be a more suitable form. Even when using this method, it can be expected that surveys, which are filled-out after authorized log in (e.g., into the school's information system), will not fully reflect students' true opinion. The only way to eliminate this is to give students access to the electronic survey without them having officially to logging in.

The aim of our research was to obtain information on how students of the five faculties of the Czech University of Life Sciences Prague perceive the actual usability of various types of study supports for their studies. The research identified students' preferences regarding the form or possibly functionality of traditional as well as modern educational supporting methods, and it further verified how students view the effectivity of some didactic procedures and the extent to which teachers are unified in their demands that lead to the successful completion of individual courses.

## **MATERIALS AND METHODS**

The group consisted of students from the Czech University of Life Sciences Prague, Faculty of Economics and Management (FEM), students of Faculty of Agrobiology, Food and Natural Resources (FAFNR), Faculty of Engineering (FE), Faculty of Forestry and Wood Sciences (FFWS), and Faculty of Environmental Sciences (FES). All students currently enrolled in the daily form of studies in bachelor's study programmes and master's study programmes taught in Czech language were asked to participate in the survey, overall 11 081 students (5 664 FEM, 2 322 FAFNR, 891 FE, 1 000 FFWS and 1 204 FES), 5 022 were men and 6 059 women. Participation was voluntary. The select group consisted of 1801 respondents out of which 776 were from FEM, 545 from FAFNR, 147 from FE, 210 from FES and 123 from FFWS. The group consisted of 1177 female students and 624 male students. Students in various years of their studies were evenly represented (365 were enrolled in the 1<sup>st</sup> year of bachelor's degree program, 399 were in their second year, 328 in their 3<sup>rd</sup> year, 328 were students of the 1<sup>st</sup> year of master's degree programs, and 327 were in their second year of a master's degree program.)

The research was done during the spring 2017 semester. The questionnaire was placed on the internet, and students received an e-mail message saying that they should fill out the questionnaire. The e-mail was sent to the e-mail address that they had previously indicated to be used for e-mail communication with the University. Students were ensured that they would remain anonymous.

Preliminary research was conducted among FEM students; it was in the form of a focus

group. The questionnaire was printed and handed out to the students. Afterwards the students were interviewed in order to see whether the questionnaire was comprehensible and in order to find out to what measure the questionnaire covered the given topic. The wording of the responses was slightly rephrased so that they would be more comprehensible to students. The query on the extent to which students make use of textbooks was divided into two separate parts depending on how important they perceive the subjects to be.

The SPSS system was used for statistical data processing. The Chi-Square Test of Homogeneity was data analysis (testing the differences between the distributions of responses coming from individual faculties). When we came across significant findings we added post hoc tests of adjusted residuals ( $\alpha = 0.01$ ) to the analysis. Only the number of respondents that answered all the questions in the given part of the questionnaire were entered into the actual statistical analysis.

A nonexperimental research design was used for conducting the research. The goal of the research was to describe the research problem, become oriented in it, comprehend it, as well as to identify and describe the differences between the selected groups of respondents. A questionnaire put together “ad hoc” was used as part of the research. It was presented in a motivational e-mail to the respondents with an active link to the page with the questionnaire. The introductory part contains basic identification data (faculty, year of study, and the respondent’s gender). The main part of the questionnaire consisted of 18 unfinished statements, where each one offers four possible endings and the respondent chooses one of these. The statements are focused on different areas, one is related to working with printed texts, another area is related to working with study support and materials that are available at learning management system Moodle, another area focuses on students’ activities during lectures, and one area focuses on finding out the extent to which students use “unofficial” study materials and the reasons behind it.

## RESULTS

When asked about *subjects that students perceive as being important*, and for which specific textbooks were published, 39.1 % of CULS students replied that they use textbooks as the main source of information when preparing for tests or examinations, 38.2% of students use textbooks as a secondary source of information, and 10.4% of students do not use them at all. A significant difference was detected ( $\chi^2 = 149.7$ ;  $p < 0.001$ ) in students’ answers among individual faculties. 58.2% of FAFNR respondents regard textbooks as the most important source of information, while in the other surveyed categories textbooks have much lower preferences. FEM students use textbooks for important subjects more as a source of secondary information (42.1%), or they do not use them at all (15.2%). FE students use textbooks significantly more often as a secondary source of information (48.3%), however, they use it less often as their main source of information (27.2%).

When asked about *subjects that students consider to be less important*, and which have textbooks specifically published for the given course, CULS students answered that they do not use them too much to prepare for the final examinations (34.6%), possibly they list through the textbook rather than studying it (32.0%). 21.5% of respondents use it as a secondary source of information and 11.9% of respondents use it as the main source. There was a significant difference in the distribution of responses among faculties ( $\chi^2 = 157.9$ ;  $p < 0.001$ ). The difference was mainly caused by FEM students (43.3%) and FE (46.9%) students responding more than others that they do not use them. On the other

hand, FAFNR students significantly more often answered that they use textbooks as the main (23.1%) or secondary (25.9%) source of information.

Overall CULS students do not tend to pay special attention to *recommended literature* (53.6%). A significant difference in the distribution of answers ( $\chi^2 = 91.5$ ;  $p < 0.001$ ) among faculties was given mainly by the higher rate of answers “I do not pay attention” among FEM students (64.7%).

If the subject has an *study support created for it in the learning management system (hereinafter LMS) Moodle*, where supporting materials are placed, students of CULS prefer the possibility to print out these materials (38.8%), possibly to download them into an offline mode (38.6%). 20.6% of CULS students prefer to work on the internet. Significant differences in the distribution of answers among faculties ( $\chi^2 = 51.0$ ;  $p < 0.001$ ) were mainly caused by the higher rate of preferences of the printed out form of materials among FEM students (43.9%), who prefer this choice above all others. Moreover, FEM students chose the off-line version of study materials to a much lesser degree (32.0% of respondents). FE students prefer the online form of materials (29.9% of respondents), which is highly above the average of students from other faculties. Furthermore, they much less print out the available materials (21.8% of respondents).

The different approach FE students have toward electronic study materials than students of other CULS faculties is also supported by their different approach to the requirements they think the form of these materials should have ( $\chi^2 = 44.5$ ;  $p < 0.001$ ). Overall CULS students prefer more simply constructed study materials, especially with a printing option (47.2%), to materials that are more varied and interactive but cannot be printed out (43.9%). FE respondents prefer variety and interactivity (62.6%) highly above the average of other students and significantly less often chose the option of easy printing (31.1%).

If *videos* are contained within the electronic learning materials, overall students from all faculties regard these as beneficial and helpful for understanding texts related to the individual subjects (62.2%).

If *tasks and exercises* are included in the electronic study materials and it is clear that these are additional exercises, 56.5% of CULS students at least sometimes try them out.

If electronic study materials contain tests that the student can fill out at home, but at the same time serve as tasks leading to earning credits, 46.9% of respondents try to fill them out independently. However, they admit to consulting a friend or textbooks if they feel that they will have problems fulfilling the requirements. 40.4% of respondents answered that they have an honest approach toward this type of knowledge testing.

If *tests* are included in the electronic study materials that serve as materials required for earning credits and which the student must fill out in the Test Center, 33.8% of respondents regard this as preparation for the final examination, another 30.6% regard this as something they just have to do during their studies. Nonetheless, they appreciate the fact that they can choose the time when they will write the test. 25.8% of students would prefer to take the test in the classroom.

50.2% of respondents get their *study materials* in collaboration with friends from sources *recommended by the teachers*, 10.6% do this independently. 36.3% of respondents take their study materials from unofficial sources. A significant difference was detected between the distribution of responses among faculties ( $\chi^2 = 91.0$ ;  $p < 0.001$ ). FEM students (46.3%) prefer using unofficial sources, which is highly above the average of other students, and vice versa they pay significantly less attention to recommended materials than students from other faculties. This is valid whether they obtain them with the help

of friends (43.2%) or alone (7.3%). FES students show a distinctly above average use of recommended sources that they look up with the help of friends (64.8%). On the other hand, they significantly less make use of unofficial sources (24.8%). FAFNR students also make use of unofficial sources to a lesser degree (30.3%), and they too prefer to get hold of the official materials on their own (16.1%).

A significant difference in the distribution of responses among faculties ( $\chi^2 = 102.4$ ;  $p < 0.001$ ) was detected among answers related to unofficial study materials. Overall 38.6% of CULS respondents use this sort of material as a secondary source of information, 32.1% use it as the main source of information. FEM students use it distinctly more often as the main source of information (44.2%), on the contrary FAFNR (22.4%), FES (21.9%) and FFWS (17.1%) respondents use this kind of material distinctly less often.

52.4% of students randomly verify the correctness of the information coming from unofficial sources, 6.6% do not verify it at all.

When answering questions regarding *their lecture attendance*, students answered that they more or less attend lectures; however, if for some reasons it is not convenient for them to attend, they do not go to the class (41.6% of respondents). 36.9% of respondents try to regularly attend classes, 7.8% do not attend very often, and 13.7% only attend the first couple of classes. The significant difference in the distribution of responses among faculties ( $\chi^2 = 99.4$ ;  $p < 0.001$ ) was given mainly by the different approach of FEM students. They had a significantly higher rate of answers saying that they do not attend lectures (13.3%), or that they attend only the introductory ones (16.6%). Furthermore, FAFNR students have an above average rate of answers indicating that they regularly attend lectures (46.1%).

The distribution of answers regarding the reasons why students attend or do not attend lectures distinctly differs between individual CULS faculties ( $\chi^2 = 105.2$ ;  $p < 0.001$ ). 60.6% of FAFNR students state that they go to classes, because they should attend. Only 38.5% of FEM students give the same answer (as opposed to the 48.3% of all of CULS respondents).

2.3% of students indicate that they commonly record lectures for their own purposes, 6.6% then do it for a whole group of students. 7.1% of respondents indicated that they sometimes record a lecture. 6.3% of students sometimes take photos of presentations at lectures. 41.2% of respondents answered that they do this because it is not available at LMS Moodle, 28.1% answered that they do it out of their own interest. 33.2% students regularly take notes during lectures. If there are not any study materials available for the given subject, 33.9% of respondents take notes, and 14.3% of respondents take notes in classes of a subject they enjoy.

Significantly different distribution of responses among students of individual CULS faculties ( $\chi^2 = 187.4$ ;  $p < 0,001$ ) was detected in relation to *the distribution of duties during the semester*. FEM students prefer to have a forced pace by writing tests throughout the semester with the help of LMS Moodle. 46.3% of FEM respondents prefer this while overall 31.5% of students from CULS chose this answer. Regular testing of knowledge, mainly during tutorials or lectures, is distinctly preferred by FAFNR students (31.9%) and FFWS students (30.9%) as opposed to 21.5% of all of the CULS respondents. FE students prefer to have their responsibilities culminate towards the end of the semester (30.6%), and so do FZP students (27.1%), in comparison with 20.2% of all of the CULS respondents.



## DISCUSSION

Due to the method used, an unusually high number of respondents accepted participation in the survey (16.2% from the initial group of addressed students.) We interpret this as a synthesis of demonstrated loyalty of students toward their faculties, guarantee of remaining anonymous by using the Google platform for the questionnaire, and of focusing the questionnaire on study supports and materials, which students consider to be very important. Due to the fact that students confessed to activities that are unethical (getting “help” when taking tests through LMS Moodle), and under the Czech law sometimes even illegal (recording lectures and taking photos of presentations), we presume that the mentioned platform for administering the test was a good choice and that it presented a safe and anonymous space for students. The highest participation rate was among FAFNR students, where 23.5% of the initial group of students took part in the survey. Furthermore, 13.7% of FEM students participated, 16.5% of FE students, 12.3% of FFWS and 17.4% of FES students. This fact is in a certain sense in favor of the argument that it is absolutely necessary to create anonymous questionnaires (Hrbacek, 2017). FAFNR is the only CULS faculty where it is compulsory for students to fill out surveys on the evaluation of university teachers of individual courses. Without filling them out the students cannot sign up for the final exam, hence they are identifiable. It is reasonable to question the value of such conducted investigation, nonetheless, we can presume that this formality will embed the idea that evaluations are necessary, and that it is necessary for students to collaborate with their faculty on this. This habit then leads to greater participation even in investigations that are strictly anonymous.

The results of the research identified contemporary trends in the students’ approach and preferences for various types or parts of study supports. Moreover, it also detected differences in the preferences that students of individual faculties have. The students’ answers have also shown that if they are not happy with the form of the study materials, they turn to unofficial materials, the quality of which could be highly questionable. On basic level the investigation confirms that interest in study materials in the form of formal textbooks is decreasing, especially among elective subjects. On the contrary, the frequency of using e-learning study materials is increasing as we saw in Hinke and Svoboda (2014). However, when looking more closely at the issue, we find that (with the exception of FE students) students tend to prefer electronic materials with the option to print them out, even when this option is at the expense of greater variability and interesting forms, which high quality electronic support systems allow. Most students prefer “paper” version, only the source from which they get it changes. Interesting information for teachers is also that students tend to prefer compulsory study pace (having regular deadlines for assignments or tests or other duties that lead to earning credits for a course). This fact may raise the question whether it is really most suitable for students to study subjects spread out into semesters, or whether we should consider other options, such as study blocks.

On the basis of the given findings, it is possible to recommend (with some simplification and without taking into consideration various specifics of individual courses) that the school moves away from paper version of textbooks and focuses on creating complex electronic study support. The texts (hopefully downloadable) could be accompanied by video sequences, which would help explain the difficult passages of the curriculum. This type of study support should also be supplemented by systems allowing students to continuously fulfill course requirements, which lead up to earning credits, throughout the semester, and not just at the end of it. Nonetheless, in compliance with Kuncova and Vojackova’s findings (2012), it is important to take into account that students often

behave very purposefully when looking for sources of information for their studies, and that they prefer materials with “dense” content, which evoke the feeling that it is possible to successfully pass examinations having studied the given texts. With respect to the type and the breadth of education that the University offers its graduates, it is also necessary to construct such study support that would encourage students to use different resources as well.

The limitations of our investigation can be seen in the actual method of using a questionnaire, where the answers could be distorted by individuals trying to give their actions a more acceptable social form, or possibly to give the interviewer answers that may be understood as expected. We tried to minimize such distortions by sending a motivation letter that introduced the survey, and also by placing the questionnaire outside of the University’s electronic system. Nonetheless, when working with the collected data, it is necessary to take into account that it is impossible to completely eliminate such distortions. In the future it would be ideal to connect the survey with methods capturing true students’ behavior, at least in those areas where it can be done.

## CONCLUSION

The research set out to gain an overview of the actual use of study supports by students. It focused on the amount of printed texts used in the form of textbooks, it analyzed selected elements of study supports and materials placed on LMS Moodle, it focused on the activities of students during lectures, and it investigated the extent and reasons for using “unofficial” study materials.

The results of the research provided valid information to university teachers of the given faculties, which can help create more attractive study materials for students, and thus contribute to the student’s motivation to study, and it can further contribute to CULS’s effort to provide high quality education.

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# OBSERVING HOW FUTURE PRIMARY SCHOOL TEACHERS REASON ABOUT FRACTIONS

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## ABSTRACT

The contribution focuses on the possibility to use an educational tool called Concept Cartoons in future primary school teachers' education, especially as an instrument for observing how future primary school teachers reason about fractions. The task which we adapted to the Concept Cartoons form belongs to primary school mathematics, i.e. it focuses on the concept of a fraction per se, in particular on the parts-and-whole decision and on comparison of two pre-partitioned models with diverse wholes. Using Concept Cartoons, we observe which statements about the issue our respondents consider as correct, and which kinds of reasoning they use in their justifications. We also mention other related concepts (percentages), and related tasks from entrance exams to lower-secondary selective schools.

## KEYWORDS

Concept Cartoons, Fractions, Future Primary School Teachers, Problem Solving, Reasoning

## INTRODUCTION

In our contribution at last year's ERIE conference (Samková and Tichá, 2016a) we presented a study focusing on the possibility to develop open approach to mathematics in future primary school teachers during a university course on mathematics conducted in inquiry based manner, and introduced Concept Cartoons as a diagnostic instrument in this study. In particular, we used Concept Cartoons during *problem solving* activities to observe whether the participants of the study searched for different solutions of a given problem, and whether they accepted different forms of notations of a given solution. Lately, in the extended version of the contribution that was published in ERIES Journal (Samková and Tichá, 2016c), we also used Concept Cartoons as a diagnostic instrument during *problem posing* activities in order to observe whether the participants of the study were able to pose Concept Cartoons that could allow their pupils to experience open approach to mathematics.

Now we investigate other opportunities related to using Concept Cartoons in future primary school teachers' education, and introduce Concept Cartoons as an instrument for observing future primary school teachers' *reasoning*. As a mathematical topic in the centre of the study we choose fractions, a topic that is just on the boundary between primary and secondary school curricula in our country, since the concept of a fraction per se belongs to the primary school curriculum, and issues related to operations on fractions belong to the secondary school curriculum.

Our research question is "What kinds of reasoning about fractions can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument?"

From the perspective of ERIE conferences and ERIES Journal, the topic of our contribution is in relation to educational issues such as students' ability to solve mathematical problems (Novotná et al., 2014), or pupils' academic efficacy in the course of transition between primary and secondary school levels (Hoskovcová and Krejčová, 2015).

## Fractions in the primary school classroom

As mentioned above, the part of the fractions topic belonging to the primary school mathematics in the Czech Republic consists of the concept of a fraction per se. The fundamental interpretation of fractions is the *part-whole interpretation* which is based on partitioning either a continuous quantity or a set of discrete objects into equal-sized subparts or sets (Behr et al., 1983), the continuous quantity might also be indicatively pre-partitioned (Lamon, 2006).

So that the primary school teachers and pupils meet usually tasks requiring

- to match fractions with various continuous models (e.g. to colour a fractional part of a shape, to ascertain which part of a shape is coloured, to ascertain a whole for a given fractional part of a shape, to find a fractional part by paper-folding, etc.); for samples see Fig. 1 (pre-partitioned model) and Fig. 2;
- to match fractions with various discrete models (e.g. to colour a fractional part of a set of discrete objects, to ascertain which part of the set is coloured, to ascertain a whole for a given fractional part of the set, etc.), for a sample see Fig. 3;
- to compare fractions using the models.

The models used for this purpose may be linear, planar, and also spatial. Being on the primary school level, models that use manipulatives are first in line – pupils may use scissors, do paper-folding, glue coloured papers together, manage mosaics, marbles or cubes, etc.



Figure 1: “Name by a fraction what part of the shape is coloured.” (source: Divíšek, Hošpesová and Kuřina, 1999: 100; own translation).

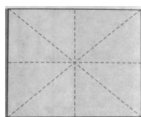


Figure 2: “Divide by folding a sheet of paper into eights.” (source: Divíšek, Hošpesová and Kuřina, 1999: 93; own translation).

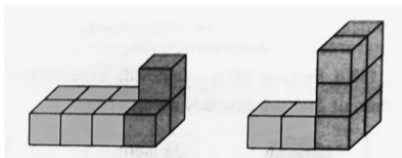


Figure 3: “a) Use yellow and blue cubes to build the building by the picture. b) Write by a fraction what part of the cubes in the building is blue. c) Add or remove some cubes, so that the blue cubes form  $\frac{1}{3}$  of all the cubes in the building.” (source: Koman, Kuřina and Tichá, 1997: 8; own translation).

Primary school teachers and pupils can also meet more complex tasks that combine several different fractions (either with the same whole for all given fractions, or with different wholes for particular fractions), or tasks that are based on one or more fractional changes:

There were 16 cakes on a plate. Petra ate a quarter of them, Michal ate a half, and Eva ate the rest. How many cakes ate Eva? (Divíšek, Hošpesová and Kuřina, 1999: 119; own translation)

In the beginning of the season, the price of peppers was 72 crowns per kilogram. In the middle of the season, the price has fallen by half. In the end of the season, the price again grew, by half of the new price. What was the price in the middle and in the end of the season? (Koman, Kuřina and Tichá, 1997: 124; own translation)

Some rather difficult non-standard tasks based on the concept of a fraction can be found in entrance exams to lower-secondary selective schools, i.e. in exams that are taken by pupils in the last year of primary school level (pupils' age 10 to 11):

A half of the ketchup in a bottle is already consumed, and the bottle with the ketchup weighs 690 g. After dinner, at which the family consumed a half of the remaining amount of the ketchup, the bottle with ketchup weighs only 430 g. What is the weight of the ketchup in a full bottle? What is the weight of an empty bottle? (Brlíková, Vémolová and Zelený, 2016: 23; own translation)

Lumberjacks cut up the trunk of a spruce. A half of the logs were one-meter-long, a quarter of the logs were 75-cm-long, and the remaining 2 meters were cut to logs half-a-meter long. How long was the trunk of the spruce? (ibid: 69; own translation).

To solve such tasks, the pupil (as well as the teacher) has to be well oriented in the described situation, and has to decide properly what are the parts and the wholes of the situation.

Generally said, the decision about what is the whole in a task is the crucial one, and we shall focus on this issue from the perspective of future primary school teachers. Inability to identify the whole causes many misconceptions and wrong solutions, not only within the topic of fractions but also in many others. The reasoning employed within fractions topic serves as an important base for reasoning in other topics, namely percentages – a topic that is widely applicable in our everyday life, with high impact on personal financial issues:

Is it better to have 30 % coffee extra free or a 25 % discount on the price of a jar? (Littler and Tylor-Basil, 1999: 76)

## **MATERIALS AND METHODS**

### **Participants**

Participants of the referred study were 31 future primary school teachers, completely all students of the third year of five-year master degree program at the Faculty of Education,

University of South Bohemia in České Budějovice. They are not math specialists; after graduation they are expected to teach all primary school subjects.

The study was conducted as a part of a longer lasting research project that had started a year before the study. In the beginning of the project, each of the participants had been randomly assigned a unique code number. The code numbers had been chosen between 1 and 39, to provide anonymity not only for the initial group of participants but also for potential newcomers.

### **Diagnostic instrument**

As a diagnostic instrument in our study we used an educational tool called *Concept Cartoons* (Keogh and Naylor, 1999). Each Concept Cartoon is a picture showing a group of several children in a bubble-dialog, where individual children present alternative viewpoints on the displayed situation, e.g. opinions, statements, proposals of ways of solving, possible results. The alternatives may be correct as well as incorrect; their correctness may also be unclear or conditional. Concept Cartoons and their history were introduced in detail in our previous contributions (Samková and Tichá, 2016a, 2016c; Samková, 2016), various samples of Concept Cartoons may be found there.

Our recent research showed that the tool may be widely employed in future primary school teachers' education: besides identifying the aspects related to open approach to mathematics, we used it also for identifying various aspects of the process of grasping of a situation (Samková and Tichá, 2015), for distinguishing between procedural and conceptual knowledge (Samková and Hošpesová, 2015), as an instrument promoting the awareness of the need of proper argumentation and leading towards deductive argumentation (Samková and Tichá, 2016b), for investigating pedagogical content knowledge (Samková, 2016), or for observing reasoning on pattern generalization (Samková and Tichá, 2017).

### **Data collection**

Data collection took part in several independent stages during the school year. Each time we assigned the respondents a worksheet with a Concept Cartoon on fractions, and asked them to decide which children in the picture are right and which are wrong, and to justify the decision. For the purpose of data collection, the participants worked on the worksheets individually, during the lesson.

For the study referred here we choose one of the assigned Concept Cartoons – the one shown in Fig. 4. The task behind this picture concentrates on the parts-and-whole decision from various perspectives, since it is based on comparing two pre-partitioned models with diverse wholes. This Concept Cartoon has two correct bubbles (Petr, Mirka), two incorrect bubbles (Standa, Katka), and one open bubble indirectly inviting respondents to present their own opinions on the pictured situation (Dan).

The worksheet with the Concept Cartoon from Fig. 4 was treated only by 28 respondents, because 3 of the respondents absented at the lesson where the worksheet was assigned.

### **Data analysis**

During data analysis we registered combinations of bubbles that were chosen by individual respondents as right, and combinations of bubbles that were chosen as wrong. Afterwards we also analysed which kinds of reasoning appeared in justifications presented in worksheets.

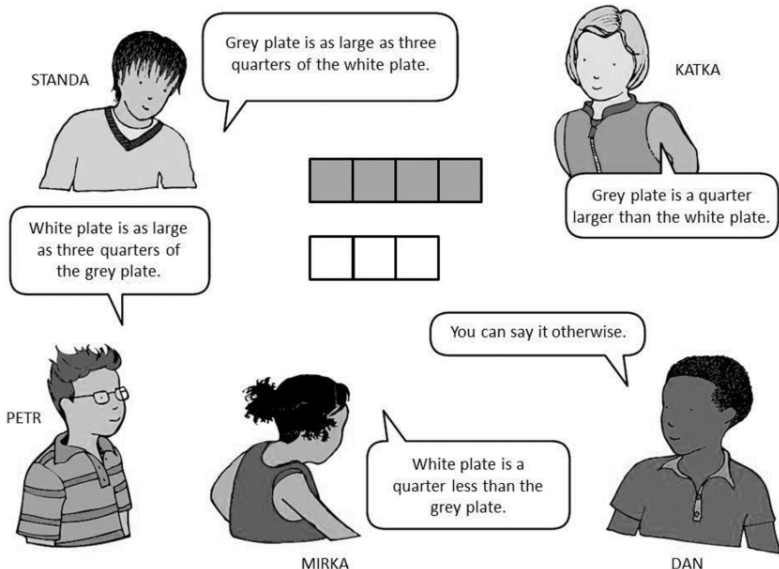


Figure 4: Concept Cartoon on fractions; (source of the template of children with empty bubbles: Dabell, Keogh and Naylor, 2008: 5.9).

## RESULTS

### Combinations of bubbles

Initially we observed responses from the perspective of individual bubbles, and without further analysis of the reasoning behind the answers. From this perspective the responses seemed to be rather comforting: all of the respondents correctly agreed with Petr and disagreed with Standa, majority of the respondents correctly agreed with Mirka. Just responses to Katka's bubble pointed out that the respondents might have faced some difficulties: minority of the respondents correctly disagreed with Katka. For proportional details see Fig. 5.

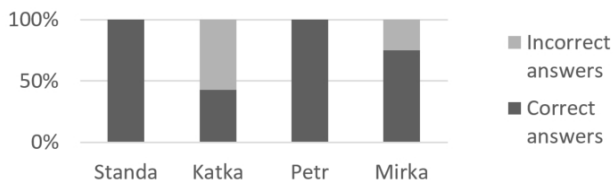
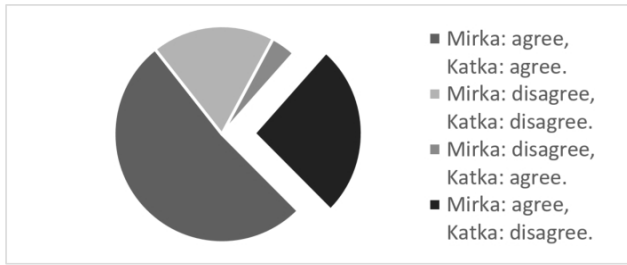


Figure 5: Answers to bubbles (source: own calculation).

Next we focused in detail on responses related to Mirka and Katka, and observed which combinations of agreement and disagreement appeared in worksheets. This method revealed us that the range of the difficulties might be wide: only minority of the respondents who correctly agreed with Mirka displayed also disagreement with Katka. For proportional details see Fig. 6.





**Figure 6: Combinations of answers to Mirka's and Katka's bubbles; the only correct combination "Mirka: agree, Katka: disagree" is separated (source: own calculation).**

### Kinds of reasoning

Alarmed by the previous results, we observed more thoroughly the reasoning that led the respondents to their decisions, especially to the incorrect combinations of responses related to Mirka and Katka.

Most of the incorrect responses were caused by handling fractions as an additive structure:

S16: Mirka and Katka – the same solution, just one of them used the word "less" while the other used "larger", and they swapped the plates.

by not realizing that the whole in Mirka's interpretation is not the same as the whole in Katka's interpretation:

S25: True: Katka, Mirka, Petr. They took the whole as  $\frac{4}{4}$ , and then matched and compared. They were thinking in fractions, and properly.

S30: Katka is true, the grey plate is a quarter of the grey plate larger. She would not be true, if she thought of it as of a quarter of the white plate.

or by handling  $\frac{1}{4}$  as a new reference unit, as a "named number" (Hruša and Vyšín, 1964):

S32: Katka – correct. ... grey =  $\frac{4}{4}$  white =  $\frac{3}{4}$   
grey is  $\frac{1}{4}$  bigger than white

Among the respondents there were several who saw the sources of errors in linguistics, and proposed their own corrections of texts in bubbles. Some of them considered both Katka and Mirka as incorrect:

S19: Katka – the grey plate is by its own  $\frac{1}{4}$  larger than the white plate  
– just more precise formulation is needed  
Mirka – the white plate is smaller by  $\frac{1}{4}$  of the grey plate

some considered Katka as correct and Mirka as incorrect:

S13: Katka – yes. But I would rather write "by its own quarter".  
Mirka – no. It is not clear by which quarter.  
I would rather write "by a quarter of the grey plate".

On the other hand, majority of the respondents who correctly identified Mirka as being true and Katka as being wrong, also proposed proper reasoning in their worksheets. For instance, the respondent S33 who suggested to show that  $\frac{1}{4}$  of the grey plate does not equal  $\frac{1}{4}$  of the white plate (and accompanied the suggestion by an illustrative picture), or S2 who deemed it necessary to emphasize that even though the grey plate is compared to the white plate by  $\frac{1}{3}$  larger, the white plate is compared to the grey plate by  $\frac{1}{4}$  less.

## DISCUSSION

We can say that our results are in accordance with the results of the research that preceded our study. Looking at the results from the perspective of Concept Cartoons, we can see the importance of not considering respondents' answers apart from reasoning behind the answers, and the importance of observing the answers in complexity – the data excerpts in the 'Results' section together with Figs. 5 and 6 clearly illustrate this issue. Since Concept Cartoons offer several alternative viewpoints to comment on, they make the respondents to reason not only in the context of their "favourite" interpretation of the topic behind the picture, but also in the context of other interpretations – an activity which is a very important part of teachers' education, especially in case of primary school teachers and fractions (Behr et al., 1993; Lamon, 2006). Generally said, in this contribution we offered an illustration of how Concept Cartoons could help in future primary school teachers' education: by perceiving Concept Cartoons as a representation of practice, the educators can study future teachers' responses to fictitious pupils' ideas or observe how future teachers create their own Concept Cartoons, and thus obtain information on various dimensions of teachers' knowledge (e.g. to what extent they have ideas on sources of misconceptions and errors).

Looking at the results from the perspective of the fractions topic, we can see the importance of focusing on proper grasping of the concept of the fraction, namely of the whole-and-parts relations. In accordance with previous research on primary school teachers' knowledge of fractions (e.g. Cramer and Lesh, 1988; Ma, 1999; Tichá and Hošpesová, 2013), analysis of the data collected during our study revealed various serious misconceptions that future primary school teachers employed in their reasoning, mainly handling fractions as an additive structure, identifying improperly the whole in a task, and handling fractions as named numbers.

Our data also revealed several respondents that saw the sources of errors just in linguistics but not in mathematics, a phenomenon which we know from our previous experience with future primary school teachers responding to Concept Cartoons (see Samková and Hošpesová, 2015). Nevertheless, the linguistics is an integral part of mathematics and cannot be treated separately, mathematics cannot be separated from its own language. Each mathematical topic has its own terminology and the way how it should be employed, the terminology is tied to the context of the topic in which it originated, and very often undergoes some changes when used in another context. For instance, the statement "Peter has 5 more books than Paul" originates in the context of natural numbers and refers to an additive structure, while the statement "Peter has  $\frac{1}{5}$  more books than Paul" originates in the context of fractions and refers to a combination of multiplicative and additive structures. Both the statements have the same wording (only numbers differ), and one has to be able to distinguish the diverse contexts given by the numbers, to understand that the fraction  $\frac{1}{5}$  refers to the whole that is stated in the statement after the conjunction "than". The responses given by the respondents S13 and S19 clearly show that these respondents are not aware of the reference to the whole that is given in the text which they comment

on. In Czech language (which is the language of our respondents) the syntax of the above mentioned statements differs only a little from the English syntax, the core of the problem stays the same. More details on the Czech case can be found in (Tichá and Macháčková, 2006), details on the English case e.g. in (Lamon, 2006). Talking of linguistics and mathematics, we must not forget to mention that the mathematical language often differs from the informal everyday language, and that this fact may become another source of mathematical misconceptions that look like linguistic ones (for illustrative examples see Kuřina, 1986).

We are aware that the weak point of our study consists in size of the sample and in homogenous nature of the sample, and that the results cannot be generalized. But we hope that our study can become a source of an inspiration for other educators of teachers.

## CONCLUSION

In this contribution we focused on the possibility to use an educational tool called Concept Cartoons as an instrument for observing how future primary school teachers reason about fractions.

Our small study confirmed the efficiency of using Concept Cartoons in education of future primary school teachers, as well as the importance of focusing on future primary school teachers' knowledge of fractions, especially on the knowledge related to the decision about what is the whole in a task. Concept Cartoons lead to awareness of existence of various views on a situation and various ways of solving.

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# RAISING THE INFORMATION LITERACY OF STUDENTS BY USING THE DIGITAL LIBRARY

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## ABSTRACT

This paper aims to outline the perspectives for increasing the quality of education at South-West University describing some important organizational approaches and methodological guidelines for the development of digital competences among students. The focus is on the level of information literacy of students and their need to use scientific information sources in the University Library.

The main objectives and results of the current study are shown in the empirical part of the paper presenting the students' attitude towards the use of the University library resources and services. The survey results suggest that in today's digital society it is particularly important for the Library to become an information-communicative center for improving the skills of students using the rich collection of information and digital resources, and increasing the quality of education and training at the University.

## KEYWORDS

Information Literacy, University Students, Library Competitions, Digital Library

## INTRODUCTION

In today's university education, the integration of information and communication technology in the processes of teaching and learning, requires students to adapt to the new literacy by developing thinking skills (such as problem solving, reasoning and critical assessment), research skills (such as gathering, evaluation and organization of information, argued writing, generating new ideas), cooperation and self-control skills. In the created Framework for information literacy for higher education, the Association of College and Research Libraries (ACRL, 2016) draws attention to the role played by the IT ecosystem in the life and the work of people, as well as on the new responsibilities of students to find and use data and information in the creation of new knowledge in the information environment. The term “meta-literacy” has been introduced as a set of skills, where students are consumers and creators of information and can successfully collaborate in teams and communities. Moreover, what is required is the “behavioural, affective, cognitive, and metacognitive engagement with the information ecosystem”, which is crucial for lifelong learning.

In the scientific literature the role of the library is increasingly focused with its rich information resources in the modern educational environment to support and facilitate the research activities of the students in building a strategy for information search, in acquiring criteria for finding and analyzing results, for selection and evaluation of electronic resources (George et al., 2006; Lacović, 2014, etc.). Significant place in this process have the library experts who can offer specific services for information literacy of students on the path of self-sufficing learning and the “increasing the pedagogical communication between faculty and librarians fosters greater focus on learning outcomes and a shared understanding of information literacy as an institutional priority” (Booth et

al., 2015: 636). In some studies, the focus is on the possibilities of the library consultant to develop a critical capability by engaging students in questioning the power structures and relationships involved in the production of information, especially within the academic environment (Beilin, 2015).

In recent years, many studies, focused on the information skills of students to work effectively to meet their learning and research tasks, found the lack of developed skills in the use of the rich resources of the e-library (Head and Eisenberg, 2010; 2011; Smith et al., 2013, etc.).

Moreover, many researchers indicate the bond which exists between library information skills of the students and the academic success and the need to improve the collaboration between lecturers and librarians (Bowles-Terry, 2012; Kovalik, Yutzey and Piazza, 2012; Mezick, 2007; Smith et al., 2013). It is not by chance that the library specialists are called “heart of the university” (Bowles-Terry, 2012: 83), without them the whole university life subsides.

The Bulgarian authors (Milusheva and Martinova, 2005; Shopova, 2011; 2013, etc.) also came to the conclusion about the need to search for useful approaches and solutions to enhance the quality of education at the university space using the rich information resources of the library and active participation of librarians as “managers of information”. The empirical part of the current paper aims to establish the level of information (library) literacy among the students at the South-West University - Blagoevgrad, their needs for using the services and sources of scientific information in the University Library (UL). It involves the main objectives and results of the survey realized from the author in February-March 2016. The aim of the study was to understand: 1) The degree to which students use their information literacy skills in order to successfully perform their learning and research tasks; 2) The motivation of students to increase their information (library) skills and 3) How to help students to improve their information (library) literacy.

## **MATERIALS AND METHODS**

The methodology of the study corresponded to the intended objective and envisaged the conducting of a survey based on a questionnaire that it had to establish:

1. The level of usage of the rich services and information resources of the University Library;
2. The level of knowledge and usage of means of access to information;
3. The extent of use of various library catalogues, funds and services;
4. The preferences of students to use certain types of library resources, services and facilities during their training;
5. Whether the students use the information resources of an e- library and how often?
6. The degree of satisfaction of students by the university e-library in their scientific research and development;
7. The motivation of the students to raise their level of Information competence and outlining the approaches for its improvement in the university environment.

**Questionnaire:** The survey was conducted by the method of direct individual survey through a pre-designed questionnaire comprising 21 questions. The questionnaire was composed of three logical groups; the first three questions were introductory (age, specialty, internet use); the other two groups related to the use of the library with its rich resources and services in the learning process and the research, and establishing the motivation of students to enhance their library skills.

**Sample size:** The survey was conducted among 130 people - students and PhD candidates

who were randomly selected. 74.62% of the respondents were women and 25.38 % were men of different courses and specialties at the SWU. Surveyed students were studying mainly Social, Economic and Legal Sciences (43.85%), Humanities (23.85%), Natural Sciences, Mathematics and Informatics (10.77%), Pedagogical Sciences (9.23%), Health and Sports (3.85%). 78.26% of the respondents were in the range of 18-23 years old.

Data processing: The statistical apparatus includes statistical methods - frequency, mean value and confidence level – 95%.

In the survey were made the follow tentative assumptions: 1) Most students at the SWU do not benefit enough from the library information services and resources in the preparation of their teaching and research assignments; 2) Most university students do not have the needed skills for using the rich variety of electronic resources and services at the university library. They prefer to use the Google search engine and its services as a primary source of information on the Web.

## RESULTS

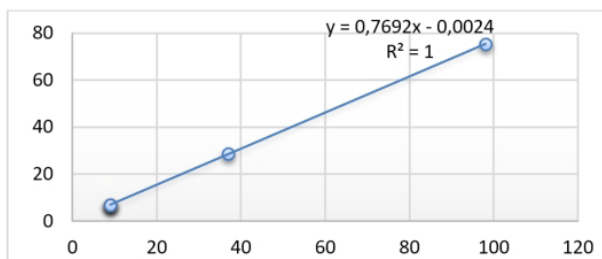
According to the data obtained the majority of respondents said they had daily access to the Web - 84.62 %, while those who answered “rarely” were 2.31%.

The study showed that most students included in the sample were not effectively used the library and information services in the University. Only 29.23% answered “yes, often” and 40 % - “sometimes”.

Moreover, prevailing was the number of students who very rarely (42.31%) used the services of the e-library at the University in the process of their training. Few were the students who used the library every day (3.08%), or 2-3 times per week (19.23%).

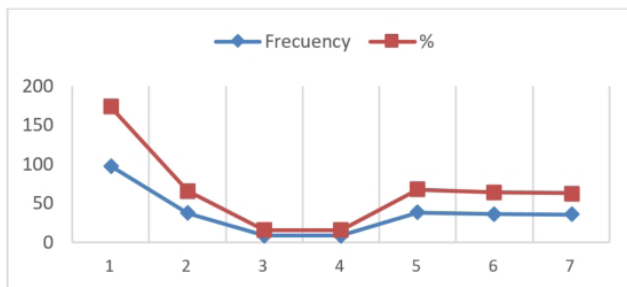
Of the library information resources it was given preference to the printed books and journals – 60%. Fewer students used the resources of the e-library and sought electronic books and journals (30.77%) or digitized primary sources (3.08%). The services of interlibrary loan were used only by 5.38% of the surveyed students while 33.85% have never used them.

In preparing their research tasks the majority of the respondents gave their preference to Google as a means of access to information (75.38%) and to a much lesser degree to academic search engines such as Google Scholar (28.46%), to academic databases such as Science Direct, Springer Link, EBSCO Publishing and others (6.92%) or to open electronic resources such as DOAJ (6.92%). It can describe the following linear equation  $R^2 = 1$  (Figure 1).



**Figure 1: Linear equation of using means of access to information**

The mean value was 29.4% at a frequency of 98 to 9, the standard deviation was 28%, and CL-95% - 27.4% (Figure 2).



**Figure 2: Using means of access to information**

Among the library collections and services, preference was given mainly to searching in online information systems (49.23%) and 39.23% of the surveyed students consulted the help of the librarian in finding the necessary sources. 44.62 % said they took advantage of organized classes /lessons/ in information literacy while 49.23% answered “no” (Table 1).

Do you use library collections or services such as:	Yes, often	Sometimes	Rarely	Very rarely	No, never
Finding information on the book market and the range of the information resources	8.46	34.62	28.46	6.15	20.0
Databases	16.15	37.60	20.0	6.92	16.15
New books in various fields of scientific knowledge	13.08	34.62	26.92	8.46	15.38
Searching in online information systems	49.23	30.77	10.77	2.31	6.15
Assistance of a librarian	39.23	27.69	16.92	6.15	9.23
Mean	25.23	33.06	20.61	6.0	13.38
SD	16.02	3.45	6.51	2.03	5.0
CL-95 %	14.04	3.03	5.71	1.78	4.39

**Table 1: Use of library collections and services and seeking the assistance of a librarian (in %)**

To the question what types of library resources, services and tools they use when they solve their scientific tasks, most respondents indicated the traditional resources, such as books, records, etc. (47.69%), and the electronic resources such as books, library catalogue, databases, digitized primary sources, etc. have preferred by 45.38% (Table 2).



Use of library resources, services and tools to research	Yes, often	Sometimes	Rarely	Very rarely	No, never
Electronic resources such as books, library catalogue, databases, digitized primary sources, etc.	45.38	32.31	14.62	1.54	4.62
Traditional resources such as books, archives, etc.	47.69	32.31	11.54	1.54	5.38
Services such as references, instructions, research consultancy and interlibrary loan	19.23	33.50	22.31	6.15	16.92
Technical tools and equipment for individual and group training, use of computers, photocopiers and printers	50.0	23.85	10.77	3.08	10.0
Mean	40.58	30.49	14.81	3.08	9.23
SD	12.43	3.86	4.56	1.89	4.89
CL-95 %	12.18	3.79	4.47	1.84	4.80

**Table 2: Using types of library resources, services and tools (in %)**

Another set of questions was related to the establishment of the degree of satisfaction of students by the e-library at the University. The study found out that only 24.62% of the respondents believed that it fully meets their requirements, 25.38% had the opinion that it partially meets them for the purposes of their research (Table 3).

To what extent the electronic research library satisfy your scientific research and developments?	Frequency (N)	Percent (%)
It completely satisfies me	32	24.62
Partly for the purposes of my research work	33	25.38
More for education	31	23.85
I'm not satisfied	3	2.31
I can't decide	29	22.31
Mean	25.60	19.69
SD	11.38	8.75
CL-95 %	9.97	7.67

**Table 3: Level of satisfaction of the electronic research library at the University**

It was interesting to understand the motivation of students to improve their information literacy skills. More than half of the surveyed students (57.69%) understand that the work at the library impacts their academic success and therefore most of them would participate in training courses organised in the library. According to the data obtained, 66.92% of the respondents said they were willing to participate in such courses to increase their library (information) skills and only 13.85% responded negatively (Table 4).

Would you like to participate in training courses organized in the university library to increase your library /information/ skills?	Frequency (N)	Percent (%)
Yes	87	66.92
No	18	13.85
I can't answer	23	17.69
Mean	42.67	32.82
SD	31.41	24.16
CL-95 %	35.55	27.34

**Table 4: Motivation of students to improve their information literacy**

Majority of the respondents also approved the introduction of digital collections of scientific works of students, undergraduates, graduate students and faculty in the University's library. Most said it was useful (58.46%) or very useful (26.92%) to be introduced and offered to use such collections.

## DISCUSSION

The survey data showed that most students used both printed (60%) and electronic library resources (30.77%) in their scientific searches. This indicates a positive change in the attitude towards information resources compared to the studies in the previous years (Shopova, 2011; 2013). Facilitated in their daily scientific searches of the electronic publication of information, students largely rely on the electronic format of searching books, newspapers, journals, books, documents, etc. for the purposes of their learning. But they have not yet acquired skills to fully benefit from the advantages of the electronic library and its resources. Very few of them are familiar with the research databases of the university's library and Google remains the preferred tool for accessing needed information.

The study confirmed the initial assumption about insufficient knowledge of information (library) literacy among the students, most of whom are not sufficiently aware of the abundance of electronic resources of the electronic university library; they still do not have the necessary skills and habits of using academic search engines and databases in their learning and research activities; the services of the e-library as a whole are rarely used.

Nowadays, the university libraries and their services are dominated by information technology, which is used in all aspects of library activities to connect consumers with the information resources, including preparation of the data, discovery, delivery and storage of the recorded information (Raju, 2016). In today's learning environment the librarians began to play "a key role in the development of an integrated curriculum of information literacy" (Nwosu and Onwubiko, 2014: 2). The role of the library consultant grows as long as he needs to support students in searching, finding and evaluating relevant information. With the exponential increase of information resources of major scientific and research libraries, the students are faced with the problem of how selectively and efficiently to use these resources. Some library organizations and leading universities in the world have already developed programs and initiatives for building information literacy of students and carrying out the mission of universities (Buchanan et al., 2015; Knapp, Rowland and Charles, 2014; Miller, 2014; Moselen and Wang, 2014).

Training of students in the information literacy is offered by some libraries in Bulgaria. For example, the Library Information Centre of the University of Architecture, Civil Engineering and Geodesy in Sofia has developed a methodology for conducting open

library literacy course in order to be integrated into the curriculum of the first year students from all specialties. It had been also proposed a course of exercises on information literacy in the University for upperclassmen on a modular principle (Rafailova, 2008-2009). In the South-West University some steps have been made to assist students in finding scientific information in traditional and electronic format. But it is necessary to create a digital guide that would offer a list of links to the most frequently searched library resources in different branches of science and instructions for their finding (books, theses, journals, etc.), as well as wider information concerning how users can use the library services. The focus is on supporting e-learning in the University Library. There are now library lessons, which outline the required knowledge and skills that are learned when operating under internet environment for a broader study. But this is not enough to organize on a modular basis all the content of a course in information literacy, which can be introduced in the library information centre for training of students.

The exhibited results of the current study show insufficient satisfaction of students with the electronic research library and their increased interest in the use of its digital resources. These results lead us to the conclusion that it is necessary to outline a new model for the university library that has developed physical resources and related services in digital format in support of teaching, learning and research (Raju, 2016: 164). With the digitization of scientific products the university library would become such a research centre that can assist in increasing digital competence of the academic community.

## **CONCLUSION**

Outlining the importance of the problem concerning the analysing and evaluating the library information competencies among the students at the South-West University and the extent to which they are used, is an important prerequisite for building a more effective strategy for the University and to ensure a higher level of using digital technology as well as developing skills and competencies for effective inclusion of students in education and training.

In a practical sense, the presented study seeks to offer new approaches and ways to motivate students toward effective use of digital information and of new tools for working in the digital environment - by creating programs for raising information literacy among the academic community and building a Digital Repository at the UL. The role of the Digital library is clearly outlined in the university environment for the collection, management and long-term storage of rich digital content, aiming to support the user communities and their ability to creatively use it to generate new information.

And what is important to be emphasized here, this is the need for adequate strategy to accelerate this process by modernizing the university library for students to develop and improve their academic skills and competences. In the foreground, it is outlined the new role of the library experts as “managers of information”, who apart from the programs of information literacy they will offer, will also take on the function of establishing a system for organizing the knowledge at the University.

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# STUDENTS AND ONLINE PRIVACY

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## ABSTRACT

At the University of Economics we have carried out a survey investigating students' opinions on information privacy. This issue is relevant for educational institutions, as with the spreading of e-learning and information systems educational institutions have a lot of students' data at their disposal. We used the CFIP and IUPC scales to evaluate the components of information privacy. Our results show students are aware of the lower level of ethics in the online environment, but are relatively tolerant to unethical behaviour of companies. We haven't found any significant correlations of our results with students' gender, age and number of hours worked. That may be explained by the non-transparent functioning of ICTs and the lack of bad experience students have with information privacy misuse.

## KEYWORDS

Information Privacy, Information Ethics, Information Accuracy, Information Collection

## INTRODUCTION

Privacy is a difficult concept because it stands at the intersection of information, people and technology. Modern information technologies including social networks and mobile applications where users' social interactions reveal both their and their friends' personal information affect man's privacy and have an impact especially on the weakest subjects - young and older people. We perceive the technologies' implications on privacy particularly in areas which are very sensitive, like healthcare information.

Smith, Diney and Xu (2011) suggested a model where privacy experiences and awareness, demographic differences, personality differences and culture are factors influencing privacy concerns which on the other hand affect regulation, behavioural reactions, trust and risks. However, their model has not been confirmed by repeated studies and may be biased by privacy paradox (people behave differently from their statements – e.g. Holland, 2010) and two-way loops (implications affect conditions). In our survey we were testing the influence of age, gender and hours worked on sensitivity to privacy issues.

