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BLENDED LEARNING: ASSESSMENT OF FLIPPED CLASSROOMS BY STUDENTS MAJORING IN HUMANITIES

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Abstract

This paper is devoted to flipped learning as an innovative pedagogical technology and a type of blended learning. Flipped learning intertwines traditional place-based and online forms of education. Our aim was to analyse the attitude of students majoring in humanities towards this instructional strategy. In 2018, 15 semi-structured interviews were conducted with 4-year undergraduate humanities students of the Ural Federal University (Russia). It is shown that lecturers in humanities subjects are reluctant to apply the methods of blended learning in their teaching practices, largely due to the lack of respective skills and insufficient institutional support. The advantages of flipped learning include the possibility for students to organise their educational process according to their needs, while its disadvantages consist in the lack of direct interaction with lecturers.

Keywords

Blended learning, flipped classroom, higher education, undergraduate students

Introduction

Social change is embracing all spheres of society, including the education system. Many universities are increasingly using information and communication technologies, which are expected to intensify traditional educational forms and methods. One of the major breakthroughs in teaching methods has lately been blended learning. Blended learning is based on formal curricula, in which a part of instructional content is delivered in the context of computer-mediated environments, outside of the classroom. Students exposed to this form of education normally study full-time, but have a possibility to learn at their own pace. Blended learning makes the whole process of education more integrative (Staker and Horn, 2012).

Blended learning is believed to have a number of distinct advantages. Firstly, students can gain knowledge and information in a personally convenient mode. Secondly, financial expenses borne by the university can be significantly reduced, thus raising its overall resource efficiency. Thirdly, the learning process can be realised regardless of time and place. Fourthly, students enjoy a higher level of independence in terms of managing their personal time. Fifthly, blended learning combines both online and offline learning forms, thus meeting the needs of younger generations, so-called digital natives (Prensky, 2001). Finally, this form of education implies personalised guidance for every student.

The quality and competitive advantages of university education can be boosted by the educational technology of flipped learning. The flipped learning model is commonly believed to be a specific type of blended learning (Foldnes, 2016). However, it should be viewed not only as another instructional strategy, but also as a model of a non-linear educational environment, which is based on recent achievements in information technologies. The use of technologies in the learning process meets modern challenges and becomes a condition for the formation and development of students' IT literacies.

Flipped education reverses the conventional learning dynamics by exposing students to instructional content via electronic media, with classroom time being assigned to deepening understanding of the subject and developing the required skills. Therefore, educators pursue the task of supporting the students' cognitive activity and scrutinising complex problems, rather than presenting new topics. Thus, instead of being the mediator of knowledge and a supervisor, the educator becomes a coach and a partner, providing support to students in their mastering new knowledge and skills.

The flipped learning approach involves the following stages: acquiring knowledge using video resources – collaborating in the classroom to apply and practice concepts – receiving supervision / feedback / evaluation (Bauer-Ramazani et al., 2016). Lectures are delivered outside of the classroom, in the form of video classes and online homework sets (Bergmann and Sams, 2014). Previous research in the field of higher education has shown a high level of student satisfaction with flipped learning (Yeung and O'Malley, 2014).

Nevertheless, it should be noted that the flipped approach is characterised by both advantages and disadvantages. On a positive note, such strategies have been shown to stimulate students' active learning and independence (Yoon, Park and McMillan, 2017), as well as to improve the overall quality of interaction between educators and students (Fulton, 2012). However, a number of disadvantages involved with this model have also been identified. In particular, Herreid et al (2014) noted a decrease in student satisfaction with flipped classrooms in the long run. According to Roehl, Reddy and Shannon (2013), another problematic area is the insufficiency of technical skills among educators, which impedes the creation of high-quality lecture presentations.

Conflicting opinions concerning the use of flipped learning in university education explain the importance of undertaking further efforts in elucidating this phenomenon. In particular, students' attitudes towards the flipped approach, its advantages and disadvantages should be analysed before its wide implementation. Such an analysis might reveal barriers in the implementation of flipped learning; establish compliance of the learning process to the interests and needs of a broader student community; assess the innovative potential of universities; and to expand the application of modern learning technologies in higher education.

On the basis of the abovementioned, we have formulated the following research hypothesis. Russian students majoring in humanities are inclined towards innovative methods of education. However, this readiness is not supported by an appropriate level of training in the field of online education on the part of their university professors.

MATERIALS AND METHODS

This study was carried out following the tradition of qualitative sociological research. Our major research aim was to analyze university students' attitude towards flipped classrooms. To this end, two research objectives were distinguished: (1) to assess the level of awareness about flipped learning among students; (2) to reveal difficulties that impede the implementation of this promising educational technology. Primary data was collected using semi-structured personal interviews with students taking a bachelor degree course at the Ural Federal University named after the first President of Russia B.N. Yeltsin (UrFU), Ekaterinburg, Russia. A total of 15 undergraduate students were surveyed. The respondents were majoring in journalism (n = 3), philology (n = 3), political science (n = 3), philosophy (n = 3) and social work (n = 3). All the respondents were 4-year students. In terms of gender structure, male and female students accounted for 5 and 10 people, respectively. All the respondents were successful students having no unfulfilled curriculum requirements.

The students were interviewed during March-April, 2018 in their free time. The average interview lasted about 30 minutes. We created a semi-structured interview guide with predominantly open-

ended questions to elicit their experiences of flipped learning. The respondents were given an opportunity to formulate their own opinion while answering the questions. The interview questions were grouped according to the following directions: (1) do you know of blended learning and flipped education?; (2) do your professors apply IT technologies, in general, and flipped classrooms, in particular, in the course of education?; (3) why do you think flipped education is not widely applied? What are the major obstacles to its implementation? (4) what are the advantages and disadvantages of the flipped education model? In the process of interview, we demonstrated 4 slides containing essential information about flipped education to those students that had been found to be unaware of this approach. All in all, 7 people demonstrated the need to watch the slides.

The next step in our study was the transcription of the obtained interview texts. Afterwards, the respondents' answers to the same questions were grouped together. Such a grouping allowed the commonality and specificity in the interviewees' responses to be revealed, thus facilitating interpretation of the obtained data.

RESULTS AND DISCUSSION

Students' awareness of blended learning and flipped education

According to our findings, Ural Federal University students demonstrate a rather low level of awareness concerning the model of flipped education. Only half of the respondents mentioned they had some knowledge about this approach: *"... I have no idea what flipped education is, as our teachers always use traditional classes, such as lecture – seminar, lecture – seminar…"* (female, social work student). Those students claiming that they possessed information about flipped classes noted that this model has something to do with online learning technologies: *"... the other day I read an interesting article about online education, it described flipped education. But we have never used it with our teachers during all the years of my undergraduate education…"* (male, political science student).

The respondents admitted that educational innovations on the basis of information and communication technologies are being actively used in contemporary higher education. In particular, mention was made of online courses: *"... now you can choose online education in your first year, for example, in history or philosophy. These are mainly lectures delivered by professors from the Moscow State University or the Higher School of Economics… "* (female, social work student).

Nonetheless, according to the respondents, Ural Federal University educators teaching at humanities departments never apply the methods of online education. Their awareness of flipped learning is shown to be rather low. "It seems that our professors have heard about blended learning; however, I doubt they know anything about flipped education. They might start using such technologies, but not today for sure" (female, social work student). Flipped classrooms are believed to become a reality in 5-7 years, not sooner. It is of interest to analyse reasons behind such a situation.

Barriers to the implementation of the flipped education model

The first reason is that lecturers themselves lack comprehensive information about innovative teaching technologies, likely because most of them received their education more than 20 years ago. At that time, pedagogical innovations in higher education requiring the application of information and communication technologies were at the nascent stage. *"Almost all our teachers are over 45+. They simply fail to adjust to the new format. They were not taught using such technologies when at university themselves"* (male, philosophy student).

The second reason is believed to lie in the specifics of teaching such subjects as humanities. The

point is that almost all university lecturers teaching humanities are graduates of non-STEM university departments. As a result, such tasks as creating an electronic text, overcoming the feeling of alienation from unseen students, organising online communication are felt by lecturers as insurmountable barriers to using new educational modes. *"Our teachers are specialists in humanities, it is difficult for them to master online technologies. And it is completely unrealistic to expect that 60-year old teachers would be able to maintain a constant online dialogue with students"* (female, journalism student).

All the respondents noted that the current educational process should be restructured, emphasising the contradiction between students' need for new forms of work and the lack of respective skills in their educators. The students tend to associate new forms of education with the following two key points. On the one hand, every fifth respondent is not fully satisfied with the existing channels of communication between them and their teachers. The respondents claimed that teachers should interact more closely with their students, allocating time in their schedules for online meetings: *"I have been writing to our lecturer for about a week, but received no response so far… It is necessary to allocate some hours for online consultations so that I knew that, at a specific time moment, there will be a teacher out there, whom I could address a question. It would be more convenient: today everything is moving into the digital sphere"* (male, philosophy student). On the other hand, the respondents mentioned that they feel the need for new educational practices: *"I would probably learn something else, I really want to try something new, related to online learning, maybe a flipped class…"* (female, journalism student).