According to the article by Warren and Brandeis (1890) privacy is defined as the right to be left alone. In computer science the big problem of privacy is the lack of anonymity which is related to unlikability, unobservability and pseudonymity (state of disguised identity). That is why privacy is often defined as an individuals' ability to control the terms by which their personal information is acquired and used (Westin 1967). However, this definition has been criticized as unsatisfactory and the current situation can be summarised by the words of D. Solove: "Privacy is in disarray and nobody can articulate what it means" (Solove 2006: 477). In any case we can identify concepts that belong under the category of privacy and help us analyse it into simpler elements. In our survey we asked participants, what categories belonged under the notion of privacy.

There are two famous scales measuring the privacy concerns. The first one called Concern

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for Information Privacy (CFIP) focuses on organizations' responsibilities for the proper handling of customer information and has a 15-item scale (Smith et al. 1996) comprising of four categories: collection of personal information, unauthorized secondary use of personal information, errors in personal information and unauthorized access to personal information.

The other scale called Internet Users' Information Privacy Concerns (IUPC) focuses on individuals' perceptions of fairness or justice in the area of information privacy (Malhotra et al. 2004). It consists of a 10-item scale organized into three categories: collection of personal information, control over personal information and awareness of organizational privacy practices. In our privacy survey we were inspired by these two scales.

H. Nissenbaum (2010) has proposed a contextually based concept of privacy. For her contextual integrity is defined by context-relative informational norms. She notes that these norms are characterized by "four key parameters: contexts, actors, attributes, and transmission principles" (Nissenbaum, 2010: 140). According to her concept, privacy in an online and real environment differs as the context is different. We confirmed that conclusion in our survey.

## **MATERIALS AND METHODS**

In our survey we asked students at the University of Economics in Prague by means of an online questionnaire in the time period 4.12.2016-12.1.2017. We used the Likert scale in questions asking for opinions and students expressed their agreement/disagreement with the given statement. We received 60 answers, 38 from male respondents (63.3%), 22 from female respondents (36.7%). 26.7% of students do not work during their studies, 20% work occasionally in temporary jobs, 46.6% work in part time jobs and 6.7% have a full time job. 41.7% of students have their average grade between 1-2 in the four item scale, 56.7% have their average grade between 2 and 3 and 1.6% between 3 and 4. 31.7% of students were from the first baccalaureate studies, 13.3% from the second year of the baccalaureate programme, 13.3% from the third year of the baccalaureate programme, 1.7% from the fourth year of the baccalaureate programme. 30% were in the first year of the master programme, 8.3% in the second year of the programme, 1.7% in the third year of the master programme. Their age was between 18 and 25 years.

For the results' analysis we used methods of descriptive statistics and methods analysing contingency (Kruskal-Wallis and chi-square test) and correlation (Spearman rank order correlation coefficient  $r_s$ ) between dependent variables and age, hours worked and gender. All these tests were suggested by Řezanková (2007) for the respective type of variables. We have applied both the CFIP and IUPC methodologies to research students' opinions on privacy. We were also testing the hypothesis of gender, age and hours worked relevance for the sensitivity to ethical issues. We investigated the hypothesis of the relevance of prior bad experience for ethical awareness.

## **RESULTS**

70% of students consider the standard of information ethics on the internet worse than in the real world, 26.7% as the same as in the real world and only two respondents (3.3%) consider the standard of information ethics on the internet as better than in the real world. That shows students realize the threats of the cyber environment and know they should be more careful in it. On the other hand, the results imply there is a need to improve the ethical situation in the cyber environment. 48.3% of students see the biggest problems in the work of media, 33.3% of students find the social relation an area with the worst ethical

problems, 11.7% think the worst ethical problems are in the area of copyright (pirate copies), 6.7% find the worst ethical problems in the labour relations. 50% of students rather agree and 38.3% definitely agree that universities should teach their students ethical principles. That shows students themselves feel a lack of security and expertise in ethical issues.

As for the content of private information 93.3% of students consider health state to belong into the category of private information, 88.3% think the monthly income belongs into this category, 85% of respondents find one's address to be private information, 75% religion, 73.3% political preferences and only 25% think one's name is a private information. Majority of students (78.3%) thinks that a responsible behaviour of users is the best instrument for privacy protection. Only 38.3% support state regulation and 31.7% self regulation of the economic branch. 46.7% of respondents think privacy protection is at a higher level at desktop computers compared to mobile applications, 38.3% think it is the same and 15% think privacy is better protected at mobile phone applications.

As for unauthorized access to personal information 40% of students don't mind that electronic information on the internet is used without consent and notice of those who are the subjects of the information. 1.7% don't mind it at all, 48.3% mind it and 10% mind it a lot. The results are on the 5% significance level independent on age ( $p = 0.143$ ,  $r_s = -0.276$ ), independent on hours worked ( $p = 0.907$ ,  $r_s = -0.015$ ) and independent on gender ( $p = 0.083$ ,  $\chi^2 = 3.006$ ).

Regarding information accuracy only 3.3% of students is sure that private information in databases shouldn't be several times controlled to provide their accuracy, 16.7% rather disagree that it should be controlled, 45% rather agree and 35% definitely agree that it should be controlled and checked for accuracy. The results are on the 5% significance level independent on age ( $p = 0.186$ ,  $r_s = -0.173$ ), independent on hours worked ( $p = 0.898$ ,  $r_s = -0.017$ ), and independent on gender ( $p = 0.535$ ,  $\chi^2 = 0.384$ ).

5% of respondents strongly disagree that companies shouldn't use personal information for other purposes than those approved by the respective subjects, 5% rather disagree, 5% agree and 85% strongly agree to this statement. The results are on the 5% significance level independent on age ( $p = 0.597$ ,  $r_s = -0.07$ ), hours worked ( $p = 0.923$ ,  $r_s = 0.13$ ) and gender ( $p = 0.657$ ,  $\chi^2 = 0.198$ ). This question belongs into the category of unauthorized secondary use of personal information and control over personal information.

As for information collection, 33.3% of respondents rather think companies don't have too much information on them, 45% rather think they have too much information and 21.7% definitely think they have too much information on them (see figure 1). The results are on the 5% significance level independent on hours worked ( $p = 0.179$ ,  $r_s = 0.176$ ), independent on age ( $p = 0.443$ ,  $r_s = 0.101$ ) and independent on gender ( $p = 0.197$ ,  $\chi^2 = 1.661$ ).

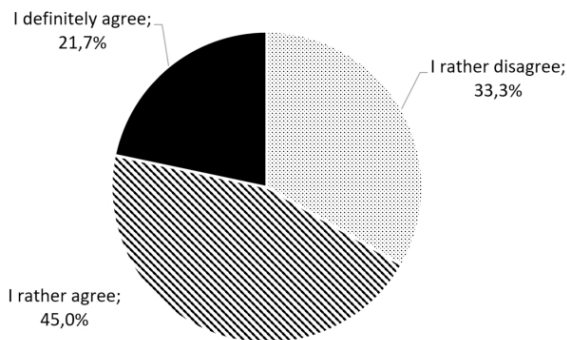
On the general question if students mind if an application asks for their personal information 35% answered they mind it a lot, 45% rather mind it, 20% rather don't mind it. The results are on the 5% significance level independent on hours worked ( $p = 0.677$ ,  $r_s = 0.055$ ), independent on age ( $p = 0.486$ ,  $r_s = 0.092$ ), independent on gender ( $p = 0.568$ ,  $\chi^2 = 0.326$ ).

Regarding awareness of organizational privacy practices we asked students if they read and understand the terms and conditions of internet services and applications providers. 41.7% of students don't read the terms and conditions, 3.3% sometimes read them, but usually don't understand them, 51.7% sometimes read them, and understand them, 3.3% always read them and understand them. The results are on the 5% significance level



independent on hours worked ( $p = 0.410$ ,  $r_s = 0.108$ ), independent on age ( $p = 0.647$ ,  $r_s = 0.060$ ), independent on gender ( $p = 0.474$ ,  $\chi^2 = 0.513$ ). The results confirmed our conclusions from previous years.

Companies have too much information on me.



**Figure 1: Information available to companies, 2017-2018 (source: author)**

55% of students don't have negative experience with misuse of their personal data, 21.7% have faced one misuse of their personal information, 21.7% several misuses and only one student (1.7%) has the experience with many misuses of his personal data. The question didn't specify the meaning of misuse and so the explanation may be that students don't perceive some unauthorised uses of their personal data as a misuse. The results are on the 5% significance level independent on age ( $p = 0.855$ ,  $r_s = 0.112$ ), slightly dependent on hours worked ( $p = 0.005$ ,  $r_s = 0.355$ ) – the more students work the more frequently they have negative experience with misuse of their personal data. The results are independent on gender ( $p = 0.518$ ,  $\chi^2 = 0.418$ )

Interesting are the results of correlation between bad experience with misuse of private information and the level of discontent if an application asks for private information. On the 5% significance level we have found a small correlation between these variables ( $p = 0.033$ ,  $r_s = 0.275$ ). The more frequent the bad experience, the higher the resistance towards submitting personal information.

## DISCUSSION

Some researches about students' privacy perceptions have already been published. Ifenthaler and Schumacher (2016) have researched 330 university students on their perception of privacy issues related to learning analytics. The results show the conservative approach of students to data sharing. There are papers pointing out to the risks of online learning, which is becoming more and more popular and gives providers of online services access to students' sensitive information and patterns of their behaviour. (Kelly and Seppälä, 2016).

Some educational institutions use students' data analytics to improve their education and learning environment. This use of data poses many ethical problems (Ruble and Jones, 2016). The problematic issues consist in information access concerns, intrusive nature of information-gathering practices, justification of learning analytics with regard to the potential distribution of consequences and benefits, student's autonomy and issues questioning whether learning analytics reaches the aims of higher education or contradicts

them. Abilock and Abilock (2016) point out that educational institutions offer their students many externally provided online services which may harvest information on students. The relationships with these online vendors should be regulated to protect students' private information and to avoid misuse. Some articles stress the role of librarians in privacy education in the age of big data (Ewbank, 2016), (Panter, 2015). Lewis, Kaufman and Christakis (2008) analyse factors predicting students to have private or public profiles on social networks.

In the Czech National Strategy for Cybernetic Security 2015-2020 the increase of public awareness of cybernetic threats including privacy represents an important goal. Arnseth, Erstad, Juhanák, and Zounek (2016) stress the importance of researching wider implications (including the ethical ones) of integration of ICT into the educational process. One of the recommendations we can find in the ICILS (International Computer and Information Literacy Study) report which focused on the students from the ninth class of the elementary school, is that the role of school in teaching the ethical and security standards needs to be improved (Basl, Bird, Boudová and Tomášek, 2015). In the year 2010 a survey in 25 European countries was organized to compare the internet skills of European children and their parents (EU kids online II) (Ševčíková, 2015), between 2012 and 2013 a survey called Risks of Internet Use among Youths and Adolescents (Rizika užívání internetu dětmi a dospívajícími) took place in the Czech Republic (Ševčíková, 2015). Even though there has already been established some general awareness and carefulness regarding online threats including privacy issues, all of the surveys have shown some limits and lacks of skills required in identification of cybernetic threats on the internet. Also a survey among students (ISIC 2015) shows lacks of privacy awareness among Czech students. We can confirm these results. Students know the risks, but are relatively tolerant. The ICIL survey has shown differences among boys and girls regarding the computer skills and relative resistance to online threats. In our survey we didn't confirm that conclusion.

Smith et al. (1996) concluded that individuals who have experienced misuse of their personal information have stronger concerns regarding information privacy. Okazaki (2009) also supports the higher sensitivity of mobile phone users to provide private information if they had previous bad experience with it. Their respondents have also shown high level of information privacy concerns regarding awareness of how private information is used and control over the type of information, which is collected, used and shared. They were quite careful as for providing personal information.

In our research, we found out that ethics is context dependent and internet ethics needs a special attention. Maybe there is some space for teaching ethics and internet ethics as part of the university curricula. Students think about privacy in online environment and are critical towards the amount of private data companies have on them. They also don't consider the companies' privacy policy satisfactory. What is surprising is the fact that they don't think authorities can solve the issue, but pass over the responsibility for privacy protection to the respective subjects. That is closer to the American than to the European way of thinking.

We also realised that students are still quite benevolent to unauthorized use of their personal information, probably because the negative effects of such a behaviour is still not very transparent. On the other hand, they support information accuracy regarding private information and are quite critical to unapproved use of private information. That suggests they are tolerant to unnoticed use of personal information, but reject breaking the agreement on use of private information.

We haven't found any important gender or age differences in the results, neither do numbers of hours worked affect them. That does not comply with the Czech surveys. We have confirmed the effect of bad experience on the distrust and unwillingness to provide private information found in other studies.

## CONCLUSION

We may conclude information privacy represents a topic of interest for students of our university disregarding gender, age and work experience. We may hope that with the revealing, explaining and publishing of bad ethical practices the awareness and sensitivity to these issues will increase and public pressure would force companies to behave ethically. The problem of information ethics lies namely in its hidden (non-transparent) nature. The results of our survey are relevant for educational institutions as they also collect and process a lot of private data of their students and allow external providers of some services to access them.

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# EDUCATION OF EMPLOYEES DURING DISMISSAL PROCESS

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## ABSTRACT

Employee education should be ensured not only when employees are needed to fulfil the corporate objectives but also at the time of their dismissal. Dismissals can be understood as the natural shaping of teams. They need to be perceived as a part of the life of the organisation. However, the consequences of dismissal processes should be viewed in the least negative extent by the stakeholders. Therefore, every organisation should establish a dismissal process incorporating the education of the dismissed employees, thus making job searching and subsequent succeeding at a new position easier to them. The objective of the article is to identify the rate of use of education in dismissal processes. We conducted a research indicating that despite an increasing trend between 2013 and 2016, representing a positive change by 1.1 % at the current 6.2 %, this is insufficient from the global perspective.

## KEYWORDS

Education, Dismissal Process, Employees, Human Resource Management

## INTRODUCTION

The dismissal process should be managed by the department of human resource management with the intention to ensure that dismissals are executed in the scope of the valid legal regulations of the country of operation of the institution (in the Slovak Republic, it is Act 311/2001 Coll., which is a part of the Labour Code) and to ensure a comprehensive care about both the dismissed employees (Arslan, 2005; Bragger et al., 2015) and employees remaining in the organisation, as well as to maintain the positive image of the organisation as an employer and provider of services and products (Alewell, Pull, 2009). The objective of the article is to identify the rate of the use of education in the dismissal process and to highlight the significance of education for the success of this process, and to try to identify whether the rate of the use of individual trainings during outplacement increased in the monitored period.

The outplacement process and its effects on individual involved groups are characterised in the paper, the importance of employee education in this process is further underlined, while the identification of the areas on which organisations most frequently focus in the education of dismissed employees is based on the results of our research conducted in individual regions of Slovakia.

## **THEORETICAL BACKGROUND**

Such a broad objective of the dismissal process results from the fact that dismissals do not only affect the dismissed employees. The effects of dismissals on stakeholders can be divided into three categories. The first category obviously includes the dismissed employees (Westaby, 2004), who can be helped in their search for a new job by targeted education. The second category includes the remaining employees, who need to be motivated, as the dismissals in the organisation considerably affect both the performance and work ethics of the remaining employees (Arslan, 2005) especially in an event of collective dismissals (if the employer or a part of the employer dismisses an employee for the reasons specified in the Labour Code, Section 63 (1) (a) and (b), or if the employment is terminated otherwise for a reason unrelated to the person of the employee during 30 days a) with at least ten employees of an employer employing more than 20 and less than 100 employees, b) with at least 10 % of the overall number of employees of an employer employing more than 100 and less than 300 employees, c) with at least 30 employees of an employer employing more than 300 employees). (Vicen, 2016). Concerning the employees remaining in the organisation, it is necessary to focus on reducing the concerns of managers about unhandled dismissals, which is why their education in coping with mentally demanding situations resulting from dismissing needs to be focused on. The third category includes the external environment of the organisation such as suppliers, customers and the general public, and their perception of the organisation (Alewell, Hauff, 2013; Remišová, Búciová, 2012, Gubiniová, Bartáková, 2014).

Scientific literature denotes the comprehensive dismissal process as outplacement (Koubek, 2006; Hroník, 2013). The outplacement process has been defined differently by different authors, who have divided it into a various number of steps. It most frequently includes four-step to eight-step processes, while most of the outplacement processes are only focused on the leaving employees, which is insufficient. We identify in the greatest extent with Hroník (2013), who comprehended the outplacement process comprehensively and divided it into four steps:

- Step 1: The creation of an outplacement project - it is necessary to determine a person responsible for the management and execution of the dismissal project (internal/ external sources); which employees will be affected by dismissals (who will be dismissed, who will be included in a retention programme, incentive scheme or knowledge delivery programme); a time interval of the whole process needs to be specified (from one day to 12 months) along with a form of education of both the managers who will manage the dismissals and the dismissed employees (individually, in groups); the needs of employee education need to be identified (leading of dismissal interviews, possibilities how to find a new job, requalification possibilities, legal and social counselling as well as provision of psychological help); and educational methods need to be defined based on the content of education (personal assessment, also including personal SWOT analysis and development plan, lectures, role-plays and e-learning).
- Step 2: The creation of an outplacement communication plan (the procedure and content of both internal and external communication, preparation of managers for a change, i.e. understanding, acceptance, adoption)
- Step 3: Outplacement execution (programme for key employees, programme for dismissed employees)
- Step 4: The evaluation of executed outplacement (outplacement costs and effectiveness, proposals, modifications and changes)

It is necessary during the dismissal process to focus on the education of three following groups of employees:

**The education of the employees of the department of human resource management focused on the creation of comprehensive dismissal processes** The need results from the fact that the comprehensive dismissal process is not a typical part of the curricula at universities. This procedure has not been established in our organisations, and has only been dealt with by a small number of consultancies.

**The education of the dismissed employees** The need to educate these employees should be especially focused on the possibility of their further succeeding on the labour market (Wagnerova, 2011). Trainings in how to structure a CV, cover letter and how to prepare for a job interview need to be focused on (Bragger, et al., 2015). The education should also include social and legal rights and responsibilities (Alewell, Hauff, 2013), where the employees should be informed on their entitlement to severance pay, right to receive financial benefits such as unemployment benefit and other social benefits, the possibility to receive scholarships for dependent children or social housing benefits, etc., as well as on their responsibilities related to notifying the health insurance company of the change of their employment status, or their obligation to report to the Office of Labour, Social Affairs and Family. Within the legal aid, they can also be informed on the possibilities and procedures associated with establishing a trade or other type of company. Financial consultancy is suitable for the employees with lower education (Bragger, et al., 2015). Education in the form of different requalification courses is also suitable (at the expenses of the organisation and on the basis of demand on the labour market).

**The education of the managers informing employees on dismissals** The education of managers in this area can be considered to be key, as dismissals are among the most difficult managerial responsibilities from the emotional perspective. Successful handling of a dismissal interview significantly reduces its negative effects on both the dismissed employee (Westaby, 2004) and the dismissing manager. Such education, containing coping with mental stress as well as the current requirements of the labour market (Martin, Lekan, 2008), is typically not involved in the education of managers during their studies, hence it is completely up to the organisation to focus on such education of their managers.

**The education of the remaining employees** In addition to the development of employees, education also fulfils the stabilising and motivating functions. If the organisation educates their employees, or incorporates them in a development programme, it provides them a clear signal about their future and importance for the organisation (Urbancová, 2015; Kampf, et al., 2014). The primary objective of the education of the organisation's key employees during dismissals is to minimise the risk of their undesirable leave and to prevent their unsettlement. The research conducted by Doherty et al. in 1992, which involved almost 630 companies in Great Britain, showed that over 46% of the organisations perceived decreased motivation among remaining employees, an indication of the potentially detrimental effects of redundancy on "survivors" (Doherty, et al, 1993).

## **MATERIALS AND METHODS**

For the needs of this article, the data obtained from our research conducted between 2014 and 2016 at School of Economics and Management in Public Administration in Bratislava were applied, and the top representatives of Slovak institutions were interviewed. The questions were asked through personally delivered questionnaires. The amount of the interviewed institutions was 573 - 609 every year (depending on the availability of personal contacts of external students, which were used to address the respondents in the

research), while the response rate of comprehensively completed questionnaires was 60 % - 65 %.

In order to define a sufficient research sample, two stratification criteria were determined. The first criterion was the region of operation of the organisation based on the NUTS classification; Slovakia was divided according to the NUTS 2 category, while the structure of the research sample was based on the data provided by the Statistical Office of the Slovak Republic.

The second stratification criterion was a minimum number of employees, determined to 50 employees, thus excluding small enterprises from the research sample on the one hand, however the importance of focusing on a formal human resource management system in organisations with 50 and more employees was followed on the other hand.

The data provided by the Statistical Office of the Slovak Republic during the monitored period indicated that the number of organisations with 50 and more employees in individual regions was oscillating around similar values, while the regional structure of the organisations with over 50 employees in the given years is provided in the following Table 1.

Region - NUTS II.	Bratislava Region	Western Slovakia	Central Slovakia	Eastern Slovakia
Districts	BA	TT, TN, NR	BB, ZA	KE, PO
Number of organisations 2013	1,102	911	645	606
Number of organisations 2014	1,098	904	644	612
Number of organisations 2015	1,105	916	651	613
Number of organisations 2016	1,114	923	649	621

**Table 1: Regional structure of organisations with more than 50 employees (source: data processed according to the Statistical Office of the Slovak Republic)**

Determining an optimal research sample of the given basic group of organisations, Confidence Level of the research was set at 95 %, and Confidence Interval of the research was set at  $H = \pm 0.10$ . On the grounds of the given criteria, an additional, respectively relevant research sample for individual regions of Slovakia was set in the analysed years (see Table 2).

Region - NUTS II.	Bratislava Region	Western Slovakia	Central Slovakia	Eastern Slovakia
Districts	BA	TT, TN, NR	BB, ZA	KE, PO
Number of organisations	1,102 – 1,114	904 - 923	644 - 651	606 - 621
Size of research sample	88	87	84	83

**Table 2: Size of the research sample for individual regions of Slovakia (source: own research)**

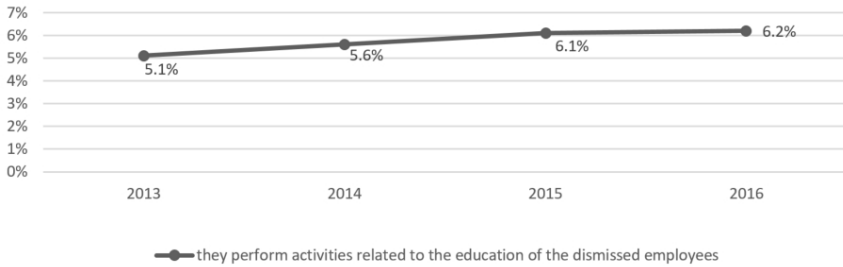
The research sample of  $n=342$  was selected. The respondents answered 90 questions. Four of them, which were focused on education in the process of outplacement, were processed for the needs of this article. The data obtained from the research were subsequently processed by the statistical software SPSS 15.0 for Windows®.

## RESULTS

The conducted research indicated that only a small amount of Slovak organisations (6.2 %) dealt with the dismissal process comprehensively (see Figure 1). In the dismissal process, they primarily focused on complying with the statutory rules. This clearly demonstrated their approach to both the dismissed and remaining employees, and their approach of

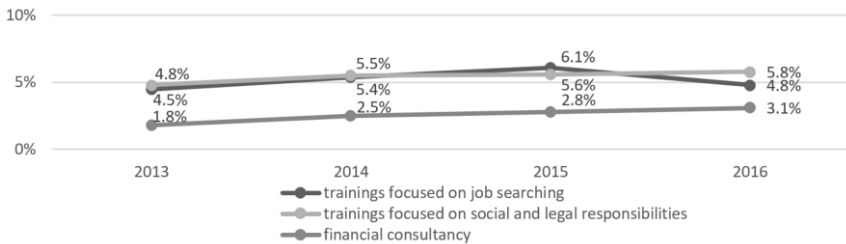


socially responsible entrepreneurship. The amount of Slovak institutions focusing on outplacement had increased by only 1.1 % over the last four years.



**Figure 1: Number of organisations focusing on outplacement (source: own research)**

The areas on which the organisations focused within the education of the dismissed employees were most frequently associated with job searching (Internet, employment agencies, advertisements, etc.), trainings focused on social and legal responsibilities (orientation in the Labour Code, registration at the Office of Labour and health insurance company, entitlement to severance pay and other entitlements related to the organisation such as retirement allowance, validity of notice, etc.) and financial consultancy (how to deal with mortgages, loans, credits, etc.). Even though the level of implementing individual trainings recorded a slight increase by 1 % on average in the monitored period, the overall achieved state is considered to be considerably insufficient (see Figure 2). The fact that only less than 2 % of the interviewed institutions focused on the education of the dismissed employees comprehensively is also among the negative outcomes.



**Figure 2: Level of implementing individual trainings during outplacement (source: own research)**

The research also indicated that the organisations primarily executed dismissals on their own and used external organisations in a small extent. The education of the managers conducting dismissal interviews was not focused on either, however 3 % of the organisations indicated that such education, or support for managers, was ensured if requested by them.

## DISCUSSION

There are several reasons why organisations should focus on the comprehensive dismissal process from the perspective of the future. They include the fact that a currently unneeded employee becomes a desired employee again (the organisation goes through the recession, implementation of a new similar production in the future, etc.), whom the organisation

has already verified, who knows company values and is identified with them and behaves according to them (Stachová, Stacho, 2013). The second reason is that the dismissed, respectively voluntarily leaving employee can become a work partner or customer immediately or after some time. Successful dismissal process makes the dismissed employee maintain a positive relationship to the company (Marzucco, Hansez, 2016). The third reason is that dismissals primarily evoke a negative state of the organisation to all stakeholders, although dismissing is frequently related to the implementation of new modern technologies or the organisation's recovery (Stacho, Stachová, 2015).

When comparing dismissal process comprehensiveness in Slovak organisations and organisations operating in more developed countries, it can be assumed that we are at the beginning of its gradual implementation, as only 6.2 % of the organisations deal with this process. It is similar in the Czech Republic, where only 10 % of organisations deal with outplacement, as indicated by the research of Urbancová, who analysed more than 100 companies (Urbancová 2014). The countries of Western Europe achieve much better results, e.g. according to a research conducted by Alewell Pull on a sample of over 1,000 German organisations in Germany in 2009, 40 % of them performed activities associated with outplacement. Up to 70 % of organisations operating in the United States of America focus on this process. In order to improve this state, it is necessary not only to appeal to businesses but also to introduce some obligations in the Labour Code, and not to rely on the social responsibility of organisations. This process is frequently difficult to implement, as it is financially burdensome. In 2001, Association of Career Consulting Firms Int was analysing the costs of the global volume of outplacement services and discovered that USD 1.5 billion out of the overall USD 2.5 billion was invested in outplacement by the organisations operating in the United States of America, which was 50 % more than money invested in it by all European countries (Stýblo, 2005) (Table 3).

<b>Monitored countries</b>	<b>Volume of outplacement services in USD</b>
<b>United States of America</b>	USD 1.5 billion
<b>Europe</b>	USD 600 billion
<b>Rest of the world</b>	USD 400 billion
<b>Total</b>	<b>USD 2.5 billion</b>

**Table 3: Volume of outplacement services in USD in 2001 (source: Stýblo 2005)**

## **CONCLUSION**

It is necessary to realise in the context of dismissal that as a part of the life of every organisation, it cannot be avoided, and it does not have to be viewed only negatively. It is frequently a part of the organisation's modernisation and revitalisation, which affects the life of the organisation positively and has an important place in its life cycle. Handled and unhandled dismissal processes and the impact of dismissals on the organisation's stakeholders need to be discussed in the given relation. The article points to insufficient focus of Slovak organisations on targeted employee education in the dismissal process. The rate of the use of individual trainings during outplacement increased in the monitored period (from original 4.8 % of organisations in 2013 to 5.8 % in 2016 for trainings focused on social and legal responsibilities, and from 1.8 % in 2013 to 3.1 % in 2016 for financial consultancy, however the increase for trainings focused on job searching was from original 4.5 % to only 4.8 % in 2016). The need of education of not only the dismissed employees but also the managers informing the employees on dismissals and the remaining employees is underlined. The lack of adequate support of employees results

in deteriorated relationships with all the organisation's stakeholders and lost status of a socially responsible institution. Further research can deal with identifying the reasons of the low levels of focus of organisations on employee education in the dismissal process.

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# FACTORS AFFECTING THE MOTIVATION OF STUDENTS AND THEIR IMPACT ON ACADEMIC PERFORMANCE

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## ABSTRACT

The paper deals with the motivation of students in the learning process because students' inner motivation for education is declining and thus decreases their academic results. The sample included students of the first and second level of study at the Faculty of Materials Science and Technology (MTF), Slovak University of Technology (the number of students was 132). To analyse the current state of motivation, the authors have used a standardized psychodiagnostic questionnaire D-M-V (D – Questionnaire, M – Motivation, V – Performance) and a reliable Motivational factors questionnaire customized by the authors. The obtained data were evaluated in the statistical program SPSS IBM along with descriptive statistical analysis in MS Excel and through their evaluation, the authors have found significant differences and relations between selected variables.

## KEYWORDS

Correlation, Influencing Factors, Motivation Towards Students' Performance, Students

## INTRODUCTION

Nowadays, it is very important to examine the motivation in the work sphere as well as in the educational sphere. „Creating motivational programmes is a difficult and expensive activity for any organization” (Lorincova, et al., 2016). “Motivation to study and work is quite variable process, to which should be constantly paid a high attention. The term “motivation” originates from the Latin word “movere” i.e. to move, and it is a hidden activity of internal driving force in the human psyche for his/her action. The inner stimulus is the motive, which can be expressed as a rational impulse making the human behaviour psychologically meaningful; therefore, it is the cause of a human behaviour.” (Rosicka, Hoskova-Mayerova, 2014). “Motivation is one of the most important issues in education that can significantly support efficiency of educational process.” (Krejčova, Berkova, 2016). Motivation has a dominant position in the educational process in educational establishments (Kováčová, 1992). As the above mentioned authors declare, the authors of the paper consider student motivation as an important process in order to ensure effective learning too.

Basic classification of motivation: “Motivation resources and problems determine students' internal, external, and negative motivation.” (Yardimci, et al., 2017) Internal motivation – deals with the fact that the student learns because he or she is interested in a topic, issue, and other activities. Student works actively and independently without pay pledges or guaranteed

praise or a threat of penalty. External motivation - Students learn primarily because they want to get some external reward or in order to avoid punishment for failure in performing the task.” (Hayes, 2003).

„The aim of education is to improve and enhance the knowledge, skills and abilities“ (Samakova and Sujanova, 2013). Education has to be a purposeful process, which is based on a certain structure. “Education needs to be permanent, reflects all current needs resulting from the reality of changes” (Stachova; Stacho, 2015). Involving students in academic activities affects their motivation for study too. Through academic activities students acquire skills. They use the skills during their studies, as well as after graduation and during participation in work life. “It is possible that being involved in academic-oriented activities, given their similarities to classroom activities, affects both activity-based and school-based motivation, therefore explaining the generalization effects.” (Denault, Guay, 2017). “Properly set educational goals enable to management to concentrate on educational activities in such a way as to reflect current and future needs of the organization” (Babeřová et al, 2010). “Identified key factors can also become evaluating indicators of education quality within the internal or external system of quality management on universities” (Fiřa, 2014).

The aim of this paper is to identify and analyse the factors that influence the motivation of students in the educational process and the impact of identified factors on the results of the academic subjects (Mathematics I. and Operational analysis).

## **MATERIALS AND METHODS**

### **Pre-research factors affecting motivation of students**

*The aim of pre-research* was to identify the set of factors that most influence the motivation of students before the exam and during the exam itself. The authors of the paper further identified the factors used in the actual research.

*The research sample* consisted of students of the second year (2nd year Bachelor’s degree studies). The sample group of students was selected from the study programmes Industrial Management (PMA) and Personal Work in an Industrial Enterprise (PPP).

#### *Data collection tool*

The customized questionnaire of the motivational factors consists of factors that can influence the performance of students prior to or during the actual exam (pre-research model questionnaire is included in Appendix A).

### **The research of students’ motivation and academic achievements**

*The aim of the research* was to analyse factors influencing the motivation of students in the educational process and to find out the impact of identified factors on the academic results of chosen subjects (Mathematics I. and Operational analysis).

#### *Research question (RQ)*

**RQ 1:** What score the examining respondents - students reach in the individual items of D-M-V performance motivation questionnaire?

**RQ 2:** Are there differences in items measured by D-M-V questionnaire between students in the first and fourth year and are these differences statistically significant?

### *Hypotheses (H)*

**H1:** There is a statistically significant correlation between the measured score of the height/number of transmitted points factor - continuous evaluation and student success in passing examinations in selected subjects.

**H2:** There is a statistically significant relationship between the high scores measured in the item PM (MV) - Performance motivation from the D-M-V questionnaire and composite scores of all factors that can influence students' performance.

*The research sample* was composed of students of the Faculty of Materials Science and Technology in Trnava, Slovak University of Technology in Bratislava. For greater representativeness of the sample the authors of the paper decided to carry out the research among the first grade university students (1st year Bachelor's degree studies) and the fourth grade university students (1st year of the Engineer's degree).

### *Data collection tools*

The questionnaire of motivation performance D-M-V was published in 1984. The questionnaire contains three scales - scale of MV (MV - Performance Motivation), which is understood as one of the essential parts of achievement motivation by the authors, followed by a scale of AB (AB - Anxiety lowering the power) and a scale of AP (AP - Anxiety supporting the power). The first entry of the questionnaire is used for instruction only and it is not evaluated. Furthermore, the questionnaire contains fifty-two factors that are evaluated on a 6 point scale: it does not apply for me at all, it does apply seldom for me, it never applies for me, it often applies for me, it mostly applies for me, it entirely applies for me (Pardel Maršálová, Hrabovský, 1984).

The questionnaire research consists of factors affecting students' motivation before and during the exam writing, which were identified in the pre-research. Furthermore it consists of general questions and questions which discuss the achievement of the students for the selected subjects (Mathematics I and Operational analysis) and their satisfaction with the results achieved on the subject.

### *Pre-research and research methods*

To evaluate the collected data, the authors have used several methods: firstly, descriptive and quantitative statistical methods (histograms of frequencies, pie charts and additional analysis in table form). Secondly, the authors have used parametric and non-parametric exams - **correlation** Pearson exam ( $r$ ), Spearman's range exam ( $r_s$ ), Student's t-exam, Kolmogor-Smirn's exam, Cronbach's  $\alpha$  and Cohen's  $d$ .

## **RESULTS AND DISCUSSION**

The results of the pre-research and research itself are listed in the following section. The research questions are evaluated based on the results.

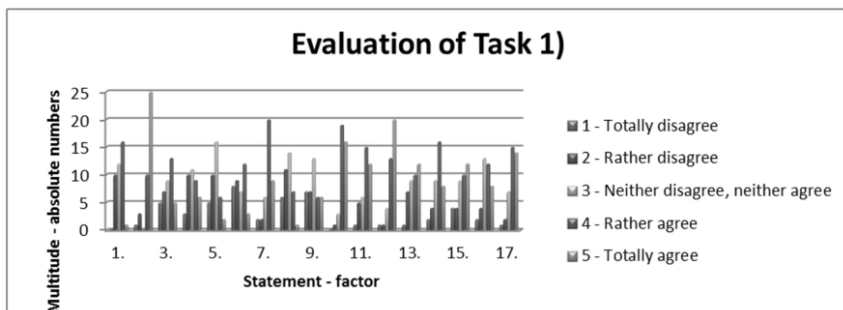
### **The results of the pre-research – factors affecting motivation of students**

The pre-research was carried out from December 2014 to January 2015. The authors have distributed 40 questionnaires within the pre-research, 39 returned answered. The success rate of the questionnaire survey was 97,50%.

The collected questionnaires were evaluated based on the multiplicity of the students answers. The authors have also executed the reliability of the survey, which has reached

the level of **Cronbach coefficient**  $\alpha = 0.732$ , that is sufficient enough for the scientific purposes.

The multiplicity of the students answer from the task 1) can be seen in absolute numbers in Fig. 1 and it provides an idea about which of the listed factors affect the students the most and the least.



**Figure 1: Factors affecting performance before and during the exam (source: own elaboration)**

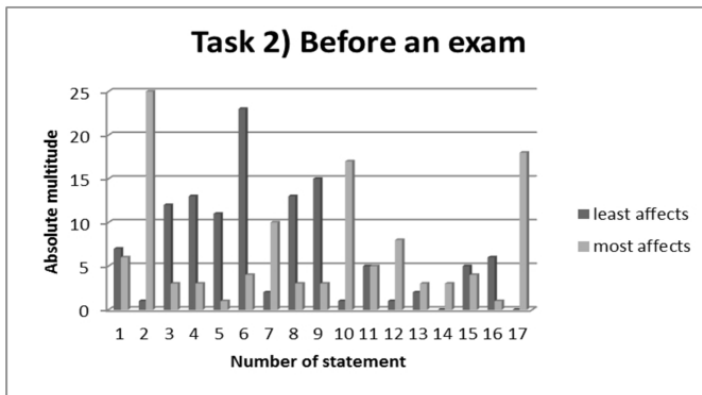
From Fig. 1 the authors have evaluated values from the fourth column for each item, which belongs to the answer rather agree and the values from the first column for each item, which belongs to the answer totally agree. Based on the sum of these two values the authors have created the order of seven factors which affect the students the most according to their subjective selection. They are factors 2, 10, 12, 7, 17, 11 and 14. In the final research questionnaire the authors have merged factors 11 and 12 into one answer. The sum of multiplicity of answers 4 (rather agree) and 5 (totally agree) in absolute numbers can be seen in tab. 1.

The sum of the frequency of the most common answers – rather agree and totally agree							
Factor number	2	10	12	7	17	11	14
Absolute sum of answers	35	35	33	29	29	27	24

**Table 1: Sum of answers 4 + 5 from task 1 (source: own elaboration)**

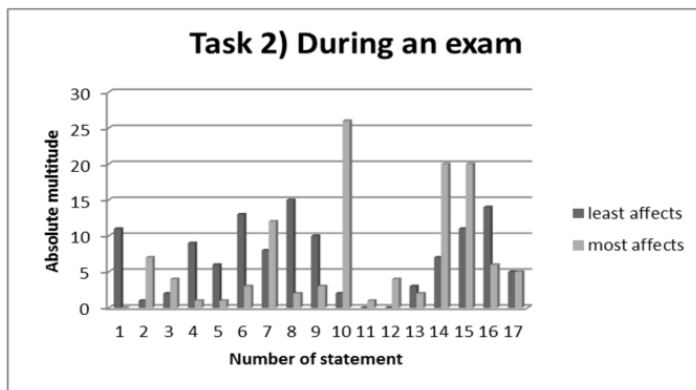
In task 2) of the pre-research questionnaire, the authors selected factors which have been distributed into two groups: a group of factors that influence the students the most and the least prior to the exam and a group of factors which influence them the most or the least during the exam. Fig. 2 shows the results for all seventeen factors, which influence students prior to the exam. According to the answers, the students are influenced the least by these four most frequented factors – 6, 9, (8 and 4) and 3. On the other hand, they are influenced the most by the factors no. 2, 17, 10 a 7.





**Figure 2: Factors affecting the students prior to exam (source: own elaboration)**

In Fig. 3 the authors can see the results for all seventeen factors which influence the students during the exam. The answers show that students are influenced the least by following the most frequented factors no. 8, 16, 6, (1 and 5) and 3 and on the other hand they are influenced the most by factors no. 10, (14 and 15) and 7.



**Figure 3: Factors which affect the students during exam (source: own elaboration)**

The pre-research has given to the authors of the paper the final set of factors – motivators which motivate students to achieve better results at exams. The set of factors has been used for the evaluation of the research hypotheses. Based on the results of pre-research, the authors have identified six most important factors that affect students before and during an exam, these factors are: height / number of transferred points – mid-term evaluation of the student, the time of the exam (weekday, morning hours, afternoon hours, evening hours), exam type (test, open questions, exercises, oral exam) and the way of executing exercise sessions during semester (approach and expertise of the teacher, proceeding, type), the atmosphere at the actual exam (relaxed, tense) and the clarity and accessibility of study materials (lectures in academic information system, scripts).

## The results of the research of students' motivation and academic achievement

The research was conducted from January 2015 to March 2015. The addressed sample of respondents was selected through non-probability quota sampling. A total of 100 questionnaires were distributed, of which 93 were returned. This number refers to the 93% success rate of the questionnaire survey. Quota sampling was based on ensuring the same or similar distribution of a single characteristic within the group. The characteristic represented the number of students of both surveyed grades (first and fourth grades), where 50 and 50 questionnaires were distributed to each group of students.

**RQ 1:** What score the examining respondents - students reach in the individual items of D-M-V performance motivation questionnaire?

**RQ 2:** Are there differences in items measured by D-M-V questionnaire between students in the first and fourth year and are these differences statistically significant?

The first research question expects the answer concerning to the composition of the frequency of respondents that were classified into three groups according to score achieved (high, medium and low) in the D-M-V questionnaire. Tab. 2 shows the overall frequency of respondents by the assigned score.

DMV – measured values $\Sigma$			
Scale / Score	High	Average	Low
scale MV	35	57	1
scale AB	6	65	22
scale AP	4	65	24

**Table 2: The absolute multitude of the gross score of D-M-V questionnaire (source: own elaboration)**

In Tab. 2 the authors consider the absolute frequency by gross score achieved by freshmen and fourth graders together in all scales of D-M-V questionnaire. Evaluation of Tab. 2 is converted to relative frequencies. In the M-V performance motivation scale, it was found that high score achieves a total of 38% of respondents, medium score achieves 61% of respondents, and low score achieves only a negligible number of students (1% of respondents). The authors of the paper view positively that the analysed students have a sufficient degree of motivation in terms of high and medium score for the MV item. This fact explains the stamina at work and orientation towards the future. From additional analysis where the population has been divided to students in the first and the fourth grade, it is evident that the first graders have much higher scores in the MV scale, than fourth graders, which means the first graders are more motivated. Within AB scale – performance-slowness anxiety, the authors of the paper recorded the following values: high score achieves 6% of respondents, medium score 70% of respondents and low score is achieved by 24% of respondents. Students at AB scale do not reach high scores, which indicates that increased load does not motivate students. The last scale is AP – performance-supporting anxiety. The following values were found in the given scale: high score achieves 4% of respondents, medium score 70% of respondents and low score achieves 26% of respondents. The authors of the paper view positively that the analysed students achieve medium and low scores at the AP item that supports performance at recalled activity.

The second research question identifies whether there are significant statistical differences in the measured values at the scales of D-M-V questionnaire among students in the first and fourth year. All parameters follow normal distribution of data in the population, which can be seen in tab. 3 which shows the results of the Kolmogorov-Smirnov test for normality for D-M-V scales.

Scale D-M-V	Year	Kolmogorov-Smirnov test		
		Statistic	df	Sig.
Scale MV	First year	.122	48	<b>.072</b>
	Fourth year	.068	45	<b>.200*</b>
Scale AB	First year	.097	48	<b>.200*</b>
	Fourth year	.117	45	<b>.146</b>
Scale AP	First year	.079	48	<b>.200*</b>
	Fourth year	.129	45	<b>.056</b>

**Table 3: Kolmogor-Smirn test for scales D-M-V (source: own elaboration)**

All scales indicate the normal distribution of data in the population, so the authors can proceed to the parametric Student's t-test for two independent samples.

Item of D-M-V questionnaire		Levente test for equality of dispersion		Student t-test		
		F	Sig.	t	df	Sig. 2
Scale MV	Expects the same deviations	.103	.748	<b>-.356</b>	91	<b>.723</b>
	Does not expects the same deviations	-	-	-356	90.892	.723
Scale AB	Expects the same deviations	1.639	.204	<b>2.057</b>	91	<b>.043</b>
	Does not expects the same deviations	-	-	2.076	86.785	.041
Scale AP	Expects the same deviations	.119	.731	<b>-.009</b>	91	<b>.993</b>
	Does not expects the same deviations	-	-	-0.009	90.848	.993

**Table 4: Student t-test of differences between first year students and fourth year students D-M-V (source: own elaboration)**

Results of Student's t test for two independent selections (see Tab. 4) show a statistically significant difference between the groups of first and fourth graders in D-M.V AB subscale - ( $t = 2.057$ ,  $sig. = 0.043$ ). The value of practical significance estimated by Cohen's  $d$  parameter is  $d = 0.431$ , which can be considered a low effect size (Soukup, 2013). For subscales D-M-V MV ( $t = -0.356$ ,  $sig. = 0.723$ ) and D-M-V AP ( $t = -0.009$ ,  $sig. = 0.993$ ) there were no visible significant differences between the groups.

To evaluate the various correlations, the authors of the paper started parametric Pearson's correlation test ( $r$ ) and non-parametric correlation test, Spearman test ( $r_s$ ).

**H1:** There is a statistically significant correlation between the measured score of the height/number of transmitted points factor - continuous evaluation and student success in passing examinations in selected subjects.

Spearman correlation test result shows that there is a statistically significant relationship between the measured score of "mid-term evaluation of student" factor and successful completion of selected exam of Mathematics I and Operational analysis. The variable

correlates at sig. = 0.05 with value of Spearman correlation coefficient  $r_s = 0.356$ . The significance value reached the required level (sig. < 0.05), therefore the authors of the paper do not reject this hypothesis and it can be confirmed that there is a weak correlation between the monitored variables.

**H2:** There is a statistically significant relationship between the high scores measured in the item MV - Performance motivation from the D-M-V questionnaire and composite scores of all factors that can influence students' performance.

Pearson correlation test result shows that there is a statistically significant relationship between the high scores measured in MV – performance motivation and composite score in all factors. The variable correlates at sig. = 0.05 with value of Pearson correlation coefficients  $r = 0.496$ . The value of significance reached required level (sig. < 0.05), therefore the authors of the paper do not reject this hypothesis and it can be confirmed that there is a moderate relationship between the monitored variables.

## **CONCLUSION**

Based on the results of pre-research, the authors have identified six most important factors that affect students before and during an exam, these factors are: height / number of transferred points – mid-term evaluation of the student, the time of the exam (weekday, morning hours, afternoon hours, evening hours), exam type (test, open questions, exercises, oral exam) and the way of executing exercise sessions during semester (approach and expertise of the teacher, proceeding, type), the atmosphere at the actual exam (relaxed, tense) and the clarity and accessibility of study materials (lectures in academic information system, scripts). The authors of the paper used the aforementioned factors in the implementation of the actual research work. The results of the standardized D-M-V questionnaire brought us a picture of the current status of each scale of the questionnaire which are AP, AB and MV. The results show that the students in the first and fourth year of the MTF do not reach statistically significant differences in the achievement scores of MV and AP. On the contrary, the item AB - performance-slowness anxiety showed a statistically significant difference between the group of first graders and the group of fourth graders. Test results have shown that students achieve desired high and medium scores at MV item and required medium and low scores on items AB and AP. These facts confirm the good condition of internal and external motivation of students. After the evaluation of research hypotheses, the authors have found that there is a significant relationship between selected factors height/number of transferred points – mid-term student evaluation and success in passing examinations in selected subjects (Mathematics I and Operational Analysis). The final result obtained is the finding of a significant relationship between MV item of D-M-V questionnaire and composite scores of all identified factors. Overall, the authors of the paper assess students' motivation at MTF as sufficient. In the future the authors of the paper plan to expand this research by the analysis of the factors affecting the motivation of MTF graduates and make a comparison of the results.

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## APPENDIX A) QUESTIONNAIRE – PRE-RESEARCH

Totally disagree	Rather disagree	Neither disagree, neither agree	Rather agree	Totally agree
1	2	3	4	5

**TASK 1:** Slowly and carefully read (the following 17 statements). The statements describe the factors that may affect the performance of students before or during an exam. After reading, please indicate according to the scale shown above, how the factors can affect your performance before or during an exam (For example, if you mark statement 7 with number 2, it means: “I rather disagree, that *the time of the exam* affects my performance before or during the exam).

Number of exam dates in AiS (total number of exam dates for the exam period),	
the amount / number of transmitted points - continuous evaluation,	
I know the examiner, I have made another test with him / her,	
the capacity of exam date (a large number of students at exam),	
the capacity of exam date (a small number of students at exam),	
location of the exam (building, room),	
the time of the test (morning, afternoon, evening hours),	
the number of credits that are connected with a given subject,	
the success rate of the subject shown in AiS of prior periods,	
examination form (written exam, open questions, examples, oral exam),	
the way seminars were taught during the semester (process, form),	
approach of the educator during seminars (experts, appreciates students as colleagues),	
approach of the educator during seminars (non-expert in the field he/she teaches)	
atmosphere during the exam (relaxed, tense)	
the number of people on supervision during the exam (examiner, lecturer, PhD students),	
feedback of the exam (the possibility to consult irregularities),	
clarity and accessibility of study materials (lectures in AiS, scripts).	

**TASK 2:** Now, regardless of previous assessment statements, please write into the tables below the **number of three statements** (factors) that in your option affect you **the most** and affect you **the least** before and during **the exam**. Please type the chosen answers into the following tables.

Statements (factors) that affect you <b>before the exam</b> .	
3 statements that affect you <b>the least</b> .	3 statements that affect you <b>the most</b> .

Statements (factors) that affect you <b>during the exam</b> .	
3 statements that affect you <b>the least</b> .	3 statements that affect you <b>the most</b> .

**TASK 3:** In case you have other statements (factors) that affect you and your performance before and during the exam, write them on the other side of the paper (please write a maximum of 3 additional statements, but bear in mind that it/they should not be mentioned in the table above.

## APPENDIX B) RESEARCH QUESTIONNAIRE

Totally disagree	Rather disagree	Neither disagree, neither agree	Rather agree	Totally agree
1	2	3	4	5

**TASK 1:** Slowly and carefully read (the following 6 statements). The statements describe the factors that may affect the performance of students before or during the exam. After reading, please indicate according to the scale shown above, how the factors can affect your performance before or during the exam

1.	the amount / number of transmitted points - continuous evaluation,	
2.	the time of the test (morning, afternoon, evening hours),	
3.	examination form (written exam, open questions, examples, oral exam),	
4.	the way seminars were taught during the semester (process, form),	
5.	atmosphere during the exam (relaxed, tense),	
6.	clarity and accessibility of study materials (lectures in AiS, scripts).	

**TASK 2:** Fill the following questions with respect to distributor's instruction:

1. With respect to distributor's instruction answer the question:

I passed the exam	I did not pass the exam.
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2. My grade was:

A	B	C	D	E	FX
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3. Given the particular subject I passed the exam or I did not pass the exam on the:

First try – the proper term	Second try – resit	Third try – resit	I did not pass the exam.
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4. How are you satisfied with the exam results? Mark the specified range:

1	2	3	4	5
I am totally dissatisfied	I am partially dissatisfied	I am not satisfied, I am not even dissatisfied	I am partially satisfied.	I am totally satisfied



# SUCCESS OF STUDY REGARDING THE ADMISSION PROCEDURE OUTCOMES: CASE OF THE FEM CULS PRAGUE

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## ABSTRACT

The aim of the admission procedure should be an objective assessment of knowledge and especially of the capability for study both in candidates for the Bachelor's degree and in candidates for the Master's degree. The admission procedure outcomes should not only assess the candidates' knowledge but they should predict with sufficient reliability the academic success of study in the field given, at the same time. The presented paper offers research results as it concerns this issue at the Faculty of Economics and Management, Czech University of Life Sciences Prague.

## KEYWORDS

Admission Procedure, Academic Success, Bachelor's Degree, Master's Degree, Field of Study, Statistical Analyses

## INTRODUCTION

Universities represent the highest level of the education system. They are the top centres of scholarship, independent knowledge and creative activities. They offer and develop University education and contribute this way to the development and exploitation of scientific knowledge. A key position in the scientific, cultural, social and economic development is thus played by education, the fundamental mission of which is preparation of high quality professionals for practice. In this sense, universities as the top centres of scholarship, independent knowledge and creative activities have an irrecoverable role.

The non-negligible factor in this sense is the admission and selection of study applicants. The admission procedure conditions differ between separate Universities, faculties or study branches. A number of Universities have started admitting students without admission exams recently, some Universities have replaced admission exams of the vocational subjects by a test of general study aptitude, some accept the results of national comparative examinations. Anyway, most of the traditional Universities keep to the classical admission procedure with their own vocational subject tests.

The conclusion that a candidate with the best preconditions for study at the given University, faculty or study branch has been selected, is available when analyzing his/her University study success, where the outcome of his/her admission results is one of the factors considered.

Most of the research outcomes published assess the candidates' knowledge level at the admission procedure. Klůfa (2013, 2015) pays attention in his works to the comparison of mathematics tests results and, furthermore, comparison of mathematics tests varieties Klůfa (2016). A similar issue has been solved by Brožová, Rydval (2013), Hrubý (2013), Kohanová (2012). Relations between the admission procedure outcomes and the University study success have been dealt with by Kučera, Svatošová, Pelikán (2015).

Here, the impact of admission procedure outcomes upon the first University study year has been examined. The research by Svatošová, Poláčková (2014) concentrated on an analysis of the level of findings, at which the University study success can be predicted based upon the admission procedure outcomes.

Members of the 3<sup>rd</sup> Faculty of Medicine, Charles University, Prague, Höschl (1997), Kožený (1994, 1995, 1996, 2001), dealt with vetting not only knowledge but the study capability, too. The candidates' knowledge was tested here using written tests on the vocational subjects, the study capability then by a verbal interview. The results were subject to a very detailed statistical assessment. The team dealt at the same time with the relations between separate parts of the admission exam and the academic study success at the Faculty, where the impact of admission exam outcomes upon the overall study success rate was clearly demonstrated. Rubešová (2009) has proved in her works that success of study at the Faculty of Natural Sciences, Charles University has a clear connection with both the admission procedure outcomes and the previous secondary school benefit. Zvára, Anděl (2001) performed an assessment of study success at the Faculty of Mathematics and Physics, Charles University, over 1993-1997, regarding the form and outcome of admission exam. Here, too, was the influence of admission procedure proved. The SCIO Ltd., Hučín (2011) offer study success prediction at the Faculty of National Economy, University of Economics, Prague, as based on the OSP test.

Kubanová, Linda (2012, 2013) have paid attention especially to the correlation between the study presumptions test results and the University study results. The study success issue as related to various didactic techniques and ways of teaching has been dealt with by many authors. Especially the study results in the distance learning have been examined here, e.g., Jarkovská et al. (2011), or, the new approaches implementation in teaching, Houška, Beránková (2011).

The Department of Statistics team, Faculty of Economics and Management, Czech University of Life Sciences Prague (FEM CULS Prague), have been dealing with the issue of admission procedure outcomes since 1978 – Macháček et al., (1978). At the first stages the research was concentrated at admission exams only and the format of these, later then attention was concentrated at the academic study success and its connection with admission exam results - Svatošová (2000).

The paper is based on long-term analyses of the relationships between the admission procedure and the academic success of study at the FEM CULS and it is aimed at assessing the relationship between admission exam results and the University study results. Taking into account that the Faculty is preparing own tests aimed at covering the study presumptions just for FEM CULS, the analyses have concentrated at two fundamental problem's solution:

1. How strong is the impact of admission exam results upon the University study success, both at the Bachelor's study level and the Master's level especially.
2. The assessment of the vocational subjects' admission exam reporting ability within the particular Master's study branches.

## **MATERIAL AND METHODS**

The admission procedure outcomes and the 2016 Bachelor's and Master's graduates study results have been included in the analyses. The random sample of Bachelor's study graduates contained 200 graduates of the study branches taught in Czech language – Economics and Management (EM), Business Administration (BA), Informatics (INFO),

Public Administration and Regional Development (PARD) and Economic and Cultural Studies (ECS).

As concerns the Master's study graduates, samples of graduates have been employed of the Business Administration (BAM) – 125 graduates, Economics and Management (EMM) – 140 graduates, Administration and Regional Development (PARDM) – 73 graduates, Economic and Cultural Studies (ECSM) – 37 graduates and Informatics (INFOM) – 38 graduates.

The recent analyses have dealt with the Bachelor's study level admission procedure at the FEM CULS. The admission exam subjects here are unified for all the study programmes. Mathematics and Foreign Language are examined and the extent of knowledge at secondary school level is expected. The analyses have proved a significant relationship between the admission procedure outcomes and study results over the first study year especially.

Current research has been concentrated at the assessment of admission exam results and study success in the Master's study programmes. Here, the admission exam subjects already differ according to separate study programmes. Candidates undergo the Economy and Management examination in all the study programmes and then the second exam subject is aimed at the knowledge expected for study of the programme given:

<b>Programme (language(s))</b>	<b>Subject 1</b>	<b>Subject 2</b>
Business Administration (CZ, EN) - BAM	Economics and Management	Fundamentals of Entrepreneurship
Public Administration and Regional Development (CZ) -PARDM	Economics and Management	Humanities sciences
Economic and Cultural Studies(CZ) - ECSM	Economics and Management	Humanities sciences
System Engineering (CZ)	Economics and Management	Quantitative Methods
Project Management (CZ)	Economics and Management	Quantitative Methods
Economics and Management (CZ, EN) - EMM	Economics and Management	Quantitative Methods
European Agrarian Diplomacy (EN)	Economics and Management	Social sciences
Informatics (CZ, EN) - INFOM	Economics and Management	Information Technologies

**Table 1: The Admission Exam subjects in Master's study programs**

Hence, while general knowledge is requested for the Bachelor's study level, for the Master's level a basic knowledge is requested for study in the study programme given. The admission procedure outcomes then should predict the academic success better.

Regression and correlation analysis methods have been applied here, from the statistical methods. The relationship between study results and admission exam results has been assessed using the Spearman rank correlation coefficient (Kendall, Stuart 1969) the impact level of admission procedure upon study success has been analysed using the multivariate regression model and the principal component analysis (Timm 2002).

Programme	Number of students	Admission test results (number of points)		The study results (average grade)****
		Subject 1	Subject 2	
Bachelor's (all programmes)	200	25.2*	32.0**	2.09
Master's		***		
BAM	126	34.9	32.5	2.12
PARDM	73	31.7	30.4	1.88
ECSM	37	29.8	35.0	2.28
EMM	140	33.1	26.9	2.11
INFOM	38	26.8	27.8	1.99

\* Mathematics, \*\* Foreign Language, \*\*\*Economics and Management, \*\*\*\* 1.00... the best; 3.00... the worst

**Table 2: Basic characteristics of analysed files**

## RESULTS

The basic question to which this study is looking for an answer is the question up to what extent the study success at FEM CULS can be predicted based on the admission procedure outcomes. Necessary analyses have been performed both at the Bachelor's and the Master's study levels.

At the Bachelor's level, on the sample of the 2016 year graduates the relationship between admission procedure outcomes and the FEM study results has been assessed using correlation analysis. As given above, at the Bachelor's level, exams in Mathematics and Foreign Language are performed in all the study branches (programs). Here the relationship between admission exam results and the average grades at the Bachelor's level over all the study branches has been examined first. Considering the nature of data, the Spearman rank correlation coefficient has been applied in order to establish the power of relationship.

	Spearman correlation coefficient		
	Total	Mathematics	Foreign Language
Graduates total	-0.386	-0.347	-0.332

**Table 3: Spearman correlation coefficient values assessing the power of relationship between admission exam results and the average grades at the Bachelor's study level at FEM CULS**

Based on the figures above it can be stated that, the relationship between the overall study results at the FEM CULS Bachelor's level and the admission exam results is not negligible. The results are significant at  $\alpha=0.05$  significance level. Impact of the Maths admission exam over the total sample looks stronger.

However, when grouping by study branches passed is done, then it becomes obvious that, the Maths admission exam impact is reflected more strongly on those study branches, where quantitative data operations are more frequent, (INFO, SE, EM), while in the branches based more on the humanities (ECS, PARD) the overall study results seem more affected by the Foreign Language admission exam results. Regarding that, the relationship between the number of points in the admission exam and the average gain at the University is being measured, the correlation coefficient values are negative, since the relationship is negative.

Programme	Spearman correlation coefficient		
	Total	Mathematics	Foreign Language
EM	-0.324	<b>-0.262</b>	-0.231
BA	-0.326	-0.192	<b>-0.325</b>
INFO	-0.598	<b>-0.554</b>	-0.469
SE	-0.521	<b>-0.461</b>	-0.378
PARD	-0.315	-0.142	<b>-0.268</b>
ECS	-0.391	-0.158	<b>-0.397</b>

**Table 4: Spearman correlation coefficient values assessing the power of relationship between admission exam results and the average grades by the study branches at the Bachelor's study level at FEM CULS**

The admission exam results, the study results by separate study years and the State final examination results have then been analysed using the principal component analysis. The admission procedure effect reflected itself in the third component which explained 11.5 % of the total variance.

For the following Master's degree study analysis again the sample of 2016 graduates in study branches EM, BA, INFO, PARD and ECS has been used. Here there is a compulsory examination of Economics and Management for every study branch and the second exam subject is aimed at verifying the knowledge required for study of the given program. To find the answer up to what extent the study success in the given program can be predicted based on the admission exam results, first the simple correlation analysis has been used for the assessment of power of the relationship between admission exam results and the average results in Master's study following, and then the multiple stepwise regression model has been applied.

Here, additional variables have been included, presenting the study results and the State final examination results. The main task here was to find which variables have the crucial importance in the model given. Then, similar as in the Bachelor's case, the multivariate method – principal component analysis has been applied, in order to assess the impact and position of admission procedures in the model.

Study branches	Spearman correlation coefficient	
	Economics and Management	2 <sup>nd</sup> subject
EMM	<b>-0.256</b>	-0.169
BAM	-0.237	<b>-0.276</b>
INFOM	-0.437	<b>-0.489</b>
PARDM	<b>-0.548</b>	-0.346
ECSM	-0.104	-0.112

**Table 5: Spearman correlation coefficient values assessing the power of relationship between admission exam results and the average grades by the study branches at the Master's study level following at FEM CULS**

As it is seen in the Table 5, the admission procedure results have the greatest impact upon the study results at the Master's study level following, in the PARDM and INFOM study branches. A weaker but not negligible relationship there is in the EMM and BAM branches. In the ECSM study branch the relationship is very weak. Considering the admission exam subjects, then a stronger role has the Economics and Management exam in the EMM and PARDM branches (logical background in the EMM case), while in the BAM and INFOM branches a stronger role is played by the special subject exam connected to the branch.

Using a multiple regression model we have examined which variables apply a significant impact upon the result (the average marks in the Master's study following) and which variables can be excluded from the model, on the other hand, since they offer a tiny (insignificant) information only. A reduction of the variables followed in all the models but in the ECSM model only, the admission exam results, too, were excluded, as the variable offering a little information. As to the remaining study branches, these were always considered, being one of the most important variables of the model. Similar as in the simple correlation analyses, in the EMM and PARDM branches the crucial information has been offered by the Economics and Management examination, while in case of the INFOM and BAM branches this has been covered by the second special subject exam. The principal component analysis examined the position of admission exam results in the whole model. In all the cases, the admission exam results have proven to be offering an important information. The Table 6 brings summary results in brief. In all the principal component analysis models the total variance has been practically explained in 80 % by means of four components.

The strong correlation of admission exam results with the component given, which can then be reported the admission procedure component, is presented in the last two columns of the table.

Study branches	Total variance explanation share - %				Inclusion into component		
	Four comp's	Out of which comp. No.				Economics and Management	2 <sup>nd</sup> subject
		1.	2.	3.	4.		
EMM	78.6	38.5	14.8	14.0	11.3	2.	2.
BAM	78.6	40.3	17.4	11.4	9.5	2.	2.
INFOM	82.2	49.1	12.3	11.7	9.1	1.	1.
PARDM	79.4	42.4	16.2	11.4	9.3	1.	2.
ECSM	79.0	37.6	16.2	13.1	12.1	2.	4.

**Table 6: Principal component analysis results**

## DISCUSSION

Selection of suitable adepts for study of a specific study branch has to solve questions of selection criteria, what properties and capabilities are to be requested from the candidates, what ways of evaluation of the criteria chosen to adopt in order to select those candidates who not only have the best presumptions for study in general, but have presumptions for study at the Faculty or University of their choice. This is the condition for education of the best specialists for practice and the precondition to consolidate and maintain the University's prestige.

The analyses done have shown that, the admission exam results have an impact upon study success. As a more powerful has this impact shown itself as concerns the admission procedure for Master's study. Similar research findings can be seen with the authors cited above, too. (Zvára and Anděl, 2001) included the average gain at high school level in the analyses of the Master's programmes study success, and its impact proved itself, too.

On the other hand, study success analyses at Faculty of National Economy, University of Economics in Prague (Hučín, 2011), where the test of general study presumptions is being applied have shown that, the impact of admission exam results for the Bachelor's study manifested itself more markedly on the first study year only. The impact of general study presumptions test results was assessed at more Universities (Synek, Otrřisal, 2008). Here, too, correlation with the first study year results was confirmed. A more pronounced

impact was found at the faculties of natural sciences. Correlation of the general study presumptions test with the average gain over the whole study was not proved.

The study success prediction can be improved using the special test study presumptions in certain branch. This test has been applied on a long-term basis, e.g., at the 3rd Faculty of Medicine, Charles University, and the results of studies (Kožený et al., 1994, 1995, 1996, 2001) have been published. The test, where the capabilities for study of the programme given are tested, completes the tests of knowledge and uniting the two, the selection of candidates is becoming more efficient. The study presumptions test was applied at FEM CULS, too, over the 2000-2002 years, and the impact on the study results at the Faculty was proved, too.

The findings presented speak in favour of the Faculty's own admission exams with knowledge and skills requirements for the given field of study. Assessment of the University study results as related to admission exam results needs a long-term monitoring of the whole course of study. The current analyses have concentrated at study results monitoring using the format of averages by years of study and the State final examination results. The admission procedure's influence proved unambiguous especially in the Master's study, where admission exams in the subjects are prepared stressing the basic knowledge needed in study of the study branch given. Besides the analyses conceived this way, an analysis of unsuccessful study reasons and background have been considered for the future, where the admission procedure outcomes will be included, too.

## **CONCLUSION**

Conclusions of the analyses have confirmed the importance of admission procedures for the following study at the Faculty. It can be said, the admission procedures have been performed at a qualified level, and study success both in the Bachelor's and the following Master's study can be predicted based on the level of these.

A different extent of influence of the separate admission examination subjects at the separate Bachelor's study branches of the FEM CULS could bring changes of the admission procedures in future such that there could be tests of different levels of sophistication in the admission exam subjects for the different study branches.

Also in the Master's study following, the impact of the admission procedures outcomes upon study success has shown itself. Here, the attention has been paid especially to the question, how much the results of the second special subject of the admission exam can predict the study success in the study branch given.

A very strong impact has been shown for the INFO and BA branches, and for the EM branch, too, where Economics and Management is just assumed to be the principal special subject.

In the PARD branch case, the impact of Economics and Management has been found more significant, even when the impact of Humanity Science is not negligible, either. A slightly different situation is in the ECS branch. We can consider the candidates having different ideas of the study, even when having been informed of the nature of the study branch where the economy and management knowledge is a necessary condition of further study. This can bring troubles to them later when trying to rule the economic courses. At the same time a warning has been obtained from the analyses, that even the Humanity Science subject has not served a desirable information either. Here, apparently, some changes will be needed in the course contents.

All in all, it can be stated that, the current ways of admission procedures, when the Faculty themselves establish priorities in the prerequisites expected from the candidates

of admission to study the programme given, have their importance and the outcome of these really is the selection of candidates having the prerequisites.

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# EFFECTIVENESS AND EFFICIENCY OF TEACHING STATISTICAL SUBJECTS AT UNIVERSITIES

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## ABSTRACT

The aim of the paper is to assess the effectiveness and efficiency of learning the statistical subject at universities. Primary research held in November 2016 on subject *Time-series* at university in Prague questioned 115 students about the most effective learning method that leads them to achieve good results from the test. Students mostly marked individual explanation on tutoring or by classmate and solving exercises according to the teachers' explanation at seminars. But only the later mentioned helped them to achieve good results. Students from grammar school achieved more points than others. The outputs (points from the test) were compared with the inputs (hours of learning) using DEA. Average efficiency was 48.59% under constant and 59.86% under variable returns to scale. We recommend using practical methods of learning the *Time-series*. Individual explanation by tutor or classmate might be convenient, but practical solving of statistical exercises brings better results.

## KEYWORDS

Data Envelopment Analysis, Effectiveness, Efficiency, Learning, Time-series

## INTRODUCTION

Subjects related to the calculations such as *Mathematics*, *Statistics*, *Econometrics*, or *Time-series* are often problematic to learn by the students and hence not popular. Very often are the learning difficulties of the calculations rooted in the fact that they are taken by the most students without its reference to any reference in real world. Brahim et al. (2014: 3367) suggests that "to restore the meaning of calculation, the allocation of spatial place for students to a formal expression is needed." This requires certain didactic methods and teachers' skills. There are teaching methods suggested to teach effectively such subjects. For example Lupu (2014) states following eight principles that should be followed by the teachers in order to create conditions for the effective learning of pupils: (1) the principle of positive formative orientation of the maths lesson, (2) the principle of systematization of the maths lesson, (3) the principle of accessibility, (4) the principle of the optimal participation in the lesson, (5) the principle of interdependence between intuitive knowing and logical knowing, (6) the principle of interaction between theory and practice, (7) the principle of essential results (in assessing the class), and (8) the principle of permanent self-regulation of activities.

Ismail, Shahrill and Mundia (2015) examined the factors that contributed to effective *Mathematics* teaching in Brunei. They found out that the most important were the teachers themselves, whereas the school context or the school administration only seems to impact teaching effectiveness to a minimal extent. The success of learning the subject depends

of course on also depends on the students' ability to learn. Lai and Hwang (2016: 126) found "that the higher self-regulation students showed significantly different learning achievements when learning with different approaches, while there was no significant difference between lower self-regulation students with the different learning approaches." They suggest integrating the self-regulated strategy into learning as it can improve students' self-efficacy and their strategies of planning and using study time, and hence they can learn effectively and better. (Lai and Hwang, 2016).

The aim of the paper is to examine the effectiveness and efficiency of learning the subject *Time-series*. The methods used to assess the effectiveness and efficiency are introduced and then the data obtained from primary research are described. Next section presents and discuss the results. Final section concludes and gives recommendations.

## MATERIALS AND METHODS

The effectiveness was examined in terms to what extend the aims of the learning were achieved. Whether the learning methods achieve the set goals. There were several types of learning methods taken into consideration. The students were asked what is the best way how they learn the curriculum of the subject. As the *Time-series* subject requires calculation and computation skills, it was expected that the most effective method of learning will be independent calculations of exercises. On the other hand, passive types such as mere reading of the textbook or listening to the topic at seminars was expected to be less effective in learning *Time-series*.

Examined methods included: (1) independent analysis of solved exercises (e.g. from textbooks, lectures, seminars), (2) independent calculations of exercises, (3) solving exercises according to the teachers' explanation at seminars, (4) individual explanation on tutoring or by classmate, (5) independent reading of the textbook, (6) listening to the explanation of the curriculum at lecture, (7) listening to the explanation of the curriculum at seminar. Students can evaluate each method by certain number of points: "none" – I do not learn this way, 1 – I learn the best this way, I learn almost everything, 2 – I learn well this way, 3 – I learn poorly this way, 4 – I learn the worst this way, I learn almost nothing. We calculated average mark and suggest appropriate type of learning. The most convenient method was put to the relation with points from the test.

It was also expected that type of previous students' education could have influence their results in the test from subject *Time-series*. According to Shapiro-Wilk test the distribution of the points from the test among students was not normal. A non-parametric two-sample Wilcoxon rank-sum test was used to test the differences between groups. Null hypothesis ( $H_0$ ) stated that the results do not statistically significantly differs based on whether the student previously studied general grammar or other type of school. Similarly, it was also examined if the results depend on the gender ( $H_0$ : The results do not depend on gender of the student).

Then, it was surveyed how long took the different types of preparation on the test: a) participation at lectures, b) at seminars (1 lecture and seminar = 1.5 hours), c) learning at home, and d) tutoring. A linear regression model was estimated by ordinary least squares method to see how the number of points increase with time spend by various types of learning.

The efficiency was understood from the input oriented point of view. It was assessed how to minimize the inputs to achieve the same output. The approach searched the minimum effort of the students that must be expended to achieve desired results. There were  $n = 4$  inputs and  $m = 1$  output. As inputs ( $x_{jk}$ ) were considered the number of hours spent by the

preparation to the test – see above. Output ( $y_{ik}$ ) was the number of points achieved from the test. Input oriented data envelopment analysis (DEA) was used to calculate technical efficiency (TE) under the assumption of constant returns to scale (RTS) and pure technical efficiency (PTE) under variables returns to scale. Two DEA model were elaborated: (1) CCR model introduced by Charnes, Cooper and Rhodes (1978) that assumes constant returns to scale and (2) BCC model, proposed by Banker, Charnes and Cooper (1984). The value of efficiency equal to 1 means that the student (decision making unit) is 100% efficient in preparation for the test. Lower values suggest that the student could have done better.

CCR model maximizes the efficiency level of a student. There were  $Q = 115$  students. Efficiency is expressed as the ratio of weighted outputs and weighted inputs. The condition is that efficiencies of other units are equal or less than 1. After Charnes-Cooper transformation (Jablonský and Dlouhý, 2004), CCR model can be expressed by general formula as (1):

$$\begin{aligned} \max z &= \sum_{i=1}^m u_i y_{iq} , \\ \text{r. c. } \sum_{i=1}^m u_i y_{ik} &\leq \sum_{j=1}^n v_j x_{jk} , \quad k = 1, \dots, Q, \\ \sum_{j=1}^n v_j x_{jq} &= 1, \\ u_i &\geq \varepsilon, i = 1, \dots, m \\ v_j &\geq \varepsilon, j = 1, \dots, n \end{aligned} \tag{1}$$

where  $z$  is efficiency of a student,  $x_{jk}$  is the value of the  $j^{\text{th}}$  input,  $y_{ik}$  is  $i^{\text{th}}$  output,  $u_i$  are weights of inputs,  $v_j$  are weights of outputs,  $\varepsilon$  is infinitesimal constant (usually  $10^{-8}$ ), that ensures that weights of all inputs and outputs are positive. It maximizes the sum of weighted outputs of a student when the weighted sum of outputs of other students is less or equal to weighed sum of inputs and sum of weighted outputs is equal to one.

BCC model differs from CCR by adding variable  $\mu$ , that represents the difference from constant returns to scale and has value of 0 in case of constant returns to scale, less than 0 when non-increasing returns to scale and higher than 0 in case of non-decreasing returns to scale (2).

$$\begin{aligned} \max z &= \sum_{i=1}^m u_i y_{iq} + \mu , \\ \text{r. c. } \sum_{i=1}^m u_i y_{ik} + \mu &\leq \sum_{j=1}^n v_j x_{jk} , \quad k = 1, \dots, Q \\ \sum_{j=1}^n v_j x'_{jq} &= 1, \\ u_i &\geq \varepsilon, i = 1, \dots, m \\ v_j &\geq \varepsilon, j = 1, \dots, n \\ \mu &\in \mathfrak{R} \end{aligned} \tag{2}$$

where  $\mu$  can have any real value ( $\mathfrak{R}$ ). For details of DEA see e.g. Jablonský and Dlouhý (2014).

Survey by questioning method using anonymous questionnaire with closed answers was done at the university in Prague from 30<sup>th</sup> November to 2<sup>nd</sup> December 2016. A sample contained 115 university students from which 46 were females (40%). The students were from the 1<sup>st</sup> year of the master studies having subject *Time series*. Majority of university students graduated from grammar school, only 26% from others, mostly business academy (almost 15). Four persons had technical and one person economical lyceum. The distribution of the points was skewed to the right as majority of students got more than 20 points out of 25. On average, the students got 18 points from the test. Median was even higher (19 points). Male students had 18.1 points on average and females 17.9. Statistical description of the data is at Table 1.

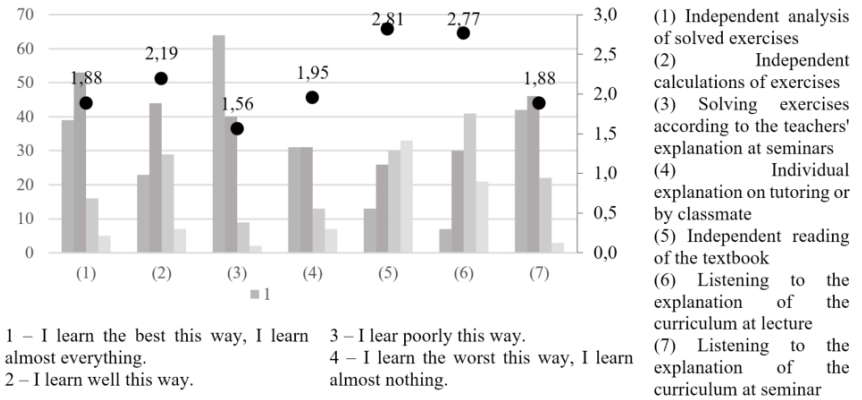
Type of high school	No. of observation	Average points from test
Grammar school	85	18.4
Economic lyceum	1	18.0
Technical lyceum	4	19.0
Vocational high school	8	15.6
Business academy	17	14.3
Total	115	18.0

**Table 1: Statistical description of the data (source: own research and calculation)**

## RESULTS AND DISCUSSION

The effectiveness of learning depends on the convenience of the used method. Students could have evaluated different methods by points from 1 to 4, where 1 was the best way and 4 the worst, none point were given when the student is not using this type. On average, the highest mark (1.56) had solving exercises according to the teachers' explanation at seminars. Second highest (1.88) was given to both independent analysis of solved exercises and listening to the explanation of the curriculum at seminars. Then was valued the individual explanation on tutoring or by classmate by 1.95 points. However, in this case, the average number of points from test was only 16.1. Hence, even preparation on tutoring is not sufficient to get desirable results. It may be due to the passive nature of the tutoring or explanation by classmate where the student does not have to practice the calculations individually. In absolute terms, the most convenient way how to learn was according to 64 students the solving exercises according to the teachers' explanation at seminars.

On the other hand, as expected, independent reading of the textbook (2.81) was assessed as the less convenient way of learning, followed by the lectures (2.77). Students do not consider the way of learning convenient if there is no possibility to try the calculations by themselves. It was astounding that 12 students were not learning the subject by independent solving of exercises. Considering that it is mathematical subject, the individual solving and practicing of solving should be crucial. When the students marked as the most convenient independent analysis of solved exercises and solving exercises according to the teachers' explanation at seminars, their average achieved points were the highest (18.5). The results are displayed at Figure 1.



**Figure 1: Effectiveness of ways of learning *Time-series* (source: own elaboration)**

Despite certain preferences for individual explanation on tutoring or by classmate when learning new curriculum, we take caution to recommend only one type of studying. “Students may simultaneously hold multiple conceptions of learning rather than using a dominant one while learning”. (Wang et al., 2017: 92) The transfer of the knowledge “is a complex phenomenon due to the involvement of several interacting categories of variables, namely, learner characteristics, learning and transfer tasks, and instructional and transfer contexts”, (de Corte, 2007: 28). As it was proved by Crawford et al. (1998) approaches to learning mathematics are related to differences in students’ conceptions of mathematics, their experiences of studying the subject and their performance on assessments. A comprehensive review of relationships between learning strategies, conceptions of learning, and learning orientations can be found in Vermut and Vermetten (2004).

It was tested whether the results of students statistically significantly differ based on gender or previously studied school. It was found (p-value of Wilcoxon rank-sum test = 0.7790) that gender does not influence students’ results. However, it is important, what type of school the students studied (p-value = 0.0005). While the students from grammar school had 18.4 points, from other types was the average 16.5 points.

The efficiency of learning put into the relation the number of hours spent by different types of learning and achieved points. The most time took to the students learning at home (14.0 hours on average). Students also participated at the seminars (7.5 hours on average that means that they mostly visited 5 of them, i.e. the maximum). On the other hand, the students attended only 3 lectures on average. Average hours of tutoring were about 38 minutes. Linear regression model did not reveal any statistically significant influence on the length of the preparation on the number of points gained. While the number of hours spent by attending the lectures and seminars helped to increase the number of points, longer tutoring decreased it. It seems that preparation at home does not influence the results at test at all. However, we must keep in mind, that the research considered only the length of the preparation, not the actual content. It would be harder to assess the curriculum, intensity of concentration etc. of the student that undoubtedly influence his or her performance at the test.

The poor school performance and results in general may depend on many things. Robison et al. (2017) showed that across all models that they constructed, juvenile justice contact and

school expulsion were the best predictors of negative school outcomes. Besides according to Masci, de Witte and Agasisti (2016), the students' performance in mathematics is partly correlated with the management practices adopted by the school principal/head teacher. "Schools and schooling can only explain a minor part of the variance in achievement scores, however, and the characteristics of the students themselves play the most significant role." (Masci, de Witte and Agasisti, 2016: 1) Similar results were achieved in Australia in a study by Geiger, Anderson and Hurrell (2016). "A finding of the study is that 'successful' practice is strongly tied to school context and the cultural practices that have been developed by school leaders and teachers to optimise student learning opportunities." (Geiger, Anderson and Hurrell, 2016: 1).

Results of VRS input oriented DEA efficiency shows that on average, students learning was efficient from 59.86% if we consider only constant returns to scale, then only 48.59%. The effort that students put into the learning process was not that fruitful as it could have been.

Variable	Obs.	Mean	Std. dev.	Min	No. of 100% efficient
CRS TE	115	0.4859	0.1828	0.0184	4
VRS PTE	115	0.5986	0.2051	0.1961	14

**Table 2: Efficiency of learning subject *Time-series* (source: own research and calculation)**

As benchmark units can serve those that are 100% efficient. For example, student no. 1 despite that she did not attend any lecture and only 1 seminar, spent 2 hours by preparation at home and 4 hours at tutoring, got 23 points from the test. Good result without big preparation might be caused by her background as she graduated from technical lyceum. Student no. 3. from grammar school gained even 1 point more as he prepared at home for 6 hours and attended all seminars. Student no. 5 that also graduated from grammar school got only 17 points, but it was due to less time spent by preparation (only 2 lectures, 2 seminars and 1 hour at home). Student no. 82 attended only all seminars and prepared at home for 3 hours and got more points (19). All those students were 100% efficient under constant and variable returns to scale, hence they managed to be also scale efficient.

We must keep in mind that DEA method has certain limitations and hence the interpretation of the results of measuring learning efficiency must be careful. DEA is relative method that compares the inputs and outputs, so the situation, when the student did not prepare at all (it is not the case of our sample) and got some points from the test might be evaluated by DEA as efficient. But the student can fail as the number of points might not be sufficient (student can fail also from second test). Therefore, complete evaluation is available only after the end of the semester and DEA shall be accompanied by the analysis of total results of the students.

Research can be further enlarged in the way of searching the factors that affect the efficiency. Then the second stage regression analysis using efficiency scores can be done. Zhang and Wang (2014) showed that affection of mathematics learning is the most important factor that influences learning efficiency. "Efficiency is highly correlated with the advance of mathematics academic performance", (Zhang and Wang, 2014: 67). Mathematics learning can also differ based on whether it is practiced in or out of school. "Many of the differences can be narrowed by creating experiences that engage students in doing mathematics in school in ways similar to mathematics learning and practice outside of school", (Masingila, Davidenko and Prus-Wisniewska, 1996: 175) Similarly

the efficiency of *Time-series* learning can be influenced by many factors that shall be examined in future research.

## CONCLUSION

The aim of the paper was to assess the effectiveness and to analyse efficiency of learning the curriculum of the statistical subjects at universities. Particularly we examined the subject *Time-series* that is taught at university in Prague. Primary research was held in November 2016. We asked 115 students about their learning and preparation methods and about the results from the test. The most effective method of learning was understood in terms what type of learning leads students to achieve their set goals. The students of *Time-series* marked that the most convenient way of learning the curriculum solving exercises according to the teachers' explanation at seminars. This type of learning similarly to learning by individual calculations of exercises by lead the students to achieved 18.5 on average. Therefore, we can recommend the students to prefer practical methods of learning while preparation for the test.

The efficiency compares the outputs of the learning process (points from the test) with the inputs (hours of learning by various ways). On average, the students were efficient from 60% (when it is assumed that one unit of input brings still the same amount of output – i.e. constant returns to scale) and from 40% (under variable returns to scale). However, it cannot be clearly stated what method of preparation on the test is the best in terms of efficiency, as the hours spent by learning at lectures, seminars, tutoring or at home is only an approximation for the effort. Real curriculum and content of learning cannot be assessed easily. Besides, the length of the preparation for the test cannot capture all factors that are influencing the success at first test. It seems that high school from which the students graduated is also important in determination of the efficiency of *Time-series* learning. Therefore, the challenge for future research is to search for the factors that are influencing the efficiency and include them into second-stage regression analysis.

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# OPTIONS FOR ASSESSING TEACHING QUALITY AT UNIVERSITIES

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## ABSTRACT

The first objective of this article is to verify whether the questionnaire currently used for the assessing the quality of teaching shows internal consistency and whether it can be considered a standardized instrument. The second objective is to establish whether full-time and part-time students show the same strictness (criticism) in evaluating the quality of teaching.

A questionnaire developed at the Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem, is used to establish the quality of teaching on a regular basis. For the first objective, Cronbach's alpha is used to verify whether the questionnaire is internally consistent or not. The Mann-Whitney U test is used to establish whether the assessment provided by full-time students differs from that given by part-time students. The results show that the questionnaire has high internal consistency (reliability), in the assessment by full-time as well as part-time students. Moreover, full-time students show statistically significantly greater strictness in evaluating the quality of teaching than part-time students.

## KEYWORDS

Assessment of Teaching, Cronbach's Alpha, Factor Analysis, Reliability, Teaching Quality

## INTRODUCTION

When talking about assessing teaching quality at universities, one of the most important indicators will apparently be the evaluation of teaching quality by students. This issue had not been tackled in certain countries more systematically until legislative changes. Upon the German amendment to the University Act in 1998 ("Hochschulrahmengesetz") universities started preparing questionnaires to evaluate teaching quality at the end of each semester (EVALON assessment system). Studies (e.g. Wittmann et al 2012) followed afterwards to find out whether teaching quality had improved in the period 2006 – 2010. Assessing teaching quality using students' evaluation has also been the topic of long-term research at Deakin University in Australia. Palmer (2012) states that despite having their own developed assessment systems, they pay increased attention to their own tool, i.e., a questionnaire which has been improved on a continuous basis.

Yin and Wang (2015) also introduced diligent access to the development of the tool for the evaluation of teaching quality by students. The Course Experience Questionnaire, as they call it, looks into the quality of teaching, study results as well as the educational environment. They also point out that there has been a dramatic increase in university graduates in China. 5% of the population were university graduates in China in 1990, while the number increased to 30% in 2012 (which is more than 33 million university

graduates). Such a dramatic increase raises concerns about maintaining teaching quality at universities.

The Czech Republic does not show such a dramatic increase as China, however, there have also been important changes since 1990 as a result of social events. Universities have been established in individual regions and private universities have been given the green light as well. In 2001, there were 30,102 university graduates and in 2015, the number had nearly tripled to 82,004. According to current trends, on average 35% of young people in OECD countries will achieve tertiary education before reaching the age of 30. This number amounts to 34% in the Czech Republic (Ministry of Education, Youth and Sports, 2016).

Hence, great attention is also paid to the quality of education at the universities in the Czech Republic. Assessing university quality is emphasised in connection with the new University Act and evaluation of teaching quality is one of the important indices for the accreditation process (National Accreditation Bureau for Higher Education, 2017).

Assessing teaching quality forms an integral part of the overall evaluation of the standard and quality of universities. Kinash et al (2015) state that student evaluation is considered to be one of the indicators of university performance and also a tool which helps bring about necessary changes at both the institutional and sector level. For example, Dian-Fu and Yeh (2012) discovered within the student assessment in Taiwan that students' expectations are not met in the area of classroom equipment, possibilities of scholarships, fair evaluation by teachers and other fields. Once the school had managed to obtain the necessary funds it focused on eliminating the uncovered deficiencies. It is recommended to introduce student evaluation as a tool that will help to promote continuous improvement in teaching quality.

On the contrary, Ngware and Ndirangu (2005) say that student evaluation is not reliable and it is necessary to use other supporting evaluation systems to assess teaching quality. Wibbecke et al (2015) similarly point out that student assessment itself does not lead to a significant improvement in teaching quality. They point out that the role of the teacher has changed in recent decades and teachers need to have greater didactic competences. Student assessment results should serve as a basis for subsequent teacher evaluation. Apparently, student assessment cannot be the only tool which would enable one to ascertain teaching quality and point out methodological aspects which should be taken into account in the tool development process.

At the Faculty of Social and Economic Studies, which is part of the Jan Evangelista Purkyně University, a questionnaire was created by the authors of this article which has been used to ascertain teaching quality since 2013. The concept of the questionnaire was based on a complex evaluation of the whole education process. Spooren, Mortelmans and Denekens, (2007) point out that a lot of questionnaires currently used are based only on a single-point type evaluation and have no theoretical background. In addition to that, most of these questionnaires are not statistically proven in terms of validity and reliability. Therefore, the first objective of this article is to verify whether the questionnaire currently used for assessing the quality of teaching shows internal consistency and whether it can be considered a standardized instrument. The second objective is to establish whether full-time and part-time students show the same strictness (criticism) in evaluating the quality of teaching.

## **MATERIALS AND METHODS**

The authors of this article wanted to avoid the aforementioned deficiencies in student evaluation. After a thorough analysis of the issue, a questionnaire was created by the authors of the article. It has 38 questions in total and is divided into several categories: evaluation of a subject, personality of the teacher, organisation of teaching and the conditions connected with the completion of the subject.

Students express the level of their satisfaction on the Likert scale (1 – 7). They evaluate each completed subject separately. The questionnaire is attached as Appendix 1.

In most existing assessment systems of teaching quality students evaluate the past semester overall, which means they do not distinguish individual courses. However, it is necessary that all students evaluate each completed course separately. Consequently, analytical evaluation is then possible, i.e., the university (all results are added up), the individual field (only results from students in a specific field are added up), and the teacher (only results from courses that the teacher taught within the semester are added up). Therefore, the level of the university can be found out and individual fields of study can also be compared (within one faculty and also as an inter-faculty comparison) as well as individual teachers.

Having completed the development process of the evaluation tool, the authors of this article wanted to verify its validity and reliability. Testing was performed on a sample of 669 students of the Faculty of Social and Economic Studies (190 males and 479 females). Students of all three branches of study (Economics and Management, Regional Development and Public Administration and Social Work), all grades and both forms of study (full-time and part-time) participate in the evaluation process. Questionnaires are filled in by students in the last 14 days of each term within the seminars which feature the highest attendance. The hypothesis is – part-time students are less strict in evaluating the quality of teaching than full-time students. Data were processed using MS Excel and the SPSS software was used. Factor analysis was used from statistical methods (the appropriateness of the items for the use of factor analysis was verified by the Kaiser-Meyer-Olkin rate and Bartlett's test), the Mann-Whitney U test and Cronbach's alpha. For the calculation, data from the first four questionnaire categories, i.e., 16 fundamental questions, were used as the primary focus was the teaching quality.

## **RESULTS**

Firstly, the internal consistency of the questionnaire and the first research question will be verified. Students evaluated the quality using a seven-point Likert scale ranging from “strongly disagree to strongly agree”. Some questions were excluded after the basic data analysis because there was a very high proportion of no. 8 answers (i.e., “can't evaluate”). These were the questions “answering e-mails”, “abide by consultation hours” and “cancelled lessons were compensated”.

Table 1 shows average values and other characteristics of individual items of the total score established for the group of full-time and part-time students.

Table 1 apparently shows that students most strictly evaluate the questions: “interesting”, “useful” and “interesting presentation” and “meeting the requirements is easy”. However, the last item is of a different nature than all the other items. An evaluation in the lower part of the 1–7 score does not mean a worse evaluation in this case. The table also shows that the full-time students questioned are more critical than part-time students.

Type of studies Item	Full-time students		Part-time students	
	Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation
1.1 interesting	4.64	1.03	5.36	0.92
1.2 useful	4.75	1.06	5.49	0.96
2.1 interesting presentation	4.79	1.01	5.39	0.94
2.2 understands the topic very well	6.09	0.90	6.43	0.84
2.3 got respect of students	5.48	0.99	5.92	0.96
2.4 helpful approach	5.59	0.97	6.13	0.84
2.5 fair-minded	5.89	1.01	6.30	1.03
3.1 the lesson starts on time	6.24	0.97	6.61	0.81
3.2 the lesson ends on time	6.23	1.04	6.72	0.79
4.1 I know all the requirements	6.39	0.97	6.56	0.86
4.2 requirements weren't changed during the semester	6.44	1.01	6.66	0.89
4.3 meeting the requirements is easy	4.09	1.27	4.15	1.48
4.4 final examination will be fair	6.07	1.10	6.36	1.05

**Table 1: Scores of individual items in the group of full-time and part-time students, 2015-2016 (source: own calculation)**

It was further established whether the student evaluation differs in different types of study, i.e., full-time and part-time. The results of the Mann-Whitney U test show that the total average score in both groups shows a statistically significant difference. The test values are

$$u = 23,341.00 \quad (1)$$

$$z = -7.615 \quad (2)$$

$$p < 0.001 \quad (3)$$

The test results confirmed that the values of the total score are statistically considerably lower in the group of full-time students than those of the total score in the group of part-time students. The hypothesis was confirmed.

The internal consistency of this questionnaire was further verified by the factor analysis. The value of the Kaiser-Meyer-Olkin rate (KMO rate) of item suitability for the factor analysis is 0.909 so therefore the items are suitable for the factor analysis. The suitability of item factoration was also documented by Bartlett's test, the result of which is statistically significant. In both groups of students, full-time and part-time, the questionnaire was a two-factor tool, where individual factors comprise the same items. The first factor determines the progress of the term and helpful approach of the teacher, the second factor relates to the subject (interesting, useful and presentation) and an assessment of the requirements to pass the subject.

Only in two components are the eigenvalues higher than 1. The first component (factor) covers 54.5% of the variance in items in full-time students while the second component covers 14.087% of the variance. Both factors together explained 68.596% of the common variability. In case of part-time students, the first factor covers 60.36% of the variance in the items and the second factor covers only 10.29% of the variance. Both factors together explain 70.65% of the common variability.

Table 2 shows the basic characteristics of the groups of full-time and part-time students.

To examine the internal consistency, Cronbach's alpha was used, which measures the dependence between individual items and thus expresses the internal rate of consistency. Cronbach's alpha for the group of full-time students was 0.923, and it was 0.928 for the group of part-time students. The internal rate of consistency is very high then in both groups.

Group of full-time students		Group of part-time students	
Group size	517	Group size	152
Ar. mean	72.67	Ar. mean	78.10
Standard deviation	9.62	Standard deviation	9.13
Median	74.53	Median	80.16
Cronbach's alpha	0.923	Cronbach's alpha	0.928

**Table 2: Basic characteristics of the group of full-time and part-time students -total scores, 2015-2016 (source: own calculation)**

## DISCUSSION

The aim was to test a tool that ascertains the teaching quality assessment from the students' point of view. The tested questionnaire meets basic statistical parameters, and its added value lies in two fundamental areas.

The questionnaire structure is designed so that it enables one to evaluate results not only on the institutional level - teaching quality assessment at a selected school - but also to perform analytical evaluation by individual field of study and, last but not least, the evaluation of individual teachers. Its contribution is not only that it ascertains the teaching quality at the school but it also allows the school management to continuously check the quality within the institution, i.e., to compare teaching quality in individual fields of study or observe the performance of individual teachers. If any deficiency is discovered, this evaluation method allows us to take subsequent measures that are targeted. Such targeted measures are very effective because they quickly eliminate the deficiency in the place where it was discovered. If the questionnaire is used over a long-semester period, the follow-up assessment will clearly show whether the potential measure was effective or not.

The disadvantage of this method of assessing the quality of teaching, i.e., by written questions, is its considerably great time demands, as pointed out by Felton et al (2007) on the Ratemyprofessors.com website, where students evaluate their university teachers. Students use the platform particularly if they are very happy or dissatisfied. Such assessment fails to provide specific data about the actual quality of teaching. In any case, such information is inspiring. Apparently, other forms to collect data faster have to be found.

The contribution of the respective assessment system is that it meets the teaching quality assessment according to the set indicators and provides valuable feedback. Students evaluate each subject separately, which allows one to evaluate individual subjects.

In connection with improving teaching quality, some authors primarily focus on a teaching method where the basic teaching methods are compared, that means a lecture and a seminar (teamwork). An experiment performed by Opdecam and Everaert (2012) with first-year students of financial accounting suggested that students show significantly greater satisfaction with teaching that is performed in the form of team cooperation. Eroğlu

(2015) points out that students prefer different methods of teaching than their teachers. While teaching quality assessments by students are relatively common, student assessments of teachers' performance organised by the university are rather rare. The countries that have already introduced this method include Mexico, Spain, the Slovak Republic and Sweden. Yet, as Looney (2011) points out, properly designed evaluation systems of teachers may contribute to improving teaching quality and provide better results of students.

The described system is designed so that it provides the possibility to evaluate the teaching quality of individual teachers. The authors of this article are planning to introduce student assessment as part of a regular annual assessment of teachers' performance. Hence, great attention is paid to the tool for assessing teaching quality with the intention to modify the questionnaire upon the data collected. Nemejc and Smekalová (2016) came up with an inspirational idea that it is the understandability of the teaching which is important, since it influences the quality of teaching. One of the questions students answer by choosing option 8 on a long-semester basis (i.e., "can't evaluate"), such as "abide by consultation hours" or a question showing a high rate of correlation, will probably be replaced in the current questionnaire.

## CONCLUSION

The presented results show that the questionnaire used at the Faculty of Social and Economic Studies for the regular assessment of the quality of teaching can be considered a standardized tool. High internal consistency of the questionnaire was established using factor analysis. The authors of the article established a high item reliability, measured by Cronbach's alpha.

The research also established that assessments by full-time students show greater strictness compared to those by part-time students. The Mann-Whitney U test also confirmed that assessments of teaching quality are statistically significantly different in full-time and part-time students. Full-time students are significantly more critical.

Should the questionnaire be used to establish teaching quality as well as a managerial tool for management within an institution, it should be further developed and corrections should be made after completion of the phases identified.