The implementation of flipped learning strategies requires the content of lectures to be properly adjusted. Lectures should, first of all, be aimed at presenting the logic of scientific research into specific problems and existing approaches to their solution, rather than the history of the issue and the results obtained so far. Two thirds of the respondents are found to be interested in studying lecture materials outside of the classroom. The main advantage, according to the respondents, is the possibility of managing their personal time. *"Such a model would suit me very much. In the evening, with a cup of coffee at home, watch a lecture. You can rewind it if something is not clear. Very convenient, because it is only I who decide when I should study"* (female, philology student). According to Abeysekera and Dawson (2015), a significant strength of flipped education is the possibility of adjusting learning content to the level of individual students.

However, every third respondent mentioned that the opportunity to learn at your own time and pace could be an obstacle to the implementation of flipped learning. It is common knowledge shared by our respondents that traditional classes are conducive to strengthening students' discipline. *"I know that I need to come to the class according to the established schedule. I think that if I were to study using video resources, most likely I will not watch them. There are so many other things to do. Well, maybe I will take a look in the break between classes"* (female, philosophy student). *"… of course, you can watch lectures at home, or on a bus, or in a cafe, but it is better to come to the classroom and gain knowledge there"* (male, political science student). Seereekissoon (2018) discussed a similar impediment to blended learning in his study. He discovered that most students enjoyed the process of flipped learning, since they could re-watch video lectures multiple times. However, some students were found to be reluctant to watch video lectures at home.

Another obstacle identified by our respondents–philosophy students consists in their need for a permanent direct interaction with the professor throughout the entire period of study. *"We, students majoring in philosophy, probably do not need such an approach, we want to understand the content, we want face-to-face communication with our teachers, we want to listen to real lectures…"* (male, philosophy student). Some respondents mentioned that, while watching video lectures, some questions requiring immediate clarification from the teacher might arise. Afterwards, these questions lose their relevance and urgency*: "… of course I can ask these questions later, but either they will become unimportant or I will just forget them…"* (male, philosophy student). This question was also raised in a study undertaken by Milman (2012):

during out-of-class content delivery, students cannot receive a direct response from the lecturer.

One of the pressing issues, according to our respondents, is the question of providing technical support to educators realising flipped classes. The lack of professional videographers, programmers, administrators and other technical specialists becomes a critical factor in the implementation of flipped education. A humanities lecturer, unfortunately, is not always capable of solving technical issues. How to make a high-quality recording of your lecture using professional equipment? How to upload materials on a specialised electronic platform? How to provide students with a productive feedback? How to update your materials? These questions can be solved only with the assistance of technical specialists. In addition, the respondents noted that educators do not apply the principles of flipped learning, most likely because they lack the respective skills themselves and have no information whom to turn to for assistance. *"… I suppose our professors might want to introduce something innovative, but they do not know how to organise it…"* (female, philology student).

Despite the aforementioned difficulties, which are characteristic of the entire system of modern higher education, our respondents reported that university lecturers do make use of some technological tools, which can serve as the basis for the development and implementation of flipped classrooms. Thus, some UrFU professors are shown to apply online testing assignments in the monitoring of students' knowledge. Moreover, the domineering majority of lecturers regularly use electronic presentations created using various kinds of software. It should be noted that computer presentations have become everyday reality both for modern students and lecturers; however, not all classrooms are equipped with necessary technical means (computer, screen, etc.). Since 1998, UrFU has been operating Moodle, a learning management system, which allows the teaching staff to create and update various materials. STEM lecturers actively use this system as well. In his study, Nouri (2016) found that the majority of STEM students demonstrate a positive attitude towards flipped learning, the use of video learning resources and Moodle. Unfortunately, lecturers in humanities are still lagging behind their STEM colleagues. Therefore, specialised training courses aimed at acquainting the university staff with the basics of online education should be seen as a prospective approach for overcoming barriers and enhancing the university learning environment.

Conclusion

Our research has allowed us to draw the following conclusions.

Firstly, awareness about the model of flipped education is still low among students taking a bachelor degree course in humanities. To a large extent, this is explained by the reluctance of academics teaching at humanities departments to implement such pedagogical strategies in their classroom activities, preferring the traditional system of education.

Secondly, the implementation of flipped education is hampered by a weak training of lecturers in the field of online education. University professors are frequently unable to launch flipped classes without specialised technical assistance. Flipped learning is characterised by both advantages and disadvantages. Among the advantages, our respondents have mentioned the possibility of managing their own time, as well as the inclusion of information and communication technologies in the modern educational space. The drawbacks include the lack of direct communication with the professor during the lecture, as well as the lack of time management skills.

Therefore, our research hypothesis about the discrepancy between students' preparedness for innovative educational technologies and the lack of respective skills among their professors has been verified.

We believe that administrative support will be a factor in the introduction of flipped learning practices in the educational process. Moreover, educators need to master new competencies and literacies in

accordance with the challenges of contemporary higher education. Flipped learning is a promising approach that organically intertwines the advantages of traditional and interactive learning. Its implementation in universities is becoming a key area of higher education modernization not only in Russia, but also globally.

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EVALUATION OF KNOWLEDGE RELATED TO FINANCE IN STUDENTS OF SELECTED CZECH UNIVERSITIES

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Abstract

The goal of this paper is to evaluate the level of financial literacy possessed by students in relation to their knowledge of terminology and attitudes. The primary data were acquired through quantitative research survey (n = 585). The respondents were students at selected faculties of two universities. These faculties' specializations always differed: at every university a faculty focused on economy and a faculty focused on agriculture were picked. The results show that only 54.5% (320) of the respondents were able to correctly characterize the term inflation. Only 29.2% (171) of the respondents knew the real difference between the terms leasing and credit. Barely a quarter of the respondents (24.8%, 145) were able to correctly define the term APR. A statistical analysis of the data only showed a provable dependency between the respondent saving some of their income for unpredictable situations and the respondent's field of study.

Keywords

Education, financial literacy, knowledge, student, university.

Introduction

The digitized, global world of today is a new communication environment, native primarily to the young generation. The young people of today have been born and grew up in a world tightly interconnected by communication and information technologies, seen by this generation as a natural part of everyday life (Ferri-Read, 2014; Zemke a Filipczak, 2013; Noble, Haytko a Philipps, 2009). The Internet environment and smartphone technologies make it possible to engage in many everyday activities and satisfy real-world needs in a fast and simple manner (Tippelt a Kupferschmitt, 2015; Bolton et al., 2013).

However, as the economy and society progress dynamically, individual reality is paradoxically becoming more complex. The number of opportunities in all fields of life is growing, but demands on knowledge are growing with it, as is the difficulty of all decision-making processes. To put it in other words: the wide spectrum of opportunities means it is getting harder and harder to succeed in everyday life. The knowledge necessary for one to function successfully and responsibly in a developed economy no doubt also includes the field of financial literacy.

The percentage of people with university education is growing in the young generation and we can expect that in the future, these people will occupy key positions in the private and state sectors and their attitudes and decisions will therefore shape society. It is therefore paramount to educate the young generation in financial literacy, to evaluate their grasp of basic terminology, and to observe their knowledge concerning economic and financial variables (Williams, 2007). Elementary and secondary school curricula in the Czech Republic include financial literacy as part of each

institution's framework education programmes (Belás et al., 2016) In tertiary education, this field is not approached comprehensively, but each university addresses it individually, generally through including some segments of it in appropriate modules and other institutional activities.

Many university study programs offer different knowledge of financial literacy. However, financial literacy is inevitable in daily life of each person who becomes a customer, debtor, client, creditor, guarantor etc. In this context, each person should have a certain level of financial literacy (Kubák, et al., 2018).

The goal of this paper is to use primary research to evaluate the financial literacy of university students who study natural, agricultural, and veterinary sciences in the Czech Republic, and identify potential differences between the knowledge level of students of economic and non-economic programmes.

First, we must provide a theoretical framework. The Materials and Methods chapter describes how the primary research was carried out and what the sample looked like. In Results we present the results of the study and in Discussion we discuss and compare the findings of the study with similar studies in the field.

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.

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

Gender	Female	63.8
	Male	36.2
Level of study	Bachelor's degree	67.9
	Master's degree	32.1
Field of study	Economics field	42.1
	Non-economics field	57.9
University	USB	44.3
	MEU	55.7
Size of Place of Residence	up to 500 inhabitants	19.8
	501 – 2,000 inhabitants	24.6
	2,001 – 5,000 inhabitants	12.7
	5,001– 10,000 inhabitants	13.5
	10,001 – 50,000 inhabitants	10.6
	over 50 000 inhabitants	18.8

Table 1: Sociodemographic factors of respondents in%, 2018 (source: own research)

The questionnaire survey was carried out using printed questionnaires in the fall of 2018. The respondents were full-time students at two selected universities, focused amongst other things on agriculture, forestry and veterinary science. These were the University of South Bohemia in České Budějovice (hereinafter referred to as USB) and Mendel University in Brno (hereinafter referred to as MEU). At each university, the researchers approached both respondents studying at a faculty focused on economics (at USB this was the Faculty of Economics; at MEU it was the Faculty of Business and Economics) and respondent studying at a faculty not focused on economics (at USB this was the Faculty of Agriculture and at MEU it was the Faculty of Agri Sciences).). The economic and non-economic fields chosen for the purpose of comparison. The selective sample was intentional, with 585 respondents taking part in the financial literacy questionnaire survey. The paper focused on questions that have one objectively correct answer

and are connected to knowledge from the fields of financial terminology, financial products, mathematics or macroeconomics.