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# APPENDIX 1

## Teaching quality assessment

←	→							
Strongly disagree	1	2	3	4	5	6	7	Strongly agree

Chart 1 - Use Likert's scale to express your opinion. If you're not able to rate some part, fill the box with number 8 = "can't evaluate".

Course:	Course #1	Course #2	Course #3	Course #4
Lecturer:	Lecturer name	Lecturer name	Lecturer name	Lecturer name

### 1. Overall course rating

1.1 interesting				
1.2 useful				

### 2. Lecturer rating

2.1 interesting presentation				
2.2 understands the topic very well				
2.3 got respect of students				
2.4 helpful approach				
2.5 fair-minded				
2.6 answering e-mails				
2.7 abide by consultation hours				

### 3. Semester rating

3.1 the course starts on time				
3.2 the course finishes on time				
3.3 cancelled lessons were compensated				

### 4. Final examination

4.1 know all the requirements				
4.2 requirements remain unchanged during the whole semester				
4.3 meeting the requirements will be easy				
4.4 classification will be fair				

### 5. University's facilities

5.1 university library	
5.2 university cafeteria	
5.3 student advisory office	
5.4 faculty secretariat	

Additional information:

Gender: Male

Female

# APPLICATION OF U-MAP CLASSIFICATION AT UZBEK UNIVERSITIES

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## ABSTRACT

Ranking of universities at national as well as international level is currently considered as tool for comparison of quality of higher education institutions. In our paper, we piloted an alternative approach using modified U-Map methodology applied on the sample of three Uzbek universities with different major study fields. As data collection tools, questionnaires, group discussions and personal interviews were used. The institutional profiles were developed for each university showing its main focus. We can state that the U-Map classification is suitable for the Uzbek specific context and can be used for further analysis or for planning of quality assurance systems.

## KEYWORDS

Higher Education Institutions, Quality Assurance, University Ranking, Uzbekistan

## INTRODUCTION

Currently much attention is paid to national and international rankings of universities and these are presented predominantly as objective mirrors of quality. Very simply said: better position of higher education institution (HEI) means better quality of it. Nevertheless, there exist different approaches to evaluation of HEIs, i.e. classifications. These classifications are usually multidimensional, reflect activities and according to some authors (e.g. Huisman and van Vught, 2009 and others) they also better illustrate growing diversity of HEIs.

The institutional diversity in higher education is a term indicating variety of entities within the system at a specific point in time (van Vught, 2009). Van Vught et al (2010) refer to Huisman (1995) and Teichler (2008) when mentioning two basic types of diversity: external and internal. Internal diversity refers to differences within HEIs (different units, departments, programs, etc.) and external diversity focuses on differences between HEIs. Horizontal diversity concerns differences in institutional profiles while vertical diversity (as a logical opposite) follows differences in prestige and reputation of HEIs (Teichler, 2008). Teichler (2007: 81) adds that he: “frequently has advocated to examine the possible competing hypothesis that a relatively low extent of vertical diversity and a broad range of horizontal diversity could serve more easily a socially acceptable balance of objectives.”. Two different opinions on the diversity of European HEIs characterize current academic discussion. For some authors HEI diversity is growing evidently (Bartelse and van Vught 2009) and there is a need to map/show it. There are also several studies assuming immanent drive of higher education system towards differentiation (Parson and Platt, 1973 or Clark, 1978 cited in van Vught, 2009). But other studies demonstrate reverse

direction: de-differentiation of systems (Birnbaum, 1983 or Rhoades 1990 cited in van Vught, 2009). Despite these contradictions there exists a consensus the larger diversity of higher education institutions is worthwhile and more capable to respond to changing needs of society (van Vught, 2009; Teichler 2008).

In our paper we take into consideration a specific approach of classification of HEIs – U-Map methodology. Such creation of the classification intended originally to be the tool for mapping the diversity and uniqueness of European higher education institutions. It is focused on external and horizontal institutional diversity of HEIs (van Vught et al, 2010). This multidimensional classification is based on broad spectrum and relevant criteria (indicators). At the same time, U-Map should be comprehensible, accessible, and reliable for different types of users (van Vught, 2009). U-map thus consciously reacts to the single dimensionality and methodological non-transparency of international (world) rankings (e.g. Hazelkorn, 2007 or Rauhvargers, 2011 point at this) which are popular probably due to their simplistic presentation of hierarchical overview of institutions.

Within our research we used this classification (U-Map) in quite different contexts. Firstly, we used U-Map as a tool for quality assurance. Actually, U-Map is not a tool for quality assurance itself. However, it could be a relevant and useful starting point for thinking about internal quality assurance and about (the relevancy of) mission of HEIs. Secondly, we used U-Map as an alternative approach in the higher education area of Uzbekistan where a Decree on University Rankings came in force in 2012 (World Bank, 2014). It means in the area which is still relatively far from the “usual” European situation. The Uzbek higher education is to a great extent elitist (i.e. not mass-oriented) and autonomy of universities is not developed, meaning that the dominant actor within HE is the government (i.e. central management of HEIs). Of course, the years of Uzbek national independency as well as globalization, have led to rapid development of higher education and we have witnessed signs of process of harmonization with European situation and there is a big probability of growing institutional diversity in near future.

In our case using of U-Map classification had also practical reasons. We used it as a tool for closer involvement of partner’s Uzbek universities into the issue of internal quality assurance and into active participation during our common workshops.

Hence, in the text we present three institutional profiles of Uzbek HEIs in the form of U-Map profiles. We show differences and modifications needed to be done from methodological as well as practical reasons. Finally, we discuss institutional focus and diversification “state of art” in given HEIs.

## **METHODOLOGY**

The research was conducted within the project IQAT, co-funded by the Erasmus+ Programme of the European Union, focused on enhancement of quality of education in Kazakhstan and Uzbekistan. The focus on Uzbek universities follows the prioritization of the Uzbek Government to increase the quality assurance in tertiary education as well as to support internationalization of HEIs. The selected universities are members of the project consortium. This fact allowed us to get reliable data.

For U-Mapping we followed the methodology developed in the project U-Map (van Vught et al, 2010) designed for classifications of European HEIs. Six dimensions were created (Table 1). Data always refer to the selected year in such a way that they can be compared; in our case to the academic year of 2014/2015. U-Map then focuses (with respect to given theoretical starting points) on description or characteristics of selected areas from

higher education institutions' activities. This description is then converted into a graphic form – a map of the HEI – in the form of the sunburst chart or flower with rays/petals of different length. Longer ray/petal means more activities within given indicator. However, the individual graphs illustrating the institution are also put into the context with other institutions. In this respect, there is a danger of comparing one institution's activities in a specific area. Nevertheless, the question here should not be whether it is possible to prevent such comparison (as it is a natural part of any categorization), but it is essential to realize the risks involved in this, i.e. not to get overwhelmed by one approach (discourse). This is true especially for the representatives of public politics as well as higher education institutions' representatives.

Dimension	Information base for indicators	Colour in the flower
<i>Teaching and learning profile</i>	structure of graduates according to types of study graduates according to the group of fields (ISCED 97) graduates according to types of study orientation (generally formative, licensed, and career-oriented study programs) expenditures on educational activities	Dark blue
<i>Student profile</i>	number of students in <i>distance learning</i> number of students over 30 number of <i>part time</i> students total number of students	Green
<i>Research involvement</i>	production of PhD graduates expenditures on research number of academic publications number of professional and other publications	Red
<i>Involvement in knowledge exchange</i>	number of cultural activities (exhibitions, concerts, performances) income from licenses, life-long learning, contracts with private entities, copyrights number of patents sold average number of <i>start-up</i> firms in the last three years	Light blue
<i>International orientation</i>	number of students from abroad (with previous foreign degree) income from international sources number of students from international exchange programs number of staff from abroad (employees)	Yellow
<i>Regional engagement</i>	number of bachelor students in their first year of studies from the region proportion of graduates working in the region after two years income from local/regional sources	Purple

**Table 1: Dimensions and information base for indicators (source: Authors according to van Vught et al, (2010: 26-30))**

The survey was carried out at the following universities: Andijan State University (ASU), Samarkand Agricultural Institute (SamAI) and Tashkent Chemical-Technologic Institute (TCTI). The basic facts about the selected HEIs are shown in Table 2. The target groups involved 5 representatives of each HEI who were subjected to the questionnaire survey and participated in two focus group discussion. Unclear parts were clarified in personal interviews. The questionnaire was designed according to the indicators (Table 1).

HEI	Size*	Year of establishment	No of faculties	Main fields
ASU	Middle	1931	8	humanities, pedagogy
SamAI	Middle	1929	5	agriculture
TCTI	Small	1991	4	food technology

\*Notes: Size – small <5 000 students, middle – 5 000 -10 000 students

**Table 2: Basic facts about Uzbek higher education institution (source: Authors)**

The most important part of creation of institutional U-Map flower is availability of relevant data. Especially in our case we had to very carefully discuss with Uzbek partner's institutions not only availability but reliability and relevance as well. Data availability is not for granted in Uzbekistan. In principle, HEIs are not obliged to publish annual reports or other documents although they have these data at disposal. Relevance of data is another issue. As mentioned above HE systems in Uzbekistan differ from European countries in many elements. That is why some indicators are not fully relevant for Uzbekistan. It is minimally from two basic reasons: 1) no comparable elements (e.g. distant students) and 2) elements with no particular importance for HEIs (mature students, mobility of academic employee). Particular limitations for using U-Map indicators are discussed in the section Results.

## RESULTS

Considering both availability and relevance of data for our case we made some modifications in indicators in order to better reflect the specific situation in Uzbekistan but at the same time to keep basic comparability with European HEIs. Differences are described in table 3. In principle, there are two types of changes: 1) some indicators were omitted entirely, as they are not relevant for Uzbekistan; 2) some indicators were adjusted. In addition, expert estimation was used for some indicators as no statistical data was available. There are also individual differences: some indicators were not available at all three institutions (transparent rays/petals in the flowers).

Dimension	Indicators	Modifications
<i>Teaching and learning</i>	Original	Expenditure on teaching - <b>expert estimation</b>
<i>Student profile</i>	Original	Distant students (not existing in UZ) - omitted
<i>Research involvement</i>	Most indicators modified	different definition of publications (peer review, professional, other), as for academic publications we used number of articles and books, for professional publications – number of textbooks and methodical books – <b>expert estimation</b>
<i>Regional engagement</i>	Original	<b>Expert estimation or statistic data</b> – different availability in HEIs
<i>Involvement in knowledge exchange</i>	All indicators modified	Number of cultural activities is absolute/per one year Number of patents/per last three years Start-up firms (no element in UZ)
<i>International orientation</i>	Original	Expenditure from abroad – <b>expert estimation</b>

**Table 3 – Modifications of U-Map indicators (source: Authors)**

Hence, the following figures of U-Map –the institutional “flowers” (Appendix A) - respect all limitations we mentioned above, nevertheless even in this limited form it is possible to find out focus of given institution.

## **APPENDIX A. INSTITUTIONAL “FLOWERS” OF SELECTED UNIVERSITIES**

Note: transparent rays/petal means non-availability of data for a concrete indicator  
The detailed input data we used for the elaboration of institutional profiles are shown in Appendix B and interpreted in the following text.

### **Teaching and learning profile**

All three HEIs are focused on teaching activities (major part of annual income is used for teaching and learning activities), at the bachelor study programmes, in particular. This BA focus is caused by the fact that the Uzbek HE system is on one hand still in the elite phase according to Trow’s HE stages (Trow, 1995), and on the other hand it is strongly practically or professionally oriented, i.e. most of graduates are directly after their graduation put into job-market either like teachers at primary or secondary schools or employees in industry and agriculture. Production of MA and PhD graduates is relatively low; most BA graduates do not continue their studies.

### **Student profile**

Considering the Uzbek HE system as a whole, it is not surprising that HEIs do not provide distant study programmes. The Uzbek system, however, has got some specific form of part-time study developed for the purpose of study for employees of concrete firms and enterprises. Analogically, the proportion of mature students is not a current issue for Uzbek HEIs, because most of the HEI students enter to higher education directly after finishing their secondary education. It is evident that diversity of student’s body is currently out of the main interest from many interacting reasons (different traditions of tertiary education, elite phase of HE; Uzbekistan is not a member of Bologna process where diversification of student’s body and lifelong learning activities are prioritized, etc.). For the Uzbek situation it makes better sense to monitor different data such as the proportion of women or IT equipment at HEIs.

### **Regional engagement**

Regional engagement in the form of students’ portfolio (i.e. proportion of students with residency in region where HEI operates) exists rather naturally than it has been systematically supported. It mainly comes from the existence of HEI in a given region. Currently, we have no evidence about the competitiveness of HEIs for students and hence, no evidence of differentiation among HEIs in Uzbekistan. Most of funding comes from the central administration than regional budget.

### **Knowledge exchange**

The Uzbek HEIs are considered as educational institutions which should serve to the needs of enterprises or public sphere but it is mainly in form of production graduates (bachelors, especially). Nevertheless; the production of patents and organizing of cultural activities seems to have substantial importance as well. Social service for a country and its national identity belongs to HEIs priorities; it is probably connected with relatively short existence of independent state. On the other side, relatively successful production of patents is possible to link to direct cooperation with factories and firms.

### **Research involvement**

Research activities according to U-Map typology have only a limited prescriptive value and it is mostly because of significantly different situation of Uzbek HEIs in comparison

with Europe where U-Map originated from. Research and consequent publication activities are not considered as important as teaching, especially on institutional level. Teachers have some research obligations but in comparison with European strong shift from teaching to research, research seems to be still what rather goes above prioritized teaching. In addition, the system of publications has not been yet developed in Uzbekistan but HEIs have got overall data on journals, books, textbooks and methodical books/manuals produced by teachers (and students). According to the Law on Education there exist three main types of HEIs: universities, institutes and academies, but they are different in terms of the spectrum of study fields.

## **Internationalization**

Internationalization seems to be clearly the most under-developed dimension in all three universities. Especially academic mobility of students and teachers is not usual and rich at HEIs: Only few students or academic employees are in three partner's HEIs.

## **DISCUSSION**

Although it is problematic to assume general findings about the whole system if we know only small part of it, U-Map institutional profiles of three Uzbek HEIs show not very diversified institutions. HEIs are strongly focused on teaching activities and production of BA graduates, students belong to the traditional type of students (young, entering HEI just after finishing secondary schools). Regional engagement and research activities are "natural" ones for all three Uzbek HEIs, i.e. they have the place within mission of HEIs, but no special support or conditions for those areas are developed. Findings are in accordance with the content of the Decree on University Ranking where teaching quality makes 35%, employability of graduates 20% and research activity 35% of overall score (World Bank, 2014). On the other hand, internationalization currently seems to be supported in different directions. The internationalization does not happen in form of student's and teacher's mobility abroad (exchange programs) but exists rather in the form of participation within international projects.

U-Map typology was developed in conditions of European diversified higher education area, but 6 dimensions (which are very broad and follow main "general" roles of universities globally) are relevant for the Uzbek situation. If any changes are needed, these are rather on the level of concrete indicators. This is also supported by van Vught et al (2010) who see such flexibility as an asset of this approach. It is commonly used in national applications (Jongbloed and Kaiser, 2011), e. g. in Estonia (Kaiser et al, 2011) and the Czech Republic (Šmídová and Zimmerhaklová, 2014).

Uzbekistan, as a non-member of Bologna process, preserves some national specialty in terms of higher education (Nassipbayeva and Dalayeva, 2013), hence there are no distant study forms, issue of "mature" students is not "day topic" etc. but even in this conditions it is possible to create a relevant institutional profile. It is necessary to emphasize the fact, that typology (or rather design of the institutional profiles) does not speak about quality of particular areas of institutional activities. It provides a simple and quick view on institutional activities which match focus of a HEI or rather on it quantifies activities in the certain domains. It is also necessary to consider that low or lower achievements in individual indicators do not mean that the particular category or even the whole domain belongs to the weak points. Van Vught et al (2010) suggest to use U-Map profile as a business cards of the HEI, e.g. suitably applicable in presentation of HEI while looking for partners in international projects.

## CONCLUSION

Even though our conclusions are limited to the U-Map application only at three investigated Uzbek HEIs, we can state that U-Map methodology is well usable also in this specific context. Uzbek higher education area with its post-soviet tradition of centrally managed society and economics needs modified approach relating to data gathering and definition/understanding of the meaning of higher education institution/university. We understand this research as a kind of pilot study within institutional profiling. Further research should follow including all HEIs and providing so more complex overview of diversification in Uzbekistan.

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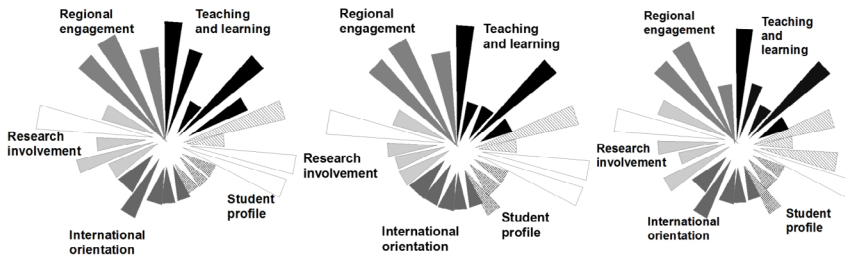
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# APPENDIX A. INSTITUTIONAL PROFILES OF SELECTED UNIVERSITIES (SOURCE: AUTHORS)



Dimensions/Universities	Indicators	SamAI		ASU		TCTI	
		Value of indicators	Evaluation of indicators	Value of indicators	Evaluation of indicators	Value of indicators	Evaluation of indicators
Teaching and learning	Degree level	94.3% graduates	Major	94.7%	Major	78.5%	Major
		4.9% MA graduates	None	4.9%	None	21.5%	Substantial
		0.8% PhD graduates	None	0.3%	None	0%	None
	Expenditure on teaching	75%	Major	> 40%	Major	> 40%	Major
Students	Range of subjects	All linked with agriculture	Specialized	>6	Comprehensive	3-6	Broad
	Distance learning students	0	N/A	0	None	N/A	None
Research	Mature students	< 5%	None	1.1%	None	0.9%	None
	Part time students	< 5%	None	< 5%	None	4.1%	None
	Size of students' body	5023	Medium	7540	Medium	4285	Small
	PhD production	0.02	Some	0.01	Some	0	None
	Expenditure on research	1.7%	None	5-20%	Some	6.4%	Some
Peer reviewed academic publications	Not available	None	1.5	Substantial	0.1-0.75	Some	
Peer reviewed other research products	Not available	Not available	Not available	None	Not available	Some	
Professional publications	1.2%	Some	0.07	None	0.5-3.75	Some	

**APPENDIX B. OVERVIEW OF U-MAP INDICATORS AT SELECTED UNIVERSITIES (SOURCE: AUTHORS)**

<i>Knowledge exchange</i>	Cultural activities								
	Patents	50-100	Substantial	>100	Major	>100	Major		Major
	Start-up firms	3.2	None	<5	None	6.9	None		Some
<i>International orientation</i>	Foreign degree seeking students	5-10	Substantial	0	None	N/A	None		None
	Incoming international programmes	0%	None	0.1%	None	0.02%	None		None
	International academic staff	0.04%	None	0%	None	0.07%	None		None
	International income	0%	None	0%	None	0	None		None
	Outcoming international programmes	1-5%	Some	0%	None	0.09%	None		Some
<i>Regional involvement</i>	BA students from the region	1.8%	None	0.04%	None	0	None		None
	Graduates working in the region	70%	Major	80%	Major	>10%	Major		Major
	Local/regional income	Most	Major	94.5%	Major	46%	Major		Major
		1.7%	Some	6.4%	Substantial	1-5%			Some

# INNOVATING BUSINESS ENGLISH? IMPLEMENTING ICC-CONTENT INTO HE CURRICULUM

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## ABSTRACT

As part of a larger debate about efficiency and responsibility in education, the presented study discusses the challenges connected with the implementation of ICC-based (Intercultural Communicative Competence) content into BE (Business English) classes at the MIAS School of Business and Interdisciplinary Studies, Czech Technical University in Prague (MIAS CTU), and evaluates the results of a post-implementation follow-up survey. The rationale behind this project is based on addressing the need for the integration of ICC-based content into language education in HE (Higher Education) which stems from the changes put on language education by the social and economic phenomena such as the globalisation of the job market, growing importance of English as Lingua Franca (ELF), and the emergence of global business networks. The study compares student's perception of three different ICC-based modules, aiming at elaborating best practice scenarios for future implementations.

## KEYWORDS

Intercultural Competence, Telecollaboration, Language Learning, Higher Education

## INTRODUCTION

Implementation of new educational content into already functioning curricula is always a matter of efficiency and responsibility. This seems particularly true for one of the most dynamic branches of language teaching (LT), namely, Business English (BE), where the pressure on implementing new contents, methodologies, and approaches remains virtually ever-present. Consequently, maintaining the balance between a pragmatically motivated need for an "efficient class" on one hand, and the responsibility of the teacher to innovate the curriculum by responding to the changes enforced by the growing importance of networked and globalised environments, internationalisation, interculturalisation, as well as changing demands of potential employers and corporations on the other becomes one of the key competencies of a language teacher in HE.

With the growing importance of ELF (Jenkins 2009, 2011; Dewey 2009), LT opens even more space for the implementation of ICC-based activities into the HE curriculum (Byram, Nichols and Stevens 2001; Feng, Byram and Fleming 2009; Byram 2012, 2014; Popescua and Iordachescu 2015, Reid 2015). Despite calls for caution, careful methodological scrutiny or even open scepticism regarding the use of ICT in LT communicative activities (including ICC-based activities) articulated by a number of renown researchers (Kern 2006, 2014; Kramsch 2013; Liddicoat and Scarino, 2013), the international ELT (English Language Teaching) community was quick to exploit the opportunities offered by various ICT tools to develop joint LL/ICC contents (O'Dowd 2015) and integrate these contents into BE classes (Tomalin and Nicks 2007; Lustigová 2012; Polyakova 2016). Even though most ELT teachers seem "to have a positive attitude towards the use of computers in their language teaching" (Yükselir 2016:28), the

implementation of ICT-supported/telecollaborative ICC tasks, and careful evaluation of “the options with which telecollaborative instructors are confronted when designing tasks for their learners” (O’Dowd and Waire 2009: 174) remains a methodologically complex undertaking (O’Dowd and Waire 2009; Helm, 2015; O’Dowd 2009, 2016b; **Yükselir 2016**). Considering this situation, the presented study offers a contribution to the ongoing debate in the field of LT by discussing the results of a pilot phase of an ICC-based project implemented at the MIAS School of Business & Intercultural Studies, CTU in Prague (MIAS).

## **MATERIALS AND METHODS**

During the pilot phase of the presented project (winter term of the academic year 2016/2017) three test-versions of work-in-progress ICC-based modules were implemented in ten BE classes of BSc study programmes “Management and Economy of an Industrial Enterprise”, and “Personnel Management in Industrial Enterprises”. The implementation was followed by a questionnaire survey testing the response, motivation, and attitude of the students, focusing on students’ perception of their own ICC and intercultural awareness as well as on their general attitude towards the newly introduced ICC contents. The aim of the test phase was to establish best practice for future implementations of these elements into HE the curriculum. The piloted modules represent a result of an international cooperation between the teachers from partner universities, namely from the MIAS School of Business, Budapest Business School, the University of León, and Instituto Politécnico de Castelo Branco, brought together as part of the Erasmus+ KA2 Programme No 2015-1-CZ01-KA203-013992.

All of the considered module versions (A - C) were designed with a common goal to introduce ICC-based content into ELT by confronting students with the culture of the international partner. The designing of different versions was by the impossibility to secure appropriate international partner for all groups as well as by the need to enable the participation of students of all language levels. All of the implemented modules are based on the so-called “comparison method” (Reid 2015:941), and might be classified by the following criteria: Content: Project-based vs. Blog-based activity, and Form: Telecollaborative vs. In-class. The designed module versions (A - C) can be further described in the following way:

As part of Module A (A) “Intercultural Blog” (A2+ CEFR level), students of BSc BE classes were asked to write a series of blog posts for the newly arriving international students of MIAS language prep-courses for potential CTU students. During the ten-week module, the BSc students wrote a given number of entries on the topic: “Advice for international students coming to live and study in Prague”, with the international students joining in with comments, questions and feedback. The aim of the blog was to provide the international students with advice, informal tips, and cultural info that might soften the impending culture shock. The blog was administered by individual course teachers; the posts were discussed for 10-15 minutes from the language and cultural point of view at the beginning of every class. The whole activity was implemented exclusively on a telecollaborative basis using an internet-based application “Google Blogger”.

Module B (B), entitled “Negotiating with International Partners” (B1+ CEFR level), was a nine-week-long module during which students, working in teams of three to four, engaged in a sequence of telecollaborative tasks. The overall goal of the telecollaboration was to simulate the processes (data collection, online consultations, and final negotiations)

of launching a selected national product of the students' choice onto their international partner's market. The module consisted of the following activities:

A1: Select products which could potentially sell well on the partner's market, and prepare a short description and presentation of these products.

A2: Discuss the selected products and prepare an in-class presentation.

A3: E-mail the finalised list of products to an assigned partner group.

A4: Provide relevant feedback on the saleability of the two products on the target market.

A5: E-mail feedback on their partner's product choice.

A6: Research the cultural background of the international partners.

A7: Prepare the product negotiation plan, marketing strategy, and preliminary quotation.

A8: Become acquainted with the stages of the negotiation process.

A9: Skype meeting/negotiation with international partners.

A10: Write a final negotiation report.

In addition to the above presented modules (A and B), a simplified, non-telecollaborative Module C (C: B1+ CEFR level) was designed. This simplified, four-week-long version of the module relied on the elimination of all telecollaborative tasks, namely A3, A4, A5 and A9. The final negotiation was replaced by a team-presentation of selected product(s), and the results of students' research into the business culture of a selected foreign market, including the rationale behind the choice. The drawback of this module was that student teams consisted of students from the same class, i.e. from the same cultural background. Upon concluding the pilot phase of the project, all of the involved students were asked to fill in a short questionnaire evaluating their experience and attitude to the ICC content. The survey was designed utilising a non-standardised questionnaire consisting of five statements (1-5) and one open-ended question. All statements offered a modified five-point Likert Scale with response categories for each of the given statements arranged in a descending order of weighting from "I Completely Agree" (5 points) to "I Completely Disagree" (1 point). Respondents were asked to express the selected level of their agreement with each statement of the inventory. The questionnaire consisted of the following statements:

After concluding the ICC-based module:

1. I understand more about how other cultures see the world.
2. I understand more about how my own culture affects the way I look at the world.
3. I understand I need to adapt my language and way of communicating to others' needs.
4. I realise that cultural diversity in business environments is something I need to study more about.
5. I realise that I need to study more about how other cultures work and communicate in business contexts.

The survey was conducted using Google Forms. In order to maintain ethical standards, all questionnaires were anonymous and student participation was strictly voluntary. The questionnaire was sent to 153 students out of which 140 (91.5%) filled in their responses. The respondent group consisted of 150 students of 2<sup>nd</sup> year BSc students of study programmes "Management and Economy of an Industrial Enterprise", and "Personnel Management in Industrial Enterprises" out of which 29 were males (22%) and 111 females (78%). The collected data were analysed and tested using standard tools such as mean and

a t-test. The aim of the test was to compare the effectiveness of individual versions of the modules (A - C) in order to determine if: a) telecollaborative modules (A and B) are more effective than in-class modules (C), and b) if project based modules (B and C) are more effective than blog-based modules (A). In order to do this, the below stated hypotheses were formulated:

$H_{0:1}$  there is no significant difference between the students' perception of the intercultural impact of telecollaborative (A and B) and in-class/non-telecollaborative modules (C).

$H_{0:2}$  there is no significant difference between the students' perception of the intercultural impact of project-based (B and C) and blog-based modules (A).

## RESULTS

First, the results for telecollaborative (A and B) and non-telecollaborative modules (C) were compared in order to establish if there is a statistically significant difference between the two versions.

$H_{0:1}$		1.	2.	3.	4.	5.
A+B ( $N_{AB}=90$ )	Mean	2.901	3.187	4.011	3.769	3.901
	Stat. Dev.	1.012	0.930	0.810	0.870	0.870
C ( $N_C=50$ )	Mean	3.500	3.360	4.100	3.780	4.080
	Stat. Dev.	0.763	0.776	0.886	0.887	0.804
<i>t</i> -values		-3.948	-1.176	-0.587	-0.071	-1.225

**Table 1: Comparison of mean scores for statements 1.-5. for telecollaborative (A and B) and in-class modules (C) with *t*-values for individual statements (source: own calculation)**

The results summarised in Table 1 above indicate that the mean scores in favour of statements 1 - 5 for A and B are in all instances greater than the mean scores in favour of statements 1 - 5 for C. The table further indicates that the *t*-values for statements 2 - 5 are not greater than the critical *t*-value 1.965 at 5% level of significance. Therefore, the scores for these statements are not significantly different. The exception is the *t*-value for statement 1 (shaded) which is, with *t*-value -3.948, greater than the critical *t*-value 1.965 at 5% level of significance, indicating that there is a significant statistical difference between the two tested samples. The tested null hypothesis  $H_{0:1}$  proposing that there is no significant difference between the student's perception of the intercultural impact of telecollaborative A and B and in-class C remains valid for all statements with the exception of the statement 1.

$H_{0:2}$		1.	2.	3.	4.	5.
A ( $N_A=70$ )	Mean	2.743	3.057	3.957	3.757	3.857
	Stat. Dev.	1.059	0.976	0.806	0.892	0.937
B+C ( $N_{BC}=70$ )	Mean	3.486	3.443	4.114	3.786	4.071
	Stat. Dev.	0.717	0.735	0.860	0.866	0.748
<i>t</i> -values		-4.861	-2.643	-1.114	-0.195	-1.493

**Table 2: Comparison of mean scores for statements 1. - 5. for blog-based (A) and project-based (B and C) with *t*-values for individual statements (source: own calculation)**

The results summarised in Table 2 above indicate that the mean scores in favour of statements 1 - 5 for B and C are in all instances greater than the mean scores in favour of statements 1 - 5 for A. However, the table further indicates that *t*-value for statements 3 - 5 is not greater than the critical *t*-value 1.965 at 5% level of significance. Therefore,

the scores for these statements should not be seen as significantly different. The exception to this trend are the *t*-values for statements 1 and 2 which are, with *t*-values -4.861 and -2.643 (shaded), greater than the critical *t*-value 1.965 at 5% level of significance, indicating that there is a significant statistical difference between the two tested pairs. The null hypothesis  $H_{0.2}$  proposing that there is no significant difference between the student's perception of the intercultural impact of project-based B and C, and blog-based A remains valid for all statements with the exception of the statement 1 and 2.

		1.	2.	3.	4.	5.
A; N=70	Mean	2.743	3.057	3.957	3.757	3.857
	Stat. Dev.	1.059	0.976	0.806	0.892	0.937
B; N=20	Mean	3.429	3.619	4.190	3.810	4.048
	Stat. Dev.	0.598	0.590	0.814	0.814	0.590
	<i>t</i> -values	-3.726	-3.191	-1.131	-0.251	-1.104
A; N=70	Mean	2.743	3.057	3.957	3.757	3.857
	Stat. Dev.	1.059	0.976	0.806	0.892	0.937
C; N=50	Mean	3.500	3.360	4.100	3.780	4.080
	Stat. Dev.	0.763	0.776	0.886	0.887	0.804
	<i>t</i> -values	-4.551	-1.892	-0.905	-0.14	-1.397
C; N=50	Mean	3.500	3.360	4.100	3.780	4.080
	Stat. Dev.	0.763	0.776	0.886	0.887	0.804
B; N=20	Mean	3.429	3.619	4.190	3.810	4.048
	Stat. Dev.	0.598	0.590	0.814	0.814	0.590
	<i>t</i> -values	0.413	-1.509	-0.407	-0.136	0.184

**Table 3: An additional comparison of mean scores for statements 1. - 5. for all modules A and B, A and C, and C and B (source: own calculation)**

In order to obtain more detailed results that would allow a more accurate comparison of all individual modules (A - C), an additional comparison of mean scores and *t*-values was conducted. The results summarised in Table 3 above indicate that the mean scores in favour of statements 1 - 5 for C are the lowest from all of the considered modules. The table further indicates similar results in terms of mean score for all three modules for statements 3 - 5. The biggest difference in terms of mean score can be observed statements 1 between modules A and B (-3.726), and A and C (-4.551, both shaded); in both cases, the *t*-value is greater than the critical *t*-value 1.965 at 5% level of significance, indicating that there is a significant statistical difference between the tested samples. The difference between B and C in terms of mean score for statements 1 - 5, and the *t*-value for the given statement-pairs is not greater than the critical *t*-value 1.965 at 5% level of significance, indicating that there is no significant statistical difference between the two pairs of tested samples. These results confirm the tendency of similar results for B and C in comparison to results for A in statements 2, and in particular in 1.

## DISCUSSION

The results of the survey are in line with the results of the latest comparable research (Lustigová 2012, Polyakova 2016, O'Dowd 2016), indicating that the traditional forms of ELT alone are no "guarantee of success in an international environment" (Candel-Mora 2015:30). Although the results make it possible to conclude that all compared module types were implemented successfully, it is interesting to consider the statistically significant differences among individual module versions for statements 1 and 2. Perhaps



unexpectedly, the most significant difference can be found between the blog-based and project-based modules, clearly proving the later of the two to be more suitable for the given “institutional and learning contexts” (O’Dowd and Waire, 2009).

This difference can be explained by a number of factors: First, the analysis of students’ comments (open-ended question 6) revealed that more than 30% of the respondents considered the blog activity as lacking “feedback from other students” and/or as not offering “relevant content”. Blogging was perceived as problematic in particular due to its lack of “structured approach”, and perhaps even “teacher intervention” (O’Dowd and Waire, 2009), proving concerns of researchers who warn that technological mediation may in fact hinder intercultural understanding (Kern 2014: 354). In this respect, the blog did not live up to the expectation of becoming a “natural” platform for students to interact spontaneously. This is especially true in the context of BE classes, in which a blog, as a prevalently “information exchange task” (O’Dowd and Waire, 2009), often does not provide sufficient motivation to business oriented BE students.

Further, in comparison to the project-based modules, the blog was described as not providing enough practical or hands-on experience with business-related situations. In this respect, the comparatively lower scores for A should not be attributed to problems with technology as part of LT (compare Lustigová, 2012) but rather to the unwillingness to actively participate in creating the non-business contents of the blog. In contrast, both project-based modules were evaluated positively as fostering the integration of culture- and business-oriented activities, clearly defined tasks, and overall “usefulness for students’ future jobs.” As one of the students speaking about B summarised:

*“This international project was very useful. We learned about communication with people from other country and we learned how to use business phrases in real word. Now I know that business habits in foreign countries are different from habits in the Czech Republic. I learned how to work in group and cooperate by computer [sic]. In my opinion this is right way how to teach business English.”*

Finally, the difference between the perception of B and C appears to be inconsequential, despite the fact that the students implementing B had to undergo a longer and much more complex series of telecollaborative tasks. The common assertion that appears in students’ answers is again the importance of real-life business context/situation (Polyakova 2016). Moreover, the role of this aspect is so strong that it seems to erase the difference between collaborative B and non-collaborative C. Rather than interpreting these results as a failure of the telecollaborative model which, with all the demands it puts on the teacher as well as the student delivers comparable results to non-telecollaborative models, it seems more plausible to see telecollaborative and non-telecollaborative ICC as complementary methodological tools that maintain their specifics and are suitable for different types of students.

## **CONCLUSION**

The lesson learned from implementing different variants of ICC-based modules clearly confirms the necessity to adjust the implemented material to the needs of individual students. This is especially true in the context of BE and ESP in general. From the students’ perspective, the need for an appropriate task layout, sequencing, and module complexity in general have proven to be at least as important as the choice of appropriate educational contents. With this being said, any attempt at integrating ICC-based modules into BE classes has to respect the specific nature of BE classes and work hand in hand with tailor made, well planned business-related tasks.

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# FACTOREASY®: DO STUDENTS TAKE A RISK?

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## ABSTRACT

In the article, we focus on students' risk level in making decisions in strategic management. To compare, in which strategy students show higher risk, we use a repeated experiment. As the experiment environment, we use business simulation FactOrEasy®, which is the online dynamic deterministic simulation of decision-making in financial, operation, or strategic management using artificial intelligence to compete against human player. We use exports from the best games of 37 students (1st year of masters' studies). To define risk, we identified decision-making spots in the game, clustered them logically, and used following groups to identify level of risk undertaken by students in the simulation: strategy behaviour, buying behaviour, selling behaviour, result behaviour, and profitability behaviour.

## KEYWORDS

Artificial Intelligence, Business Simulation, FactOrEasy®, Risk, Strategic Management

## INTRODUCTION

In the article, we follow previous research identifying the benefits resulting from the use of the unique business simulation FactOrEasy® (Švec et al, 2016) and expand the identified educational benefits focusing on risk taking attitude in strategic management decision-making and strategy implementation. As the experiment environment, we use business simulation FactOrEasy®, which is the online dynamic deterministic simulation of decision-making in financial, operation, or strategic management using artificial intelligence to compete against human player (Švec et al, 2016).

As we focus on the area of strategic management, the strategy is the key term to be defined. Unfortunately, many authors (Mintzberg, Ahlstrand and Lampel, 2009; de Wit and Meyer, 2014; Norton and Irving, 1999) agree there is no single definition of the strategy, which would be universally accepted. De Wit and Meyer (2014: 3) even say that there is too many different opinions and disagreements 'that even a common definition of the term strategy is illusive'.

Mintzberg (1987) provides sufficiently broad view of strategy definition with five terms: plan, ploy, pattern, position, and perspective. Moreover, Mintzberg explains a plan as consciously intended course of action, the ploy as a specific manoeuvre intended to outwit

an opponent, the pattern as a stream of actions, the position represents location of an organisation in an environment, and perspective as not just a chosen position, but as the common thinking behaviour of employees in specific organisation (Mintzberg, 1987). Every player in the FactOrEasy® can make only limited number of actions each round (such as decisions about how many materials to buy and for what price, how many products to produce, how many products to sell and for what price, to buy an additional factory or not, and to take a loan or not). In this article, along with Mintzberg (1987), we see strategy as stream of actions, which we consider as one of Mintzberg's point of view on strategy (pattern).

Each FactOrEasy® game is set up in an environment of decision under risk. However, every player has available analytical tools, which help to diminish the risky environment. Similarly, as in case of strategy, there is no consensus on how to define and interpret risk (Aven, 2015). 'We perceive the world before we react to it, and we react not to what we perceive, but always to what we infer.' (Knight, 1964: 201). Holton (2004: 24) adds: 'It is not easy to operationally define perceived risk because perceived risk takes many forms. To simplify the tasks, we may operationally define some aspects of perceived risk.' It might be, for example, a variance of return or maximum likely credit exposure or any other. Lopes (1987) frames the decision situation to be whether attractive (it means an opportunity) or risky (a threat). Krueger and Dickson (1994: 387) agree on that as managers 'tend to categorize decision situations into opportunities and threats. They tend to see controllable situations as opportunities and they tend to see uncontrollable situations as threats'. Therefore, risk can be understood as a situation that involves evidences of uncertainty.

Šotič and Rajič (2015) used a lot of definitions of risk from different authors and categorized them into several groups, where risk is expressed: 1) by means of uncertainty and expected values, 2) through consequences and uncertainty, or 3) in relation to objectives.

In this article, we define risk in accordance with Mun (2006) as consequence of actions taken despite an uncertainty. In addition, the following text is divided into parts corresponding to selected operationally defined aspects of risk logically linked to the corresponding research questions. We consider aspects as defined by Holton (2004): strategic behaviour, selling and buying behaviour, and profitability and results behaviour. The aim of the article is to analyse students' risk attitude behaviour in FactOrEasy® games. This analysis would provide a valuable insight leading to better comprehension of different game results, i.e. why some students bankrupt, take a loan, buy an additional factory (factories), make better cost or price estimates and some students do not. Consequently, the results of this analysis can be used not just in the Enterprise Management course regarding better aiming on students' educational needs, but also development needs in management training.

## **MATERIALS AND METHODS**

We used the results from the pilot run of the FactOrEasy® simulation, which had been played in December 2015 and January 2016 with a sample of 44 students of Enterprise Management course taught at Faculty of Economics and Management, Czech University of Life Sciences Prague (Švec et al, 2016). 'Students were in the 1<sup>st</sup> year of master studies, all of them were studying the course Enterprise Management' (Švec et al, 2016: 568). Results of 7 students had to be excluded from the further analysis as students did not finish all 12 rounds. Therefore, 37 exports from 11 male and 26 female students are used in the

risk attitude analysis. The overview of the context of FactOrEasy® and its gameplay process is described in Pavlíček et al (2015), techniques of data acquisition are described in Švec et al (2016).

The main aim in the game for students was to earn as much 'cash' as possible. Students could play as many games as wanted to present their best game (Švec et al, 2016). Each round of the game consists of three phases: 1) purchase of materials, 2) product processing, 3) sale of products. Therefore, a player of the FactOrEasy® game can make only limited number of decisions each round as: 1a) how many pieces of material to buy, 1b) what the price for the material will be, 2) how many products you can process, 3a) how many products to sell, and 3b) what the price for the products will be. Further, there are two additional decisions each player can take anytime during each round: 4) to buy additional factory, and 5) to take a loan.

We use three main aspects of students' perceived risk regarding students' in-game behaviour: 1) strategic behaviour, 2) buying behaviour, and 3) selling behaviour (regarding 3 main phases in each round). Nevertheless, we also watch two results oriented categories: 1) profitability behaviour, and 2) results' behaviour. In *strategic behaviour*, we include number of loans student takes in a game, number of factories student additionally buys, number of bankrupted competitors in the game, and a strategy student takes in a game. According to these data and its combinations, we distinguish risk averse, risk neutral, and risk seeking strategic behaviour. In *buying, resp. selling behaviour*, a student must decide about the amount of money he/she wants to exchange for a material, resp. products. In order to detect the risk level, a student is willing to take, we use student's distance from the market price (purchase price, resp. selling price). For the analysis, we use calculation of standard deviation to determine student's risk attitude behaviour.

In *profitability behaviour*, we pay an attention to three indicators of financial analysis available from game records: 1) Return on assets (ROA), 2) Return on sales (ROS), and 3) Debt-to-equity ratio. To compare students' risk attitude, we use market order of achieved ROA and ROS. ROA 'assesses a company's profitability relative to the assets it controls and is therefore a measure of how efficiently a company is using the assets at its disposal.' (Marr, 2012: 49). ROS, operating margin, operating income margin, operating profit margin basically 'tells how much money a company makes (before interest and taxes) on each dollar of sales.' (Marr, 2012: 17) Debt-to-equity (D/E) ratio basically means dividing a company's total liabilities by its equity (Marr, 2012). *Results' behaviour* represents students' outputs categorised into three categories regarding student's objective in the game. Poor results' behaviour means that student experienced deviation disrupting the main objective, neutral results' behaviour shows that student did experience deviation, which undermined the main objective, whereas focused results' behaviour represents the game with no deviation in the objective.

Within the above mentioned five categories, we expressed the following research questions:

- What types of strategy or strategies do students use in the game?
- What relation is between used strategies and risk attitude representing by operationally defined aspects: 1) factory buying, 2) loan taking, and 3) bankrupted competitors in the game?
- In which strategy used in the game did students exhibit riskier behaviour in buying material?
- In which strategy used in the game did students exhibit riskier behaviour in selling products?

- In which strategy used in the game did students achieve higher level of profitability?
- In which strategy used in the game did students remain more consistent with initial aim?
- Is there any strategy used in the game we can assume to be the riskiest?

We used contingency tables in order to answer the research questions.

## RESULTS

### Strategic Behaviour

Students used three different strategies in the game. In the first strategy, students focused on the costs' lowering in their external environment (further reported as CLS1). In the second strategy, students focused on the internal factors and cutting their own costs (further reported as CLS2). The third strategy was the mutual combination of CLS1 and CLS2 (further reported as CLS1&CLS2).

Nearly half of students (49%) used CLS1 strategy, which means they tried to find ways to take advantage of cheaper material. Nearly third of the students (30%) used CLS2 strategy as they focused on lowering costs inside the production. Only 21% of students were able to follow both strategies simultaneously. As we can see (Table 1), the absolute majority of students (78%) did not take loan during the game. Games without bankruptcy occurred in 35% cases, one bankruptcy in the game appeared in 46% of games, which reveals low students' willingness to take risks and proactivity, as the exits of competitors (artificial intelligence) did not occur due to activity of human students. The overall strategic behaviour results indicate that 38% of students show risk aversion, 43% risk neutrality, and 19% of students belong to risk seeking behaviour.

Strategy used	Number of students	Students bought factory		Students took loan		Students bankrupted competitors	
CLS1	18	12	66.67%	5	27.78%	14	77.78%
CLS2	11	2	18.18%	1	9.09%	6	54.55%
CLS1&CLS2	8	7	87.50%	2	25.00%	4	50.00%
Total	37	21	56.76%	8	21.62%	24	64.86%

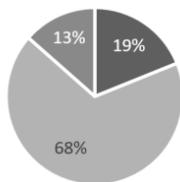
**Table 1: Additional bought factories, taken loans, and bankrupted competitors disaggregated over the type of strategy (source: own calculation)**

According to Table 1, the most active behaviour in factories buying were presented within the CLS1&CLS2, followed by CLS1. Moreover, from the point of loan taking, these two strategies (CLS1 and CLS1&CLS2) were used the most. On the other hand, CLS1&CLS2 with the CLS2 were the strategies with the lowest occurrence of bankrupted competitors (50%, resp. 54.55%).

### Buying and Selling Behaviour

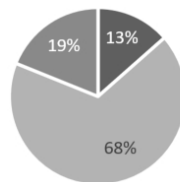
Comparing buying and selling behaviour in Figure 1, we can see very similar pattern. In both cases, students tend to be risk neutral in buying material and selling products (68%). Further, less students tend to risk in material buying (13%) than in products' selling (19%).

### Buying behavior



■ Averse ■ Neutral ■ Risky

### Selling behavior



■ Averse ■ Neutral ■ Risky

**Figure 1: Overview of buying and selling behaviour (source: own calculation)**

Strategy used	Number of students	Risk averse		Risk neutral		Risk seeking	
		Count	Percentage	Count	Percentage	Count	Percentage
CLS1	18	1	5.56%	13	72.22%	4	22.22%
CLS2	11	2	18.18%	6	54.55%	3	27.27%
CLS1 & CLS2	8	2	25.00%	6	75.00%	0	0.00%
Total	37	5	13.51%	25	67.50%	7	18.92%

**Table 2: Buying behaviour disaggregated over the type of strategy (source: own calculation)**

In Table 2, we can distinguish differences in risk buying behaviour regarding all three strategies used in the game, whereas Table 3 summarizes risk attitude considering selling behaviour. There are clearly visible changes in buying and selling behaviour in risk averse and risk seeking category and stability in risk neutral category across all strategies. Strategies in which students did not take risk at all are CLS1&CLS2 in buying behaviour and CLS2 in selling behaviour. Strategy, which does not lead to risk averse in selling behaviour is CLS1&CLS2.

Strategy used	Number of students	Risk averse		Risk neutral		Risk seeking	
		Count	Percentage	Count	Percentage	Count	Percentage
CLS1	18	2	11.11%	13	72.22%	3	16.67%
CLS2	11	5	45.45%	6	54.55%	0	0.00%
CLS1 & CLS2	8	0	0.00%	6	75.00%	2	25.00%
Total	37	7	18.92%	25	67.57%	5	13.51%

**Table 3: Selling behaviour disaggregated over the type of strategy (source: own calculation)**

### Profitability Behaviour

The most students (60% for ROA and 81% for ROS) were the first in profitability (ROA, ROS) at their markets/games. In total 87% of students behaved profitably in the game. Despite that fact, only 41% of students did follow the objective of the game with no deviation (Results focused), 43% of students experienced deviation which undermined the main objective (Results neutral), and 16% of students experienced deviation disrupting the main objective (Results averse).



Strategy used	Number of students	Results averse		Results neutral		Results focused	
CLS1	18	1	5.56%	9	50.00%	8	44.44%
CLS2	11	4	36.36%	6	54.55%	1	9.09%
CLS1&CLS2	8	1	12.50%	1	12.50%	6	75.00%
Total	37	6	16.22%	16	43.24%	15	40.54%

**Table 4: Results behaviour disaggregated over the type of strategy (source: own calculation)**

Strategy used	Number of students	Profitability averse		Profitability neutral		Profitability focused	
CLS1	18	1	5.56%	0	0.00%	17	94.44%
CLS2	11	0	0.00%	1	9.09%	10	90.91%
CLS1&CLS2	8	1	12.50%	2	25.00%	5	62.50%
Total	37	2	5.41%	3	8.11%	32	86.49%

**Table 5: Profitability behaviour disaggregated over the type of strategy (source: own calculation)**

Table 4 shows the difference between strategies in results' focus. The most results oriented were students using the CLS1&CLS2 strategy (75% students) followed by CLS1 (44.44% students). The highest objective rejection is evident within the CLS2 (36.36%). We can assume as the most profitable strategies CLS1 (94.44%) and CLS2 (90.91%). Table 5 summarizes all profitability behaviours with regard to all three strategies.

## DISCUSSION

### Strategy Behaviour

Lowering costs of its operations, which was the strategy of all students in the game, is the 'Cost-leadership strategy' described by Porter (1998). To use this strategy, cumulative costs of a student must be lower than the cumulative costs of his/her competitors. The students used three ways to reach the cost-leadership in the game: (1) they controlled external factors affecting costs better than competitor (CLS1), (2) they improved balance of cost activities in the chain (in internal environment) (CLS2), and (3) they used both previous strategies in a combination (CLS1&CLS2). These findings perfectly fit with the Pohlmann's, Gardiner's and Heffes's (2000) view of the ways how to implement Cost-leadership strategy.

In general, we can say the students maintained within a low-level risk in the games (35% of games without any bankrupts, 46% of games with one bankrupts). In the real world, we usually cannot compare in which strategy the 'students' show higher risk in strategic management decision process or within the strategy implementation. In our context, using benefits of repeated experiment, we are able to determine any relation of strategy type and students' risk attitude. If we would express the risk in relation to the objective of the game (the highest possible amount of money earned by students), we can say that the higher number of events out of status quo (consciously decided by a student beyond the obvious gameplay) the higher risk attitude a student shows. Therefore, we can say, according to Table 1, that the strategies in which the students showed the riskiest behaviour were strategies CLS1 and CLS1&CLS2. Strategy in which students did not show such high level of risk behaviour was the CLS2.

## Buying and Selling Behaviour

In the buying and selling behaviour students used the price setting, which had been the best prediction of real market price in each round. Real market price of materials and products is set by the one-round auction, where minimal price for buying material and maximal price for selling products exist. This mechanism of products' price setting in the game is close to 'price leadership' strategy in real market's conditions. 'Price leadership is common in oligopolies whereby a price leader sets the price and all the other competitors feel compelled to lower their prices to match.' (Investing Answers, 2017) The conditions in the game best suit to barometric model of price leadership in which 'particular firm is more adept at identifying shifts in applicable market forces, allowing it to respond more efficiently within the market sector' (Investopedia, 2017)

Meanwhile the selling behaviour of a student directly affects the conditions of external environment, the buying behaviour directly affects the conditions of internal environment. This effect can be seen in Table 2, where the students undertaking CLS2 strategy are the riskiest in buying behaviour (27,27%) while in Table 3 we see they are the most risk averse in selling behaviour (45,45%). Similarly, the effect works almost the same for the buying behaviour. From Table 3 it is obvious that the CLS1 and CLS1&CLS2 are the riskiest strategies within the selling behaviour (16.67%, resp. 25%) and from Table 2 we can see, that the most risk averse strategy in buying behaviour is CLS1&CLS2 (25%).

As the students had a little or none knowledge in theory of cost-leadership or price-leadership strategy, there may be a premise the knowledge of strategy name, characteristics, the pros and cons, or even the strategy placement in the typology is not necessary for successful strategy execution in the game. The more important is to make an unbroken stream of good decisions, which we can than see as Mintzberg's point of view on strategy – pattern (Mintzberg, 1987).

We see from the previous results that there are two extreme types of behaviour among students in the game (CLS1 and CLS2) and their combination (CLS1&CLS2). In the game, students naturally split into three groups within the strategy affiliation. In the first group of extreme behaviours (CLS1), students missed the internal environment and, in the second one (CLS2), they missed the external environment. It is important to remind that the results of this analysis are based on the best games of participating students and the number of games they could play was not limited. We also expect no or little knowledge in theory as already mentioned. Therefore, we suggest that the most students are not either capable of holistic approach in the game (they are not able to create a stream of good decisions in both environments simultaneously) or they do not consider one of the business environments in the game to be important based on their experience from previous games. As Akan et al (2006) stated, there must be a low-cost leadership mind-set to achieve a low-cost advantage. We will consider these results in following research within the usage of qualitative methods and improved monitoring of students' development depending on finished games.

## Profitability Behaviour

We consider results' behaviour in relation with the focus to the objective demonstrated by students in the game. The highest risk averse attitude (36.36%) and the lowest focus (9.09%) to results are present in CLS2. As students undertaking CLS2 are concentrated only on internal firm processes, they might lose sight of the main objective. On the other hand, strategies orientated to external environment show more focus to results (CLS1

44.44% and CLS1&CLS2 75%). This result leads to the hypothesis that more holistic strategy is also more focused to the aim. We will test this hypothesis in further research. The highest focus to profitable behaviour present strategies CLS1 (94.44%) and CLS2 (90.91%). The higher profitability in CLS2 is caused by lower investments in factories' purchases (Table 1). On the other hand, the highest profitability within the CLS1 was caused due to high number of students who invested in factories' purchases, as well as the students were able to bankrupt the opponents and increased market revenues.

## CONCLUSIONS

In the article, we follow previous research (Švec et al, 2016) and we expand the outcomes of FactOrEasy® focusing on risk attitude in strategic management decision-making and strategy implementation. The students playing FactOrEasy® used in general Cost-leadership and Price-leadership strategies. They used the strategy naturally without previous deep theoretical knowledge. Only a minority of students could take an advantage of using the holistic approach to Cost-leadership strategy. Majority of students tended to miss the internal or external environments' settings. The level of students' risk attitude in the games was a lot less than we expected. Yet it is obvious that there is a certain level of risk in each of identified strategies. Unfortunately, we are not able to identify what strategy is the riskiest one in this moment as we do not have sufficient number of observations. Very important output for further work is that there is a group of students who, playing the CLS2 strategy, changed the initial goal for the intended goal and therefore missed the assignment. The conclusions we made in this article are only valid for the analysed sample. Thoughts, assumptions, and hypothesis arising from this study must be verified on samples with greater range.

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# STUDY EFFICIENCY IMPROVEMENT USING PERSONALIZED TEACHING AND ADAPTIVE POSSIBILITIES OF LMS MOODLE

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## ABSTRACT

The paper describes subject teaching personalization of informatics nature from the point of view of constructivist approach towards the learner. The authors' aim is to find efficient ways of information technologies for optimal adjustment of teaching procedure supporting e-learning support creation for personalized activity choice in the e-learning course Computer Architecture/ Logical Systems. In general, activities depend on ways of providing study materials, self-tests, questionnaires, etc. with regard to learner's cognitive and intellectual skill development that currently is a research subject of adaptive hypermedia system. By implementation of adaptability into teaching using e-learning might bring the possibility of individual approach to studying. It offers students a way to decide what part is next to follow. This decision makes the student feel as if he had a free hand in his study and creates the possibility of a non-linear passage through teaching system. The adaptive approach of educational system towards students brings to e-learning more elements of a real, educational environment where the teacher might approach each student individually and considers their skills and abilities.

## KEYWORDS

E-learning Course, Teaching Personalization, Ideal Student's Passage, Learner's Activity, Adaptive Hypermedia Systems, Petri Nets

## INTRODUCTION

How to use technologies efficiently in teaching? That is the question that resonates the last few decades in technical lectures of teachers, psychologists, theorists and experienced practitioners. Does technology help to improve the quality of teaching? The quality here means the quality of acquired knowledge of learners.

Naturally, e-learning is a part of this process (Kostolányová, Šarmanová and Takács, 2011). It is becoming a more popular way of learning and an access to education at universities mostly because of rapid growth of web technology. E-learning in this college form is a long-term and complicated process. It has to overcome a range of internal and external factors affecting the teaching efficiency and quality of content (Drlik and Skalka, 2011).

Personalized learning might be a solution – teaching tailored to student's needs, adaptable to his/her qualities – that is becoming more popular nowadays (Kostolányová, Šarmanová and Czezočková, 2010). There are various learning methods: some students start reading the materials from the beginning until the end, some deal with topics that are not clear enough, etc. Therefore after factor analysis that affects the identification of student's style, it is possible to choose a presentation of teaching materials. This kind of study organization would support study quality improvement in order to achieve better

results of learners (Preidys and Sakalauskas, 2010). For this reason, the implementation of adequate e-learning tools is one of the significant approaches of possible solutions of the problem (Kostolányová, Šarmanová and Takács, 2009). The keynote to create an e-learning environment is to respect and support the use of different styles of student learning. Then it is possible to prepare an educational environment that is more efficient and with an increased user friendliness and quality (Kostolányová, Šarmanová and Takács, 2011).

A typical accompaniment is an attempt to personalize the teaching process with the support of information technology. Siemens (2016) calls it as an adaptive teaching. Standards are taken, digital teaching materials are created and are built into a system of teaching control. Then the control attempts to present the most suitable (adapted) procedure to meet the united, educational objectives according to individual data acquired by user activity. Basically, the path is the same for all the learners; it is only the time and order of the tasks modified. Apparently, the development of this field heads to application of artificial intelligence. Knowing that for the future of learners, the importance of factual knowledge in teaching material content (textbook) is lower than the ability to learn the whole life how to adapt (to learn) to changing conditions, Siemens (2016) concluded: **adaptive current learners are needed more than adaptive computer systems.**

Spencer (2011) drafted 4 levels of education personalization. In the paper the target group is oriented on college students.

1. **Standardization** is the first phase. Teaching is focused on the whole group but it is rather difficult. The teacher attempts to plan the lesson and to get the interest of average students.
2. **Differentiation** is the second phase. The aim is to cover various levels and groups within one class. The teacher thinks about what the various group need and how their activities can be differentiated. Thus, the student can choose a teaching activity that suits his own style.
3. **Adaptability** is the third phase. The aim is to secure individual teaching activities so that the learners might affect their own learning. There is also a bigger number of possible ways where teaching can head. The student receives an offer of teaching possibilities. This offer is defined by a system working according to data acquired on the base of previous activity.
4. **Personalization** is the fourth phase. Students have the authority to set their own teaching.

At this point it would be convenient to think about the difference between Spencer's (2011) personalization and individualism since they are often being mixed.

The mentioned issue would be assessed from the point of view of personalization. Spencer (2011) has expressed its teaching nature perfectly when he described the way how to reach it by four phases: standardization, differentiation, adaptability and finally personalization for which he used the metaphor "jamsession". According to him, here all the participants had their own space to apply and to create a joint work together. There is not yet a single automated computer system that would be able to support this kind of personalization.

The boundary where technologies cannot get yet is possible to characterize as four steps heading to a personalized group of learners (Pruett, 2014).

1. Truly know students.
2. Adapt teaching activities to individual needs.
3. Evoke student interaction (via technologies).
4. Help students to set their own goals.

A teaching system called Knewton is considered to be an innovator of adaptive teaching systems. A corporate developer Nepom explains the differences between technologies supported by differentiated, personalized and adaptive teaching as follows:

**Differentiated teaching** is the case where students are provided by a number of various ways to knowledge from which (typically recommended by the teacher) they choose one.

**Personalized teaching** means that teaching process is tailored to all according to their abilities (knowledge) found out before the start of teaching activity (usually in a form of a pretest). There are no modifications during teaching.

**Adaptive teaching** happens when the teaching process is modified during the activity (e.g. a test) based on immediately achieved results.

During the activity, Knewton registers data about what the student is doing, his results, what style of work suits him the most. According to the data, in each moment it recommends him how to continue in his study if he wants to achieve the stated objective. Each student proceeds to a different automatically generated trajectory due to different needs, interests, abilities and also weaknesses (Harrison, 2013).

### **Systems to support adaptive teaching and e-learning**

For learner's orientation in the created e-environment, an important aspect for the learner is his possibility to orient in an educational environment and at the same time to use the possibilities of the educational system for his own learning. To achieve these objectives, software systems are used – hypermedia. The use of these systems for e-learning can be considered as a standard issue. Their importance rises because of the extensiveness of information system space for e-learning. Despite this, compared to other hypermedia systems, current systems for education have an advantage that the information space is relatively small and closed. Without any additional support the user (student) can “get lost” in information space easily. It is set not only by the extent of information space in quantitative concepts (the number of lines in the text, pictures, etc.) but mostly by possibilities of intellectual mastery that in most cases do not depend on presented material quantity. Orientation in study materials has a significant influence on learning process efficiency. Some pre-defined ways in application domain model can be a possible solution. Although the problem with this might be that each student has his own order of lessons (e.g. depends on his level of knowledge, learning style, learning time). Because of this reason it is essential to adapt the teaching process to the student's requirements and abilities. The learner adapts in the amount of information to achieve the objectives given by the teacher. For this purpose there is a so-called adaptive hypermedia (AH) that enables to apply individual approach to running study with e-learning support. Methods and techniques of AH provide ways of dynamic presentation adaptation, content or navigation considering the actual state of user characteristics or environment where the information can be provided. The main aim of AH in teaching is to improve learning process efficiency or familiarization process with the information related to educational activities. Adaptation happens based on using various user characteristics (defined by user model) and environment characteristics in which the application is used (environment model).

The paper has nature of a summary of knowledge about the personalization influence of teaching in a specific branch of study. The authors deal with college teaching form where the satisfactory acquired knowledge is expected that is needed for the given professional studies acquired in secondary school. They are not interested in analysis of students training system and evaluation at secondary school, but their preparedness for a specific

college study. In the case of a specific chosen study, the authors have chosen a study at an informatics department. An IT subject Computer Architecture/Logical systems has been chosen for efficiency evaluation of technological support for improving learning outcomes.

## MATERIAL AND METHODS

### Personalized E-learning System (PeLS) focused on the learner

The success of personalized e-learning system (PeLS) requires a systematic modelling process of teaching processes, planning, creation, evaluation and on-line teaching environment realization where learning is actively encouraged and supported. An important part of e-learning system creation is its modelling and simulation in various environments. For teaching management, the aim of the system is routing communication according to student's knowledge and abilities and thus to direct the amount and demands of the material presented to learners. Considering control theory understanding, a transition from combination method to sequential series and optimized processes is obvious. For description and following control of this kind of teaching, Petri nets are suitable to use (Klimeš and Balogh, 2012). When modelling educational process, it is necessary to follow its interactive understanding, from mutual social participant interactions of the educational process. Subsequently created general model of educational process covers a wider environment, input factor, the process itself, such as its products, its immediate results and long-term effects. One of the modelling tools is Petri nets that have been used by Balogh et al. (2014) for educational process modelling and creation of student transition model through e-learning system. The model of the transition modelled in Petri nets is shown in Figure 1.

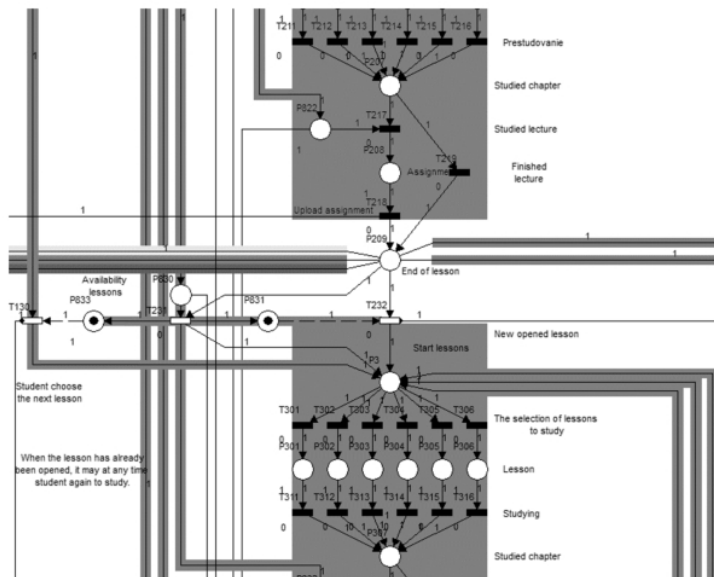


Figure 1: Example of modelling student transition through e-learning environment modelled in Petri nets.



Partial results and the particular model of student transition through e-learning system are presented in various publications (Balogh and Turcani, 2011; Balogh et al., 2011; Balogh et al., 2012).

PeLS should be reasonable not only for students but also for all participants including the teachers, support staff and the given institution. It is more probable that PeLS will be meaningful for the learner if it is accessible, clearly organized, well written, presented unequivocally and with certainty, oriented on the learner, affordable, effective, flexible and has an easily accessible teaching environment.

The analysis of the target group provides a specific characteristic of the learners. A proper acquisition of logging data provides important information that is needed to create activities for the target group. Since e-learning is accessible anytime and at any place, the learner can come from a culturally rather different environment and they might differ in access to study. Information about student's output knowledge and abilities, personal and social characteristics, skills, preferred styles of learning, needs and interests are the most important from the target group analysis point of view.

To obtain data about the target group, various methods can be used such as questionnaires, interview, observation, digest. Data with the utmost importance are mostly: quantified data about the level of knowledge in the given branch of study, results of standardized tests, preferences in learning, skills in the ICT field, knowledge of various systems for teaching support, previous experience with e-learning.

Another way of obtaining important information is Usageanalysis. System usage analysis helps to understand the students' behaviour in virtual educational environment. Focusing on end user, Usageanalysis represents a significant source of information. It is possible to get rather interesting and useful information from Log files. Log file is a software, an automatically generated electronic file. It is possible to find the saved information about the user's activity in a format predefined in advance. In order to analyse the generated file, it is necessary to know who, when, what and how has been carried out (Borhuis, 1997). It is the data sequence about user's behaviour saved on a permanent media. Log file analysis is one of the systematic approaches of data investigation and interpretation about behaviour. The aim is to find patterns in user behaviour and their interactions with the computer. The analysis serves in formulating association rules of user behaviour in an electronic course as well as in formulating rules about access sequence and frequency to electronic sources. It is an important tool enabling to make end user behaviour more transparent. It helps to better understand student behaviour in an educational electronic environment.

The more information is obtained from the abovementioned categories; the more can the creators of PeLS understand the target group. If the authors have complex information about the target group, they can create adequate teaching materials for the group. The analysis might also define those students for whom the e-learning course does not have to be suitable (Khan, 2006).

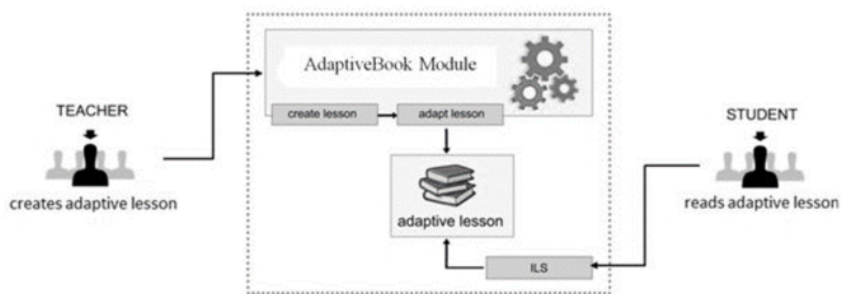
PeLS dynamically influences the learner, i.e. it does not have linear character of providing study material. The difference between the standard, linear transition through e-learning course and a direct one is interactivity. The concept of interactivity was explained by Mareš (2011). He says that it is a reciprocal activity between the learner and the e-learning system. The action/reaction of the learner is dependent on action/reaction of the system itself.

Each personalized e-learning course is characterized by:

- Specific data about the learner.
- Controlling system enabling choice adaptability.
- Structured content.
- Teaching objective of the given subject.
- Didactic function.

## RESULTS AND DISCUSSION

ILS questionnaires have been implemented into Adaptive Book in order to assign each learner a suitable learning style. When implementing the questionnaire, previous experiences (Nakić, Graf and Granić, 2013) have been followed where a module of similar nature has been implemented into LMS Moodle (Figure 2).



**Figure 2: Teacher's and student's interaction with AdaptiveBook module**

By obtaining information data from the completed questionnaire at the beginning of the semester and by application of association rules, the learner receives a personalized access in a form of adaptive providing of study material. By applying module Adaptive Book and a follow-up study result evaluation during the semester it has been found out that some students did not get sufficient study results. It follows that these students did not receive sufficient knowledge during secondary school study either.

It was not possible to determine the complete activities of learners by observing with the help of standard kit Report in LMS Moodle either. Determining the activity is one of important steps to personalization. It is possible to apply the association rules more consistently on the bases of information about the learner's movement in the course. Usually, the module Adaptive Book works on the basis of assigned learning style to a particular student. But what if the style changes during study because of unforeseen circumstances?

From study material access it has been found out that the learners had problems how to analyse and understand the provided study material even despite the fact that they have been provided by learning style. They were using the reverse transition to previous lessons that was considerably chaotic despite the Adaptive Book module.

For this reason, the relevant interactive module has been linked with the Adaptive Book module in order to identify more easily the learner's activity. By this module link a tool has been obtained that enables to mine data directly in learner activity with study material and to design them rolling changes in their learning styles. As a correction result, study materials have been provided, or an option to choose its part through implemented interactive animation. E-learning course has been significantly simplified. The number of

pictures and texts decreased and were replaced by this type of interactive media element itself.

At present, many authors' professional publications dealing with the implementation of ICT in education (Bhuasiri et al., 2012; Houška and Beránková, 2010) point to the fact that the development of ICT is higher than their actual use, and requires thinking about the elements that we need to improve to produce ICT effective integration in educational processes (Melia, Gonzales-Such and Garcia-Bellido, 2012). As Internet use has proliferated, e-learning systems have become increasingly popular. Many researchers have taken a great deal of effort to promote high-quality e-learning environments, such as adaptive learning environments, personalized/adaptive guidance mechanisms, etc. These researchers need to collect large amounts of behaviour patterns for the verification and/or experimentation. However, collecting sufficient behaviour patterns usually takes a great deal of time and effort.

## CONCLUSION

In the paper, authors were thinking about a way of creating a personalized procedure for the learner based on information about knowledge quality obtained from his input analysis. After getting the data that are specific for the learner, it is essential during the study get and evaluate his activities for his ideal transition through e-course in order to develop his cognitive and intellectual ability. A prerequisite for the design and realization in this form of ideal transition model of learner e-learning course were not only results showing the way of transition among each lessons from previous years of study but also the possibility of development of learner's psychomotor abilities by means of solving interactive types of tasks.

Ideal learner transition that has been the model designed and verified with modelling tool Petri nets has been successfully implemented in the academic year 2011/2012 into e-learning course Computer Architecture that is currently applied under the name Logical Systems. To remove the problem of linearity of teaching process that according to Balogh and Koprda (2014) represents a firm and binding sequence of steps in one line, it is more advantageous to use student transition in e-learning system realized by tests (interactive types of tasks) with continuous results within feedback.

As a conclusion there is a reflection. Education cannot resist the current trends in technology and should introduce effective tools applying adequate techniques and methods as describe Burgerová and Cimermanová (2014). The form of education has changed despite the concerns of experts from pedagogy, psychology and close branches. We are in the epicentre of technological development and the related knowledge sources in a form of an infinite data space.

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# THE ROLE OF EXPERIENCES IN MAINTAINING HIGH STANDARDS IN HIGHER EDUCATION

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## ABSTRACT

The goal of the paper is to analyze the effectiveness of upholding high ethical standards within the teaching-learning process in technical higher education in Romania. The methodology consists in conducting data analysis on the experience of university teachers and students and their academic conduct and results within the educational process, through quantitative and qualitative research. Results provide insights on how teachers' experiences and students' perceptions influence academic results and overall student conduct, as well as student perceptions on how teachers should deal with non-compliance when assessing projects or exams, as well as ethical issues. Results show that students from different years communicate amongst them and adapt to teachers' requirements being aware of their level of exigency, history with special cases and decisions in case of failing to meet their specific criteria.

## KEYWORDS

Higher Education, Ethical Issues, Academic Misconduct, Responsibility, Students' Pass Rate

## INTRODUCTION

Education is one of the most important pillars in a country's future development and enables the growth of quality of life and general welfare in the long-term, being an important asset of competitiveness. One of the most important aspects of education, besides the obvious role of providing knowledge and developing thinking and analytical skills in a specific domain, is teaching the role of proper conduct through ethics and encouraging high moral values amongst students. Most European countries value education and not surprisingly many European countries' education systems are ranked very high within the assessments and evaluations carried out on this topic. The focus on upholding certain standards and inspiring students to work hard and fair to achieve their academic results and become successful graduates are main concerns not only for higher education institutions, but for education in general (Espinoza and Najera, 2015: 1077). An effective educational process will provide graduates with a solid formation in skills and character traits both in their professional and personal careers and will enable the basis for the development of a successful career (Orosz, Toth-Kiraly, Bothe, Kusztor, Kovacs and Janvari, 2015: 2). This will in turn source a win-win strategy for both sides by raising the competitiveness of both the educational system, through the high quality of its graduates, and of the community which it serves, by supporting highly educated people and qualified human resources. One of the most important challenges universities in Romania face is the lower quality freshman students they enroll, who lack fundamental knowledge when entering

higher education. This raises issues for a fair amount of students from most faculties who are mainly oriented towards the goal of obtaining their degree, by passing exams, sometimes without even considering the means they use to do so (Gallant, Van Den Einde, Ouellette and Lee, 2014: 297). Sometimes cheating is unwarily facilitated by teachers as well, through their inefficient teaching methods or the lack of taking appropriate measures when faced with misconduct issues, when students try to gain an advantage by using unfair or deceitful methods (Kun, 2015: 1172). This indirectly encourages misconduct as it leads students to think that this kind of behavior is acceptable and they will try it again, if they see it works, creating further problems for the image of the institution (Foltýnek, Kravjar and Glendinning, 2014: 22).

The present paper focuses on a case study conducted at the Faculty of Management in Production and Transportation within the Politehnica University of Timisoara and highlights results in three specialization subjects regarding semester activity and exam results. An analysis upon semester activity results is carried out, which deals with student conduct in relation to teacher reputation and provides interesting findings in regards to exam results and pass rate for each of the three specialization subjects. The final part of the paper underlines the importance of proper ethical conduct within education in general and higher education in particular. The objective of the paper is to assess the effectiveness of strictly upholding ethical issues and how tolerating misconduct issues influences students' behavior and their academic results.

## **MATERIALS AND METHODS**

The overall quality of students in general and freshman students in particular has constantly been decreasing within the last decade according to teacher perceptions, which raises important problems when entering the higher education system as they often lack even fundamental high school knowledge. This is a challenge for both the freshman university teachers, who feel overwhelmed by the increased difficulty, as well as for the teachers who need to find solutions and bring them to the required academic level. The graduates from the Faculty of Management in Production and Transportation have a very good reputation within their specialization area, as they receive quality academic training and the Board is making efforts to continue to uphold its high academic standards for future graduates as well. The faculty is in line with the Politehnica University's strict policy against fraud or trying to breach ethical conduct through cheating attempts from students during evaluations (exams, projects or semester evaluations). These problems usually occur due to the scarce knowledge background from high school of the students and their inability to overcome this lag between what is required and expected from them during certain subjects (Turi, Mocan and Pujol, 2016: 593). Recent events in Romania have however shown that corruption and misconduct are no longer indirectly endorsed by the population, as the protests against the government have been the most impressive after the revolution almost 30 years ago, with almost 600,000 citizens participating, half of them in the capital, in Bucharest.

The research in question uses the case research method to analyze student results in three different core specialization subjects using quantitative and qualitative data. A year to year comparison based upon the effects on how ethical issues were handled by the teachers in question and students' behavior adaptation are provided, as well as applying an anonymous questionnaire through online tools as is Google Form to the students of the third year at the Faculty of Management in Production and Transportation. The main research questions refer to analyzing why and when students resort to cheating (hypothesis

1: students rely on word of mouth information about topics such as subjects and teachers and act accordingly), why students perform differently in certain subjects (hypothesis 2: most of the students will always try to comply with only the minimum set of established criteria for passing required by the teacher) and why higher education institutions need to uphold a strict ethical policy (hypothesis 3: the lack of unitary application of measures generates frustration and weakens the ethical standard of the university).

The sample used were the students within the third year at the Faculty of Management in Production and Transportation from the specialization Engineering and Management, as was the case a year before. The selection criteria considered the same three common core subjects, all of them having an important contribution to the students' skills development, which were commonly taught to all four groups (each group having a different specialization area). The instruments used for the case study were the grade register of the faculty, the exam reports for the three subjects, the Google Form online questionnaire, individual interviews and comparative data gathered by the teachers in all three subjects based upon the last year's experiences. Data analysis employs tables and figures to help interpret quantitative results, as well as relative change percentage interpretations, which are completed with qualitative results obtained from the online questionnaire and individual conducted interviews.

## RESULTS

	Subject 1	Subject 2	Subject 3
Total number of students	109	109	109
Number of students that passed	109	107	79
Number of students caught cheating	5	2	19
Number of students caught and punished	0	0	19
Number of students that did not pass (and did not cheat)	0	2	11
Total number of students that did not pass	0	2	30

**Table 1: Overview of semester activity results within the three core subjects, 2016 (source: own processing)**

	Subject 1	Subject 2	Subject 3
Total number of students	119	119	119
Number of students that passed	118	117	104
Number of students caught cheating	7	2	4
Number of students caught and punished	0	0	4
Number of students that did not pass (and did not cheat)	1	2	9
Total number of students that did not pass	1	2	13

**Table 2: Overview of semester activity results within the three core subjects, 2017 (source: own processing)**

Subject 1 achieves an impressive 99% pass rate, with almost all students having passed the semester activity. Although this seems to be a close to perfect record, 7 students have been caught while copying down answers from their colleagues during an evaluation at the seminar, but the teacher chose not to take any other measure than making them repeat the test. Last year this subject had a 100% pass rate and similar conduct during the seminar (when 5 students had copied down answers during an evaluation, without being punished in any way at the time). Subject 2 has a 98% pass rate, with only two students not being able to pass the semester activity. The teacher in charge at this subject also caught two students with a copied project, but chose to let them redo their project after the students



had admitted their fault and asked for a second chance (exactly as one year before, when the same situation happened and the same clemency was proven by the teacher). Thus, the results in subject 2 are practically mirrored for the last 2 years, both in results and conduct handling. Subject 3 has an 87% pass rate only (15 percentage points more than in 2016), with 9 students not being able to pass the semester activity and other 4 students being caught having rendered a copied project (5 times less than in 2016), as opposed to 2016, when 12 of the 19 students caught cheating (63%) came to ask for a second chance and 6 students (33%) even went to ask the Dean to overrule the teacher's decision because they has good grades and they would lose their scholarships due to their misconduct. Both the Dean and the teacher's decision were however upheld, the cheating students were not given a second chance and had to redo the entire semester activity in the following academic year, with extra charge.

After last year, when 2 students caught cheating had been expelled from the faculty, student awareness has increased and this year the exams had no problems in misconduct or fraud attempts. This was also noticed by the teachers from all 3 subjects: "I am pleasantly surprised to see that this year's students are more focused on their learning activity and overall I can say that they are more preoccupied with trying to be good students, which makes it easier to work with them and does not raise any problems. Last year's students were a little bit problematic, unfortunately, but I still say they were also pretty good students, some of them." (Subject 1) "I think there is a big difference in this year's student's conduct and last year. Their attitude is more proactive, they are more implicated and I feel there are far less cheating attempts than last year. I am quite surprised to see such a difference." (Subject 2) "I think last year was a good lesson for everyone and we can see immediate benefits, because the experience is new and almost all students are aware and know about it. I think rules are rules for everyone, no matter their grades in other subjects. This is by far the best generation I have had and I have been told by these students at the end of the semester that I am not at all as bad and harsh as they heard I was from last year's students. This is due to the fact that they did their job in a proper way, without attempting to try out my flexibility in ethical matters." (Subject 3)

Student representatives have shared their own and their colleagues' opinion, on the results of subject 3 and more specifically on how they view the measures taken by the teacher in regards to the students failing the subject by copying projects. A student representative is chosen by the students from each group (there are two groups of 35 students and two groups of 25 students) and one student representative is chosen by the students for the entire class. According to the first group's representative (35 students), the students were pleased with their grades and with the evaluation, which they considered fair, as well as all the support provided by the teacher throughout the entire semester. Within this group only 2 students failed to pass the seminar, thus leading to a pass rate of 94% overall for the group. The second group representative (35 students) said the students were very pleased with their grades and also with the entire seminar activity, which they said was very pleasant, despite being challenging. Within this group only 1 single student failed to complete the seminar with a passing grade, leading to a pass rate of 97% for the entire group and the highest for the entire class. Thus, within the two largest groups of the class, there had been no misconduct issues. The third group representative (24 students) also stated that the students were generally pleased with the way the seminars were conducted, but that they were disappointed of themselves for not being able to achieve better results, both for the project as well as for the evaluations, whilst some stated that they felt the evaluation was more difficult for them than for other groups. The third group has the

smallest passing rate, of only 71%, as 5 students did not obtain passing grades, whilst 2 others were caught copying the project and punished accordingly with immediate failure, although their grades had been high enough for them to pass. The fourth group representative (25 students) said that everyone was happy with the results and wanted to thank the teacher for his way of conducting the seminar activity, which everyone considered pleasant and thus kept their attention span high. Within this group only 1 single student failed to obtain a passing grade, but 2 students were again caught having copied the project and failed the seminar (surprising, because their grades had been high enough for them to pass), leading to a pass rate of 88%. One of the students having copied the project has also attempted to copy during a semester evaluation, along with another colleague from this group. Both of them had been dismissed and their evaluation was marked with no points. The second student managed to pass however as he worked hard for the rest of the semester and his project grade managed to compensate the lack of being graded for the evaluation.

Overall there were 14 students caught cheating, 4 students rendered a copied project for subject 3, whilst two other students did the same within subject 2, a further 7 copied down answers from colleagues during an evaluation in subject 1 and one other student was caught cheating during a semester evaluation. Interestingly one student attempted to cheat both at the project as well as at the evaluation in subject 3, being caught both times and when the teacher from subject 3 came in to supervise the exam in subject 1, that same student was the first to leave the exam. The students know that the regulations say that if they are caught cheating during an exam, they will be expelled. The students having rendered copied projects in subject 3 and the students caught cheating at the seminar during the semester evaluation were all punished (35%), whilst the rest were offered another chance by the other teachers, proving clemency for misconduct. Thus only 4% of the class students were caught cheating and punished, 8% were caught and were only given a warning, whilst the rest (88%) have not been exposed to misconduct issues and measures during the first semester within the three analyzed subjects. Although the misconduct issues within the class and overall had decreased overall since last year, the students had a very responsible attitude towards the way these ethical issues should be handled by the teaching staff of the faculty. "Our group worked very hard for these results in subject 3 and I think it is fair that those who failed to comply with the criteria were not given another chance, because the rules should be for everyone and not bent for "special" cases, as it happens sometimes" (group 1), "we are all very happy, it was a great seminar, although the project was really hard, the teacher really graded us the way he said he would and we are sorry we do not have more seminars like that; we all had very good grades, but I think we also worked really hard for them, so they do not come as a surprise to me" (group 2), "personally I was so happy with the fact that I passed that the grade I got or what results the others had, did not matter anymore to me; however I was pleasantly surprised to see that all those who really worked hard, despite having made mistakes in the project or during evaluation had passed" (group 3), "everyone knows what they did and it is their choice, but I think that it is better for hard work to be rewarded and for cheating to be sanctioned and not the other way around as we sometimes see, unfortunately" (group 4). The class representative concluded that "We were aware of the teacher's reputation to not tolerate misconduct, we heard about it and he told us that at the beginning, so I think everyone knew what his expectations were. All the class worked very hard and we learned many things during this seminar in a very nice atmosphere, which is due to the teacher, as he knew how to keep us focused, but also make it pleasant and even funny sometimes.

I am not surprised that not everyone passed, but I'm convinced that who worked hard is not disappointed with his results for this subject". Hypothesis 3 is confirmed.

The tenured teacher for subject 3 saw a big change in the results and the overall conduct of the students within these last 2 years: "Last year I remember having given the worst grades since I teach and many students coming to the exam without having learnt anything at all and rendered blank papers. This year attendance was very high for the course during the semester and at the exam almost all students had written very good exams, being a very pleasant surprise for me." This change in student conduct was explained by the group representatives: "after what happened last year with those caught cheating, everyone was a bit tense and I saw colleagues of mine working and studying as I never seen them do before" (group 1), "many students told me the teacher is awful and fails a lot of students, but after this semester I could see with my own eyes it was not the case; he appreciates hard work and implication and we really enjoyed the semester, despite being really challenging towards the end" (group 2), "this year everyone started working more and learning more than in the previous years and I think ethical issues have decreased, because of this year's teachers" (group 3), "the large majority of the colleagues in my group do not cheat, that's why we still have not passed all our exams, but although we were told that subject 3 is very difficult, it was actually not the case, because if you work and think things over, then it actually is pretty easy" (group 4). The class representative added "I am personally against cheating and tolerating this behavior as it is frustrating for those who work to see others get higher grades by using this employed "technique". There are still teachers, who do not enforce and uphold these regulations, but this year I think everyone knew who they were up against and it would be a good thing if more of the teachers were like that." Hypothesis 1 is confirmed.

	Subject 1	Subject 2	Subject 3	Group overall average
Group 1 average grade	8.96	8.33	7.85	<b>8.38</b>
Group 2 average grade	8.23	8.16	8.40	<b>8.26</b>
Group 3 average grade	6.96	6.60	5.77	<b>6.44</b>
Group 4 average grade	7.44	7.08	7.31	<b>7.27</b>
Overall class average	8.03	7.75	7.55	7.77

**Table 3: Average grades per group for the semester activity in all three subjects, 2016 (source: own processing)**

	Subject 1	Subject 2	Subject 3	Group overall average
Group 1 average grade	9.57	7.80	8.66	<b>8.67</b>
Group 2 average grade	9.00	7.58	9.32	<b>8.63</b>
Group 3 average grade	7.66	6.22	7.76	<b>7.21</b>
Group 4 average grade	8.28	6.58	8.27	<b>7.71</b>
Overall class average	8.74	7.17	8.65	8.18

**Table 4: Average grades per group for the semester activity in all three subjects, 2017 (source: own processing)**

The grades for the semester activity presented in tables 3 and 4 are averaged only for the students who passed the subject in discussion, while those who failed to do so are not taken into account. A student passes a subject if he obtains minimum 5 out of 10 for both the exam and the semester activity in order to be able to receive a final passing grade for that particular subject. In the event of failing the semester activity or/and the exam, they will not receive the associated credits for the subject and will need to retake the semester

activity or/and the exam within the following academic year with an extra charge. Results show that two of the four groups manage to obtain the best results in subject 1, whilst the other 2 groups achieve their best results in subject 3. Surprisingly all four groups score their lowest average in subject 2, which also has the lowest overall average. This is surprising because subject 2 is not considered by the students as a very tough one, whereas subject 3 for example is considered very hard. The smallest difference between grades is for group 3, where there are 1.54 points separating the highest and lowest average grade, followed by group 4 with 1.7. Group 1 has the widest discrepancy, 1.77, whilst group 2 has the second biggest range with a difference of 1.74 points. Subjects 1 and 3 are within the top three averages, with group 1 having the highest average in subject 1 (9.57), as well as the highest overall average in all 3 analyzed subjects (8.67), group 2 has the second highest average overall, but its best average is for subject 3 (9.32), as well as the third best overall average individually in subject 1 (9.00). The lowest average grades are all obtained by group 3 (under grade 8 for each of the three subjects), with subject 2 having an overall individual average under grade 7, which is a pretty low grade for higher education standards (6.22). Subject 2 achieves the three lowest group averages for groups 2, 3 and 4 (groups 3 and 4 having an average of under grade 7), with group 3 only scoring 6.22, whilst group 1's average in this subject is only slightly above (7.80) the average of group 3 in subjects 1 (7.66) and 3 (7.76). Hypothesis 2 is confirmed

Exam results	Subject 1		Subject 2		Subject 3	
	after 1st	after 2nd	after 1st	after 2nd	after 1st	after 2nd
Group 1	15	26	18	24	14	20
Group 2	14	25	18	20	8	12
Group 3	7	21	5	15	6	7
Group 4	6	14	8	11	8	9
Class overall results	42	86	49	70	36	48

**Table 5: Overview of exam results within the three subjects, 2016 (source: own processing)**

Exam results	Subject 1		Subject 2		Subject 3	
	after 1st	after 2nd	after 1st	after 2nd	after 1st	after 2nd
Group 1	28	34	26	31	17	31
Group 2	23	33	18	23	24	30
Group 3	5	16	11	12	9	10
Group 4	8	22	12	15	10	13
Class overall results	64	105	67	81	60	84

**Table 6: Overview of exam results within the three subjects, 2017 (source: own processing)**

Subject 1 has the highest pass rate after the first two exam presentations, as was the case last year, with 105 students managing to successfully complete the course (a 22% increase compared to 2016), representing 88% of all students (compared to 80% in 2016). Group 1 has the best passing record in this subject as 34 students of the 35 managed to complete the subject (97%), whereas group 2 comes in second with only two students not managing to pass the exam from the first two presentations (94%). Groups 3 and 4 score less impressive results, as only 88% passed from group 4 (22 students), whilst group 3 has the least best record with only two thirds of the students managing to pass the exam from the first presentation (16 students). These groups combined only roughly achieve the passing rate of groups 1 and 2 individually, whereas in group 3 twice as less students passed the exam compared to groups 1 and 2. Subject 3 has the second best pass rate of

the three subjects with 84 students having passed the subject (a 75% increase compared to 2016), representing more than two thirds of the entire class (70%). Group 1 scores the best passing rate for this subject with 31 students having passed, representing 88%, whereas group 2 follows with 30 students passing the exam (85%). Group 4 achieves a 52% pass rate, whilst group 3 has the least best overall record (10 students), representing 41%. Subject 2 has the lowest pass rate after the first two presentation as only 68% managed to pass (81 students), which represents a 15% increase since 2016. Interestingly subject 3 has the highest pass ratio for the students who attended the exam, few students coming unprepared for the exam (70% in the first presentation), whereas subjects 1 and 2 both had 60% in the first presentation. Subject 1 had the highest pass rate in the second presentation (81%), subject 3 had 72% and subject 2 only 46%.

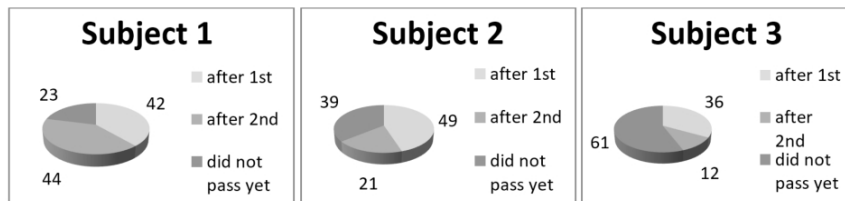


Figure 1: Proportion of passed students at the exam within the three subjects, 2016 (source: own processing)

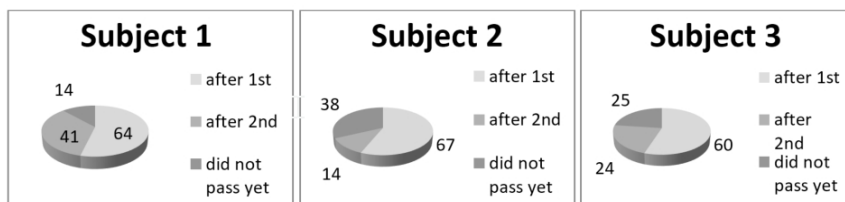


Figure 2: Proportion of passed students at the exam within the three subjects, 2017 (source: own processing)

	Attendance	Implication	Evaluation grades	Project grades
Group 1 average	85%	216	5.75	<b>7.98</b>
Group 2 average	77%	273	5.64	<b>7.38</b>
Group 3 average	77%	178	2.64	<b>4.82</b>
Group 4 average	84%	338	6.34	<b>8.47</b>
Overall class average	81%	1005	5.17	7.38

Table 7: Average the semester activity indicators per group in subject 3, 2016 (source: own processing)

	Attendance	Implication	Evaluation grades	Project grades
Group 1 average	92%	592	6.71	<b>8.40</b>
Group 2 average	86%	484	6.11	<b>8.11</b>
Group 3 average	80%	423	4.23	<b>7.14</b>
Group 4 average	95%	790	7.93	<b>8.81</b>
Overall class average	89%	2289	6.43	8.79

Table 8: Average the semester activity indicators per group in subject 3, 2017 (source: own processing)

The first indicator is the level of attendance students had for the semester activity, which according to university regulations needs to be at least 66% of the total number of seminars within the semester in order to be able to obtain a passing grade. Last year attendance figures were pretty good with a class overall average of 81%, two of the groups having an average attendance of over 75%, whilst the other two close to 85%. There were 7 seminars where attendance was higher than 90%, with group 4 having recorded 4 seminars with such a high attendance rate, group 1 with 2 such seminars and group 2 with one such seminar figure. The lowest average attendance per group ranged from 70% for group 4 to 56% for group 3, with group 2 having 60% and group 1 a level of 57%. Attendance figures increased in 2017 with 8 percentage points, representing a 10% overall increase. Moreover two of the groups had an average attendance of over 80%, whilst the other two over 90%, with group 4 having a record level of 95%. There were a number of 4 seminars with a 100% attendance from the 2 largest groups (35 students), two for each of groups 1 and 4. In addition there were 17 other seminars where attendance was over 90%, within 4 of these cases only one student was missing. Group 4 recorded 7 such seminars, group 2 four such seminars with groups 1 and 3 having each recorded three such seminars. The lowest average attendance per group ranged from 83% for group 4 to 65% for group 3, with group 3 having 82% and group 2 a level of 72%. Thus in 2017, there were 3 times more cases of attendance rates of over 90% and the lowest attendance levels increased by an average of 15 percentage points.

The second indicator is the level of implication the teacher recorded during the seminars, where each question and good answer is marked down as an activity contribution for the student and is added to his semester activity grade. This is a bonus the teacher provides for those students who are involved in better understanding the subject's topics and who participate in the teacher-student interaction during the semester. Last year's implication was pretty good, as there were a total of 1005 questions and good answers recorded from the students of the class, with an average of 9.22 for each of the 109 students. Although group 4 (30 students) had the most questions and answers (338), the best average per student was recorded by group 2, with 11.38 questions and good answers per each of the 24 students, slightly over group 4's figure of 11.27. Group 1 (30 students) had an individual average of 7.20, whilst group 3 (25 students) an average of only 7.12 questions and good answers per student and the lowest total (178). In 2017, there was a class total of 2289 questions and good answers provided by the students, with an average of 19.24 for each of the 119 students, in both cases more than double the figure from last year's contributions. Group 4 (35 students) had the highest level of implication (790) and the highest individual average as well (22.57 per student), double the level recorded last year. Although group 1 scores second in the total number of questions and good answers (592), the group's average is of only 16.91 for its 35 students, more than double the level of the previous year. Group 2 (25 students) has the second highest rate, with 19.36, representing a 70% increase however since last year's results, whereas group 3 (24 students) averaged a 17.63, two and a half times more than in 2016, being the highest improvement of all groups in the current year.

The grades obtained by the students for their semester evaluation were not very high, as the class average in 2016 was only 5.17, with group 4 scoring the highest group average (6.34). Groups 1 and 2 also scored higher than average scores (5.75 and 5.64), whereas group 3 had a very low average of only 2.64, by far the least impressive results. A number of 12 students (11% of the entire class) scored very good results, whilst an entire group had a very poor record of grades at the evaluation: 5 students from group 4 scored a perfect

10.00 and 2 other students from the same group obtained a grade of over 9.00, with 4 other students managing the same from group 1 and 1 other student from group 2. There were only 2 students who obtained passing grades from group 3, whereas the rest had very low marks, far from the 5.00 passing level. This year however results improved, with the class average increasing to 6.43 (24% increase since 2016), with group 4 scoring the highest group average (7.93), representing a 25% increase since last year. Groups 1 and 2 scored higher average scores than last year, with group 1 having achieved an average of 6.71 (16% increase), whilst group 2 recorded an average of 6.11 (8% increase). The biggest improvement came from group 3, where although the average level was still under 5.00, the group average of 4.23 meant a 60% increase. A number of 18 students (15% of the entire class) scored very good results, with every group having a couple of representative students: 5 students from group 4 scored a perfect 10.00 and 3 other students from the same group obtained a grade of over 9.00, with 4 other students managing the same from group 1, where there was a further case of a student scoring a perfect 10.00. Group 2 had 2 such students, one obtaining the maximum grade and another one scoring over 9.00, whereas group 3 had 3 students who managed to obtain a grade higher than 9.00, a significant improvement in results within this academic year for all groups.

The grades for the project the students had to complete by the end of the semester were however better than those obtained at the semester evaluation, possibly because the project grade would have a share of two thirds in their seminar grade, whilst the evaluation only one third. The class average for 2016 was 7.38, with group 4 having the highest average of 8.47, followed by group 1 with 7.98. Group 2 scored an average of 7.38, whereas group 3 scored the lowest average of only 4.82. A number of 5 projects obtained a grade higher than 9, with one of these projects scoring a perfect 10.00 from group 4, where two other projects were graded higher than 9.00, whilst the other two were from group 2. There were a total of 7 projects being copied and all the students were punished by the teacher with direct seminar failure, regardless of their grades, attendance level or previous implication in the semester activity. Group 1 had 4 such projects (10 students), group 3 had 2 projects (6 students) and group 4 only 1 project (3 students), whilst there were no copied projects rendered by group 2. A further 11 students failed to pass the seminar because their average grade was under 5.00, almost all from group 3 (10 students) and one further student from group 2. This year the class average increased to an impressive 8.79 (19% increase), with three of the four groups scoring an average above 8: group 4 (8.81), group 1 (8.40) and group 2 (8.11). The increase in average grades was also impressive, as group 4 achieved a 4% increase, whilst a 5% improvement was recorded for group 1 and 10% for group 2. Although group 3 only scored an average of 7.14, this was still a 48% increase since 2016, the most impressive improvement of all three groups. A total number of 16 projects obtained a grade higher than 9 (three times more than last year), with three of these projects scoring a perfect 10.00 (one from groups 1, 2 and 4) whereas 13 other projects were graded higher than 9.00, an impressive improvement since 2016. Group 4 had a 6 such projects, whilst group 1 had 5 such projects, as groups 2 and 3 each had 1 such project. There was only one copied project rendered this year (from group 3) and all the students were punished by the teacher with direct seminar failure, regardless of their grades, attendance level or previous implication in the semester activity. A further 9 students failed to pass the seminar because their average grade was under 5.00, most of them from group 3 (5 students), with the rest from the other groups (2 from group 1, 1 from groups 2 and 4). The overall pass rate increased from 72% last year to 89% this year, the average grades significantly improved as did the attendance figures and there

were far less cheating cases than one year before, which was noticed by the teacher: "I was pleasantly surprised to see such high attendance figures and such a deep concern with not missing any hours of the seminar from the students this year, showing a high willingness and implication during the seminars. I also saw a very good and consistent increase in the level of quality in their questions and good answers, as well as an overall satisfactory level for the semester evaluation. I was however impressed with their projects this year, they worked really hard and the results showed it, but I am sure last year's experiences and word of mouth had also something to do with it."