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, 2007). Obviously, the χ^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 the test statistic χ^2.

$$m_{ij} = \frac{n_i . n_j}{n} \tag{1}$$

$$\chi^2 = \sum \frac{(frequency\ observed - frequency\ expected)^2}{frequency\ expected} \tag{2}$$

$$\chi^2 = \sum_{i=1}^{r} \sum_{j=1}^{s} (n_{ij} - m_{ij})^2 / m_{ij} \tag{3}$$

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 χ^2 to the critical value χ^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 χ^2 is larger than the table value. This test is valid asymptotically, and thus can only be applied if there are enough 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 analyse a derived table, created by merging a small number of categories (Hendl, 2009). Cramer's *V* was used to determine the degree of association between the variables.

The data analysis was focused on the following tested hypotheses.

- H01: There is no dependence between whether the student makes a personal budget and their field of study.
- H02: There is no dependence between whether the student saves money for unpredictable expenses and their field of study.
- H03: There is no dependence between whether the student has thought about old age savings and their field of study.
- H04: The respondent's perceived knowledge of the abbreviation APR is not dependent on their field of study.
- H05: The respondent's factual knowledge of the term inflation is not dependent on their field of study.
- H06: The respondent's factual knowledge of the difference between credit and leasing is not dependent on their field of study.

The following abbreviations are used in this paper: APR = Annual Percentage Rate (RPSN); USB = University of South Bohemia in České Budějovice; MEU = Mendel University in Brno.

RESULTS

This chapter presents the results of the primary research focused on university students' financial literacy, including commentary.

Field of study / Answer	yes	no	Total
Economic	193	53	246
Non-economic	281	58	339
Total	474	111	585

Table 2: The relation between whether the student makes a personal budget and their field of study, 2018 (source: own research)

The final value of χ^2 is 1.82, meaning it is lower than the critical value, which is 3.84 in total, with 1 degree of freedom in the division and the level of significance being 0.05. The null hypothesis therefore cannot be rejected. There is no dependence between whether the student makes a personal budget and their field of study. 81.0% (474) of the respondents, out of the total number (n = 585), stated that they track their personal income and expenses. 65.8% (312) of the university students kept electronic records, while 8.2% (39) preferred written records. Roughly a quarter of the respondents stated that they only have a general idea about their personal income and expenses, and only internally, not keeping a precise record. The respondents who said they did not keep any records (19.0%, 111) generally stated their reason was that they thought there was no point (50.5%) or that they had no time capacity for the activity (36.0%).

Field of study / Answer	yes	no	Total
Economic	172	74	246
Non-economic	279	60	339
Total	451	134	585

Table 3: The relation between whether the student saves money for unpredictable expenses and their field of study, 2018 (source: own research)

The final value of $\chi2$ is 5.50, meaning it is higher than the critical value, which is 3.84 in total, with 1 degree of freedom in the division and the level of significance being 0.05. The null hypothesis can therefore be rejected. There is a dependence between whether the student saves money for unpredictable expenses and their field of study. The degree of association, measured using Cramer's *V*, is 0.15, meaning association is weak. Over three quarters of the students (77.1%, 451) out of the 585 total stated they were saving money for unpredictable expenses. Students of the non-economic fields answered yes more often (82.3%) than students of the two economic fields (only 69.9%). Only less than a half (47.7%, 279) of the total number of respondents (n = 585) said they were currently using a savings account. There were no major differences between the students based on their field of study in this case.

Field of study / Answer	yes	rather yes	rather no	no; I don´t know	Total
Economic	59	68	73	46	246
Non-economic	70	73	124	72	339
Total	129	141	197	118	585

Table 4: The relation between whether the student has thought about old age savings and their field of study, 2018 (source: own research)

The final value of $\chi2$ is 5.39, meaning it is lower than the critical value, which is 7.81 in total, with 3 degrees of freedom in the division and the level of significance being 0.05. For statistical evaluation, the answer "I do not know" has been aggregated with the semantically similar answer "No". The reason is that only two respondents have answered "I do not know". The null hypothesis therefore cannot be rejected. There is no dependence between whether the student has thought about old age savings and their field of study. When it comes to financing their needs in their old age, 72.0% (421) of the students believe they will live on their old-age pension and other

sources of income (for example savings). When comparing this answer to the fields of study, we can see that the students of non-economic fields answered yes slightly more often (74.0%) than the students of economic fields (69.1%). Only 15.0% (88) out of the total number of respondents (n = 585) stated they would rely on the state-provided old-age pension and 13.0% are expecting income from other sources (renting out houses or flats, etc.).

Field of study / Answer	yes	no	Total
Economic	78	168	246
Non-economic	84	255	339
Total	162	429	585

Table 5: The relation between the respondent's perceived knowledge of the abbreviation APR and their field of study, 2018 (source: own research)

Only 162 (27.7%) of the respondents stated that they knew what the abbreviation APR meant. The final value of χ^2 is 3.42, meaning it is lower than the critical value, which is 3.84 in total, with 1 degree of freedom in the division and the level of significance being 0.05. The null hypothesis therefore cannot be rejected. The respondent's knowledge of the abbreviation APR is not dependent on their field of study. Analysis showed that out of the total number of respondents (n = 162) who stated they thought they knew what the abbreviation APR meant (27.7%), almost 90% were in fact capable of correctly defining it (89.5%, 145). No differences between the students' answers based on their field of study were found.

Field of study / Answer	Correct	Incorrect	Total
Economic	155	91	246
Non-economic	165	174	339
Total	320	265	585

Table 6: The relation between the respondent's factual knowledge of the term inflation and their field of study, 2018 (source: own research)

Over half (54.5%, 320) of the respondents (n = 585) were able to correctly verbally define the term inflation. The final value of χ2 is 4.25, meaning it is higher than the critical value, which is 3.84 in total, with 1 degrees of freedom in the division and the level of significance being 0.05. The null hypothesis therefore can be rejected. The respondent's knowledge of the term inflation is dependent on their field of study. There was a significant difference between how many students knew the correct answer depending on their field of study, with students of economic fields reaching 63.0%, and students of non-economic fields only 48.7%.

Field of study / Answer	Correct	Incorrect	Total
Economic	66	180	246
Non-economic	105	234	339
Total	171	414	585

Table 7: The relation between the respondent's knowledge of the difference between credit and leasing and their field of study, 2018 (source: own research)

The final value of χ^2 is 1.18, meaning it is lower than the critical value, which is 3.84 in total, with 1 degree of freedom in the division and the level of significance being 0.05. The null hypothesis therefore cannot be rejected. The knowledge of the difference between credit and leasing is not dependent on their field of study. Only less than one third (29.2%, 171) of the respondents (n = 585) knew the factual difference between credit and leasing. Respondents who studied non-economic fields had a slightly higher percentage of correct answers (31.0%, 105) than those who studied economic fields (26.8%, 105).

DISCUSSION

Financial literacy of the young generation is currently seen as a very important issue in many different countries. A number of studies have been carried out, providing relevant data on financial literacy in various demographics and looking for potential space for improvement (Kubák et al., 2018).

The results of our research show that 81.0% of all respondents, regardless of their gender or field of study (out of the total n = 585) engage in budgeting and tracking their income and expenses. Many authors see this sort of budgeting activity and the process of thinking about income and expenses as a first positive step in financial literacy (Lucey, 2018). Similarly, the respondents showed some awareness in the field of old-age financial security. 72.0% of respondents stated they would finance their old age through a combination of the state-provided old-age pension and other sources; 13.0% stated they would rely purely on other sources (their own investment); and 15.0% of respondents stated they would rely only on state-provided old-age pension. Their responses show that the respondents are aware that they will need to take on responsibility for making financial decisions, for example in planning for their retirement, although it can seem like a faraway decision to them now (Laudan, Nica and Lazaroiu, 2016; Lusardi, 2015).

The first statistically significant dependency was found in the question of whether the respondents save money for unpredictable expenses. Despite expectations, students of non-economic field answered yes (82.3%) more frequently than students of economic field (only 69.9%). This result corresponds to Tortorice's (2012) claim, in the context of his research into people's attitudes on financial literacy. He stated that education and the field of education only partially influence the likelihood of erroneous behaviour in financial decision-making. On the other hand, Jan, Hahn and Park (2014), as well as Özdemir et al. (2015) and Kuchařová, Pfeiferová a Prášilová (2018) state that an economic field of study is a determinant that has positive influence on an individual's financial literacy behaviour.

The second statistically significant dependency was found in the question about respondent's knowledge of the term inflation. Students of economic field answered correctly (63.0%) more frequently than students of non-economic field (only 48.7%). The same opinion is held also by Mouna and Anis (2017) who studied financial literacy determinants and concluded that understanding the specific contents of certain financial terms in particular, is influenced by the fields of study.

A major gap was found in case of the factual knowledge of the term APR. Only 27.7% of respondents thought they knew this abbreviation and only 89.5%, meaning 145 respondents were truly able to correctly define it. More than 70% of respondents are unable to define the difference between terms lease and loan. A similar relatively low knowledge of basic rates and financial products can be found for example in a study conducted at universities in the USA (Lusardi, Mitchell and Curto, 2010).

The study was focused on respondents who study at university in different fields. Kubák (2018) and Peng et al. (2007) believe that studying economics improves financial literacy. On the other hand, Fernandes, Lynch and Netemeyer (2014) note that the influence of a financial education on an individual's behaviour is limited in its duration and believe that after 20 months, it becomes negligible.

CONCLUSION

The primary research was conducted throughout 2018 at two selected Czech universities, focused amongst other things on natural sciences, agriculture and forestry, and veterinary sciences. It compares the knowledge of students in the field of economics (represented by faculties of economics) and in a non-economic field (represented by faculties in the field of agriculture).

The results showed that the field of study has minimal impact, with only two proven statistical dependency.

The paper's theoretical contribution is that it emphasized the issue of financial literacy in relation to elementary terminology in the field. Its practical contribution is presenting the results of financial literacy for university students at two Czech universities in different fields.

Acknowledgements

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ANALYZING BACHELOR STUDENTS DROPOUT AT THE UNIVERSITY OF ECONOMICS, PRAGUE

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Abstract

Not completing the study by a large portion of students is a serious problem at the universities worldwide. In-depth studies report various factors that influence the student's dropout. Such detailed analyses require to gather a lot of data about (and from) the students using questionnaires. As we worked only with data automatically collected for the university information system, our analysis was less complex. Using data about students who enrolled for the bachelor study in the academic year 2013/14 we try to differentiate between students completing the study and students being dismissed from the university.

Keywords

Bachelor study, dropout, contingency tables, decision trees

Introduction

Not completing the study by a large portion of students is a serious problem at the universities worldwide. Regardless of the countries, the numbers are very similar: about one half of students who enrolled for the bachelor study leave the university before obtaining the degree. In-depth studies report various factors that influence the student's dropout (Sagenmuller, 2018; Norton and Cherastidtham, 2018; Vossensteyn et al., 2015; Fischer et.al, 2016). Such detailed analyses require to gather a lot of data about (and from) the students using questionnaires. As we worked only with data automatically collected for the university information system, our analysis was less complex. We are analyzing dropout factors related to the transition between secondary school and the university and to the study achievements at the university. To do this, we used the data from the university information system. Our work fits thus into the area of educational data mining, a sub-field of data mining that aims 'to detect patterns in large collections of educational data that would otherwise be hard or impossible to analyze' (Romero and Ventura, 2013). A particular task to be solved within educational data mining is dropout and retention analysis; Dekker et. al. (2009) consider pre-university data and data from the first year of study to predict dropout of freshmen at particular university department, other authors focus on predicting dropout from e-learning/distant courses (Kotsiantis et. al., 2003; Lykourentzou et. al., 2009). Our paper presents some initial results when solving a similar task.

In the rest of the paper, we describe the used data, show how these data were used to create decision trees to differentiate between students completing the study and students being dismissed, discuss the results and show future research directions.

Materials and Methods

We used data about bachelor students who enrolled for their study at the University of Economics, Prague in the academic year 2013/2014. The available dataset contains 3132 students. Two types of variables can be found in the data: socio-demographic characteristics (e.g. age, sex, region) and study progress at the university (e.g. credits spent and lost, study results, date of graduation, date

of dismission). Our initial data exploration shows some basic characteristics of the data set: the number of male students was slightly higher than the number of female students, about one half of the students come from Prague and Central Bohemian region, followed by students from South Bohemian region, almost all students (3109 out of 3132) enrolled for study programs in Czech language, most of the students study in the full-time form of study (2955 out of 3132).

There are two ways how a student can leave the university before obtaining the degree. A student can be dismissed during his/her study if he didn't cope with the study rules (at UEP, he may run out of allocated credits). But the student can also leave the university by himself during the study. We used this information as the dependent variable in our analyses. The proportion of students within these three groups, together with the proportion of students who obtained a bachelor degree is shown in Fig. 3 left, Fig. 3 right shows the proportions only for students who defended and who were dismissed. The similar situation can be observed at other Czech universities as well, see https://dropout.pef.czu.cz/Info.aspx.
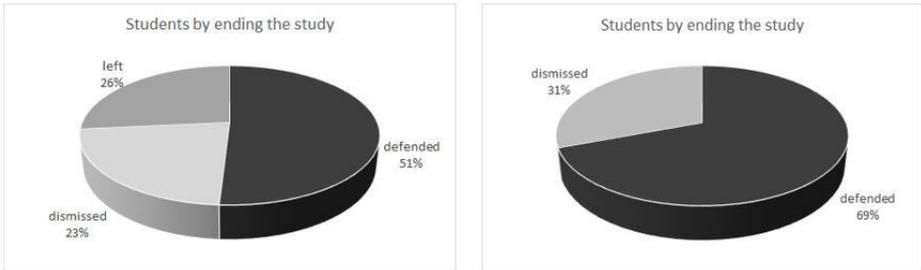
Figure 1: Students by ending the study (source: own calculation)

The aim of the study reported in the paper was to find factors that can be used to differentiate between students who successfully passed the study and defended their bachelor thesis and students who were dismissed from the university. So we removed students who left the university on their own. We further removed students who did not study in a Czech program. So our data sample we work with consists of 2283 students. We decided to analyze the data on the university level in our initial study, so not going onto faculty or study program level.

Following the typology of data mining tasks as presented in (Chapman et al., 2000) we choose dependency analysis and concept description tasks. Dependency analysis 'consists of finding a model that describes significant dependencies (or associations) between data items or events', concept description 'aims at an understandable description of concepts or classes. The purpose is not to develop complete models with high prediction accuracy, but to gain insights' (Chapman et al., 2000). We used contingency tables for the first task to find dependencies between variables characterizing the students (input variables) and the dependent variable. We used decision trees for the second task to find a more complex relationship between input variables and the target.

A typical method used for dependency analysis is association rules discovery. Association rules have been proposed by R. Agrawal in the early 90th (Agrawal et. al., 1993). An association rule has the form of an implication

$$X \Rightarrow Y \qquad (1)$$

where X and Y are sets of items (itemsets) and $X \cap Y = \emptyset$. An association rule expresses that transactions containing items of set X tend to contain items of set Y. This idea can be extended to other forms of relationships between values of categorical variables. In association rule discovery, the task is to find all rules of a given form that fulfill user-given criteria. To automatically generate

and evaluate contingency tables, we are using the KL-Miner procedure of the LISp-Miner system developed at the University of Economics, Prague (Rauch, Šimůnek, 2014). LISp-Miner offers a wide variety of different forms of association rules that can be found in the data (the system can be freely downloaded from http://lispminer.vse.cz). The KL-Miner procedure mines for KL-patterns in the form

$$R \sim C/\gamma. \tag{2}$$

The KL-pattern $R \sim C/\gamma$ means that the attributes R and C are in a relation given by the symbol $\sim$ when the condition γ is satisfied. The relation $\sim$ is thus evaluated on a K x L contingency table. Decision trees belong to the most popular models for solving classification tasks but, due to their interpretability, can also be used for concept description. Algorithms for building decision trees recursively partition the attribute space in a top-down manner (therefore the general name for these algorithms is TDIDT – top-down induction of decision trees) into regions homogeneous with respect to the target (Quinlan, 1986). This method, also known as "divide and conquer" has been implemented in various algorithms. We used the decision tree learning algorithm implemented in JMP system developed by SAS (https://www.jmp.com). The algorithm creates only binary trees and uses a relaxed stopping criterion: if the number of examples within a node drops below a given threshold, this node becomes a leaf regardless on its purity (proportion of examples of different classes).