## **DISCUSSION**

Results provide interesting insights upon the importance of experience and perceptions of students with their teachers. Communication and word of mouth has always been important among students and this importance has increased in the last years due to the expanded utilization of social media. This enables students to know what the consequences of misconduct are and how teachers handle certain issues and they will act accordingly at each subject. The teacher is the authority in charge of promoting and upholding proper conduct as well as the one who sets the standards for passing the subject. The students merely adjust their learning conduct according to each teacher's requirements, therefore making students aware of the importance of high ethical standards and having a zero tolerance policy against those who fail to comply is one of the most important pillars in maintaining high standards and upholding higher education responsibility (Vich, 2016: 622).

Students acknowledge the importance of complying with ethical standards and lean towards encouraging the upholding of ethical issues within all activities associated with university evaluation. Problems occur when teachers do not enforce these regulations, enabling certain students to pass or even obtain high grades without having worked for them and through cheating, creating an unfair advantage over the other students. Some students prefer to take the path of minimum effort, because they are less interested in their grades or overall results and are more focused on passing the subject, whereas the majority of students adjust their learning effort according to the teacher's requirements (Brožová and Rydval, 2014: 62). This is also emphasized by their fellow students' feedbacks upon the teacher's way of handling certain matters and issues and aligns with some of the student's attitude of not wanting to learn anything, just to pass the subject. When however aware of the fact that certain teachers are not likely to negotiate such matters, students adapt themselves and prove proper conduct as well as adjust their learning behavior as to match the standards imposed by the teacher. Within this type of subject students are more likely to participate, learn and achieve better results as the minimum standards imposed are higher and their overall awareness is increased due to their perception of having to work more than in other subjects in order to obtain the desired result.

Higher education can only provide good graduates if their studies, training and skills acquired are of high quality, as well as the ethical and moral values they guide their actions upon (Švarcová, 2010: 41). Nowadays freshmen usually lack basic knowledge and have a scarce basis when entering higher education, creating difficulties for both the teachers who need to adapt their teaching level and the students who need to make extra efforts to be able to understand the content. The lack of finding a proper solution to this issue may lead to cheating attempts and prove to be a source for further important problems. By bending the rules and tolerating this kind of misconduct the universities indirectly discourage the hard-working students who make efforts to achieve their results fairly. If higher education



does not uphold a strict reputation of enforcing ethical issues then these misconduct issues will later appear in society as a result of indirectly encouraging this kind of behavior. The best countries in the world, where the quality of life and the population's well-being is at very high standards are the countries which have an education system based on very solid principles and where teaching is effective. Education in general and higher education in particular should be a reference in both providing relevant skills as well as a high ethical conduct for its graduates in order for these traits to be reflected in the society of tomorrow as a pillar of a country's sustainable development.

## CONCLUSION

Results show that there is a feeling of frustration from students who work hard for their results when the misconduct of their fellow students is tolerated and indirectly encouraged by certain teachers. This conveys the message that proper ethical conduct is optional, lowering the chance of students appropriately performing their duties and facing the issue of very poor students throughout their studies as well as the lowering of the quality of a university's graduates, which will also affect its reputation in the long-term (Blumenfeld, 2015: 25). The role of experiences is essential, as upholding equitable passing criteria and high ethical standards throughout time will source a solid reputation, enabling students to be more aware of their duties and work appropriately to achieve their results.

Universities thus need to not only focus on developing the specific required skills and competencies within their specialization area, but also give special attention upon the role of ethics and appropriate conduct through the teaching-learning process in order to make this behavior part of the graduates' habit. Despite the relatively small number of students that are caught cheating, all teachers should proactively and without hesitation enforce the strict upholding of ethical regulations and apply unitary sanctions upon those students who fail to comply with university ethics standards in order to discourage misconduct issues and prevent the increase of this type of behavior (Hoskovcova, Krejцова and Kodysova, 2016: 191).

Having a very tight reputation (clear set of passing criteria, upholding ethical principles and making the students work hard for their results) will rapidly be spread within the students and their communication networks and they will adjust their learning behavior accordingly (Vnouckova, Urbancova, Smolova and Smejkalova, 2016: 663). This will bring about better results for both the teacher and the students and will enable them to have a correct foundation to support their future both as professionals and human personalities and be better prepared for when they graduate and face the challenges of the competitive business environment.

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# PROFESSIONAL VISION: FOCUS ON KNOWLEDGE-BASED REASONING

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## ABSTRACT

This study aims to investigate the nature of future English language teachers' professional vision. Special attention is paid to its structure: noticing and knowledge-based reasoning. Knowledge-based reasoning is consequently elaborated in more detail, because it is an important component of professional vision which enables us to see and understand how student teachers reflect the moments they notice. Firstly, the concept of professional vision in the context of professions, in our case the teaching profession, is introduced. Subsequent part of the study is devoted to the research itself, i.e. deductive content analysis of students' unstructured reflections written after observing a video of an English language lesson at a lower secondary school level. The findings of the study uncover what students during their teacher preparation notice and how they reason about it, e.g. if they connect the see with theory etc.

## KEYWORDS

Knowledge-based Reasoning, Noticing, Professional Vision, Pre-service English Language Teacher Education, Reflection, Video Observation

## INTRODUCTION

Discursive practices are used by members of a profession to shape events in the domains subject to their professional scrutiny. The shaping process creates the objects of knowledge that become the insignia of a profession's craft: the theories, artifacts, and bodies of expertise that distinguish it from other professions (Goodwin, 1994: 606). Moreover, it seems to be natural, that different people perceive same events differently. Such differences in noticing, i.e. one's ability to notice, however, evinces some common features within members of a profession. Theory describes this phenomenon by a concept called *professional vision*. Goodwin (ibid.) explains professional vision as "socially organized ways of seeing and understanding events", which are, as already mentioned, often organized by a connection to a profession. Professional vision consists of two mutually interrelated processes: (1) *noticing*, or selective attention – what phenomena one pays attention to, and (2) *knowledge-based reasoning* – how one reasons about the phenomena he or she notices (Sherin, 2007). Therefore, research into the nature of professional vision enables us to uncover, what the representatives of a profession notice, and how they think about the seen.

This study attempts to capture the nature of professional vision through a research in both, noticing and knowledge-based reasoning. Our context is the teaching profession. Moreover, since the nature of professional vision is being perceived as closely related to expertise, in our case to teacher expertise, we believe, it should be paid attention to as early as during the pre-service teacher education. All aspects of professional vision should be developed in student teachers, because together with professional knowledge (i.e. knowledge by which members of a profession dispose of) and professional action

(a sum of accepted and established practices performed within a profession) they form the three crucial dimensions of teachers' professionalism (for more detail see e.g. Janík et al., 2016: 12-13).

In the past decades, much attention has been paid to the phenomena of professional vision in various fields of human activity, among that also to teachers' as well as student teachers' professional vision across various subjects, especially science/mathematics and some in English language teaching (e.g. Minaříková, 2014; Minaříková et al., 2015; Sherin, 2001, 2007; Stehlíková, 2010; van Es and Sherin, 2002, 2006, 2010; Vondrová and Žalská, 2015). To avoid repetition, relevant theoretical rationale and research outcomes will be discussed in chapters focused on data analysis and its interpretation in discussion.

To contribute to the existing research outcomes, this study firstly aims to uncover the structure of future teachers' professional vision. Consequently, more attention will be paid to knowledge-based reasoning in order to learn, how student teachers reason about various aspects they notice in teaching – in an observed lesson. We focus on one subject only, i.e. English language teaching, since many studies emphasise that teaching is strongly influenced by the specific context of the subject matter being taught, for instance Grossman and Stodolsky (1995) talk about specific subject related subcultures with their own beliefs, norms and practices.

Based on a brief introduction of the concept of professional vision and the introduction of the aims of this study above, we shall focus on the research itself as well as the formulation of conclusions and suggestions for further research that emerge from it.

## **MATERIALS AND METHODS**

The *aim of the study* was to investigate the nature of professional vision of future English language teachers. Attention was paid to the structure of their professional vision in both, the area of noticing domain-general and domain specific phenomena in an observed lesson, as well as the area of reasoning about the identified phenomena. Our research was motivated by an attempt to answer the following *research questions*:

1. What is the structure of future English language teachers' professional vision, i.e. what do they notice and how do they reason about it?
2. How do future English language teachers interpret the noticed phenomena?

### **Research methodology**

The *research sample* were 45 future English language teachers. 11 of them were future elementary school teachers (ISCED 1) with specialization in English; 34 of them were future lower and upper secondary school teachers of English (ISCED 2 and 3). At the moment of data collection, all the students were in the same phase of their teacher preparation. They had studied subjects on practical language, linguistics, literature and culture studies as well as pedagogical and psychological disciplines. On the other hand, they had not studied subject didactics, i.e. English language teaching methodology, nor participated in the teaching practice yet. All the students formed one coherent research sample, because we were interested in the students' ability to notice and reason about the noticed phenomena at this phase of becoming teachers.

### **Data collection: Choice of lesson and task**

The data were collected by an observation of one school lesson of 45 minute length in 2015. The video captures an authentic lesson which was taken in 2015. It was a lesson of English in the 8<sup>th</sup> grade of a lower secondary school level. This video was chosen

on the bases of its content variability, since it includes a number of general as well as subject-specific phenomena<sup>1</sup> (Blomberg, Stürmer and Seidel, 2011). The video is easy to be understood by an observer, contains clear structure, and thus does not need any more contextual information. The lesson focuses on teaching new grammar – relative pronouns. Students were asked to observe the lesson and write an unstructured reflection. The length of the reflection was not prescribed. They were to write everything they considered important and assured that there were no correct or wrong answers and that the reflection will not be evaluated in any way. They could watch the video as many times as they felt needed. Students wrote the reflections at home and sent them to the teacher by e-mail. 45 written observations were received and further analysed. The shortest reflection consisted of 1 400 and the longest of 3 547 characters (without spaces).

## Data analysis

The unstructured reflections were analysed by a *deductive content analysis*. Reflections were divided into units of analysis which were formed by utterances carrying a clear message, so called idea units. The division into the units was carried out by two researchers: the author of this text and a colleague.

To answer *the first research question*, the identified idea units were coded by a chosen categorial system. For the purpose of this study, we adopted a widely used categorial system by Sherin and van Es (2009) which includes both processes: noticing and knowledge-based reasoning (Table 1). It covers noticing different topics (subject matter, pedagogy, climate, classroom management) and actors (teacher, pupil, self, curriculum designer), and reasoning about them - so called stance (description, evaluation, interpretation) and a degree of specificity of the noticed phenomena (specific, general).

Actor	Topic	Stance	Specificity
Teacher	Subject thinking	Describe	Specific
Student	Pedagogy	Evaluate	General
Self	Climate	Interpret	
Curriculum developers	Management		
Other	Other	Other	

**Table 1: Categorial system: structure of professional vision**

*Noticing* is captured in the areas of Actor and Topic. The area Actor includes who and what the student teachers pay attention to in their reflections. Apart from teacher and student/s, it can also be a category so called self, in which the student teachers mostly comment own experiences as students or teachers. Coded are also utterances about curriculum or activities or textbook tasks. The area Topic includes thinking about the subject of teaching, i.e. the subject and subject didactics, in our case English language teaching methodology and concepts related to relevant disciplines. Pedagogy includes processes of teaching and learning, teaching strategies and techniques. Climate describes classroom social climate, communication among various actors in the classroom and motivation. Management refers to classroom organisation, discipline and behaviour, classroom arrangement, etc.

*Knowledge-based reasoning* is included in the areas of Stance and Specificity. The area Stance refers to the way students approach the noticed phenomena, i.e. how they reason and think about it. It covers three basic processes: description (students describe what they see in the video), evaluation (students positively or negatively evaluate the seen)

<sup>1</sup> Which was confirmed by the expert analysis of the lesson by a team of six teacher educators across various disciplines.

and interpretation, which includes quite a wide scale of processes (students explain the seen, connect the seen with some underlying theory, etc., it goes behind the seen). Last area is Specificity of the utterances which can either be general or describe some specific moments related to concrete situations or actions.

1 254 units of analysis were coded, each of them by four categories: one category from each of the four areas (Table 1). The data were coded by three independent coders. If two or three coders agreed on a category, it was chosen as the final one. The agreement among the coders reached 75 %. If the three coders coded a unit differently, it was discussed and the coders negotiated the final decision.

To answer *the second research question*, we paid detailed attention to the process of *knowledge-based reasoning*, especially interpretation. This aspect of professional vision may differ according to various authors and approaches. Studies on knowledge-based reasoning mainly vary in what stance they adopt on the processes of reasoning about the noticed phenomena. The categorization of the processes differs in the degree of specificity. Sherin and van Es distinguish between three processes, levels of stance (see Table 1). Stockero (2008) differentiates five levels of reflection: describing, explaining, theorizing, confronting and restructuring. Based on some more categorial systems, Minaříková (2014) introduces a six-level system to capture the knowledge-based reasoning: description, interpretation, explanation (equals the theorizing above), prediction, evaluation and alteration. Last but not least, Janík et al. (2016) introduced six levels of reasoning: description, interpretation, generalization, evaluation, alteration and selfreflection.

As we have already mentioned the category of *Interpretation* included various processes, therefore, we carried out a second and more detailed analysis of this category (Table 2). The focus of our attention was the students' ability to interpret the noticed moments in the progress of their preparation for the teaching profession. Therefore (apart from Description and Evaluation) we were interested in: whether they explain the seen in a lay or naïve way (Explanation); the way they can connect the seen to theory (Theorisation); whether they suggest some alternatives (Alteration); and whether they can predict the influence of the seen (Prediction).

Interpretation			
Explanation	Theorisation	Alteration	Prediction

**Table 2: Categorial system: Interpretation**

313 units coded by the category Interpretation were further coded by the four finer categories (Table 2). The data were coded by two independent coders. If two coders used different categories, the agreement was reached through negotiation.

## RESULTS

This chapter is devoted to the presentation of the obtained data to *answer the stated research questions*. Research results presentation will be followed by their interpretation and discussion. Firstly, attention will be paid to future English language teachers' structure of profession vision as such. Secondly, knowledge-based reasoning will be further elaborated, specifically the nature of interpreting the noticed phenomena.

What is the structure of future English language teachers' professional vision, i.e. what do they notice and how do they reason about it?

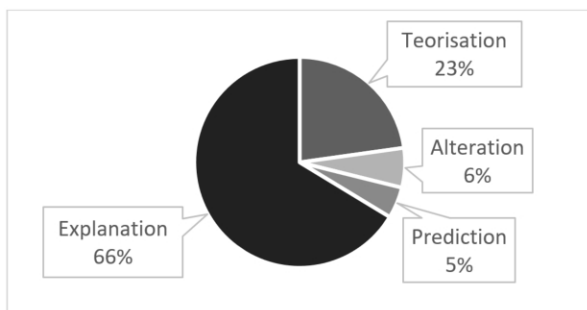
1 254 units (= 100 %) were identified in the 45 analysed reflections. Table 3 shows the frequency of occurrence of the four basic areas and its categories (Table 1) transferred to percentage proportions.

Actor	%	Topic	%	Stance	%	Specificity	%
Teacher	48.88	Subject thinking	23.29	Describe	26.24	Specific	19.22
Student	26.32	Pedagogy	44.42	Evaluate	46.41	General	80.78
Self	3.35	Climate	14.67	Interpret	24.96		
Curriculum developers	10.85	Management	13.32				
Other	10.61	Other	4.31	Other	2.39		
Total	100	Total	100	Total	100	Total	100

**Table 3: Structure of professional vision**

*How do future English language teachers interpret the noticed phenomena?*

313 units coded by a category Interpretation were identified in the 45 analysed reflections. These were further coded by 395 (= 100 %) codes according to a more detailed categorial system (Table 2). Some units of analysis were coded by two categories, however, due to a limited space, these combinations are not in the focus of our attention now. Figure 1 shows proportions related to Explanation, Theorisation, Alteration and Prediction.



**Figure 1: Knowledge-based reasoning - analysis of category Interpretation**

## DISCUSSION

The nature of student teachers' professional vision was introduced in a previous chapter. Here, we shall sum up and discuss chosen findings and relate them to existing theory and research.

Students commented the teacher and teacher's actions in a lesson the most (almost 50 %). These findings are in accord with research of future teachers of other subjects (e.g. Mitchel and Marin, 2015). It is quite interesting that when different students observe different subjects/lessons, it leads to exactly the same attention structure within the area Actor (Simpson, Vondrová and Žalská, submitted). According to Fuller (1969), novice teachers usually pay dominant attention to a teacher, usually themselves, however, we may assume, that even student teachers demonstrate similar characteristics. However, in their research on noticing, Cocca and Cocca (2016: 69) found out that even practicing teachers pay much more attention to teachers' activities than to pupils.

In Topic, students mostly commented general pedagogical phenomena (nearly 45 %). Only about 23 % of students' comments were devoted to the subject of English or English language teaching methodology, however, looking into the students' quotations, the comments were more about English language as such. We find these results exceptional since as we have explained earlier, the students had not studied English language teaching methodology yet, but they have already studied pedagogy and subject disciplines. According to Shulman's (1987) teacher knowledge base, at the moment of

the research, the students could depend on their general pedagogical knowledge, their content knowledge, but not as much on their pedagogical content knowledge. On the contrary, similar studies with qualified teachers show the teachers' ability to comment the subject specific phenomena (van Es and Sherin, 2010: 165). Ability to distinguish and relevantly comment on these phenomena is domain-specific, it is based on the knowledge of relevant subject and its methodology, thus it is quite understandable that the students under investigation reach such results. Almost equally and the least students commented classroom climate (nearly 15 %) and classroom management (nearly 14 %). These were often commented in connection to teacher's actions. Same results appeared in a study by Sonmez and Hakverdi-Can (2012: 150) who found out that classroom management was commented the least by student teachers while observing a video, because they mainly comment the teachers' actions connected to classroom behaviour, but not that as such.

Concerning knowledge-based reasoning, we draw on a two-level analysis (according to Stance – Table 1, and according to a fine coding of Interpretation – Table 2). Our respondents evaluated the seen the most, then they described it and least frequently interpreted the identified moments. It is quite expectable since the students are in the process of becoming teachers. Similarly, evaluation was a category with the highest frequency of occurrence in a study of future mathematics teachers carried out by Mitchell and Marin (2014) or in a study of practising teachers carried out by van Es and Sherin (2010: 165). On the contrary a similar research with future teachers of English showed most descriptive and least evaluative comments (Minaříková, 2014: 767) and a research of future English language teachers at the end of their study (Uličná, submitted) who mostly describe and then evaluate, thus they seem to be more reserved in evaluating the seen, they rather describe and interpret it. Similar result were also reached by Cocca and Cocca (2016: 69) in a research of practising English language teachers who described the moments they noticed and much less they evaluated them. Consequently, we analysed the category Interpretation in more detail. Uncovering the way students perceive and interpret the moments they identify may provide us, teacher educators, with a specific insight into the way they understand the teaching and learning processes. In this phase of their study, students mostly explain (66 %) what they see, their explanations are lay or naïve, they are often based on the students' own experience as teachers or students. Much less (23 %) the students connect the seen to some underlying theory and use relevant terminology to comment on it. These results are quite understandable from the perspective of analysing reflections of students in the middle of their teacher preparation studies. Moreover, a similar research carried out at the end of the teacher studies shows that the students' comments are mostly theoretical and only then explanatory (ibid.). Very few comments were devoted to suggesting alternatives (6 %) to what was seen in the video and even less to predicting (5 %) what consequences on pupils or further teaching and learning may the seen have.

Last analysed area was Specificity of students' comments. Great majority of the comments were general, i.e. did not describe any concrete moments. Our outcomes are in contradiction to the results of van Es and Sherin (2010: 165), however, their respondents were practicing teachers, thus our students seem to lack own teaching practice and because of that the ability to notice specific moments in observed lessons.

## **CONCLUSION**

The study focussed on the nature of professional vision of future English language teachers. We investigated the domain of noticing, i.e. what general as well as subject-



specific phenomena do student teachers notice when they observe a lesson of English, and the domain of knowledge-based reasoning, i.e. how they reason and think about the seen. We believe that the obtained data will support our understanding to students' thinking in the process of becoming teachers - members of a teaching profession. Furthermore, the outcomes bring valuable information about teacher preparation with specific attention being paid to what the students notice and how they reason about it before they start studying subject didactics - English language teaching methodology and participate in the teaching practice.

To sum up briefly, we found out that the student teachers mostly comment the observed teacher, their comments were mostly evaluative. Concerning the category Interpretation, they mostly explained what they saw with no direct connection to an underlying theory. The outcomes of our study were compared to the outcomes of research with practicing teachers as well as student teachers at the end of their studies and some clear differences were identified. Furthermore, we plan to investigate the categories in a qualitative way together with the insight into the combination of various categories, e.g. if the participants comment the teacher or classroom management, do they tend to describe, evaluate or interpret it? Moreover, we plan to divide the obtained data into two cohorts according to the participants' study programme, i.e. future elementary school teachers (ISCED 1) with specialization in English and future lower and upper secondary school teachers of English (ISCED 2 and 3), in order to discover if there is any difference. We believe such findings might broaden our insight into the area under investigation.

## ACKNOWLEDGEMENTS

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# TEACHER IN THE EYES OF FUTURE PRIMARY SCHOOL TEACHERS

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## ABSTRACT

The article presents current research on professional vision of future primary school teachers before their study of general and subject didactics. The students were supposed to watch a video of a real lesson and write unstructured reflections of it. The research aimed to investigate what the students notice in the observed lesson and how they reason about it. Specifically, what topics they notice in relation to the actor – teacher, to what degree they describe, evaluate and interpret the seen, and which topics they interpret and in what quality. Units of our analysis were coded by categorical system according to Sherin and van Es (2009), we emphasised more on the category interpret which was analysed also qualitatively. The outcomes showed that students mainly noticed general didactic phenomena, which were described and evaluated equally, but were interpreted less. Moreover, the major of students showed inability to link viewed lesson with the theory.

## KEYWORDS

Knowledge-based Reasoning, Noticing, Pre-service Primary School Teacher Education, Professional Vision, Student Teachers

## INTRODUCTION

Professional discourse dealing with the concept of teachers' professional vision distinguishes between two processes: noticing and knowledge-based reasoning (Sherin, 2007). Noticing or selective attention allow us to observe which phenomena teachers or student teachers identify. Sherin and van Es (2009) formulated following categories: actor, topic, stance and specificity. Using these categories, they investigated complex teaching and learning situations.

On the other hand, Blomberg, Stürmer and Seidel (2011) focused on the impact of studied subjects on professional vision. The results showed that students of humanities and scientific disciplines perceive professional vision differently. Thus, they anticipated the existence of subject-specific subcultures in relation to professional vision. Knowledge-based reasoning refers to how teachers and students reason about the observed phenomena and relate them to theory. Connection to professional knowledge of the subject, pedagogy, curriculum, etc. as well as to teachers' experience is emphasized, together with its impact on teachers' future actions.

As far as we are concerned, other studies on professional vision of primary school teacher are quite exceptional (Lefstein and Snell, 2011; van Es and Sherin, 2006).

The study is a part of a broader multidisciplinary research project realized at the Faculty of

Education, Charles University. It aims at professional vision of students in different subjects (humanities, science and arts). It might support mutual communication of university teachers concerning pre-service and in-service teachers' professional development as well as building the transdidactic theory. Methodologically, it is also possible to contribute to the investigation into domain specificity of the construct of professional vision.

The article aims to answer two research questions:

What do future primary school teachers notice in connection to the actor – teacher?

What phenomena do future primary school teachers interpret within the category - teacher?

## **MATERIALS AND METHODS**

In our study, we analyzed reflections of future primary school teachers. It needs to be mentioned, that one of the specifics of primary education is its multidisciplinary, which requires learning foundations of many subjects/disciplines at the same time. Therefore, special attention should be paid to research of professional vision of primary education students in the first phase of their study, i.e. before systematic development of subject didactics. This kind of research enables us to understand the way students perceive the role of teacher. Especially, the main focus is on teachers' actions and students reason about them.

All the primary education students in the second year of their pre-service training were asked to write a reflection on minimum one recorded lesson of a social science, mathematics or arts at the beginning of the winter semester. Reflections of an English language lesson were written by all the students with specialization in English at the beginning of their third year. All the students had written the reflections before they started studying general and subject didactics.

We analyzed 36 reflections of a social science lesson, 28 reflections of a mathematics lesson, 21 reflections of an arts lesson and 11 reflections of a lesson of English language. From all the students in the study program and its relevant year, 41 % (n = 36) of social science students, 29 % (n = 28) of students of mathematics, 22 % (n = 21) of art students and 12% (n = 11) of students specialized in teaching English language participated in the research.

### **Research instruments and data collection**

The students were assigned to write an unstructured reflection of a video recorded lesson. They watched the video at home, which allowed them to play it innumerable times. They could write about anything they had found interesting or important and their reflection was not limited by length. As there were no correct or incorrect answers, students were encouraged to express their opinion freely. Reflections were submitted in an electronic form by email or by an upload to LMS Moodle. The lessons were recorded in ordinary classes and they had been chosen on the basis of didactically significant phenomena occurrence. For instance, introducing a new content was one of the conditions. Specifically, in one social science lesson pupils were introduced to the issue of the food waste. They analyzed consequences of the waste and they were trying to find a solution for this global problem. Pupils worked mainly individually or in groups of four or five. Teacher used dialogical, visually- demonstrative and problem- solving methods.

### **Data analysis**

Data analysis was realized by a combination of quantitative and qualitative methodology. Written reflections were firstly divided into analytical semantic units, or so called idea

units. Identified analytical units were then coded by a categorical system according to Sherin and van Es (2009; see Table 1), which is widely used in the area of professional vision. After harmonization of the coding approach and reaching high level of intercoder agreement, each reflection was coded by three coders.

In this paper, we focus on the category teacher. Firstly, we investigated the topics related to this category. Consequently, stance of the statements in connection to the category Teacher was analyzed. Within the area of stance, we closely focused on the category Interpret (n=55). An overview of our research structure can be seen in Table 1. In our analysis, we mainly focus on the way students support their statements by underlying theory, terminology or didactic phenomena. We also concentrate on alterations they suggest, and how they predict the future consequences of noticed situations (Stocker 2008).

Statements which belong to the category Teacher in connection to the category Interpret and area of topic were further analysed qualitatively. We used the method of open coding. Occurred categories were structured with the technique “layout of the cards” (Švaříček, Šed'ová et al. 2007, p. 226). The analysis allowed us to see what phenomena students noticed, how they reason about it and what concepts are used in their reflections.

Actor	Topic	Stance	Specificity
Teacher	Subject thinking	Description	Specific
Pupil	Pedagogy	Evaluation	General
Self	Climate	Interpretation	
Curriculum designer	Management	Other	
Other	Other		

	Areas which are not analyzed
	Areas which are partly analyzed
	Analyzed areas

**Table 1: Categorical system (Sherin and van Es, 2009) with highlighted areas of analysis**

## RESULTS AND DISCUSSION

Analysis includes 2 439 statements/units in total. Within the area actor, students paid significant attention to the teacher and teacher action. 804 statements were coded by the category Teacher (Table 2).

Subject area of video	Mathematics	Arts	Social science	English language
Statements in the category Teacher	28.20%	29.85%	30.16%	43.58%

**Table 2: Percentage of statements of students of pre-service primary school teacher education about category Teacher, 2017 (source: own calculation)**

### Quantitative analysis

Firstly, we analysed which topics students had noticed in relation to the category Teacher. Table 3 shows that the most of the statements focussed on the category Pedagogy, in contrast to the category of Subject and Subject didactics.

Topic	Number of statements (n= 804)
Subject	132
Pedagogy	402
Climate	103
Management	161
Other	6

**Table 3: Occurrence of categories from the area topic within the category Teacher, 2017 (source: own calculation)**

Therefore, we investigated the area of knowledge-based reasoning, i.e. how students reason about the noticed phenomena in relation to the category Teacher. Table 4 shows the occurrence of descriptive, evaluative and interpretative statements. It is evident that far the least the students interpret the noticed phenomena.

Stance	Number of statements (n= 804)
Describe	373
Evaluate	372
Interpret	55

**Table 4: Occurrence of categories from the area stance within the category Teacher, 2017 (source: own calculation)**

Finally, we took a closer look at the category Teacher in connection to the category Interpret. There were 55 statements in such combination of categories (Table 4). The topics interpreted by the students are presented in Table 5. It can be noticed that students interpreted general pedagogic phenomena the most.

Topic	Number of statements (n= 55)
Subject	12
Pedagogy	28
Climate	8
Management	6
Other	1

**Table 5: Occurrence of categories from the area topic within the category Teacher in combination with the category Interpret, 2017 (source: own calculation)**

Furthermore, we investigated the nature of the 55 interpretative statements in more detail, i.e. from the perspective of knowledge-based reasoning. Table 6 shows that more than half of the interpretations were naïve statements, e.g.: “The instructions were not accepted well. Pupils are talking and not paying attention and the teacher still continues to give instructions calmly. Therefore, she has to explain the instructions again to several groups, which interrupts the others.”

Nature of noticing	Number of statements (n= 55)
Explanation (naïve)	36
Theorisation	18
Alteration	6
Prediction	0

**Table 6: Knowledge-based reasoning: nature of the interpretative statements, 2017 (source: own calculation, according Stockero, 2008)**

Theorisation occurred in used terminology, or description of pedagogical approaches and methods, e.g.: „It was not a pure presentation, but pupils themselves discovered the rules.” There were around 10 % of alterations, e.g.: „She could have asked them after they sat down.” There were no predictions among the interpretations connected to the category Teacher.

### **Qualitative analysis**

Both, category Teacher and category Interpret, were the basis for our qualitative analysis. Through this perspective, we investigated the nature of statements from the area of topic (see Table 5). We used so called open coding (Grounded method). Finally, we interconnected the newly identified subcategories with our fine coding of the interpretative statements (Table 6). Mostly the students interpreted the statements commenting general pedagogical issues. They can be classified to statements referring to methods, management of teaching and learning processes, diagnostics, evaluation, teaching skills, etc. Within the subcategory management of teaching and learning processes, students mainly interpreted the role of teachers who focus on all the pupils in the class, or change activities, e.g.: “The teacher was asking all the pupils during the lesson, so they all have chance to express their opinion.” Concerning methods, students provided reasons for group work, project teaching, inductive approach and constructivism. In two cases, students suggested and explained alterations to the methods used. Fifteen interpretations were not supported by any underlying theory. Twelve of them were theory based, most often commenting the methods, e.g. “The lesson was not simple, however the pupils themselves discovered the rules.” Theoretical terminology was used rarely and there were no predictions in this category.

In the category Subject, there were twelve interpretations. Most interpretations were related to the methods, however students connected their interpretation to the specific subjects observed, e.g.: “When practicing relative pronouns, the teacher asked the students to state an example. This way, she showed the students how to use and practice relative pronouns.” Most of the interpretations were focused on methods in English lessons (10) and there were generally naïve explanations.

The category Management included statements on classroom management, time-management and classroom arrangement. The statements within this category were mostly naïve explanations. There was no support in theory, e.g.: “After the bell rung, the teacher, standing, told the pupils what was going to happen, which made them keep attention.”

There were eight statements about motivation in the category Climate. Three of them commented motivational function of evaluation, e.g.: “The teacher controls the pupils and evaluates them verbally – and motivates them by that.” Two statements commented on activation of pupils. Four out of eight statements in this category were based on some underlying theory. The concept of safe environment in the classroom also appeared in the students’ statements.

### **DISCUSSION**

Before the systematic study of didactics and participation in teaching practice, many students are able to reason only from the position of a student, not a teacher. It is our desire to change and deepen their ability to notice and reason as a teacher during their education. That is because students’ notifications are highly valuable for planning their further professional development. It enables teacher educators to plan student support

with the purpose to teach students “think as teachers” (Richardson and Kile, 1999, in Minaříková et al., 2015: 759).

The outcomes of our research show that students of pre-service primary school teacher education pay significant attention to the actor Teacher (Table 2). Other research studies also show high (in comparison to our outcomes even higher) ability to notice the actor – teacher by novice teachers (Cocca and Cocca, 2016) and student teachers (Sonmez and Hakverdi-Can, 2012; Santagata and Guarino, 2011). However, our respondents paid even higher attention to the actor – pupil (just as students in a study by Stockero, Rupnow and Pascoe, 2017).

Furthermore, our research data also showed that in the first phase of their pre-service education, the students mainly focused on general didactics and less to the subject related aspects of teaching. These outcomes are in accord with the outcomes of other research studies (e.g. Santagata, Zannoni and Stigler, 2007). We do not find it surprising as primary school education has a multidisciplinary character and our students generally display less interest in the studied subjects.

Another result of our research is that students equally describe and evaluate, but do not interpret much (in comparison to a research with experienced teachers by van Es and Sherin, 2006: 128).

Mostly, the students interpreted the statements commenting general pedagogical issues. Qualitative analysis brought up that students mostly interpret the teaching methods as well as the management of teaching and learning processes. Connecting the noticed phenomena to an underlying theory is mainly related to the methods. We assume that knowledge of some aspects of theory (e.g. the importance and forms of active discovering of content by pupils or pupils’ communicative skills development) may be related to the students’ secondary school experience. It can be also related to the disciplines which students studied at the beginning of their university study, or to the procedures discussed and explained by teachers which they had met or observed. We can similarly explain the students’ occasional theorisations on teaching approaches and methods connected to subject.

In the category Subject, there is further evident that the students do not comment the teaching content and its selection by a teacher. The concept of content or curriculum does not occur even in the form of preconceptions. As this area seems to be crucial for quality of teaching (Slavík et al., 2014), it is obvious that another phase of teacher education should focus on it. Moreover, it is clear, that we talk about the key concept of subject didactics, therefore, we cannot expect students to work with such concept at this phase of their teacher education. Using theory to support one’s comments here is insignificant. At this phase of study, the students show inability to link the viewed lessons with the theory. Students sometimes used the professional terminology, but do not refer to any theories or concrete conceptions. Connections between theory and practice should be developed during the teachers education, e.g. by guided and consequently free reflections which is further discussed, for instance in the context of teaching practice or videoclub (Minaříková, 2014; Minaříková et al. 2015; Janík et al. 2016; Korthagen, 2011). Furthermore, we aim to focus our students’ attention to specific situations in teaching and learning and to concrete statements by various actors which may help students understand their mental processes.



## CONCLUSION

This paper has proposed that during the observation of construction, students of education pay attention mainly on general didactics, not subject didactics. Students are able to evaluate and describe the situations, interpretations occurred less often. Most interpretations are naïve statements. Students rarely used theoretical terminology. Students usually interpret general didactics phenomena, especially referring to methods, management of teaching and learning processes, diagnostics, evaluation, teaching skills. In the most cases, interpretation focused on motivational function of evaluation, activation of pupils and safe class environment. As for subject didactics, students interpret using specific teaching methods, especially in English lessons.

The outcomes of this study may serve as an important guideline for further changes and general development of pre-service as well as in-service teacher education. Korthagen et al. (2011, p. 53-54) bring out the fact that fast “washing-out of progressive attitudes” which is common at the beginning of a practise of novice teachers, is partly the cause of not knowing the concept which is brought by students to their study. These concepts should be enrolled by university teachers as it has, according to the studies, a vital influence on students. Understanding the students’ opinions on teachers and how they evaluate them, can contribute to improving the quality of pre- gradual study and help with student teachers’ professional development.

From the research that has been conducted, it is possible to conclude that it is essential to intensify development of students’ interpretative skills, especially within the subject didactics. Moreover, it is eligible to involve students’ naive theories about their explanations of practical phenomena on the basis of subject and general didactics. Based on the findings presented in this paper, it has been decided to emphasise on these specific competencies in our video clubs. These video clubs are based on analysis of records from authentic school environments. Students in clubs are divided according to their studying subject and they ought to systematically and specifically analyse situations on records. Students are also trained to suggest alterations on the basis of theory. In addition, university teachers encourage their students to focus attention on the pupils’ ability to learn or acquire new content.

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# ENVIRONMENTAL EDUCATION AND BEHAVIOR OF HIGH SCHOOL STUDENTS

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## ABSTRACT

The article deals with environmental education and behavior in the field of environmental protection among high school students. It compares the knowledge and behavior of students in a study program that incorporates the subject of environmental education at a selected high school and in a study program that does not. A general hypothesis was formulated implying that there is dependence between knowledge and appropriate activity (behavior). Although the dependence has been statistically proven, it should be noted that the statistical dependence has been demonstrated as medium. The results were summarized, evaluated and on their basis recommendations for the possibility of incorporating environmental education as a separate subject at schools were given, emphasizing the importance of the environment and thereby enhancing students' communication with their friends and family about this issue.

## KEYWORDS

Activity, Behavior, Education, Environmental, High School, Students

## INTRODUCTION

Towards the end of the 70s of the 20th century, when environmental education started to be defined, number of questions emerged. The object of research has often been a question why people who are environmentally conscious do not show environmental behavior (Kollmuss and Agyeman 2002). In their closer examination of predictive models in environmental behavior - and taking into account a number of factors such as altruism, empathy or pro-social behavior - Kollmuss and Agyeman (2002) eventually came to a conclusion that the question of what perspectives and forms the pro-environmental behavior might reach was so complex and complicated that it could not be displayed in a single graph. Many other authors such as Steg and Vleg (2009) or Heimlich and Ardoin (2008) tried to perform research which would predict pro-environmental behavior, focusing on cost-benefit analyses, moral values, social learning, emotions etc. However, even though the predictive model was useful in several situations, the authors have not yet found a unified predictive model that would comprehensively explain environmental behavior. They could not even find an explanation which model would be applicable in a given situation (Krasny and Tidball, 2009).

Several authors have recognized the fact that environmental problems are complex and difficult to solve. For example, Blackmore (2007) speaks of "resource dilemmas" concerning air, water and land which arise under conditions of uncertainty. Ludwig (2001) described the environmental problems including mainly species and ecosystems

conservation and global climate change as “vicious, mean problems”, attempting to draw attention to their complexity, inflexibility, stubbornness, indomitability and severity.

In the Czech Republic, systematic foundations of environmental education were created in the early 90s. The environmental education became increasingly incorporated into the agendas of government, local authorities and non-governmental institutions. International cooperation started to develop.

This area is enshrined in legislation, particularly in the Act no. 123, §13. The supervision and monitoring of the implementation of environmental legislation is entrusted with the Czech Environmental Inspection. In school systems, it is e.g. Methodical Instructions of the Ministry of Education, Youth and Sports (MEYS) for Environmental Education and Awareness (EVVO) in all schools and educational establishments or framework educational programs accepted since 2003 (Kulich, 2011). Financial instruments such as the State Environmental Fund or the European structural funds are created as well as sophisticated methods and educational programs, e.g. standards for further education of teachers in EVVO approved by MEYS in 2005 or ecological educational programs. The Agency for Nature Conservation and Landscape is the national nature conservation institution with the central authority in Prague and number of regional offices (Kulich, 2011).

There is a gradual improvement in terms of support and training in the field of the environment, but there are also observable significant challenges and risks. An example is a regional imbalance, little supported and underdeveloped informal education, a low level of EVVO’ stability and sustainability. The reason is not only the total amount of funds, but also the nature of support, still dominated by single, occasional financing, which reduces EVVO’ sustainability and effectiveness. A significant risk is too great dependence on foreign sources (European structural funds), or tendencies towards formal inclusion in some institutions (MŽP, 2016).

The main objective of the article is to compare the knowledge and behavior of students in a study program incorporating the subject of environmental education and a study program without this subject at the selected high school. To fulfill the objective, the following sub-objectives were set: to find out which method of obtaining information in the environmental area is prevailing for students of a selected school; to find out how high the general awareness on the environment is among students of a selected school; to find out how high is students’ specific activity and behavior in the field of the environmental protection; to compare the knowledge and activities of students in a study program incorporating the subject of the environmental education and in a study program without the incorporation at a selected high school.

## **MATERIALS AND METHODS**

The Technical High School and Vocational School in Mladá Boleslav was selected for the purpose of the survey. The school follows the history of agricultural and technical education in the region. Nowadays, the school offers education in agriculture, mechanical engineering, electrical engineering, construction, public administration and business. The latest extension of the school is the Technical Lyceum, whose aim is to prepare students for university study in technical study fields. The school, which operates ECDL (European Computer Driving License) - an accredited testing center of computer (digital) literacy and digital knowledge and skills - and was awarded the title for the school of sustainable development in the Central Bohemia Region for 2015-2017, is very flexible in adapting

to current needs of the region and the range of study programs curricula (SOS and SOU, 2016).

Based on the mentioned sub-objectives, research questions and hypotheses were set. The research questions were raised as follows:

Does a significant portion of students (40% at least) obtain knowledge at school? Are more than half of students versed in environmental issues also active in this area? Is there a difference between knowledge and behavior of students with and without incorporated environmental education? Based on the research questions, the following hypotheses were set:

1. Given the nature of the selected ecologically pro-active high school, more than 50% of surveyed students are cognizant of the environment and more than 50% are active in this area.
2. In the selected high school there is no significant difference between the students' knowledge and activities in the field of the environment in a study program with and without integrated environmental education.
3. Assuming that human behavior corresponds to knowledge and skills of a particular area and that communication about a problem increases the likelihood of a proactive approach, possibilities of such interdependence are expected to be demonstrated.

To test the distribution of normality, a null hypothesis was stated as follows:

H<sub>0</sub>: The selection comes from a normal distribution.

A sample of 129 students, 73 men and 56 women was selected to this study. 51 respondents were from a study program which incorporated the subject of environmental education, while the remaining 78 respondents were from a study program which did not.

The questionnaire contained fifteen questions. The questions were closed with a choice of two answers (two-choice) and with a choice of one option from several alternatives (multiple-choice). Given that respondents often tend to agree with submitted claims rather than oppose them, the claims were expressed in both the positive and negative form (Disman, 2014). Due to the tendency of respondents to choose a neutral category, the middle category was omitted (Disman, 2014). There are numerous variants of scaling; it always depends on discretion of investigators and a specific case (Čihák, 2009). For easier evaluation, each correct answer was awarded two points, while the expression of uncertainty inclined towards a correct answer was awarded one point. Incorrect answers were evaluated in analogy with the correct answers by minus two points and uncertain responses inclined to incorrect answers by minus one point. A prerequisite for knowledge and activities in the area of environment was gaining 6 to 12 points in relevant sections of the questionnaire.

## **RESULTS AND DISCUSSION**

The first multiple-choice question inquired how students usually acquired information on the environment. After the data collection, basic statistical characteristics were evaluated for the sources of the information obtained. They are listed in Table 1.

From the above it follows that the students of the selected high school receive much information through self-study (43.41%). The research question that at least 40% students gain information through schooling was not confirmed.

The hypothesis was that at least 50% students are environmentally conscious. Due to a lower number of respondents, some alternatives were selected by the interviewed students only a few times - this is why several percentages of certain issues occur repeatedly.

The questions were related to water saving, waste sorting and recycling, waste disposal, the impact of car traffic on the environment, the importance of energetically efficient appliances, and significance of e-communication as opposed to paper. The above data and the assumed acquisition of 6-12 points in this part of the questionnaire show that the hypothesis on the minimum of 50% students knowledgeable in the field of the environment was confirmed.

Students' source of information on environmental issues	Relative and absolute frequencies - in total
School clubs, ecological courses, debates	7.75 % (10)
Self-study (e.g. the Internet, books, magazines, radio)	43.41 % (56)
Discussion with parents and friends	9.30 % (12)
Schooling	32.56 % (42)
Residential programs for schools focusing on practical observations in nature and ecology	6.98 % (9)

**Table 1: Relative and absolute frequency of students at high school without a school year resolution (source: authors' investigation)**

Other questions asked were to map whether the students' knowledge is reflected in their behavior and their activities in the field of the environment. Such was the question whether students discussed the environmental issues with their family or friends, which was to find out whether the students were active in the area of communication on this issue. The question has confirmed that the vast majority of the students are active in the area of communication on environmental issues, with an alternative "rather yes" selected by 70.54% and "definitely yes" by 23.26% respondents. The above data and the assumed acquisition of 6-12 points in this part of the questionnaire show that the hypothesis on the minimum of 50% students active in the environmental field was confirmed.

All the questions in the questionnaire were evaluated in a similar manner.

The aim of the investigation was also the comparison of curricula incorporating environmental education and curricula without the incorporation of environmental education.

Although the scores achieved on the basis of the questionnaire from both types of study programs are on a high-quality level, students in the study program with environmental education have significantly higher results than students in the study program without the environmental education.

For quick information on the presence of normality, the David's normality test was performed:

H0: selection comes from normal distribution.

$$\text{Test criterion: } T = \frac{X_{\max} - X_{\min}}{s},$$

where  $s$  is a standard deviation. On the surface  $\alpha = 0.05$  the  $T_d \leq T \leq T_h$  relation was satisfied where  $T_d$  and  $T_h$  are tabulated critical values, and therefore a null hypothesis H0 about the normality of distribution was not rejected. The calculated  $T$  values compared with tabulated critical values are given in Table 2 and 3.  $F$ -test was further performed:

H0: variances conformity.

$$\text{Test criterion: } F = \frac{s_1^2}{s_2^2},$$

where  $s_1^2$  and  $s_2^2$  are variances. On the surface  $\alpha = 0.05$  for the respective degrees of freedom, a null hypothesis  $H_0$  about variances conformity was not rejected. The calculated  $F$  values compared with tabulated critical values are given in Table 2 and 3. Because of the conformity of variances, a two-sample  $t$ -test was used to compare the averages:  
 $H_0$ : averages conformity.

$$\text{Test criterion: } t = \frac{\bar{x} - \bar{y}}{\sqrt{s \left( \frac{1}{m} + \frac{1}{n} \right)}}$$

where  $s$  is calculated using the relation:

$$s^2 = \frac{1}{m+n-2} * [(m-1) * s_1^2 + (n-1) * s_2^2]$$

On the surface  $\alpha = 0.05$  for the respective degrees of freedom, a null hypothesis  $H_0$  about the conformity of averages was rejected. The calculated  $t$  values compared with tabulated critical values are given in Table 2 and 3.

Basic characteristics	Average	Standard deviation	Dispersion	David's normality test	F-test	Two sample t-test
With EV (n=51)	9.039	1.533	2.351	3.912	1.192	15.855
Without EV (n=78)	7.128	1.674	2.804	4.180		

**Table 2: The calculated statistical data - high school students' knowledge (source: authors' investigation)**

Basic characteristics	Average	Standard deviation	Dispersion	David's normality test	F-test	Two sample t-test
With EV (n=51)	8.137	1.482	2.196	4.048	1.253	11.569
Without EV (n=78)	6.794	1.659	2.752	4.219		

**Table 3: The calculated statistics - high school students' activities (source: authors' investigation)**

Assuming a normal distribution, the calculations of the two-sample  $t$ -test show that a critical value was at the level  $\alpha = 0.05$  and for the respective degrees of freedom was exceeded in both cases ( $t_{crit} = 1.96$ ). Therefore, a null hypothesis  $H_0$  on averages conformity in terms of both the knowledge and activities is rejected.

Based on the above results it can be concluded that - despite a high level of both study programs - the students' knowledge and activity in study programs that integrate environmental education are significantly higher than in programs that do not. The hypothesis that there is no significant difference between the quality of students' knowledge and activity in a study program with or without integrated environmental education cannot be confirmed.

An analysis of the selected obtained data - in particular, knowledge and behavior in dealing

with waste - was performed using  $\chi^2$  test of independence, focusing on the existence of a link between specific knowledge and relevant activities. A null hypothesis  $H_0$  was determined: There is no dependence between the observed characters. The calculated  $\chi^2$  value is on the level  $\alpha = 0.05$  and for the respective degrees of freedom is greater than the critical value. The null hypothesis  $H_0$  about the independence of characters is thus rejected. The values were  $\chi^2 = 148.627$  and  $\chi^2_{0.05}(6) = 12.592$ .

In this case, a link between relevant knowledge and appropriate behavior was proven.

To assess the strength of this dependence, the normalized Pearson contingency coefficient

was  $C = \sqrt{\frac{\chi^2}{\chi^2 + n}}$ , calculated:

where  $n$  is the number of permutations of the character with fewer variations for  $C_{max}$ :

$$C_n = \sqrt{\frac{C}{C_{max}}},$$

where  $C_{max} = 0.8165$  and the calculated value  $C_n = 0.5818$ . From the above calculated values a moderate dependence can be judged. Analogously, an analysis of survey data was performed regarding the possibilities of mutual dependence of certain behavior and communication in the field of the environment. To assess the strength of this dependence the normalized Pearson contingency coefficient was calculated, where  $C_{max} = 0.8165$  and calculated  $C_n$  value = 0.3241. From the above calculated values a weak dependence can be deduced.