The key question when creating a decision tree is which variable should be chosen to make a split. The decision tree algorithm in JMP uses the likelihood-ratio chi-square G^2 criterion to evaluate a split

$$G^2 = G^2_{node} - \left(G^2_{left} + G^2_{right} \right) \tag{3}$$

where G^2 *node* refers to the value computed for the node to be split and G^2_{left} and G^2_{right} refer to the values computed for the two children of the split node. Tab. 1 shows the value of G2 for input variables, we consider for a decision tree. As can be seen, the best variable is "credits obtained" and the tree having this variable in the root can correctly describe 99.47% of the students. We performed a series of experiments by repeatedly removing the best variable according to G^2 (i.e. removing variables in the order given in Table 1) and creating a decision tree from the remaining variables (note that the table shows not all variables but only 9 best to create the root of a tree).

variable	rank	G^2
Credits used	1	2253.49
Years at VSE	2	1602.49
Study average	3	1032.00
Credits lost	4	1029.24
Percentile (faculty+year)	5	931.62
Percentile (program+year)	6	916.91
Percentile (program)	7	897.92
Age when entering VSE	8	163.48
Years between secondary school and university	9	145.12

Table 1: Relevance of 9 best input variables (source: own calculation)

RESULTS

When analyzing the created contingency tables, our findings concerning the individual factors of student dropout can be categorized as trivial, rather expectable and interesting. As the standard length of the bachelor study is three years, it is obvious, that students who end their study earlier

typically do not obtain the degree (Fig. 2 left). An example of a rather expectable result is shown in Fig 2 right: losing credits during the study is a risk factor concerning successful completion of the study, but still, even when the ratio of lost credits is between 20 and 30%, the student can get a degree. Examples of interesting findings are shown in Fig. 3: the wider a "gap" between ending a secondary school and starting to study at the university, the less likely is that the student will get the bachelor degree, but students, who enter the bachelor study at the age 30+ have high chance to finish their study.
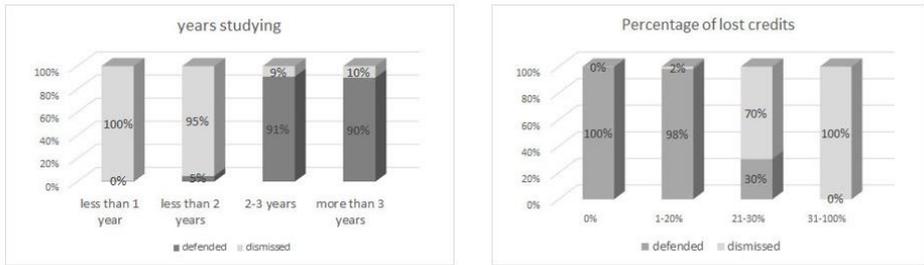
Figure 2: Years studying at the university (left) and percentage of lost credits (right) related to the target (source: own calculation)
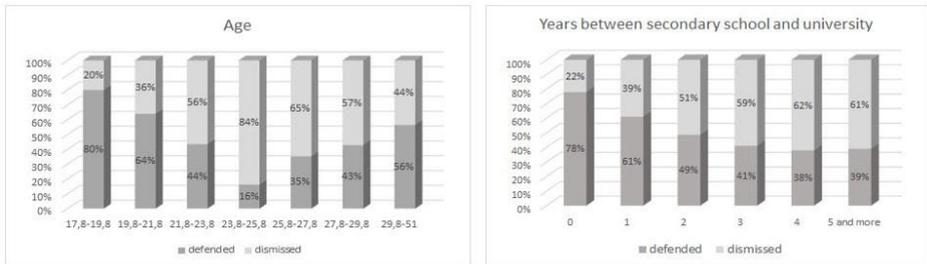
Figure 3: Age when entering the university (left) and years between secondary school and university (right) related to the target (source: own calculation)

Fig. 4 shows the impact of the removal of the best splitting variables on the ability of the created tree to differentiate between our two classes. The numbers on x-axis refer to the rank of the variable in the root of the tree, ranks are shown in Tab. 1.
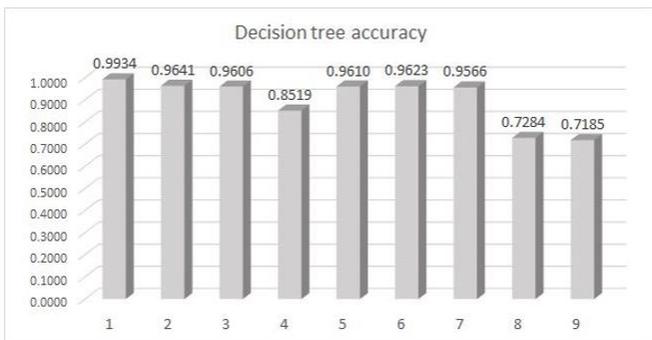
Figure 4: Accuracy of various decision trees (source: own calculation)

DISCUSSION

When using contingency tables, a number of factors related to student's dropout has been found. Most of them are obvious (examples are shown in Fig. 2), but, at least the impact of the "gap" between finishing secondary education and entering the university or the impact of age are interesting. Whether these relationships reflect some more general patterns must be verified by analyzing data about students who enrolled for the bachelor study in other years.

The decision trees show more complex (and more accurate) relationships between a subset of input variables and the target (compare the histogram from Fig. 3 left, with the tree from Fig. 5). The tree shown in Fig. 5 has also a slightly better ability to differentiate between the two classes (its accuracy is 72%, see the most right bar in Fig. 4) than the root variable itself (the accuracy when using only this variable is 71%). We perform a series of experiments by removing the best splitting variable from the current set of variables to assess the expected decrease of the accuracy of the tree. All created trees have high accuracy when describing the two groups of students: students who successfully finished their study and students who were dismissed from the university. Our experiments summarized in Fig. 4 confirm the well-known property of decision trees, namely that due to the greedy nature of the tree growing process, the best splitting attribute used as the root need not result in the best (most accurate) tree. This figure also shows that when removing variables related directly to the student achievements (lost credits, study average, percentiles), the description of the concept "successful student" becomes less accurate. These results, although the solved task was concept description, not classification, correspond to the results presented in (Dekker et al. 2009). Also these authors realize that their models (decision trees, Bayesian classifiers, logistic models and rules) created only from pre-university data are less accurate (they achieved accuracy of about 0.7) than models that include also data from the first year study (here, the achieved accuracy was about 0.8). Again, like when evaluating the results of dependency analysis, the resulting trees need to be compared with trees created for the students who enrolled for their study in other years.
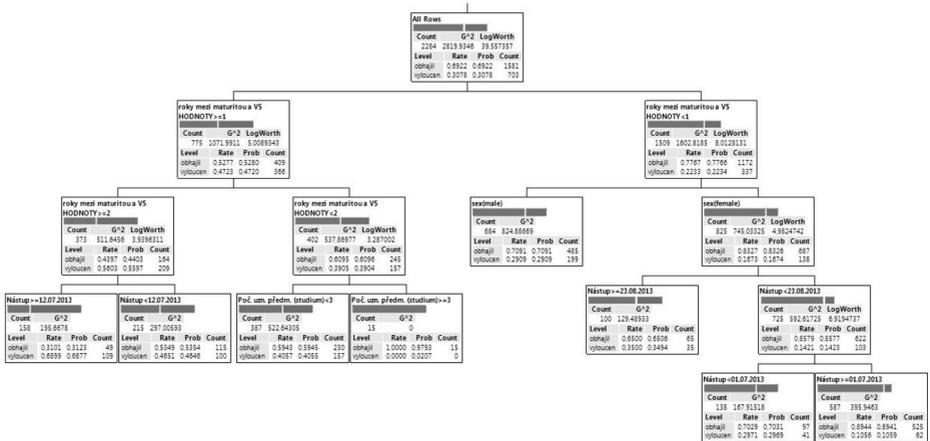
Figure 5: Example of a decision tree having the variable years between secondary school and university in the root (source: own calculation)

CONCLUSION AND FUTURE RESEARCH

We report some initial analysis of the data about students who enrolled for their study in the academic year 2013/2014. Our results show, that to distinguish between successful and

unsuccessful students, the key variables are related to the study progress. The variables known about the students when they enter the university are less important (see the significant drop of accuracy for the last two trees as shown in Fig. 4). Although the results seem not to be very novel, they bring some initial insight into the data.

We will extend our work in several directions. We plan to use additional data about the students (data related to the admission process to the university, more details about study achievements at the university collected on a yearly basis). We plan to create predictive models by using a part of the data as training set to create a model and evaluate its accuracy on a testing set.

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BENEFITS OF CLIL IN TRANSLATOR TRAINING: AN EXPERIMENTAL RESEARCH PROJECT

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Abstract

The paper presents an approach to the development of university students' linguistic and extralinguistic components of translation competence. The author reports the results of the application of CLIL (Content and Language Integrated Learning) technology with the focus on the provision of a communicative context in which the target language can be learned. The purpose of the research was to study and diagnose the efficiency of CLIL in the increase of teaching productivity and academic performance of future translators. The research design included conducting questionnaire surveys and CLIL based classes, participant observation, vocabulary output and cognitive tests. The obtained data provided support for the benefits of implementing CLIL in higher education translator training as the experimental group outperformed the control group. The results of the experiment indicate that first-hand experience and personal emotional involvement can facilitate the learning process and improve the quality of education.

Keywords

Academic performance, CLIL, communicative context, translation competence, translator training

Introduction

The problem of professional competence has received much attention in recent years with regard to the issues of competence structure, mechanisms of its formation and development, assessment methods and measuring procedures (Gong, Hu and Lai, 2018; Károly, 2012; Solovyeva, Sabirova and Morozova, 2015). Translation competence is a complex multidimensional phenomenon often viewed as a new quality acquired in the process of education integrating knowledge and skills required to translate. Acioly-Régnier et al (2015) having carried out an extensive study of contemporary translation competence models conclude that translation competence should comprise bilingual, extralinguistic and instrumental components (Acioly-Régnier, Koroleva, Mikhaleva and Régnier, 2015: 147). It is emphasized that foreign language proficiency or linguistic competence is by far not the only necessary component of translation competence (Gile, 2005: 12). Another important factor of successful translation is the so called extralinguistic competence by which we understand any kind of thematic knowledge in general and specific areas. This kind of knowledge or, rather, its lack can often hinder source text understanding and lead to translation mistakes (Boguslavskaya, 2014; Károly, 2014; Wongranu, 2017). What level of knowledge is sufficient for a translator to work in a narrow science sphere is a debatable issue. Our personal teaching experience with both linguist and non-linguist graduate and postgraduate students has lead us to believe that a specialist in a certain field of science most often performs a better translation into the mother tongue than a student of linguistics. Although translators deepen and extend their knowledge in the subjects they work on with practice, which is a lifelong task, formal training and university education should help future translators to acquire personal and professional qualities necessary to answer the conditions of the global labour market. However, educators find it difficult to stimulate the students' extensive learning and motivate them to

broaden their horizons. In this respect a search for ways of facilitating a student's motivation to accumulate new information is as relevant as ever.

The paper focuses on a teaching model that can foster the development of linguistic and extralinguistic competences of future translators with the emphasis on motivational issues. The objective of the paper is to evaluate the efficiency of Content and Language Integrated Learning (CLIL) in the increase of teaching productivity and students' academic performance.

In the subsequent parts of the paper we present the details of the research methodology used to analyze the problem, discuss the results obtained in the course of the teaching experiment and draw a conclusion.

Materials and Methods

The application of CLIL has become an integral part of higher education (see e.g. Arnó-Macià and Mancho-Barés, 2015; Chostelidou and Griva, 2014; Costales and Martínez, 2014). Various aspects of its implementation have been thoroughly investigated and discussed. However, so far there has been little research on the impact of CLIL on the development of translators' professional competences.

In our experiment we used CLIL as the basic teaching approach and tried to focus on the vocabulary output of CLIL alongside with the introduction of some specific knowledge on the topic usually not so very popular with the students. When elaborating the design of the project we made sure that all the essential elements of a successful CLIL lesson: content, communication, cognition, culture (Coyle, Hood and Marsh, 2010) were employed:

- Content – the progression of knowledge and understanding in a specific field important for translator training;
- Communication – using language to learn and at the same time learning to use language;
- Cognition – developing thinking skills;
- Culture – exposure to processes, a deeper understanding of alternative points of view.

Student activities and tasks were planned with the aim to develop and integrate all the four elements. For this we employed both text oriented and communication oriented activities (stages two and three of the experiment), as well as cognitive skills tasks (stage four).

In the course of the experiment the following data collecting tools and assessment technologies were used: the questionnaire method, participant observation, content analysis, vocabulary output test (translation dictation) and cognitive test. To evaluate the degree of linguistic and extralinguistic competences we used such criteria as: cognitive, emotional and motivational, communicative-activity (Solovyeva, Sabirova and Morozova, 2015: 420). The data were subjected to quantitative and qualitative analyses.

The research was carried out in four stages. Stage one included a questionnaire survey conducted within a period of three years at the Ural Federal University and the Ural State Pedagogical University in Ekaterinburg. The total number of respondents amounted to 65 undergraduate students, of whom 59 were females and 6 males, age range – from 20 to 21 years old. All of them majored in Linguistics specializing in Translation and Interpretation bachelor's program. The questionnaire consisted of 30 questions aimed to detect the students' preferences in the communicative topics and general erudition in related issues. The questionnaire included Yes/No questions, multiple choice items, as well as open items to be completed by the students. The main tool for questionnaire processing was therefore quantitative and qualitative data analysis.

Here we present part of the questionnaire dealing with the issues of art and culture:

1. Have you ever taken part in any creative productive activity?
   If the answer is "Yes", specify what kind of activity.
2. Have you ever read books on art?

3.   Did you attend a school or university course on world art culture?
4.   How often do you visit museums or art galleries:
     - never;
     - hardly ever;
     - from time to time;
     - quite often?
5.   When you look at a work of art do you think about the author's personality?
6.   When examining a painting what do you pay attention to:
     - subject matter;
     - composition;
     - colour scheme;
     - brushstroke?
7.   Give your own definition of the following terms:
     - realism;
     - impressionism;
     - cubism;
     - expressionism;
     - surrealism.
8.   What is the Russian realistic art school known for (names, genres)?
9.   In which sphere would you like to work as a translator:
     - science;
     - medicine;
     - arts (visual arts, music, literature, cinema);
     - technologies;
     - other?
10. I find the topic "Painting":
     - difficult;
     - not interesting;
     - useless for my future profession;
     - interesting;
     - other.

Stage two represented CLIL based classes performed in the fall semester of 2018. Students were randomly divided into two groups marked as experimental group (EG) and control group (CG). Each group included 15 – 16 students. All of them provided their agreement to take part in the experiment. The experimental group under the guidance of a bilingual artist attended two painting sessions during which they painted in oil colours two pictures in the styles of two different artists. All instructions were given in English and key units of topical vocabulary were introduced in the relevant contexts of the target language. The vocabulary included about 50 items: words and word combinations associated with art, history of art, painting technology and profession of an artist. Extensive information on artistic movements and styles of art was also provided to equip the students with background cultural knowledge. After each session, which lasted about three hours, the students reflected and discussed their experiences in English. The control group studied the same linguistic and extralinguistic material in the traditional classroom environment.

Stage three was a group discussion with the participation of both experimental and control groups. Those who took part in the experiment demonstrated one of their paining projects and gave the description of the process and the picture itself following the pattern of analysis given in advance. Control group students analyzed reproductions of pictures by famous artists. Some background search into the topic was part of the assignment. The scheme of the picture analysis is presented in Table 1.

1.	Title and Author
2.	Period, Style, School of painting
3.	Composition
4.	Contents, Subjects
5.	Colour scheme
6.	Manner of painting
7.	General impression, feelings evoked by the picture
8.	Qualities of a true artistic process

Table 1: Picture analysis scheme

Each category of the analysis was assessed in terms of vocabulary variability and extensiveness. To assess the emotional and motivational competence criterion we used content analysis grouping students' similar ideas into content units and analytical categories. The following analytical categories were distinguished: difficulty at the beginning of the project; new experience; interest; self-expression; a positive atmosphere; good mood; positive emotions. This procedure allowed us to make conclusions about the participants' attitude to the teaching method and their emotional state during and after the painting sessions.

The final stage of the experiment was carried out one month after the group discussion and included a long-term memory topical vocabulary translation dictation and a test on the identification of translation mistakes. The test was a special instrument developed with the aim to measure the effect of the CLIL program on the students' extralinguistic competence and general translation alertness. The test consisted of 10 entries each divided into two parts with the first representing an original text and the second – its translation into Russian. The translated version contained a translation mistake of the category that is typically described as a distortion of knowledge in the specific field (Boguslavskaya, 2014). In our case all the abstracts were taken from original literary sources and their translations: books on arts, painters' biographies, self-tuition manuals, novels. The task was: "Identify the mistake and correct it justifying your point".

Results

Our questionnaire analysis showed that 63% of the respondents had never taken part in any creative artistic activity. Of those who had some experience in doing arts most named school theatres and primary school drawing or water-colour classes. Almost half of the respondents hardly ever visited museums and art galleries. Although 90% of the students had attended a high school course on world art and culture, most failed to give appropriate definitions of art vocabulary items and only 50% managed to characterize the Russian School of art in terms of typical features and famous names. In answering the question "when examining a painting what do you pay attention to?" most students noted subject matter, composition and colour. The questionnaire also revealed that students found the topic "Painting" difficult (60%) but interesting (80%). About 70% would like to work in the sphere of arts, 20% opted for sciences which they considered more useful for their future profession, 10% had no idea in what sphere they would work as translators.

The CLIL part of the experiment revealed almost the same vocabulary output of the CLIL group and the non-CLIL group during the group discussion. But in the subsequent vocabulary test those who took part in the experiment demonstrated a better language performance using a more extensive and varied vocabulary. To assess the vocabulary criterion we used quantitative analysis calculating each item of the topical vocabulary used in speech during a student's oral performance and each correct variant in the translation dictation, with the maximum of 30 points in the latter case. Table 2 demonstrates the arithmetic mean of vocabulary output for both groups.

	Experimental group	Control group
Oral presentation	30	29
Translation dictation	25	20

Table 2: Vocabulary output results (source: own calculation)

As for the general impression of the students' oral performance, it should be noted that the experimental group was more active, demonstrated a deeper understanding of the topic under discussion, freedom of expression, showed more enthusiasm and interest in further self-study (communicative-activity component). Most students called their painting sessions a challenging and motivating experience, which testifies for positive changes in the emotional and motivational component of translator competence. It was interesting to note a shift in their attitude to the given task from skepticism and doubt in their creative abilities to engrossment in the process and enthusiasm and joy at the end of the painting session. In Table 3 we can see the results of the students' oral performance content analysis.