Based on the quantitative investigation it can be concluded that at the selected high school the level of knowledge in the field of the environment is high and so is the high pro-environmental behavior of the students, i.e. exceeding 40%. At the same time, it was found that preferred sources of information in this area are different. It can also be said that despite the level of knowledge and significant pro-environmental behavior of high school students, there is a statistically significant difference between students in study programs with or without incorporated environmental education. In determining other possible connections, dependence between relevant knowledge and activity in this field and a similarly selected activity and communication in this area was statistically demonstrated.

The results have proven the importance of environmental education in a school curriculum. As Misserli B. and Misserli P. (2008) argue, the concept of environmental education is the blend of different disciplines, resulting from cross-disciplinary research and emphasis on mutual transfer of information between science and the real world. According to Rittel and Weber (1973), an important factor for environmental education is creative thinking that leads to finding solutions to environmental problems. A solution to finding balance among different views on the concept of environmental education and establishing its firm position in school curricula may be to support communication between environmental researchers and pedagogical staff.

## CONCLUSION

Based on the above findings, it can be said that a high level of knowledge and significant pro-environmental students' behavior is consistent with a lively development of the region. However, for further positive development of the region, schools should incorporate environmental education as a separate subject, emphasize the importance



of the environment and thereby enhance students' communication with their friends and family about this issue.

Environmental education and public awareness (CEPA) along with environmental consulting services are important tools of environmental policy of the Czech Republic. The main purpose of environmental policy is to provide a framework and guidance for decisions and activities that are aimed at achieving an improved quality of the environment. The environmental policy is focused on applying the principles of sustainable development, increasing economic efficiency and social acceptability of various environmental programs and activities.

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# PREPAREDNESS OF A NOVICE TEACHER TO DEAL WITH DISCIPLINARY PROBLEMS

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## ABSTRACT

The aim of the paper is to present novice teachers' perception of their readiness to deal with disciplinary problems. The paper is based on the institutional project *Readiness of Students and Recent Graduates from Faculty of Education, South Bohemian University, for Solving Educational Problems of Students* and the results of the Czech and Slovak project *Personal and Professional Needs of Novice Teachers*. The first project provided results of two quantitative questionnaire surveys. The purpose of the first survey was to ascertain how well novice teachers feel prepared to deal with disciplinary problems, while the second survey mapped their readiness to deal with such problems after a short period of working in school. The second project surveyed the needs of novice teachers, reflecting on their undergraduate training and readiness for the job. The results disclosed lack of their preparedness and rather intuitive approach to dealing with disciplinary problems.

## KEYWORDS

Discipline, Novice Teacher, Preparedness, Undergraduate University Training

## INTRODUCTION

Discipline is a noticeable phenomenon in contemporary schools. The objective of this contribution is to present how novice teachers see their undergraduate university training as it prepares them to deal with disciplinary problems at school.

A definition of discipline, its enforcement in the form of pedagogical and relationship principles for coexistence, and rules of conduct in the classroom are key preconditions for improving quality teaching and achieving positive results in the development of schoolchildren. Novice teachers in particular consider discipline to be the greatest pitfall of the teaching profession (Průcha, 2009), and problems with children's conduct are one aspect that can discourage novice teachers from a professional career. It is paradoxical then, that only few authors have carried out scientific and research analyses of the subject of discipline. Most texts available to students of the teaching profession or to practicing teachers are rather practically oriented handbooks (Cangelosi, 1994; Kyriacou, 2012; Petty, 1996), or their authors only monitor the most critical manifestations of indiscipline, such as bullying or rising aggression in children (Řičan, 1995; Kolář, 2001). In the Czech pedagogical community, theoretical aspects of the substance of discipline have been systematically addressed, primarily by Bendl (2001, 2016) and, in connection with authority, by Vališová (1998, 2012). In Poland, the issue was addressed by Śliwerski (2006) and in Slovakia by Manniová (2005). Neither systematic studies of the current situation

in the school environment, nor a mapping of the problems and strategies employed by teachers for dealing with disciplinary problems, are very common.

Discipline is a sophisticated concept; its definition involves a reflection both of historical experience and the current volatility of social relations and standards, as well as the associated lack of clarity of the roles expected from teachers, schoolchildren, and parents. Kalhous and Obst (2009) see discipline as the ability of schoolchildren to comply with social and school rules, to cooperate with a teacher in order to meet the teaching goals, and to participate in the creation of a positive social environment. Bendl (2001) sees the essence of discipline as deliberate observation of educational and social rules, while at the same time emphasizing discipline as one of the preconditions of a safe school environment. Strouhal (2013) mentions Durkheim's idea that a teacher's authority, and thus also discipline, is based on the spiritual substance of school as a *museum of human virtues*. According to Durkheim, by respecting the teacher's authority and discipline, schoolchildren become integrated into the nation, state and civilization because the teacher is a representative of shared collective values. The author also refers to Durkheim's concept of moral education, in which the enforcement of discipline is seen as an involuntary path of a child from its innate unlimited desire and unrestrained craving to an observation of order, learned social conduct, and an inner understanding of morality.

This idea suggests that discipline is a process that needs to be established; discipline always involves overcoming a certain resistance or it results in self-denial or self-repression (Strouhal, 2010). For a novice teacher, i.e. in our case a teacher with less than five years of teaching experience, it is very important to develop certain procedures and mechanisms to establish and maintain discipline in the classroom. In this respect, Kyriacou (2012) recommends a behavioral approach based on affirmative teaching, i.e. the systematic support and appreciation of desirable conduct, believing that this type of reward and praise will have a formative effect on the class. Kalhous and Obst (2009) also emphasize that discipline cannot be understood exclusively as the outcome of a teacher's competent work with the class, but that a certain role is also played by the personal specifics of individual children, as well by the environment of the class, school and location.

In respect to the training of teachers which focuses on dealing with educational difficulties and disciplinary problems, there were some objections to insufficient psychological and pedagogical training. The most significant shortcomings of this component of undergraduate university training are reflected by certain underdeveloped areas of interaction with schoolchildren. We can identify e.g. a poor ability to express oneself, social sensitiveness, and an insufficient ability to accept emotions. However, novice teachers also have problems with assertiveness and the ability to provide and receive adequate feedback (Vítečková and Gadušová, 2014; Vítečková and Gadušová, 2015). In this respect, faculties have been blamed for not providing sufficient opportunities for practicing situations and skills; however, attention is rarely given to the issues of identification, support, and development of the teacher's personal properties. The problem with the establishment of discipline has both its professional aspect and its professional didactic aspect. Kyriacou (2012), in this context, speaks of competent teaching as when the power of the teacher's influence on the behavior of the schoolchildren comes from his ability to present to them his insight and enthusiasm which result from his interest in the given subject, as well as from his ability to communicate such knowledge so that the children can understand and learn. The role of a novice teacher with insufficient practical experience is also very difficult in this respect.

The objective of this contribution is to present how novice teachers see their preparedness

to deal with disciplinary problems at school. How prepared do they feel, and what was lacking in their undergraduate training at the university?

## MATERIALS AND METHODS

The presented results are a part of the project *Readiness of Students and Recent Graduates from Faculty of Education, South Bohemian University, for Solving Educational Problems of Students (GAJU 154/2016/S)*. Several research surveys were conducted as a part of the project. This contribution includes the results of two research surveys relating to undergraduate university training of teachers to deal with disciplinary problems (n = 191, 185 women, 6 men, 160 primary school teachers, 29 teachers of grade 6-9, 2 teachers did not provide their specialization) and (n = 50, 46 women, 4 men, all primary school teachers). The project was a continuation of the Czech and Slovak research project *Personal and professional needs of novice teachers* (project MOBILITY 7AMB14SK046, APVV SK-CZ-2013-0192) (Czech Republic: n = 148, Slovakia: n = 132). In all cases, the respondents were novice teachers with less than 5 years of practical experience, and their specialization was mainly primary school. The data for this contribution were evaluated with the SPSS program using the descriptive analysis method. The results are presented in the form of absolute and relative frequencies.

## RESULTS

The results of the Czech and Slovak research study implemented within the project *Personal and professional needs of novice teachers* (project MOBILITY 7AMB14SK046, APVV SK-CZ-2013-0192) identify the needs of novice teachers. The need perceived as the most urgent was “to improve the ability to deal with difficult and stressful situations (tension, conflict, etc.)”. The research conducted in 2014-2015 was a starting point for another research project *The Readiness of Students and Recent Graduates from Faculty of Education JU for Solving Educational Problems of Students (GAJU 154/2016/S)*, which has been under implementation since last year (2016). We have also presented partial results of this project concerning the preparedness of novice teachers to deal with disciplinary problems.

Before presenting how novice teachers see their undergraduate university training, specifically for dealing with disciplinary problems, it should be noted how the teachers felt prepared to deal with such problems in the classroom. They were asked to use the scale from 1 – 5, where 1 was excellent and 5 failed. One teacher did not answer this question and the average score was 4. The table 1 shows the specific scoring.

Scoring (1 – excellent, 5 – failed)	1	2	3	4	5
Absolute frequency	1	5	54	73	57
Relative frequency (%)	0.5	2.6	28.4	38.4	30.0

**Table 1: Feeling of preparedness to deal with disciplinary problems after graduation from university (n = 190)**

In both the questionnaires, the novice teachers answered the question of whether they studied a subject relating to this topic. From the total number of questionnaires in the two partial surveys GAJU 154/2016/S (n = 241), 85% of the novice teachers answered “no” while only 15% answered “yes”. The respondents who answered “yes” indicated subjects like ethopedia, pedagogy and psychology, special pedagogy, prevention of additions, etc. Since some of those subjects are mandatory, it was interesting to see how differently they were perceived by the individual students.

Similarly, in one of the questionnaires, the teachers responded to the question of whether they had taken any course on the topic. In 190 completed questionnaires, 93% answered “no”, 7% “yes”. No further education in this field was provided to 94.2% of 191 respondents, and only 5.8% did receive it. From 188 respondents, 87% answered “no” and only 13.1% answered “yes” to the question: “While studying at the university, did you ever have any opportunity to observe the course and solution of a disciplinary problem in class?” The good news was that teachers were planning to gain more education in this field (n = 191, 37.2% “yes”, 51.8% “likely yes”, 9.4 “likely no”, 1.6% “no”).

In the following part, we focused on an evaluation of the specific area of training relating to learning strategies important for discipline in the classroom. The respondents were asked to rate their preparedness with scores from 1 – excellent to 5 – failed.

Scoring (1 – excellent, 5 – failed)	1	2	3	4	5
Preventative activities to avoid disciplinary problems in the classroom	0.5	7.3	27.2	36.1	28.8
Methods to deal with various disciplinary problems in the classroom	0.5	5.2	22.0	42.4	29.8
Maintaining a positive working atmosphere in the classroom.	4.2	23.0	37.7	22.5	12.6
Communication with schoolchildren with a history of disciplinary problems.	0.5	7.3	19.9	38.2	34.0
Recognizing individual characteristics in schoolchildren	6.8	21.5	35.1	24.1	12.6

**Table 2: Undergraduate university training in the individual areas relating to discipline in % (n = 191)**

The above provided data suggest that the teachers felt lack of preparedness in all areas; nevertheless, when it came to diagnostics of the class and the children, i.e. the area associated with the prevention of disciplinary problems, the results were slightly more positive. There is no doubt that the ability of a teacher to create and to maintain a positive working atmosphere in the classroom strongly influences the discipline.

The novice teachers most frequently used the Internet as well as books to find information and inspiration.

At the end of the questionnaire was an open question: “Do you have any idea you would like to communicate regarding the topic of preparedness (in respect to undergraduate university training) of novice teachers to deal with disciplinary problems?” Apart from insufficient practical experience, also mentioned in previous research projects (for more information, see Vítečková, Gadušová and Garabíková-Pártlová, 2014), the novice teachers most frequently mentioned the connection between a growing number of disciplinary problems at schools and nearly everyday confrontations between teachers and students related to this area.

The further mentioned the focus on professional subjects and marginalization of pedagogy and psychology: “In my opinion, the education for primary school teachers, but also for other teachers, focuses primarily on the professional knowledge of the future teachers (Czech language, English language, math, life sciences, physical education, arts, etc.). Subjects like pedagogy and psychology and their practical application are marginalized or even skipped entirely in favor of professional subjects. However, this is a general problem of all faculties of education.” As students, the novice teachers missed learning by experience: “The theory taught at universities is not based on practical situations and it is not linked with learning by experience.”

## DISCUSSION

The results provided above indicate that novice teachers feel unprepared to deal with disciplinary problems. Paradoxically, if we used assumptions adopted by Pavelková (2002), who linked discipline with motivation, an efficient conduct of class, good organization of work in the classroom, and the climate in the class, we might have concluded (also based on previous studies – Vítěčková, Procházka, Gadušová and Stranovská, 2016) that the preparedness of novice teachers in this context is on a very good level. However, the students expect specific instructions: *“In my opinion, the school should focus more on model situations and how to deal with them. Not just the theory, but also practical situations in which the lecturer provides guidance to students to follow a specific procedure.”* *“An integrated course is missing, with practical examples of how to solve individual problems.”* The findings and results of the studies mentioned above point to the fact that students would rather have a “cookery book” in which they would find their specific disciplinary problem and its solution. It is likely that novice teachers are aware of the fact that at the beginning of their career, discipline is closely linked to the formal authority of the teacher, as mentioned by Petty (1996). We may therefore claim that it is partly independent of the individual teacher. But novice teachers also understand that, in the context of a real situation and given the necessity to deal with it, their authority depends on how the individual teacher responds. According to our research, 73% (n = 49) of novice teachers struggle at the beginning of their career to build authority in class.

At present, when dealing with disciplinary problems is an everyday issue, novice teachers might worry about their failure, which may lead to stress and even to a premature decision to leave the profession. In this context, we should mention the absence of a “commissioning” period for novice teachers (Vítěčková, 2014). Even the aforementioned research studies indicate that novice teachers are “plunged into the water” and nobody helps them as they try to swim.

## CONCLUSION

We can conclude that despite the provided comprehensive professional training, novice teachers do not feel prepared to deal with disciplinary problems. They expect “manuals” that they can use to address the situations they might face. They miss sufficient practical experience during their undergraduate years and illustrative examples of conflict situations. They should realize, however, that apart from a large scale of potential solutions of model situations, there is an even more diverse range of real situations the teacher may encounter only after he/she starts teaching at one specific school. It is also important to understand the factors that affect a successful negotiation of such situations. As mentioned by Kalhous and Obst (2009), one cannot see the lack of discipline only as the failure of the teacher because there are more factors at play that operate independently of the teacher.

It would be very beneficial for novice teachers to get systematic guidance in the first years of their professional career, as was also mentioned in one of the questionnaires: *“Unfortunately, nothing can probably prepare you for this; what helps the most is the advice and experience of older colleagues.”*

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# EDUCATION FOR BUSINESS INTELLIGENCE IN SME FOR ACHIEVING COMPETITIVE ADVANTAGE IN VOJVODINA

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## ABSTRACT

The purpose of this study is to better understand the link between education on the use of tools and techniques of business intelligence in order to achieve competitive advantage in small and medium-sized enterprises. Through the paper, we will present the fact that business intelligence is not linked only to the use of informational technologies solutions, but it is a holistic approach that includes a large number of stakeholders. The most important stakeholders are people in the system with their competences and inclinations towards the use of the solution in the field of business intelligence. The purpose of education for business intelligence, in addition to the use of techniques and procedures, is the ability of extracting a large number of data information relevant to decision making.

## KEYWORDS

Business Intelligence, Competitive Advantage, Decision-making, Education, Employee Training, Efficiency of Human Resources

## INTRODUCTION

Education helps in increasing the competency. However, there is the question whether through formal education we can increase the level of competence? The study, which was presented in 2015 by Hricova shows that through higher education, we do not acquire sufficient competence, and one of the reasons for that is the lack of time. The purpose of the study, among other things, was to investigate the efficiency of education in the area of troubleshooting and decision-making. One of the conclusions of the study was "...we recommend that educators take a positive approach to incorporating modern methods into the educational process and participate in the balanced development of the three types of competencies – troubleshooting, system analysis and design, and decision making. " (Hricova, 2015: 187) Although the study was conducted in the Slovak city of Košice conclusions can be used to some extent for the purposes of our work.

The data in and around SME are becoming more accessible and more complex. "Organizations are grappling to make sense of the rapidly increasing volume, velocity, and variety of data generated by both internal and external resources" (Isik, Jones, Sidorova, 2013: 13). Various sources and data types created for each enterprise a challenge in terms of adapting to new conditions of business. "Data needs to be captured, integrated, analyzed and then shared with those making business decisions on all levels" (Heesen, 2016: 22). Precisely in this lies the greatest challenge, big data must be available to decision-makers in the enterprise, regardless of the hierarchical level where they are.

Collecting and analyzing data has evolved over time, creating a series of technical improvements, such as data warehouse (DW), Online Analytical Processing (OLAP) etc. A large portion of new technologies is based on the exploitation of the possibilities of the Internet as the primary data carrier. “Historically, DW and OLAP had been used as techniques for data analysis, typically using commercial tools with proprietary formats“ (Vaisman, 2016: 33). This was the major limitation for SMEs, but the phenomenon of open source systems and technologies that are available at lower prices open up opportunities to all interested parties.

To improve decision-making there is a larger number of tools and techniques. One of the tools are the simulations, which can predict certain behaviors and thus predict the future course of development of a phenomenon. The simulations are becoming an integral part of the business so data becomes of great relevance „...since the simulation results need to be available as fast as possible-decision support is infeasible when the simulation results do not arrive in time.“ (Baumann et al, 2017: 20) In other words, the data becomes extremely important part of the modern business world.

However, BI does not provide universal solutions in decision-making “...the different application domains, we have to be aware that decision support is needed for businesses of different size and scope” (Grossmann, Rinderle-Ma, 2015: 4). Type of business, branch of industry in which the enterprise is located, the historical development of the enterprise etc. leads to the fact that the application of BI is highly customized.

“In a competitive world, a right decision, made at the right time and based on an efficient BI solution can become a consistent competitive advantage, for any SMEs” (Tutunea, Rus, 2012: 870). Better understanding of the business reality is of utmost importance. However, „...investments in BI infrastructure and functionality is associated with increased competitive advantage, and these effects occur through performance measurement capabilities“ (Peters et al, 2016: 10). Therefore, besides the will to implement the BI it is necessary to take into account the performance of the enterprise.

“Furthermore, as an organization moves up the ladder of BI maturity, the types of questions it seeks to answer shift from looking back “what happened?” to looking forward “what will happen?” or “how can we change what happens” (Isik, Jones, Sidorova, 2013: 21)? This is precisely the strongest power of BI, changing the focus from the past to the future leads to the fact that the enterprise can turn out to meet changes.

In this paper, the research focus is on the education of employees in SMEs with the aim to facilitate acceptance of BI. Thanks to BI it is possible to achieve a higher level of competitive advantage in SMEs. SMEs are the most interesting in the territory of Vojvodina for its expansion and number of existing SMEs.

In order to implement successfully BI philosophy in SMEs it is necessary to take into account the required level of competence of system users. “Defining competencies is essential for recruiting and allocating resources, reviewing performance, and training and development...” (Miller, Bräutigam, Gerlach, 2006: 71). Apart from organizational support, it is necessary to educate users to utilizing new technology of data collection and processing. “The information consumers (the business users) in the business units also must have a certain level of information skills” (Miller, Bräutigam, Gerlach, 2006: 72). This level is relatively difficult to determine because there are a large number of segments of Information System usage. It is important to mention that the IT is very dynamic, so it takes relative frequently to carry out the necessary evaluation of required IT knowledge. In the root of BI system is knowledge management, but “...taking advantage of the tools and knowledge management systems cannot bring amazing results by itself for

these companies and in the first place it is necessary to apply the initial activities of implementation and knowledge application in the organization“ (Azizi et al, 2016: 11). It takes a lot of work to implement BI to create a system that can achieve a competitive advantage. The human factor plays perhaps the most important role in this task. Equipment, tools and procedures can be relatively easy to obtain, but if there is no will to use BI in SMEs it will not achieve the desired effect.

The issue of sustainable development largely relies on education as a bearer of the idea of protecting the environment and meeting the needs of society. “The education is the core area of sustainable development, through which knowledge and experiences are shared, so it is easier to create common goals that are acceptable to everyone.“ (Vladislavljević, Soleša, Stanislavljević, 2016: 634) Business intelligence helps create a business model that is based on sustainability. According to study “...two thirds of employees are constantly developed...” (Vnoučková, 2013: 188), so education is part of ethos of many SMEs.

The goal of this paper is to examine link between education on the use of tools and techniques of business intelligence and to achieving competitive advantage in small and medium-sized enterprises.

## **MATERIALS AND METHODS**

For the purposes of this study, we have used the method of questionnaire and the interview method. Target groups are the small and medium enterprises on the territory of the autonomous province of Vojvodina, which is located in the north of the Republic of Serbia. On this territory, “High- tech sector is a fast-growing sector in Vojvodina. Software development represents the main source of revenue...” (Autonomous Province of Vojvodina, 2017) so that all enterprises have an easy access to business intelligence tools.

As a main research instrument, we have used a questionnaire that is made of two parts. The first part is relating to the examination of the reporting enterprise, this part was not given to respondents to fill in. The source of data for the first part of the questionnaire is The Serbian Business Registers Agency. Before visiting the respondents, we have analyzed data on enterprises in which respondents work. In this way, we were able to find out the size and the area of activity of enterprises and financial results in previous years. The second part of the questionnaire is relating to attitudes about the use of IT solutions related to BI and the level of training that the participants went to use them. The questionnaire is designed as a five-point Likert’s scale, where we gave the respondents to give the assessment of presented argument.

The number of questions that we have set was over twenty, but because of the volume and requirement of the paper we have chosen four questions. These questions have reflected the need for education in the field of BI with the purpose of achieving a competitive advantage.

We have chosen the subjects who are decision-makers in their enterprises and whose decisions are closely related to the collected data. In this way, we have chosen respondents who have used in the most direct way BI solutions. Enterprise visits were important for researchers and in that way the truthfulness of the data was confirmed. In this paper, we will present some conclusions interview. Therefore, interview and enterprise visits only serve as confirmation of the results we get.

As independent variable we took the type of business, we have divided the enterprises on production, trade and service. The intention of the researchers is to find out the differences between the types of enterprises and questions.

Because of the limitations related to the sample, we use the nonparametric Kruskal Wallis test. Due to the limitations of the questioner, the interviews and enterprise visits will amortize some extent shortcomings.

**Research Question 1:** Is there a statistically significant difference between investing in external education for use the tools and techniques of BI and enterprise type? In order to answer this research question we will analyze claim that: "The organization where I work is investing a lot in the external training for the use of information system." This refers to the provision of additional resources to assist employees in external education. By resources, we mean the time that has been given to employees for educational purposes.

**Research Question 2:** Is there a statistically significant difference between the investment in internal training to use the tools and techniques of BI and enterprise type? In order to answer this research question we will analyze the claim: "Often we have training and / or new guidelines for the use of the new features of our information system". In this way, we have tested the internal capacity of education in the field of using information systems in the enterprise as part of a BI system.

**Research Question 3:** Is there a statistically significant difference between better understanding of consumers and types of enterprises? In order to answer this research question we will analyze the claim: "Now I understand consumers' needs much better than in the past." The purpose of BI is to make decisions that will lead to an increase in the value of the products or services to consumers. Without understanding the needs of consumers, SMEs are practically impossible to reach this goal.

**Research Question 4:** Is there a statistically significant difference between the internal capacity to convert the data into usable knowledge and the enterprise type? In order to answer this research question we will analyze the claim: "In recent years, I have been getting better instructions, so I can carry out my duties faster and more economically." An important segment of using the power of business intelligence is to create new knowledge from raw data. Merely collecting data from the SMEs and the market is not a good strategy. The data must be converted to an operational form and only then, we have powerful BI systems that can aid in making important business decisions.

## RESULTS

The total number of respondents is 76 from 25 SMEs,  $n = 18$  (23.7%) of them are from production sector,  $n = 50$  (65.8%) of them are from trade sector and  $n = 8$  (10.5%) respondents are from service sector.

The answers to the first question/statement, which is: *The organization where I work is investing a lot in the external training for the use of information system* have been the following: *strongly agree* -  $n = 12$  (15.8%) responses, *agree* -  $n = 18$  (23.7%) responses *undecided* (neither agree nor disagree) -  $n = 38$  (50%) responses, respondents who answered *disagree* -  $n = 4$  (5.3%) responses and finally *strongly disagree* -  $n = 4$  (5.2%) responses. The answers to the second question/statement which is: *Often we have training and / or new guidelines for the use of the new features of our information system*, have been the following: *strongly agree* -  $n = 2$  (2.6%) responses, *agree* -  $n = 6$  (7.9%) responses *undecided* (neither agree nor disagree) -  $n = 14$  (18.4%) responses, respondents who answered *disagree* -  $n = 24$  (31.6%) responses and finally *strongly disagree* -  $n = 30$  (39.5%) responses. The answers to the third question/statement, which is: *Now I understand much better consumers' needs than in the past* have been the following: *strongly agree* -  $n = 26$  (34.2%) responses, *agree* -  $n = 28$  (36.8%) respondents who answered *disagree* -  $n = 14$  (18.5%) responses and finally *strongly disagree* -  $n = 8$

(10.5%) responses. The results of the fourth question/statement, which is: *In recent years I am getting better instructions, so I can carry out mu duties faster and more economically* have been the following: *strongly agree* - n = 12 (15.8%) responses, *agree* - n = 18 (23.7%) responses *undecided* (neither agree nor disagree) - n = 38 (50%) responses, respondents who answered *disagree* – n = 4 (5.3%) responses and finally *strongly disagree* – n = 4 (5.2%) responses.

Kruskal-Wallis test has revealed a statistically significant difference in all of our questions: The organization where I work is investing a lot in the external training for the use of information system (production; n = 18, trade; n = 50, service; n = 8)  $c_2(2, n = 76) = 17.753$ ,  $p = .000$  Often we have training and / or new guidelines for the use of the new features of our information system (production; n = 18, trade; n = 50, service; n = 8)  $c_2(2, n = 76) = 19.767$ ,  $p = .000$  Now I understand much better consumers' needs than in the past (production; n = 18, trade; n = 50, service; n = 8)  $c_2(2, n = 76) = 6.428$ ,  $p = .040$  In recent years I am getting better instructions, so I can carry out mu duties faster and more economically (production; n = 18, trade; n = 50, service; n = 8)  $c_2(2, n = 76) = 9.169$ ,  $p = .010$ .

	Type of enterprises	N	Mean Rank
The organization where I work is investing a lot in the external training for the use of information system.	Production	18	55.94
	Trade	50	32.26
	Services	8	38.25
	Total	76	
Often we have training and / or new guidelines for the use of the new features of our information system.	Production	18	57.06
	Trade	50	31.50
	Services	8	40.50
	Total	76	
Now I understand consumers' needs much better than in the past.	Production	18	28.94
	Trade	50	40.10
	Services	8	50.00
	Total	76	
In recent years, I have been getting better instructions, so I can carry out mu duties faster and more economically.	Production	18	44.50
	Trade	50	33.62
	Services	8	55.50
	Total	76	

**Table 1: Kruskal-Wallis test (Ranks)**

	The organization where I work is investing a lot in the external training for the use of information system.	Often we have training and / or new guidelines for the use of the new features of our information system..	Now I understand consumers' needs much better than in the past.	In recent years, I have been getting better instructions, so I can carry out mu duties faster and more economically.
Chi-Square	17.753	19.767	6.428	9.169
df	2	2	2	2
Asymp. Sig.	.000	.000	.040	.010

**Table 2: Test Statistics\***

\*Grouping Variable: Type of enterprises

We have found statistically significant differences in all of our questions (Table 2. and Table 1.). However, we have not found which groups are statistically significant. For this, we use Mann-Whitney U test, we have tested each of the questions compared to couples that determine based on an independent variable type of enterprises. The independent variable has three categories, so we have done three analyzes. In the first round, we have compared the production and service enterprises, then we have compared the production and trading enterprises, and finally we have analyzed the services and trading enterprises. In the first analysis, we have found a statistically significant difference between production and services in relation to the questions: Often we have training and / or new guidelines for the use of the new features of our information system,  $z = -2.173$ ;  $p = 0.35$ . Production type of enterprises has a higher average rank and it is 15.61. Now I understand consumers' needs much better than in the past,  $z = -2.609$ ;  $p = 0.013$ . Service type of enterprises has a higher average rank and it is 19.00. In the second analysis, we have found a statistically significant difference between production and services in relation to the questions: The organization where I work is investing a lot in the external training for the use of information system,  $z = -4.194$ ;  $p = 0.00$ . Production type of enterprises has a higher average rank and it is 50.17. Often we have training and / or new guidelines for the use of the new features of our information system,  $z = -4.304$ ;  $p = 0.000$ . Production type of enterprises has a higher average rank and it is 50.94. In recent years, I have been getting better instructions, so I can carry out my duties faster and more economically,  $z = -2.017$ ;  $p = 0.044$ . Production type of enterprises has a higher average rank and it is 42.28. In the third analysis, we have found a statistically significant difference between the trade and services in relation to the question: In recent years, I have been getting better instructions, so I can carry out my duties faster and more economically,  $z = -2.436$ ;  $p = 0.014$ . Service type of enterprises has a higher average rank and it is 42.50.

## DISCUSSION

Our research shows that there are significant statistical differences between the answers and the type of enterprise. With further analysis, we have found that a group within the type of enterprises has statistically significant difference in relation to questions.

**The answer to the research question 1:** Research has showed that there is a statistically significant difference between investing in education for external use of the tools and techniques of business intelligence and enterprise type. In additional analyzes, we have found that there is a statistical difference between the types of production enterprises in relation to the types of commercial enterprises for the benefit of productive enterprises. We can explain this by the developed infrastructure and increased market pressure on production enterprises. Opening toward the EU increases the base of competitors, also the emergence of new production technologies have changed the way of conducting business. However, no other group has had statistically significant difference.

**The answer to the research question 2:** As with the previous question and in the question number two, we have found statistically significant difference between the frequent training and/or instructions for the use of the new possibilities of information systems. In additional analysis, we have found a statistically significant difference between the production and trade, followed by manufacturing and service enterprises, all in favor of the production enterprises. This relates to the previous question, competition and the development of production technology lead to larger investments in IT sector.

**The answer to the research question 3:** In the third question, we have also identified a statistically significant difference between the type of enterprises and issues related

to a better understanding of consumers. In additional analyzes we have identified that service enterprises have a statistically significant difference compared to manufacturing enterprises. Other groups have no statistical difference in relation to the types of enterprises. We can explain this for the fact that service enterprises are closer to the market and have a direct contact with consumers. The nature of services is that users greatly influence their formation.

**The answer to the research question 4:** And at the last question, we have observed statistically significant differences between the type of enterprise and the internal capacity of the enterprises to convert the data into usable knowledge. By using additional statistical analysis, we have noticed that we have a statistically significant difference between trading enterprises and service providers in favor of services. As in the previous case, services are closer to customers, making them more flexible and better informing to the needs of specific group of customers.

Despite of numerous wholesale and retail enterprises, production and service enterprises more apply the principles of business intelligence. Vojvodina is an integral part of the Republic of Serbia and the modern history of this region is marked by great social and political changes. It is possible that the industrial tradition and proximity to various successful IT clusters made that manufacturing and service businesses that are the agents of change in the field of BI. It is interesting that manufacturing enterprises invest a lot of effort in external education, while service enterprises invest more in their internal resources.

## CONCLUSIONS

Given that, so far no one has researched the impact of BI on increasing competitive advantage in SMEs in Vojvodina, so we will compare the results of similar studies. According to a study that was performed by Guarda, et al., (2013: 189) "Due to the increased volume of data in the organization, the BI has become essential for any company, whatever its size, and is essential for decision making." In other words, BI is becoming an essential part of organizational ethos.

Other studies are dealing with organizational environment for BI, so that "...utilizing the right BI capabilities within the proper decision environment is important to allow an organization to realize maximum benefits from its BI investment." (Isik, Jones, Sidorova 2013: 21) The study showed that BI provides opportunities to establish a system management control systems that can monitor the performances of companies. One of the conclusions was that the BI might increase competitive advantage. (Peters et al, 2016: 10) Our study confirms previous results to some extent. Our results shows that at service companies that are in direct contact with the consumers and manufacturing companies, which have a tradition, are better in using BI System.

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# STUDENTS' BEHAVIOR TOWARDS EDUCATION QUALITY STANDARDS

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## ABSTRACT

Education quality assurance is the necessity for today's competitive environment in university education. This study aims to analyze and present perceptions of students towards a measurement of education quality standards and to identify significant groups of students according to their preferences in education quality. Students' questionnaires and focus groups collected the data. Two and multi-dimensional statistical methods were used to evaluate the results. The outputs show five groups based on perception of the education quality. Examination of students' interest in specific subjects and courses leads to identification of factors affecting preferences in education. The paper found five significant groups of perceived quality. These are Quality receptionists, Business oriented, Expert innovators, Distance learners and Arrangement oriented. Limit of the study is a narrow focus on one private university. This study may encourage other papers to develop and test further the impact of education quality on students' preferences for measurable improvements.

## KEYWORDS

Quality, Assurance, University, Evaluation, Education, Management

## INTRODUCTION

It is generally true that the higher education level helps to the development of any society in all countries of the world. This sector is currently, when there is laid emphasis on increasing the quality of the educational process, increasing the employability of graduates, improving interdisciplinarity of individual branches, etc. The sector is more monitored by representatives of the Ministry of Education, Youth and Sports at the national level and also by representatives of organizations and other institutions at the national as well as European level. Primarily, the reason is that the higher education helps to develop the given economy and forms the essential basis for sustainable growth.

The general goal of the higher education at the national level, including the Czech Republic, is, first of all, to achieve complex knowledge and skills within their branches. The Ministry of Education, Youth and Sports (2015) states that the character of universities has significantly changed and adapted to unusual quantities of students with more diverse previous education, profile and background compared to the era ten years ago. But the transformation is not completed yet, as there is not enough necessary formation and diversification of individual branches. Also, necessary infrastructure is not created. Furthermore, colleges and universities still face up the big problem with staffing. Considering the preference of the educational quality within the higher education, the

emphasis on the specific competencies development (set for each branch), which are exercisable in practice, the increase of co-operation with practice and others, based on the research by Cejpek et al. (2014), 5 basic spheres were determined that help to improve the quality of teaching:

- Sophisticated structure of studying programs, when using outcomes from learning helps to improve the continuity of individual subjects within the curriculum and reduces duplication between them. Benyon (1981), Williams and Howley (1989) or Xu, Duan and Chen (2002) emphasize the importance of the curriculum continuity (even through the individual levels of education) in their studies. Already from a primary school the continuity and good and logical connection between curriculum and study plans is one of the monitored key attributes of education (Sanders et al., 2005; Shields, 2009).
- The pedagogic self-reflection of teachers and understanding how students study open new possibilities to teachers to think about teaching, about active involvement of students and about what and how they learn. Jones (2016), in his research, emphasizes the role of person-level qualities or personality in the educational process quality, concretely the role of perfectionism during teaching by each teacher, laying emphasis on three dimensions of perfectionism (high standards, discrepancy and order) at work. In their researches, O'Connor and O'Hagan (2016) emphasize the importance of the regular evaluation of academic staff.
- Increased motivation of students, while especially an active involvement of students into education and providing a formative feedback has a positive influence on the students' motivation. Researches by Tsinidou, Gerogiannis, and Fitsilis (2010) emphasize the importance of opinions and feedback in the perception of the quality determinants primarily from the point of view of students against the self-assessment on the part of faculties / universities / colleges.
- Verifying the reality of set study goals, when most often it turned out that subjects are excessive as to their content or time, because many declared goals can't be realistically taught and/or verified.
- Improvement of the education quality, because as a result there must be really improved the level of obtained knowledge and skills of students within the educational process, and thus also improvement of the quality and competitiveness of graduates in the labour market.

The realized researches shows that at the present time of the high competition in the area of the higher education, it is necessary to lay emphasis on the development of academic advising, which is, according to the researches by He and Hutson (2016), one of the key functions in higher education nowadays. This leads to linking the theory and practice, which is very appreciated by students according to domestic as well as foreign researches. The aim of the paper is to identify and evaluate the factors of the education quality. The indicators used are based on students' and academicians' satisfaction with the educational process.

## **MATERIALS AND METHODS**

This paper was prepared using a method of analysing secondary and primary resources, knowledge synthesis, induction, deduction and comparison. Secondary resources, scientific monographs and articles dealing with the topic were analyzed.

The second part of this paper analyses and evaluates the results of the primary survey. The data for the evaluation of current education and learning in a Czech private university

were collected in a primary quantitative survey by means of questionnaire investigation. The survey was carried out among students and academic staff. The student dataset comprised in total 2,265 students and 168 teachers. The evaluated subjects contained the areas of Business Economy, Economics, Management, Marketing and Human Resource Management. Only students who passed the entire education and evaluation process (i.e. attended all lessons, seminars and lectures) of the mentioned selected areas were part of the survey. The data were collected using CAPI (computer assisted paper interviewing) and subsequently processed in Microsoft Excel; incomplete questionnaires were deleted. The final data source was analysed according to identification questions, and descriptive statistic was used.

Only the students who regularly and periodically attended classes were part of the survey (participation in classes is voluntary for students, not all of students attended classes or participated in the research). The results thus do not evaluate students who did not pass the entire process of education and tuition.

The respondents were structured as follows out of the valid data: Students' gender: 841 (43.01%) male, 1,414 (56.99%) female; students' professional experience: 1067 (47.54%) work in the area of study, 1,177 (52.46 %) do not work; students' future intention to work in the area of study: 1,213 (53.77 %) plan to work in the area of studied subjects, 338 (14.98 %) do not plan to work in the area of studied subjects and the remaining ones (31.13 %) do not know.

## **Research Design**

The data collection instrument included questions to measure education activities of the university in focus. The questions were designed based on theories (see the theoretical background) and similar research studies.

Each student filled a questionnaire for each subject which he/she participated in. Students evaluated all the compulsory subjects and all optional subjects they had attended. Optional subjects are part of the studies only for full-time students. Part-time students attended and evaluated only compulsory subjects. Students always filled the questionnaire in the last lecture of each subject. The questionnaire addressed three main areas (other than identification questions). Those were lessons and their content, the course/subject and its structure and usefulness, and the teacher's quality. Other than the quality of education, the questionnaires also measured study materials, texts and presentations, the teacher's personality and abilities, the technology used in the educational process, connection with practice, technical and organizational facilities and equipment.

All the primary data were evaluated using descriptive statistics. In addition, the dependence among qualitative characteristics was tested to see whether there are relations between searched attributes, to verify the data obtained and their further analyses. Multivariate statistical methods and analyses were used to lower the number of possible single approaches and practices. Factor analysis was used to analyse the data.

The process of calculation and interpretation of results was used according to Hebák, Malá, and Hustopecký (2006). The analysis was used due to the aim to classify the analysed competencies, when there was a number of variants of answers per each question. Newly designed factors should simplify the total results of the questioning. Factors explain variability and dependence of considered variables. The factor analysis is used to create factors which summarize evaluation of the educational process into coherent groups. The factor analysis was used based on statistically significant correlations. The basic conditions of attributes to enter the analysis were fulfilled according to Hendl (2006). The analysis

was used as confirmatory statistical method, when based on the correlation analysis the preposition to create fractional areas where perception of students is interconnected was designed. Theoretical factors were created and later tested by factor analysis. The factors were created with regard to their merits in terms of theory and practice in the educational process.

The number of monitored variables (factors) was reduced using the Varimax method. For the selection of substantial factors the Kaiser-Guttman rule was applied (i.e. substantial factors having a value within the range higher than 1) and subsequently Sutin test was applied. The correlation coefficients are in the interval from  $<-1;1>$ . If the correlation coefficient is positive, it is a direct proportion (negative – indirect proportion). For the evaluation, the value of variable correlation higher than 0.3 (moderate correlation) according to Anderson (2009) was used. Statistically significant results were presented at the significance level 0.005. To evaluate the results, IBM SPSS statistics was used.

## RESULTS

The chapter presents results of a study focusing on the identification of variants of perception of a quality education by students. The chapter ends with a discussion of results and a comparison with other studies that have been undertaken. According to the evaluation of the calculated data, a total of 6 significant factors were identified following the evaluation of the survey. One of them only slightly exceeded the value of 1.0 and for this reason it had been eliminated from further assessment. In total, therefore, there were identified 5 significant factors that meet the criteria according to this methodology: Quality receptionists, Business oriented, Expert innovators, Distance learners and Arrangement oriented.

Similar statements of students' evaluation were sought during the monitored education, describing subsequent responses regarding their evaluation that depends on the preferences of individual goals and personal preferences. Based on these elements, the overall perceptions of the groups of students and their responses to the set questions have been described. Identified division helps to establish appropriate criteria in the study plan and teaching-learning process to encourage students to study and progress. The goal was to find groups of variables with significant appearance at the same time to reveal main orientation of groups of students.

The analysis revealed five major categories of students' attitudes, which explains the 52.7% of the total sample. Analysis grouped variables into factors in the composition shown in the Table 1. Significant dependencies are in bold. Factors are constructed based on their content and relationships to similar variable and their simultaneous use.

The first factor is formed by variables that summarize students who are fully interested in the educational process and its components. The Factor is formed of 13 initial statements regarding quality. They evaluate areas of quality lessons, subjects and teachers. This group is not specified by gender of job position. Students grouped by Factor 1 perceive subjects as beneficial and filling their expectations, they evaluate lessons as understandable, tempo and style suits them. Additionally, this group also positively evaluates teachers, stating that they attract their interest, motivate them to learn, connect theory and practice, focus on students' needs and pay attention to practicing. They focus on the content of each subject or course. Therefore, this group formed by Factor 1 can be named Quality receptionists. It is positive to reveal that this group is large; the factor explains almost one third of behavior of students (28.1%). It is very pleasant to work with this group and teach

in such classes. They also positively evaluate quality of a study program and the benefits brought to them by education.

Statements	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
sex (female=1)	-.158	-.183	.044	<b>.658</b>	-.053
job in business	.064	<b>.844</b>	.002	-.066	.003
plans for job in business	.051	<b>.833</b>	.022	.037	-.017
subject filled expectations	<b>.660</b>	.127	-.005	.127	.108
subject is beneficial	<b>.506</b>	.244	-.013	.270	.062
study materials are available	.204	.008	.187	<b>.475</b>	-.006
adequate lessons	<b>.767</b>	-.004	.080	-.045	.150
adequate explanation style	<b>.795</b>	-.004	.088	-.029	.116
understandability of lessons	<b>.784</b>	.089	-.002	.012	.027
suitable tempo	<b>.684</b>	.115	.085	.040	-.056
suitable lessons' style	<b>.796</b>	.030	.038	.018	.135
expert teacher	.121	.044	<b>.751</b>	.099	-.016
use of modern techniques	.039	-.015	<b>.742</b>	.006	<b>.426</b>
use of modern technologies	.293	-.002	.217	.067	<b>.650</b>
motivates to learn	<b>.598</b>	.101	-.021	.278	.258
attract interest	<b>.641</b>	.088	.098	.192	.185
adequate explanation	<b>.801</b>	.003	.188	-.023	.041
connection on practice	<b>.598</b>	.097	-.103	.252	.270
practicing	<b>.595</b>	.078	-.143	.228	.293
focus on students	<b>.608</b>	.015	.223	.090	-.033
exam demands are adequate	.042	-.004	-.008	-.049	<b>.543</b>
Name of the group	Quality re-ceptionists	Business oriented	Expert innovators	Distance learners	Arrangement oriented
% of variance	28.052	6.842	6.440	5.181	5.169

**Table 1: Resultant factors – students' behaviour (source: authors' calculation)**

The second factor groups together students who already work or plan to work in the studied subject area. The factor shows that those students are a specific group with a specific behaviour. The factor analysis did not show enough details to see, what the specifics are, but the closer analysis of the data shows the group (identified by the factor analysis as 6.8% of the sample of students) is divided into two solid parts of almost the same size. The first part is focused on their business practices and finds hard to adapt to the new or different ways of thought subject content. Sometimes, they even have a problem with teachers' authority, as they perceive themselves as experts. The other part of the Factor 2 is completely opposite to the first part. Those practitioners enjoy deepening their practical knowledge and support their own theories. They closely cooperate with the lecturer and

share their ideas. Additionally, they deeply appreciate new ways of teaching techniques and possibilities.

The second factor may be named Business oriented. As described, it is a factor divided into two parts. Both parts must be closely attended. The focus should be paid to the identification of their focus to address their preferred teaching techniques to reach expected synergy and sharing ideas between a teacher and students.

The third factor revealed a group of students who are interested in expert knowledge and skills together with expert use of the modern teaching techniques. They perceive and demand the expert quality of education on the part of teacher and also by technical support. Totally 6.4% of sample of students behave in this manner. Therefore, the factor may be named Expert innovators. Those students are not oriented on exam demands, they focus on specific new knowledge gained and its form in terms of providing new information. Factor 3 describes students who are searching for something new, innovative and special that moves them forward. This group is very demanding for teaching. On the other hand, it is a good motivation for teachers to focus on new added value in all lessons given. Thus, it leads to the constant innovation of teaching-learning process.

Factor 4 shows a connection with female students. They have special demands on studies, e.g. distance study materials, voluntary participation or individual exam terms to have time for family and kids. Totally 5.2% of students behave this way. As the sample contained 62% of female, that means a significant part of female respondents that behave in this manner. They are oriented on the support by study materials. This group is not interested in teaching process, teachers' quality, experiences or style, neither lessons nor practicing. Therefore, it is possible to name this factor Distance learners. It is necessary to count also with this type of students within the design of the educational process. In current economy where the demands for employees are very high and sometimes they have to change their job position quite often even to different sector or area, it is necessary for them to be able to develop their knowledge and skills at the same time "on the run".

The factor includes students oriented more on technical arrangements of the education rather than its content. They appreciate the use of the modern teaching techniques and technologies and look forward to innovative style. Additionally, they search for perceived or actual difficulty of the subject and for learning skills necessary for passing an exam successfully. They search for a link between the content of a subject and its fit to the exam requirements. Because of this combination, the factor may be named Arrangement oriented. In sum, 5.2 % of student sample evaluate primarily these areas and are important to them.

With regards to the results of the research we can summarize that students participating in the research have different criteria, which are important for evaluating the educational process quality. That is why their answers were put into 5 basic groups describing students' emphasis. It is necessary to realize that such a feedback from students is important not only in particular ongoing subjects, also at the end of such subject, but also for the entire course of their studies. Because there is a subjective distortion of evaluation for example due to the failure during exams. The importance of the continuous feedback, which, in the case that a school management reflects it, can help to improve the quality of the educational process, provided by students during and after their studies corresponds to the recommendation by Tsinidou, Gerogiannis, and Fitsilis (2010). According to Thatcher et al. (2016), institutions in the higher education sector should draw conclusions from the individual assessments by students, as emphasized by O'Connor and O'Hagan (2016) when assessing teachers, and adjust their subsequent strategic development, because,

as indicated in the researches by Shahjahan and Morgan (2016), an assessment of the education learning outcomes brings the possibility how to improve own competitiveness in the higher education sphere. Nowadays, this is important for private as well as public universities according to the research by Ashraf, Osman and Ratan (2016).

## CONCLUSION

The present paper analyses and assess the education quality process in a selected private Czech university. The paper focuses on the perception of the education quality by students. The results show that analysed students assess the educational process quality according to 5 main identified factors, which describe their behaviour, thus what is crucial for them when assessing each subject. The first factor, "Quality receptionists", is focused not only on the evaluation of the context of the subject by students but also on the personality of the teacher, which is crucial for ensuring the quality of the educational process. The second factor, "Business oriented", is closely linked to the practice and lays emphasis on the fact if students already have own experience working in the branch they study, and thus developing their existing knowledge and experience (primarily in the combined level of studies). On the contrary, the factor "Expert Innovators" focuses on the fact if students think a teacher is an expert in his/her branch, respectively, he/she has a practical experience with his/her subject according to student's assessment and if obtained knowledge is applicable for students in their practice. This influences their further decisions to continue to the next study grade or further education within MBA, Ph.D., etc. The factor "Distance Learners" show a group of students, for whom it is important to have enough high-quality study materials (text, presentations, case studies, etc.), and factor "Arrangement Oriented" identify that these students currently lay emphasis on using modern techniques and technologies in education.

The presented results are important for ensuring continuity of the assessment process of academic staff and preparation of the new study program according to the students' perceptions. Besides this study there are several promising directions for further research. It would be useful to include the influence of the students' results at the particular exams of subjects and their final results before the practice at the state final exams and their subsequent success when looking for a job in the labour market.

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# ELITE ENGINEERING EDUCATION IN MIXED PROJECT GROUPS

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## ABSTRACT

The decreasing level of engineering education, especially of the elite one, is a threat to the sustainable development of the mankind. The Russian Government has set a task for the universities to prepare elite engineering staff. The paper studies the prospects of training elite engineering staff in mixed project groups, whose participants are people of different ages, education and skill levels (master students, postgraduate students, university professors, production specialists). The methods of expert quality evaluation of performing professional tasks enabled to explore the competencies of creating high-technical (HT) products developed by the group members. The benefits and features of the elite engineering education in mixed project groups have been proved. The educational experience in the SUSU mixed project groups has been described. The experiments confirmed improvement in the level of competencies of creating a technical product by 55.9 % in the mixed project groups.