Content units	Analytical categories
„It was difficult. I did not know where to start. I did not want to fail" (5 students).	Difficulty at the beginning of the project
„I always wanted something creative. A good opportunity to try something new. It is different from anything I have done before" (6 students).	New experience
„It was very interesting" (4 students).	Interest
„It (the picture) reveals my personality. When you paint it is like you let your feelings out" (4 students).	Self-expression
„It is relaxing. It gives relief from negative feelings. It was a kind of therapy. A feeling like I am at home. I felt restfulness, serenity. It made me feel at ease" (11 students).	A positive atmosphere Good mood
„I was very happy. Working with brush gives you a pleasant feeling of immersion into the process" (7 students).	Positive emotions

Table 3: Oral performance emotional and motivational criterion results (source: own calculation)

The final test on the identification of translation mistakes also revealed a difference between experimental and control groups. Those who took part in the experiment tended to perform better identifying mistakes in the contexts connected with the description of painting materials and their use. This fact can be explained by their having learned the vocabulary through activity-based first-hand experience of an artist's work environment. It suggests the contribution of the model to the ability to solve professional problems and to changes in the cognitive component of the competences.

The results show that the model leads to the formation of cognitive, communicative-activity, emotional and motivational components of both linguistic and extralinguistic competences.

Discussion

In the modern world and society a translator/interpreter carries an important mission of communicating culture and knowledge. Therefore one of the main requirements of this profession is high level of general cultural awareness and background knowledge in different fields and topics. Our experience in developing academic programs and delivering courses in Translation and Interpretation Studies has led us to believe that the level of general cultural awareness of undergraduate students is rather low. Academic performance and academic achievement strongly depend on the learner's internal motivation which, in its turn, is closely connected with the interest in the topic, issue or activity. Lack of background knowledge and practical experience can affect the student's ability to appreciate the learning process and develop interest in a certain field. University programs in Translation Studies do not generally offer extensive training and

learning material in arts. A possible solution to the problem can be a more contextual model of education with first-hand experience and insight into an artist's profession implemented within the framework of the foreign language course. It is common knowledge that students' involvement in interactive activities can increase motivation, promote acquisition of teaching material, give freedom of expression and has the potential to form professional competences (Yakovleva and Yakovlev, 2014: 75). According to Davies (Davies, 2004) there should be more than one approach to teaching translation.

Our idea was to apply CLIL in the form of an interactive teaching activity providing the departure from traditional instruction and changing the direction from rote learning to meaningful learning. The obtained data support the efficiency of implementing CLIL in the increase of teaching productivity and academic performance of future translators. With the same time exposure and a compatible amount of additional reading the experimental group outperformed the control group showing better results. CLIL-based lessons with meaningful contexts, where every vocabulary item and concept was immediately relevant, positively affected the students' desire to learn and develop their skills. In spite of some argument against its wide introduction (Dallinger, Jonkmann, Hollm and Fiege, 2016; Roussel, Joulia, Tricot and Sweller, 2017), we believe, following most researchers (Coyle, Hood and Marsh, 2010; Dalton-Puffer, 2007; Wilkinson, 2004), that CLIL can be advantageous in terms of both subject knowledge and language proficiency (Banegas, 2018; Catalán and Llach, 2017). By establishing the necessary conditions educators can develop a more positive attitude towards the learning process allowing their students to achieve the appropriate level of academic performance.

Conclusion

In the current research we set a goal to introduce a teaching model that will stimulate linguistic and cultural development of future translators and at the same time touch upon motivational issues. We have shown that elements of CLIL introduced into higher education language courses can be beneficial for the students' professional development in terms of both language skills and general cultural competence. The model under discussion helped to improve the students' language proficiency. Our interest focused on the provision of a communicative context in which the target language can be learned. We noted the differences between the experimental and the control groups in the understanding of the topic and the desire to make a further in-depth study of the issue. The results of the experiment show that first-hand experience and personal emotional involvement can facilitate the learning process and increase the efficiency of the current study models. Further research in the field will concern spheres which allow following the same scenario of active learners' involvement with the application of CLIL to other areas of knowledge relevant for a future translator.

Acknowledgements

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EFFECT OF A VIDEO-BASED REFLECTION PROGRAM ON TEACHERS' PROFESSIONAL VISION

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Abstract

Enhancing teachers' professional vision (TPV) may contribute to increasing the quality of teaching-learning processes through higher perceived efficacy, leading to autonomy-supportive environment. The aim of this research was to test the effect of a video-based reflection program on TPV of Physical Education (PE) teachers from a Primary School in Monterrey (Mexico). At the end of the intervention, notable changes were found in teachers' attention and reasoning processes. Our findings suggest that video-based analysis could represent an essential part of any training program aiming to increasing teachers' responsiveness to diverse in-class situations.

Keywords

Discussion club, professional development, self-reflection, teachers' professional vision, video analysis

Introduction

Teachers and their professional competence are considered central to building up and maintaining positive students' motivational climate (Kunter et al, 2013). While there is a lot of debate on what specific key teaching skills make a good teacher, scholars generally agree that the ability to reflect upon one's practice is one of the most essential components of an effective professional (Tsangaridou and Polemidou, 2015). Considering the diverse classroom compositions that teachers confront every day, observing and analyzing students' behavior and learning processes in the moment of their interactions might be considered as one of the cornerstones of teachers' professional vision (TPV). The need becomes even more apparent in subject-specific contexts, such as Physical Education (PE), when more events take place simultaneously, placing a higher demand on teachers' decision-making skills (Reuker, 2017). The ability to select and reflect meaningfully on classroom events might be one of the benchmarks towards creating highly efficient and stimulating learning environments.

Sherin and van Es (2005) describe TPV as teachers' cognitive ability to notice and interpret key teaching-learning moments addressing to two interrelated skills, *selective attention* ([SA], ability to attend key events over others) and *knowledge-based reasoning* (KBR, professional-based capability to reason about and interpret selected events). A solid ground of literature supports the hypothesis that enhanced TPV has a positive impact on both students' outcomes (Roth et al, 2011) and the quality of instructions (Sun and van Es, 2015). At the same time, research conducted in pre-service or novice teachers' contexts has also found positive correlations between improved TPV and pedagogical knowledge (Meschede et al, 2017), and/or classroom management (König and Krammer, 2016).

Although various techniques exist to improve TPV, video-based reflection has been proposed as one the most impactful across a variety of professional development and teaching programs (Luna and Sherin, 2017). Nevertheless, research also suggests that without having necessary guidance and professional support, teachers find it difficult to rigorously and meaningfully synthetize and analyze classroom events (Sherin, 2004), with more attention paid to themselves rather than to their students' behavior (Johannes and Seidel, 2012). When that happens, the benefit of such actions might not be as educative as expected (Loughran, 2002).

For these reasons, the aim of this study was to analyze the effect of a multi-step video-based approach consisting of 1) written self-reflection of own classroom video; 2) peer reflection with a facilitator-led discussion club including experts from the area of PE and sports psychology; and 3) experts' written feedback on Primary School PE teachers' TPV.

Materials and Methods

Sample

The study sample was constituted by two PE teachers: Alberto (PET1), with nine years of experience in pre-K and primary education; and Francisco (PET2), with six years of experience at the primary school level. At the moment of the intervention, PET1 and PET2 taught fourth- and fifth-grade students from a disadvantaged zone of General Escobedo, Monterrey (MEX). Due to time constraints and accessibility to school districts, our sampling technique was based on convenience.

Instruments

To assess PV (Sherin and van Es, 2009), we used an adapted version of a categorical system including both SA and KBR (Kleinknecht and Schneider, 2013); the former determining teachers' focus either on the actors (e.g. students, teacher), learning processes, or topics, the latter being further divided into: (1) to describe what has been selected; (2) to explain perceived events based on previous knowledge of teaching and learning; (3) to evaluate and predict, in which the explanation is used to assess the situation and provide possible alternatives; and (4) to use a 3-step analysis, i.e. describe, explain, and evaluate.

Procedure

The study was carried out at the facilities of a primary school from a disadvantaged zone in General Escobedo, Nuevo Leon (MEX) during a six-month period within the regular teaching schedule of both PE teachers. At the beginning of each month we recorded two lessons from both PE teachers. The participants were always given one week for analyzing their own videos and sending their written reflection to the facilitator's email. During the same week, experts were also asked to write a reflection on both PE teachers' videos. The video club met 6 times over a six-month period, during which 12 video clips were watched. All meetings were recorded for further content analysis.