## KEYWORDS

Competency, Elite Engineering Education, Mixed Project Group, Project Method, Technical Product

## INTRODUCTION

Elite engineering education is not only a condition for the development of technical and information innovations, but also a pledge of the safe existence of the mankind. Highly qualified engineering personnel are able not only to make technological breakthroughs, but also to assess the possible risks and consequences of technological innovations, to prevent their negative impact on the human being, society, nature. Graduates of the recent decades persuade that the traditional educational process does not presuppose quality training of outstanding design engineers, able to make breakthroughs in the technological development. The reasons for it are the routine of the educational process, its focus on achieving average values, its isolation from the high-tech (HT) production, its failure to ensure the education of the future elite by the best in their field personnel. Talented graduates are expected to be placed in special conditions in which the main obstacles of the traditional educational process will be eliminated, and the missing elements will be added.

Researchers have proposed a variety of models to improve the quality of the engineering education: education at industrial sites (Englund, Olofsson and Price, 2017); participation in international projects (Kotlyarova, 2016b); educational focus on the energy-saving resources (Serikov, Vaulin and Voloshina, 2015); orientation of the content of the elite engineering education to the CDIO Standards (Zamyatina, Mozgaleva and Gulyaeva,

2014); use of project-based teaching method (Zhong, 2015; Lasmane, 2015; Meng, 2015). The article proposes to carry out the elite engineering education in mixed groups, without rejecting the ways, suggested by scientists to improve the quality of engineering education. The study is based on the theories: of groups (Forsyth, 2014; Pennington, 2002), of different age education (Vydrova, Ticha and Flegl, 2015; Kubiato, 2013; Smit and Engeli, 2015); engineering education (Grauer et al., 2013; Zamyatina, Mozgaleva and Gulyaeva, 2014; Voloshina, Kotlyarova and Krysanova, 2015); innovative methods in education (Salkova and Jarkovska, 2016; Van der Ploeg, 2013: 314).

The aim of the article is to provide rationale and testing of the success of the elite engineering education in mixed groups, where the training is coordinated with the process of creating of a HT product (usually – an innovative one). This approach is not new and is natural, since the human activity occurs in different age social groups. Historically the mixed education emerged as its first form. Such was the transfer of experience to new generations in a primitive society. Such is the family education with the education of children of all ages. Education functions of mixed teaching are much more diverse and the ways of interacting are richer than in the traditional classroom. The current period also raises questions about the actualization of this form. We have proposed a model of professional education in mixed project groups including the students of master's programs, PhD students, academic staff and enterprise specialists (engineers).

The Materials and Methods section indicates the tasks and adequate methods of investigating the level of developing competencies of creating a product by the group members. The Results section describes the main findings and artifacts obtained during the study. The Discussion section analyzes the results obtained, compares them with previous results and emphasizes their novelty. The results of the study are summarized in the Conclusion section.

## **MATERIALS AND METHODS**

We conducted an empirical study of educational outcomes in a mixed project group to form and develop the competencies of creating a HT product.

To do this, we performed the following research tasks.

1. To determine the specificity of a mixed group, its structure, distribution of authorities among the participants in the educational process.
2. To identify the competencies of creating HT product the analysis of the professional and federal state educational standards was made and the expert evaluation method was used (8 experts from various technical fields). The competence level of the experiment subjects was assessed after we had created the scales and criteria for each group of competencies. The scales vary according to the criteria: completeness of the knowledge underlying the executed competency; completeness of the implementation of an action; quality of executing the competencies (Table 1).

The criteria are approved by the aim of constructing a real and unique HT product, which demands the knowledge, skills, and high quality of the product that meets the corresponding standards. To assess the level of competencies the experts used the methods of observation and studying the results of the professional works of students.

3. To test the effectiveness of the work in a mixed project group the formative experiment for the development of competencies of creating HT product by students was carried out. The final evaluation of knowledge was done, displaying the increase in the proficiency of competencies and the development of professionally significant personal qualities.

The experiment involved eight mixed groups with the following features. The groups

consisted of students of master's programs, PhD students, academic staff and engineers. The number of PhD students, future scientists and young researchers (under 30 years) in different groups ranged from 25 to 40%. Accordingly, the remaining members were of the mature and elderly age. The average percentage of the students, PhD students, research and teaching university staff and representatives of production was respectively: 19.4%, 16.1%, 42.0%, 22.5%. The number of participants in the groups ranged from 31 to 99 people. For the educational purposes some of them were divided into subgroups. The total sample volume was  $n = 522$ .

Criteria of	Indicators of		
	Emerging level 1	Developing level 2	Mastering level 3
knowledge underlying the executed competency	The presence of some knowledge of the scheme of the life cycle of HT products without any experience of using them	The presence of some knowledge of the general scheme of the life cycle of HT products and minor experience	The knowledge of the details of the stages of the life cycle of TH products and rich experience
completeness of the implementation of an action	Cannot fulfill any actions at the stage	Can fulfill some actions at the stage, not all and with mistakes	Can fulfill all the demanded actions at the stage without mistakes
quality of competencies' execution	The entire product cannot be created	The errors when executing competences are not permissible, they prevent from creating a valid technical product without defects	The errors are permissible and do not have negative impact on the quality of the technical product

**Table 1: Indicators of the levels of the HT product competencies development**

Different group participants played different social roles: of a student, of a teacher, of a producer. The social role of a student was played by all the members of a group, because everyone had to develop new skills and competencies. The group members were students of master and postgraduate degree programs, specialists, and university staff studying at the educational programs of further professional education. The content of education was strictly individualized. The roles of a teacher shifted from one group member to another depending on the stage of production. All group members also acted as producers. The roles of producers were distributed according to the stages and levels of executing competencies.

## RESULTS

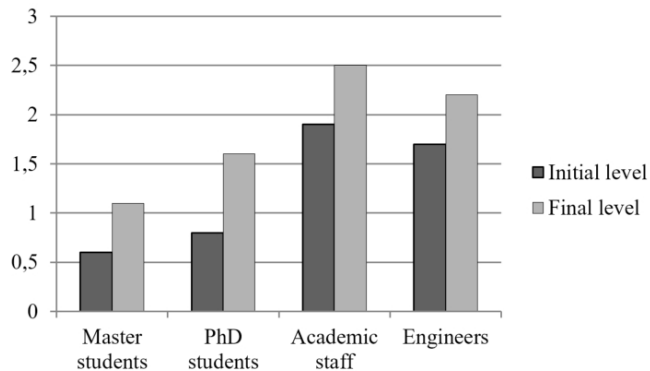
The group members were given the authority to create a completed HT technical product. The stages of the product creation were identified. The competencies of the trainees were singled out: to know the development cycle of technical products; be able: to develop a technical proposal, a technical project, design and technological documentation, to organize and carry out a test, to prepare production. The group members according to the developing competencies were divided into subgroups: norms controllers, designers, technologists, testers, estimators, metrology and patent specialists. The rules of interaction

synthesized in themselves the requirements for the group members as those of students; of scientists – project developers and of manufacturers.

The education peculiarities in mixed project groups that improve its effectiveness were identified. For this purpose we relied on the signs given by Forsyth (2014: 30) that distinguish a group from other social communities: interaction of group members based on their roles, norms and interpersonal relations; diversity of goals; cohesion; work under the common project (project method). These features, when combined, create the benefits of education in a mixed project group.

The ascertaining experiment showed that different subjects at different levels (from 1 to 3) perform the proposed competencies (Figure 1).

The study revealed a group of competencies, which are absent or present at a low level among all the group members. This, above all, the group of competencies related to the Project Documentation design (development of the design and technological documentation). This created a problem, because the group faced with the lack of a specialist with a sufficient level for training the group members. This part of the “educational material” was mastered by the group in the process of self-education and the practical implementation of a professional assignment.



**Figure 1: Initial and final levels of competencies of creating a HT product**

After this work the mixed project group showed some changes reflected in the diagram (Figure 1). There was a certain progress in the levels of acquired competencies in all the participants. However, the changes were different. The students acquired the knowledge of the cycle of creating a certain HT product and certain skills for its creation while working as assistant specialists. The average level of the students' competencies increased by 0.5 units and slightly exceeded the first (emerging) level. The academic staff reached the mastery level. Their initial level rose by 0.6 units and reached the level of 2.5. Both PhD students and the academic staff increased the level of carrying out all necessary calculations ensuring the operability of the product. Nevertheless, both categories achieved different levels, as PhD students mastered only the competence of carrying out separate calculations, while the professors carried out and controlled the implementation of all the documentation. At the same time, the postgraduates had the most significant increase in the level (about 0.8 units), since they were involved in the most complex activities assisting the academic staff, though the postgraduates had no preliminary experience. The engineers increased the average level by 0.5 units. They participated in the project mostly at the stages of product certification, the development of technological

documentation for the prototype, testing, production process preparation and acquired the corresponding skills. The average growth of the level of the competencies' acquired by all the participants is 0.59 units.

Among the results the practical outcomes produced in the educational process should be indicated. They are the technical products (there were 8 original HT products) and the retraining program, which was developed at the end of the training. The implementation of the program is described in our previous research (Voloshina, 2016: 1067).

## **DISCUSSION**

The main subject of discussion is the education in mixed project groups. Since the mixed education has never been completely excluded from the sphere of education, we found the scientific preconditions that enable to justify it as an efficient form of the elite engineering education.

The first precondition as it is claimed by the studies of Englund, Olofsson and Price (2017), Voloshina (2016), is the fact that the knowledge, skills and experience of modern people much less depend on their age and formal education than in previous century. Young professionals often have a higher level of knowledge and skills in engineering and information technology; higher language competence; higher level of readiness for self-development and innovation activities than older generations. It evokes the idea of feasibility of mutual education of people of different generations.

The second precondition is associated with the introduction of computer technologies in education (distance learning, e-learning, education through social networks, mixed education in the educational environment). In this case, education is generally available to the public and is not always adapted to the specific social and age group. The education "group" is formed not on the principle of belonging to the same school and class, but on common interests, educational needs and the level of grit.

The third precondition is an objective increase in the importance of the informal components in the education of a person (Kotlyrova, 2016a). Three forms – formal, non-formal, informal – were identified as part of continuing education in Lisbon (Commission of the European Communities, 2000: 8). Nowadays, they are included in the Russian Concept of Continuing Education of Adults till 2025 (The Ministry of Education and Science of the Russian Federation, 2015: 2). Its developers Zolotareva and Ryabko (2016) indicate the integrity of the three forms of the continuing education of adults as the meaningful core of the concept. The emphasis shifts from the formal education and from its typical classroom form to the non-conventional forms. Their methods are fundamentally not similar to the traditional ones: an excursion program, a joint resolution of any natural living situation can be a typical example of non-conventional education with the participation of people of all ages and skills.

The fourth precondition is the relevance and social environment to develop and implement the programs of the elite engineering education in different countries. Such programs cannot occur within the traditional educational process, as it is not sufficiently connected with the high-tech industries and lacks high-level teaching specialists. To implement the elite programs it is advisable to bring together the most talented undergraduate and postgraduate students, and the most highly qualified specialists, who also need to update their knowledge. This is natural for education in mixed groups.

We specified the properties of a group formulated by Forsyth (2014: 30) and revealed the features of the mixed group project work.

1. Common interests of the group members, similar motifs bring people into a group (Pennington, 2002) more often than the same age. All the group members were focused on the creation of an innovative HT product. Addressing similar cognitive needs by the group members creates the potential for a full exchange in terms of the interactive education, when all group members exchange their ideas, knowledge, skills, assessments, share emotions, ideals, and attitudes. This improves the upbringing function of education.
2. It is known that the presence of factors contributing to the psychological discomfort, leads to the decrease in the demand for getting education. In the mixed group a favorable psychological climate was created. We agree with Englund, Olofsson and Price (2017) that the favorable atmosphere contributes to the increase in the interest and need in education and fosters the motivation to work. Working in a mixed group of like-minded persons promotes a positive emotional support of education. According to Lerner and Skatkin (1995) the experience and rules of the emotional and volitional attitude to the world, to each other, which are formed at the same time, are included into the content of education, which is not always possible to achieve in practice. Thus, a positive emotional support of education is the subject of developing competencies, as well as a condition of education.
3. The group members in a company of people with similar attitudes, increase their self-esteem, get convinced of the correctness of the chosen way, and strengthen their professional self-determination in the engineering profession. The work in the project group allows people to feel more confident when they get support from their peers.
4. When working on a HT product the group participants have a sense of belonging:
  - a) to the people of the other social group;
  - b) to the company of like-minded people;
  - c) members of the group complete one another, feeling as if one entity. They help one another to realize the integrity of the process of creating technical products. Thus, a sense of belonging meets the need of being a part of a particular social group (Maslow, 2003).

Therefore, the analysis of the identified features of the mixed education showed that in general these features increase the efficiency of the education results due to the synergetic effect; enrich the process and the result due to the variety of interactivity and extremely high practical significance of the results; increase the educational effect of education. We found no similar researches but the scientists have enough proof of the effectiveness of education in mixed groups (Smit, Engeli, 2015) and during the project work (Lasmane, 2015; Meng, 2015; Zhong, 2015) that correspond our results.

## **CONCLUSION**

Discussing the peculiarities of the elite engineering education in a mixed group and the data obtained confirm the success of the group members in mastering the competencies of creating HT products.

Education in a mixed project group can be proposed as an adequate form of the elite education of talented master and postgraduate students, qualified teachers and professionals. Education in a mixed group is aimed to master the competencies of creating HT products and is synthesized with the process of its design and development. Master students acquire the competencies of creating technical products, while highly qualified academic staff and professionals deepen their knowledge and skills. Group members

perform the functions of learning and teaching, designing and producing, and flexibly pass these functions to one another at different stages of the project work.

The empirical research has shown that combining education, engineering and HT production in mixed groups increases the level of competencies (by 55.9 %) among all the group members.

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# FUTURE SECONDARY TEACHERS' KNOWLEDGE-BASED REASONING WHEN OBSERVING A LESSON

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## ABSTRACT

The aim of the paper is to shed more light on noticing skills and reasoning of 94 student teachers of biology, English and mathematics. Their written reflections about a lesson were divided into units and coded for comments on expert 'important moments'. Just before entering teaching, students did not demonstrate good noticing skills. The English language students recorded fewer moments, however, they commented on them at a qualitatively higher level. Mathematics and biology students described and/or evaluated in 50 % of cases, while the English language students did so only in 20 % and otherwise included explanations. The whole sample noticed moments connected to teaching methods more, at the expense of tasks and the teacher. It has implications for teacher education – courses should aim at developing student teachers' noticing skills in terms of the choice and implementation of tasks and their ability to interpret events from lessons.

## KEYWORDS

Biology Education, English Language Education, Expert Analysis of Lessons, Future Secondary Teachers, Mathematics Education, Professional Vision

## INTRODUCTION

Observing lessons in schools either live or on video, is an indispensable part of teacher preparation. It is hoped that by such observations, future lower and upper secondary teachers (here only 'students') will notice essential parts of the lesson and use this awareness in their professional growth. However, in our work as teacher educators, we were often surprised that students did not take any notice of an event in the lesson which we considered to be important. This is confirmed by studies on noticing skills of future teachers in different stages of teacher preparation (e.g., Star, Lynch and Perova, 2011). Lessons are very complex endeavours, there are many things happening at the same time and we can put our attention to only some. Yet, from the point of view of teacher learning, some events are more important than others. For example, we would like our students to notice how the teacher selects tasks and implements them and how he/she works with pupils' suggestions and mistakes.

The above considerations are captured by the concepts of professional vision (Goodwin, 1994) and of important moments. Professional vision in education consists of selective attention (noticing) and knowledge-based reasoning (interpreting significant features of classroom interactions) (Sherin and van Es, 2009: 22). The former captures what the observer pays attention to (providing us with evidence by describing it) and the latter how

he/she reasons about it. Clearly, one cannot reason about something which he/she does not notice.

Even though ‘significant features’ are mentioned in the definition of professional vision (Sherin and van Es, 2009: 20), most studies on noticing do not distinguish how ‘important’ the moments are. By important moments, we mean such that relate to the types of tasks used by the teacher and the kind of discourse that he/she orchestrates when implementing them (Hiebert and Grouws, 2007). In view with the constructivist view of learning, pupils’ role in developing their knowledge is stressed when identifying important moments in the lesson.

To capture an observer’s attention to important moments, an expert-like framework is usually developed. For example, in (Blomberg, Stürmer and Seidel, 2011), experts prepared items for rating video clips and an expert norm value system. The participants’ responses were assigned code 1 which meant ‘match with the expert norm’ or 0 as ‘no match with the expert norm’. The authors assessed the participants’ professional vision according to the score received. In (Star, Lynch and Perova, 2011), important features of the lesson were selected by two raters and used as a measure for assessing the participants’ noticing. Moreover, to validate measures to be used for assessing the ability to notice, the authors identified features of the lesson to be noticed and compared them against the video analysis made by six experienced teachers. Mitchell and Marin (2015) calculated the percent alignment between participants’ scores and the master rater scores. Vondrová and Žalská (2015) used an expert analysis to describe so called expert mathematics specific phenomena, i.e., the events in the lesson which experts deemed important for the successful learning of mathematics.

The aim of the paper is to shed more light on noticing skills and reasoning of future secondary teachers. Two research questions are addressed: *Do future secondary teachers at the end of their university studies notice events in the lesson which are considered important by experts? If so, how do they reason about them?* To reduce the complexity, we will only consider moments connected to the teaching of subject, setting aside the generic aspects of the lesson.

## **MATERIALS AND METHODS**

The *sample* consisted of 94 students, future secondary teachers of biology (BI,  $n = 43$ ), the English language (EL,  $n = 25$ ) and mathematics (MA,  $n = 26$ ). There were two students who studied two of these subjects (MA+BI, MA+EL) and they are included in both respective groups. At the time of gathering data in May 2015 and January 2016, the students had completed core content courses, general pedagogy and psychology courses, subject didactic courses and two teaching practices. They were in their fifth (final) year at the university and thus at the onset of their teaching profession. They represented all the students in their study groups, there was no selection made.

The *task* consisted of watching a video-recording of a 45-minute lesson on a subject for which the students would be qualified: “You can watch the video as many times as you want. Write a reflection about the lesson, the length is not specified. Write what you find interesting, what is in your opinion important. Do not feel afraid to write your own opinions, there are no correct answers. You will not be assessed according to your reflection.” The task was given to the students within their subject didactic course as the last one from regular tasks.

Video-recordings were selected by the educators (the authors and three other members of the research team) based on their content variability, since they include many general,

but more importantly, subject-specific phenomena (Blomberg, Stürmer and Seidel, 2011). For example, the mathematics lesson began with a revision of previous work via a game and the core of the lesson consisted of a manipulative task which was to end with the formulation of Thales' theorem. The videos capture authentic lessons in Czech classes which are easy to be understood by observers (as our piloting of videos with different students showed) and do not need any other contextual information. Note that the lessons were not selected as examples of good practice. The mathematics lesson came from TIMSS 1999 Video Study and the lessons from the English language and biology were recorded by cooperating teachers.

As our focus was on noticing important moments related to subject, *expert coding schemes* were developed. The researchers watched the lessons individually and wrote reflections. In the process of meeting repeatedly and discussing their ideas of important moments in the lessons, a table of pedagogical, psychological and subject didactic moments was being made and in view with the research question, only those related to subject (i.e., biology, English, mathematics) were selected. In this way, we balanced 'the input of experts from a mathematics/science background versus a social sciences/humanities background' (Blomberg, Stürmer and Seidel, 2011: 1134) and made it more probable that the phenomena are visible to pre-service teachers who do not have teaching experience. All the phenomena can be seen as examples of 'opportunities to learn' (Kilpatrick, Swafford and Findell, 2001: 333) and can be divided into broader categories (Tab. 1). Each phenomenon is assigned a code showing the subject it belongs to; examples are in Tab. 3. The *analysis of data* started with splitting the reflections into units concerning one expert phenomenon. If the student commented on it on several places, all the related comments were put together as one unit. We got 290 units whose length ranged from 33 to 1 849 characters.

Focus	The expert phenomenon primarily concerns:	Codes
Teaching method	teaching method(s) used in the lesson	EL5, BI1, BI4
Teacher	the teacher's action	EL2, EL3, EL4, BI2, MA1
Task	the task(s) used in the lesson and their implementation	EL1, BI5, BI6, MA2, MA4, MA5, MA6
Connections	connections to other subjects or real-life	EL6, BI3, MA3

**Table 1: Expert phenomena**

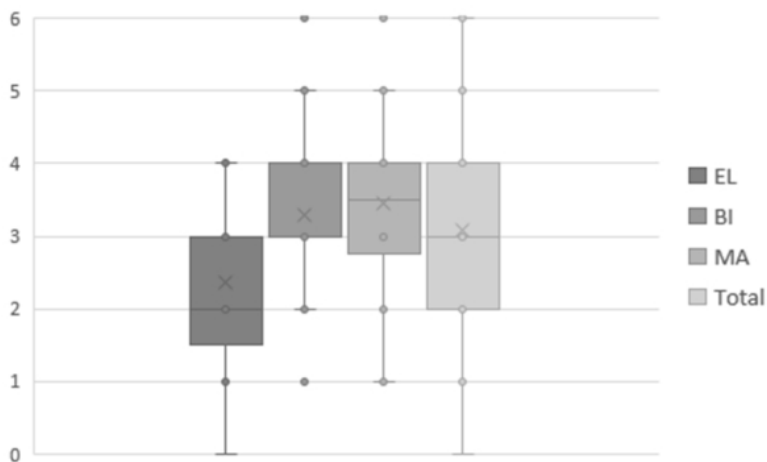
While it is important that the observer notices an event in the lesson, it can be done in different ways based on his/her *knowledge-based reasoning*. Using Stockero's (2008: 380) framework as a starting point, we distinguished six quality codes: Description (recounting of what can be seen in the video), Evaluation (subjective judgment of the event), Explanation ('layman' explanation of the event, or explanation based on one's experience as a pupil or as a teacher), Theorizing (generalisation of the event with a hint of theory), Alteration (suggestion of an alternative action regardless of its nature), Prediction (connection of the event with a future state, e.g., pupils' future understanding or use of the subject matter). There are some levels hidden in our framework. Description has a double role. If by itself, there is no reflection. But it may be needed to support higher levels of reflection. The lowest level of reasoning is evaluation by itself. At a higher level, it is accompanied by explanation or theorizing. Similarly, alteration and prediction can be enhanced by explanation or theorizing.

All the researchers coded analytical units in 4 student observations with the codes above.

Each unit could be assigned up to six codes. The team met and negotiated their codings until they reached 100% agreement. Next, all the analytical units were coded by two researchers who first coded the reflections independently and then met and negotiated differences to reach a 100% agreement. Examples of agreed-on coding are: ‘The beginning of the lesson was OK, the teacher said what would happen, described the activity and revised subject matter with the help of some pupils.’ (Description, Evaluation) ‘The lesson was nicely conducted and prepared. The revision was not absent; the pupils mostly knew the subject matter. I would include the revision of the film they saw in the previous lesson.’ (Description, Evaluation, Explanation, Alteration). Finally, summary tables were made for each group of students and elaborated in a quantitative way. As the students did not see the same lesson, we only used descriptive statistics in MS Excel and did not use any methods of inferential statistics.

## RESULTS AND DISCUSSION

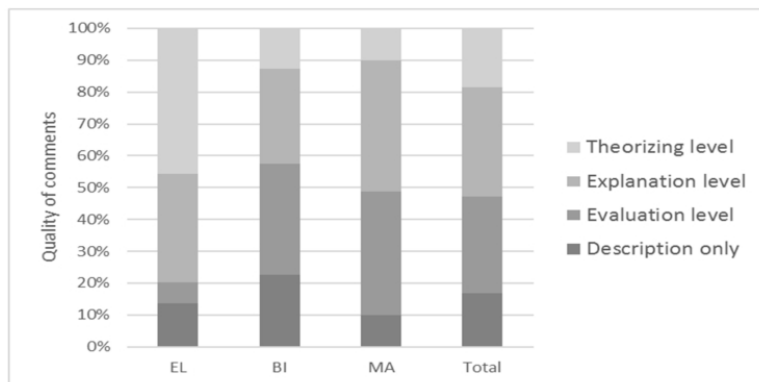
Fig. 1 shows the *number* of commented expert phenomena per student. The box and whiskers plot depicts the mean ( $\times$ ), median (horizontal segment), maximum, minimum, upper and lower quartiles. The mean for the whole sample was 3 phenomena; 75 % of students commented on 4 or less. Markedly similar results were reached by Star, Lynch and Perova (2011). They identified 26 important moments in all aspects of the lesson (not only related to subject as in our study) and the students’ mean score was 53 %. In our previous study, we found out a low level of attention to the phenomena connected to mathematics for students at the end of their university studies with the same educational experience (Vondrová and Žalská, 2015; the median was 2, the expert value was 7). The results in the presented study are better both for the mathematics group and the two other groups of students. Part of the reason lies in the way expert phenomena were identified. In our previous work, it was done by mathematics educators only while in the new study, it was done by experts from five educational fields and thus, the selected phenomena may be more visible to inexperienced students. Still, the students demonstrated noticing skills below the expectations of teacher educators.



**Figure 1: Number of commented expert phenomena per student (per group and in total) (2015-2016, source: own graphs, MS Excel)**

Star, Lynch and Perova (2011: 131–132) propose two explanations of the limited attention of students to expert phenomena, both plausible. First, important moments may be inherently harder to notice; the most ‘attention-grabbing features of a lesson (to a novice) may not be those that (in the eyes of an experienced teacher) are most important’. Second, students do not have enough teaching experience to develop the ability to distinguish important and unimportant moments. To develop students’ attention to expert phenomena, video-based interventions have been shown to improve the attention to pupils’ mathematical thinking (Stockero, Rupnow and Pascoe, 2017) or mathematics-specific phenomena (Mitchell and Marin, 2015). On the other hand, teaching experience by itself does not necessarily result in quality noticing (see, e.g., Cocca and Cocca, 2016, Sherin and van Es, 2009).

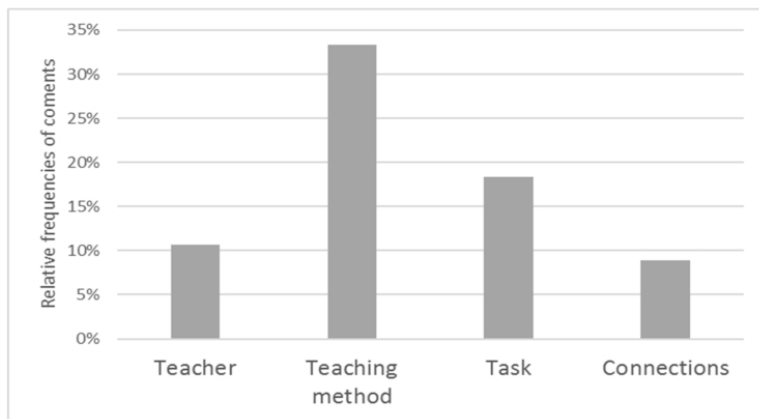
Next, we were interested to see the *quality of comments*, that is, whether the students: (1) recorded the phenomenon (Description only level: ‘The teacher said the name of the circle and mentioned something about its discoverer.’), (2) made a subjective judgement but without providing reasons (Evaluation level: ‘I appreciate the connection with the history and geography.’), (3) accounted for some phenomenon but in a ‘laymen’ way (Explanation level: ‘...the demonstrations of biological samples were very beneficial, the pupils could not only see them but also get hands-on experience.’) or (4) used elements of theory to account for the phenomenon (Theorizing level; the examples are in Tab. 2).



**Figure 2: Quality of reflection (per group and in total) (2015-2016, source: own graphs)**

Fig. 2 presents the results. Nearly 50 % of comments were at the two lowest levels of reflection (Description and Evaluation). The English language students’ comments are different, though. The quality of their noticing moves towards theorizing at the expense of description and evaluation (only 20 % of units). The share of explanation is basically the same for all the groups (about 30 % to 40 %). This is interesting when compared with the results from Fig. 1. The English language students noticed fewer expert phenomena but if they did, they did so at a higher level. The biology and mathematics students staid at the level of descriptive or subjective evaluative comments. We can speculate about the reason for that. The students underwent the same general education course but had different subject education courses. The English educator uses more theory in her courses than the other two, not only because the didactics of foreign languages is well theoretically developed. Or the reason might be that the choice to specialize in teaching languages or mathematics/biology ‘predisposes [students] for certain subcultures (e.g., different ways of reasoning and viewing teaching)’ (Blomberg, Stürmer and Seidel, 2011: 1138).

We only found one study which compared knowledge-based reasoning of students of different subjects. Blomberg, Stürmer and Seidel (2011) reached a similar result: the ratings of the knowledge-based reasoning items matched the expert norm more closely for the students in the social sciences/humanities group (where the language students were included) as opposed to the mathematics/science group. On the other hand, they caution against generalisations. They also showed that pre-service teachers of different subjects tended to score higher on clips showing social sciences/humanities instruction than on clips showing mathematics/science instruction – so the video-material may also have impacted the findings.



**Figure 3: Frequency of noticed expert phenomena per their primary focus (2015-2016, source: own graph)**

Our first research question concerns the *expert phenomena*. We divided them into groups per their focus. Fig. 3 shows the most noticed phenomena and rather neglected ones. It appears that for students, it is the easiest to notice and comment on the teaching methods but still the percent is not high – in only about 33 % of opportunities, teaching methods were commented. Teaching methods are easier to be seen, if only for spanning a longer part of the lesson. The least noticed were phenomena focused on teachers and connections, that is phenomena concerning specific events in the lesson. It confirms results of studies showing that students’ comments tend to be general and related to general issues in the lesson (e.g., Stockero, 2008). The relative lack of attention to the choice of tasks and their implementation was also shown by Vondrová and Žalská (2015).

Next, we will analyse comments coded at the *highest level of reasoning*. The students used elements of different theories to reason about what they saw in the lesson. For example, they spoke about the diagnosis of pupils’ knowledge, about the concept development in pupils’ mind or inter-subject relationship. The most theorised expert phenomena were EL5, EL6, B15 and MA1 (Tab. 2). These results must be interpreted with caution. Apparently, the students could find a theory within which they interpreted the phenomenon. For the other phenomena, they could either lack the theory (and if this is the case, it has implications for teacher education) or the phenomenon does not lend itself easily to theorising.

Phenomena and the percent of students using theory for it	Illustration
EL5 Inductive teaching of relative pronoun (65 %)	‘She elicited information from them, she tried not to say the answer. It was seen, for example, when she gave students examples and they found out the rule of using relative pronouns. This inductive way should be more effective, because students will remember it more if they come up with the rule.’
EL6 Connection to real life (24 %)	‘The teacher also explained to them where in life they will really need the presented grammar and by that, she in fact motivated them.’
BI5 Work with the text (26 %)	‘The method used by the teacher in the heart of the lesson was well chosen and suitable for the topic. The pupils had to think independently, look up information and consult among themselves, which surely helped them to remember the topic. The frontal method would not have had such an effect.’
MA1 Geometric concepts via a game (15 %)	‘In the game, I liked that the pupil had to describe the concept in own words which can, in the interaction with others, consolidate understanding the concept.’

**Table 2: Most theorised expert phenomena**

	Most commented phenomena (> 50 %)	Least commented phenomena (< 25 %)
EL	EL2 Code switching of a teacher (76 %) EL5 Inductive teaching of relative pronouns (72 %)	EL1 Introductory activity with pictures (20 %) EL3 Correctness of teacher’s language (4 %)
BI	BI1 Structure of the subject matter (88 %) BI4 Frontal demonstrations of products of nature (88 %) BI5 Work with the text (86 %)	BI3 Using examples from practice (23 %) BI2 Teacher using a lot of terminology, sometimes imprecisely (16 %)
MA	MA2 Manipulative way of introducing Thales’s theorem (92 %) MA4 Connection of both directions of the implication of the theorem (69 %) MA5 Formulation of Thales’ theorem (69 %) MA1 Work with geometric concepts (62 %)	MA3 Historic note and connection to geography (23 %)

**Table 3: Most and least noticed expert phenomena**

Finally, Tab. 3 shows the most and least frequently noticed expert phenomena for each lesson. It provides an important concrete feedback to course leaders – students need more support to notice some important moments than others.

## CONCLUSION

Our study showed that even at the end of their university studies, future secondary teachers of different subjects tended to neglect moments in the lesson which the experts and research deemed important. (Note, however, that they noticed a lot of other potentially important moments in their reflections which we intentionally omitted by restricting ourselves to the moments connected to the subject.)

The results have important implications for practice. It appears that the general and subject education courses in their present state do not lead to good noticing skills and moreover, students are little able to apply the theory taught in them in the observation of teaching. We can also speculate how the content of these courses influences noticing skills. For

example, general education courses tend to focus on teaching methods (and the students in our study were rather good observers of them). How can the courses be modified? Apparently, more experience with guided observations of lessons is needed, either live or on video. Namely, student teachers need more support in noticing important moments connected to the teaching of subject. Interventions using video analysis and noticing scaffolds proved to be successful in developing students' noticing important moments (see above). However, to realise this recommendation in practice, institutional constraints must be dealt with, such as lack of time and resources. One can also argue that noticing skills will improve as the students start teaching. However, studies caution us against such a simple conclusion as teaching by itself does not result in quality noticing.

Naturally, our study has its limitations. First, it only concerns one teacher education faculty. Even though the sample covers the whole population in the year group, the results should not be overgeneralised. Second, we should be careful in equalling the commented-on and noticed phenomenon. The student might have noticed it but did not choose to record it in writing. Still, the fact that he/she chose not to record it might be an indication that he/she does not give it the importance the experts do. Finally, what is considered important within the lesson is rather subjective. The experts in our case based their ideas of important moments on what research in their respective fields indicates.

## ACKNOWLEDGEMENTS

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# SPECIFICS OF COMMUNICATION BETWEEN TEACHERS AND PARENTS OF ROMA PUPILS

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## ABSTRACT

This case study explores communication between teachers and parents of Roma pupils. Apart from families, the only direct impact on children's development have their teachers so the parent-teacher communication is a prerequisite for effective solution to the issues that may occur during education. The overall objective of the work was to describe the specifics of communication between teachers and parents of Roma pupils at the Primary School Cimburkova in order to contribute to mapping of this situation in the Czech Republic. The case study provides information about under what circumstances and in what ways this intercultural communication takes place. To fulfil the objective of this study, a qualitative approach was used in the form of 15 semi-structured interviews conducted with the teachers of this selected school.

## KEYWORDS

The Roma, Minority Education, Communication, Social Exclusion, Parent-teacher Relationship

## INTRODUCTION

Population of Roma is estimated at 10 to 12 million throughout all European countries with some 6 million living on the territory of EU. The Roma represent the largest ethnic minority in Europe which has lived here for centuries (Paraschivescu, 2012; Bezouška 2016; European Commission: Justice, 2016). Statistical data on the numbers of the Roma living in the Czech Republic are limited as they are reluctant to report their nation, as well as the Roma people in other European countries (Roma Education Fund, 2007). A commonly published estimate of between 150 up to 300 thousand Roma people is usually accompanied by the footnote explaining, that the number is based on various definitions set by social scientists, social workers and politics dealing with Roma issues (Government of the Czech Republic 2016; ERRC 2013, Prokešová, 2010). However, no directly traceable link leading to the source of this information is to be found.

Knowing the actual size of Roma population is important for this work, as the numbers show the scope of the problem. If there should there be the Czech Roma population of 5 thousand individuals, it would make no sense to deal with the issues related to Roma social exclusion and to develop a set of policy measures.

Among experts, who deal with Roma-related issues, education is considered as a key problem (Gulová and Šíp, 2013; Sandru, 2015). European Union Agency for Fundamental Rights estimates that 72% of Roma children left school too early in 2014 (European Commission, 2016).

A causal link between the level of parents' education and their children is reported by Lipovská and Fischer (2016). In their research, they conclude that the most of the talented students come from the complete highly educated families.

Effective communication between parents and teachers is a prerequisite for solving the educational problems not only of Roma students (Epstein and Sanders, 2009). Teachers usually maintain open, conflict-free interactions with the families who care and are interested in education of their children and, vice versa, they experience complicated interactions with the families who care less (Lareau 1987, Henderson and Berla 1997; McDermott and Rothenber, 2000; Stormont et al., 2013). It is not surprising that children from a disadvantaged background and children with the highest service needs show the lowest school attendance (El Nokali, Bachman and Votruba-Drzal, 2010).

Few studies have examined problem-solving interactions between teachers and parents of Roma children. For example, the case study by Flecha and Soler (2013) presents the results of the Spanish INCLUD-ED project where Roma families took part in educational activities and decision-making processes. The project had a highly positive outcome. Although Roma parents did not acquire any expert knowledge they could pass to their children, they started to support and motivate them in education.

This paper aims to disclose the specifics of communication between teachers and parents of Roma children from the perspective of a teacher.

In the past, several specifics of Roma communication strategies have already been described. Outcomes of the conference of experts who deal with Roma issues, which was held in the Library in Hradec Králové (2014), became also a valuable contribution to the field. The paper describes different standards and ways of upbringing in Roma families including the *cultural overlap*. From the point of linguistics, the mutual communication also includes the Roma ethnolect of Czech, a specific variety of the Czech language used in Prague was examined by Bořkovcová (2006).

The aim of this paper is to answer the following main research question: What are the specifics of communication between teachers and parents of Roma pupils from the perspective of a teacher.

The paper is organized as follows: First, the review of relevant literature is briefly described. And the specification of the school, where the research was held, is presented together with the materials and methods used after literature review section. Then, the results present the findings concerning: the circumstances leading to parent-teacher interactions, the content of their mutual communication, the ways the teachers approach the communication, incl. the linguistic specificities, and the impact of the gender of communication participants. Discussion and conclusion contain comparison of the research results and similar surveys from abroad, and confront the research findings with the findings of sources on the same subject. And finally, acknowledgement is addressed.

## **MATERIALS AND METHODS**

This study includes qualitative research based on the combination of secondary sources study and primary data collection. Primary data collection is carried out through the semi-structured personal interviews conducted with fifteen teachers from the Primary School Címurkova.

This chosen method allowed the respondents to assess the relevance of the researched topics while leaving enough space for their own opinion. For these reasons, a quantitative approach was not employed in the form of a questionnaire survey, which would have required from the interview to formulate the topics and questions in advance. The interviews were conducted in December 2016 and January 2017 and each of them was approximately 90 minutes long. The teachers gradually discussed the pre-selected themes: Specifics of pupils and parents of Roma background; Reasons and circumstances

of communication (leading to interaction) of teachers and Roma pupils' parents; The teachers' approach to the communication with Roma parents. For deeper understanding of the researched subject, questions about the linguistic specifics and the impact of gender on the interaction were included.

The next step made in the study, was transcription of important parts of the interviews essential for answering the research key question. The rest of the interview recordings remain preserved in the audio-archive of the author. Analysis of the transcribed interviews consisted of finding the significant, important results, similarities and more general findings.

The research was conducted in the "lower" part of Žižkov borough, the location of the Primary School Cimburkova. According to the teachers' estimate, the school was attended by 80 % of Roma pupils out of the total number of 205 pupils in 2015/2016 school year (Cimburkova, 2016). However, as it was stated in the introduction, the exact number of Roma pupils cannot be determined.

The reason for finding such a high proportion of Roma pupils is the location of the school. In the past, Roma children were placed into special classes, which is not true nowadays. These classes were gradually merged with other regular once which resulted into a law presence of non-Roma kids in this school. For this reason, the school is attended mostly by Roma children or children who require special care. Although a number of Roma families have moved out of the Žižkov borough (or in many cases was forced to move out), their children still attend the Primary School Cimburkova, in spite of having to commute. The main reason for this is their special approach of the institution and good experience of the parents who also attended this school.

The specific feature of this school are micro-classes of about 15 pupils per one teacher and a differentiated approach towards educational needs of the children. The school focuses on creating suitable conditions for education of children from socio-culturally disadvantaged environments. The school employs 26 teachers, who use and implement special teaching methods, techniques and pedagogic approaches in the process of education, in cooperation with 10 assistants, 5 of whom are of Romani origin.

## **RESULTS**

### **Opportunities and reasons leading to interactions between teachers and Roma parents**

Nearly all the communication between teachers and Roma parents is initiated by the teachers. The teachers mainly contact parents in situations when some problems, that need to be solved, arise. The most frequent reasons given by teachers for contacting parents is a very low school attendance or poor academic performance, usually a combination of both.

Poor academic habits among pupils are obvious from the school statistic. The grade point average in the second half term of 2016 at the Cimburkova el. school was 1.98. Comparing to the primary school Fr. Plamínkové in Prague 7, where the GPA was 1.23 in the same half term (Cimburkova, 2016; Primary school Fr. Plamínkové, 2016). Only 15 pupils were enrolled in the 9<sup>th</sup> grade, one of whom was then enrolled in a high school and the other 14 continued education at various secondary vocational schools (Cimburkova, 2016).

Lack of interest in children's education brings complications even when teachers try to contact the parents. It is not possible to talk to parents during parents evenings, because twice in a row only nine parents out of all school have appeared. The situation seems to

be better in the 'year-one' classroom. The parents attendance is higher (about half of the estimate), because children are still excited and their parents worry about them. Typically, Roma parents attend the most parents evenings when it is their first child attending a school.

Just for the purposes of comparison, the case study from the ordinary primary schools in 2013 provided data on average numbers of parents attending the parents evenings. If we count one parent per one pupil, the attendance was 81 % this year. (Košnarová, 2013). In case of the Primary School Cimburkova with 187 pupils, the attendance is 5 % in maximum.

Additional space for mutual interaction between teachers and parents occurs naturally in the morning when parents accompany their kids taking them to school. Later, with growing age of a child this opportunity vanishes as they start walking to school on their own. It is also a common phenomenon that pupils come to school accompanied by their older siblings, then teachers have to communicate with them instead of their parents.

Teachers say, that they hardly ever see parents of pupils from higher years. When there is a need to contact Roma parent, teachers have to try many ways before they succeed. It can be really difficult to obtain a phone number or employ alternative social-media networks to reach parents. These methods often remind detective investigation. Making a successful contact may not be a win. To persuade the parents to come to school to participate in the meeting related to their child is a tough call. Teachers have to frequently repeat their request to make parents attend. Teachers make over and over attempts to arrange the meeting until the parents come to school. Even though parents agree to join the meeting, they quite often fail to arrive with no apology or explanation. Many issues are solved during random encounters outside the school. One of the teachers even confided, that she held the parents evening in a pub inviting each parent for a drink. She felt successful because the purpose of the event was fulfilled, nearly half of the parents appeared.

### **Specific communication and its characteristics**

A parent comes to school worried, already with apprehension and a prospect of solving unpleasant issues. For that reason, an interaction is unfavourable, negatively tuned since the very beginning. However, the research shows that school education is not a priority for the majority of Roma families, which reflects in their attitude to the schooling institutions and in the character of the communication with school representatives. The particular impact is felt by teachers in the parents' attitude to their children's home preparation.

The unique feature of this kind of intercultural interaction is, that teachers not only give information on the content of the work pupils need to catch up on, but they also advise parents how to make the child listen to the parents and how to do their homework. Parents are usually open to teacher's advice and promise to help children with a study. Unfortunately, accomplishment of this commitment rarely occurs.

The parents, who accepted to keep an eye on their children whilst doing homework, from time to time come to complain about low marks that their kids receive. They are certain that their children fully acknowledged the subject. Then the teachers try to let these parents visit lessons and experience a process of learning. Alternatively the parents can compare the children's workbook with work of other students. The problem remains how to convince parents to come to school at all.

Another important aspect of intercultural communication between teachers and parents is, that it is sometimes expressive and very open from the parent's side. Experienced senior teachers are familiar with verbal abuse and aggression, in which cursing, swearing

or threatening teachers is not rare. On the other hand, the interviewed teachers generally appreciate parents' direct approach. When a problem or a situation arises that parents do not agree with, they turn directly to the teacher. It appears to be rare among Roma parents to complain behind the teacher's back to the school management. Parents are now and then too impulsive in their attempts to solve a problem. They sometimes retroactively, yet frankly apologise. This is the main reason, why teachers say that only the strong personalities among their ranks can face to this kind of behaviour.

### **Teachers' way of communication**

Teachers do anything to maintain their assertive attitude throughout the entire communication. In case a Roma parent communicates expressively or even threatens the teacher or teachers, the teacher reiterates the request and asks if the parent understands.

When such situation occurs, a teacher tries hard to get the following message across to parents: "I do care about your child and I am sharing the same interest with you. We both want your child to be smart, to thrive and make their life successful. Let's work on it together." From a long experience of teachers, this is exactly the kind of sentences that are effective and make teacher-parent cooperation smoother and easier.

### **Linguistic specifics of communication**

There is still a language barrier of some extent, the barrier resulting from the low vocabulary and usage of the Roma ethnolect of Czech. The message that teachers need to get across to the parents must be clear and delivered in a comprehensible way.

None of the parents who keep in touch with the participating teachers speaks Romani any more. Both, parents and their children, only use Romani in the form of lexical borrowings implemented in Czech. Most often we can hear Romani greetings and exclamations. There are also known examples of Czech words subjected to the rules of Romani morphology, mainly adding the common suffixes *-is* or *-os*, which leads to transformation of the Czech nouns such as *svetr* to *svetris*, *kočky* to *kočikos*, *pošťák* to *pošťáris*. Unexperienced teachers can be also surprised by phrasal calques. Romani translation equivalent of the Czech verb *vést* also includes the meaning *nést*. On the basis of this semantic calque, parents often use the phrase *nést dítě do školy* (*carry the child to school*) instead of the Czech *vést dítě do školy* (*take or bring the child to school*). Based on the nature, this phenomenon is classified as a semantic deviation on the basis of broader meaning.

Ethnolect used in classes causes problems mainly to younger teachers, who do not come from Roma background.

### **Gender and communication**

The last factor this case-study examined was the influence of gender. Accordingly to the interviews' outcome, male educators have far more better negotiating position, especially if they deal with Vlach-Roma community. However, there is an extremely low number of men among school teachers. In case the teachers need to solve a problem effectively, they turn to the family member who has the decisive say in family matters regardless of gender. In case a serious problem arises that needs to be solved, teachers make a significant effort to involve both parents and make them come to school. From their experience, it is not rare that if only one of them is present it leads to misinterpretation of information between both parents resulting in further misunderstanding.

## DISCUSSION AND CONCLUSION

After analysing the interview's output, specifics that teachers perceive while communicating with the Roma students' parents were determined. All of them have one common denominator – rejecting attitude of Roma towards education. Lack of interest in education among Roma people was explored by the Serbian study (Vranjesevic and Frost, 2016). Serbian teachers went to the field as part of the APREME Project aiming to provide information about educational entitlement. By doing this, they showed and developed their understanding of the circumstances that discourage Roma families from coming to school regularly. The result of the survey was a deconstruction of prejudice maintained by teachers toward Roma population. Teachers from Primary School Cimburkova do not take part in any project that would recommend such action. Most of them live near the school as well as their pupils, so they understand their situation and circumstances they live in. Teachers also attend lectures organised by non-profit organizations. Evidence of their open and helpful approach is the teacher who invited parents to the pub to have an informal chance to communicate. Similar steps smooth mutual relationships and improve communication.

Strategy of inviting the parents to join their children in classes may be compared to the Spanish INCLUD-ED Project Flecha and Soler (2013). We can notice positive experience on both sides. In Spain, they used this way to transform traditionally unequal relationship and created bridges between the Roma community, school and teachers. Insights in or joining in the lessons proved to be a suitable way how to tell parents that their child has got a problem at school. They can see themselves what the child excels in and where his problems are. Further communication with teachers is smoother, as it is supported by personal experience.

The Primary School Cimburkova does not take part in any project of this kind. Its activities are follow the two projects conducted by the Ministry of Education (The “Through multicultural to mutual understanding” project and the project to support the schools which provide inclusive education and education for socio-culturally disadvantaged pupils ), “The innovative approaches in Roma children education“ international project and the EDUROM project, both initiated by the European Commission (Cimburkova, 2016).

Particular specifics of Roma communication correspond to some outcomes of the conference of experts on Roma issues (Library KH, 2014). A situation when a Roma does not arrive at the pre-arranged meeting is not explained in the publication as a sign of disrespect. If there is something that needs or deserves the priority, seen from perspective of the Roma, everyone must understand. Outputs also agree on the leading position of a man in the family. Regarding the requests and saying thanks the opinion may differ. Statements that Roma people are not used to thank or ask kindly were mentioned at the lectures as facts, but the teachers did not experience anything like that in real life.

The earlier mentioned style of verbal communication corresponds with the usage of ethnolect as it was described by Bořkovcová (2006) during her research in Smíchov borough in Prague. *The previous publication by Hübschmannová (1993) and the handbooks for teachers and educators by Žlnayová (1995) and Šebková (1995) appeared at the time when the Romani language was used more, which makes their content outdated.* Communication between teachers and Roma families might become easier when the Roma population changes their attitude towards education. In a shorter-term interval the mutual communication could benefit from the change of legislation. Currently the law only requires obligatory school attendance, which means it is the parent obligation to send the child to school. If the parents' obligation was extended to include supervision

on homework and collaboration on their child's education, teachers might save some time spent trying to reach the parents. Over some time, negative undertones of mutual interaction could begin to fade.

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