Data Analysis

Data analysis was conducted using ATLAS.ti 8. In the first step, all meetings were transcribed for further content analysis. Both meetings and written reflections were segmented into idea units (Jacobs and Morita, 2002). In order to reveal changes in TPV, we applied an adapted version of a categorical system including both SA and KBR (Kleinknecht and Schneider, 2013). We also applied an open-coding approach (Emerson, Fretz and Shaw, 1995) to identify any other key

issues that might have been addressed, sorting them into topic categories. In the second step, we analyzed relative frequencies of all categories for TPV. Afterwards, in order to enhance content understanding (Villanueva et al, 2016), a semantic model was generated based on the identified categories. All data was coded by two independent researchers; the inter-observer agreement was established at 91% for all data sources. Semantic networks (taxonomical representations; Sowa, 1991) were created to determine the way in which both positive and negative codes related to each other.

Results

Teachers' Professional Vision

Table 1 presents the relative frequencies of codes regarding teachers' SA in three dimensions: 1) Focus on Actors; 2) Focus on Learning Processes; and 3) Focus on Topic. The majority of the codes analyzed suffered changes from pre- to post-test. As our results indicate, although 57.1% of PET1's comments were on students' activities, the remaining number of events referred to his actions. PET2's selected moments were double regarding his own person than those of his students'. Furthermore, 28.6% of comments did not imply any actor-specific focus. Over the course of time, both teachers shifted their attention more towards students' behavior ranging from 63.2% to 65.0% for PET1 and PET2 respectively. As per the second dimension, both teachers selected more than 50% of events that did not involve any learning processes. Again, as evident from the table, our findings show a substantial change between the first and the last reflections, the latter having more than 60% of comments related to students' learning processes. Lastly, when analyzing the topics, we could observe a change in the relative number of selected moments of negative issues occurred during a lesson, fewer positive references being used in the beginning (24.8% and 30.3% for PET1 and PET2, respectively) compared to the last reflections (PET1 – 65.2%; PET2 – 68.5%). Furthermore, topics addressing issues in *Motor Engagement* (33.2% for PET1 and 36.9% for PET2) and *Classroom Management* (25.2% for PET1 and 27.6% for PET2) were of the highest concerns of both teachers. When compared to the last reflections, lower frequencies of both mentioned topics were found.

Similar changes can be noticed in the processes involving KBR (Table 2). As the objective was to support teachers' complex analysis, yet in the first session, both teachers were mostly using the 3-step analysis to reason about selected moments (PET1 – 47.0%, and PET2 – 35.2%). However, for both teachers, about one-third of comments were simply descriptive in their nature (PET1 – 29.4%, and PET2 – 31.3%). On the other hand, our post-test analysis indicates a significant increase in the application of the 3-step analysis, reaching 69.6% and 75.0% for PET1 and PET2, respectively. This resulted in a very low engagement in the individual steps of reasoning (description, evaluation, and explanation) in both teachers. Furthermore, in *dealing with negative events*, both PET1 and PET2 perceived considerably more moments, than being engaged in a more depth analysis, when compared to the post-test were 61.6% and 45.4% of identified alternatives. When looking at *dealing with positive events*, there are notable differences between PET1 and PET2 in the relative number of comments regarding no positive event (50.0% and 20.0%, respectively) and evaluation (13.4% and 50.0%, respectively), whereas in the post-test analysis, PET1 was more discussing alternatives (36.2%), while PET2 was slightly more reflecting on consequences (24.4%).

Dimension	Categories	PET1		PET2	
		Pre-test	Post-test	Pre-test	Post-test
Actor-focus	No focus	0.0%	10.5%	28.6%	15.0%
	Focus on teacher's behavior	42.9%	26.3%	28.6%	20.0%
	Focus on student's behavior	57.1%	63.2%	42.8%	65.0%
Process-focus	Focus on learning processes	28.6%	63.2%	42.9%	70.0%
	No focus on learning processes	71.4%	36.8%	57.1%	30.0%
Topic-focus					
Positive	Classroom management	21.4%	19.7%	12.1%	15.6%
	Behavior management	12.8%	8.0%	12.0%	5.9%
	Motivational climate	23.5%	10.8%	28.9%	20.4%
	Motor engagement	27.5%	22.6%	11.2%	22.2%
	Context	0.0%	2.3%	3.1%	0.0%
	Planning	13.4%	16.3%	5.4%	18.5%
	Pedagogy	1.4%	14.8%	18.7%	15.3%
	Communication	0.0%	5.5%	8.6%	2.1%
	Total positive	24.8%	65.2%	30.3%	68.5%
Negative	Classroom management	25.2%	19.3%	27.6%	23.5%
	Behavior management	13.4%	11.2%	18.1%	13.3%
	Motivational climate	3.4%	8.5%	5.8%	6.4%
	Motor engagement	33.2%	25.8%	36.9%	23.6%
	Context	2.3%	7.6%	4.5%	5.1%
	Planning	6.4%	9.4%	3.1%	12.5%
	Pedagogy	11.9%	11.8%	2.7%	12.6%
	Communication	4.2%	6.4%	1.3%	3.0%
	Total negative	75.2%	34.8%	69.7%	31.5%

Notes. PET1 = Physical Education Teacher 1; PET2 = Physical Education Teacher 2

Table 1: Content analysis of teachers' comments: Relative frequencies of codes regarding selective attention (source: own calculation, 2019)

Dimension	Categories	PET1		PET2	
		Pre-test	Post-test	Pre-test	Post-test
Reasoning process	Describe	29.4%	8.7%	31.3%	7.1%
	Evaluate	11.8%	8.7%	20.2%	10.7%
	Explain	11.8%	13.0%	13.3%	7.1%
	3-step analysis	47.0%	69.6%	35.2%	75.0%
Dealing with negative events	No negative events	10.0%	15.3%	10.5%	28.7%
	Perceive	53.2%	0.0%	31.6%	4.1%
	Evaluate	26.7%	7.7%	21.0%	7.7%
	Reflect on consequences	13.4%	15.4%	21.0%	14.1%
	Propose and reflect on alternatives	6.7%	61.6%	15.8%	45.4%
Dealing with positive events	No positive events	50.0%	16.7%	20.0%	21.1%
	Perceive	0.0%	0.0%	20.0%	10.5%
	Evaluate	13.4%	15.8%	50.0%	22.2%
	Reflect on consequences	23.5%	16.4%	10.0%	24.4%
	Propose and reflect on alternatives	13.1%	36.2%	0.0%	21.8%

Notes. PET1 = Physical Education Teacher 1; PET2 = Physical Education Teacher 2

Table 2: Content analysis of teachers' comments: Relative frequencies of codes regarding knowledge–based reasoning (source: own calculation, 2019)

Taxonomical Representation of Codes Linkages

Figure 1 represents negative issues that were derived from the first reflection cycle and the open codes. Each category is a rectangle labeled to others with arcs. Due to space limits, only the most important linkages are presented. The most important codes occurred in the categories of *Classroom Management*, *Student Engagement*, and *Behavioral Management*. All of the issues mentioned within were further identified as being a cause of inappropriate *Planning*.

Figure 2 represents linkages between positive codes derived from the last reflection cycle and the open codes. Many positive outcomes within the main categories (e.g. *Management, Engagement*), were either 'associated with' or 'cause of' improved *Planning*, which in turn had a positive impact on students' learning, teachers' individualized approach, or enjoyment, amongst others.
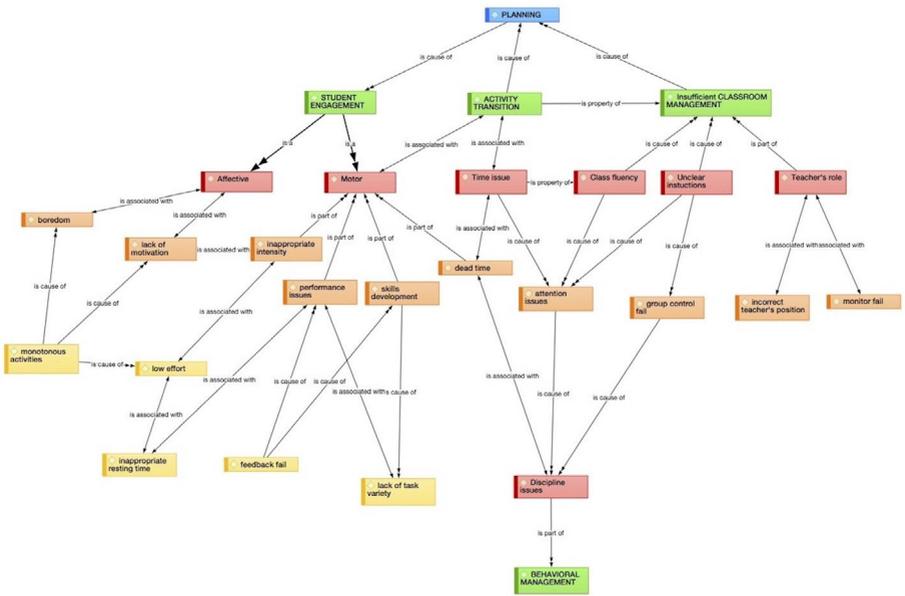
Figure 1: Taxonomical representation of negative classroom events (source: own analysis)
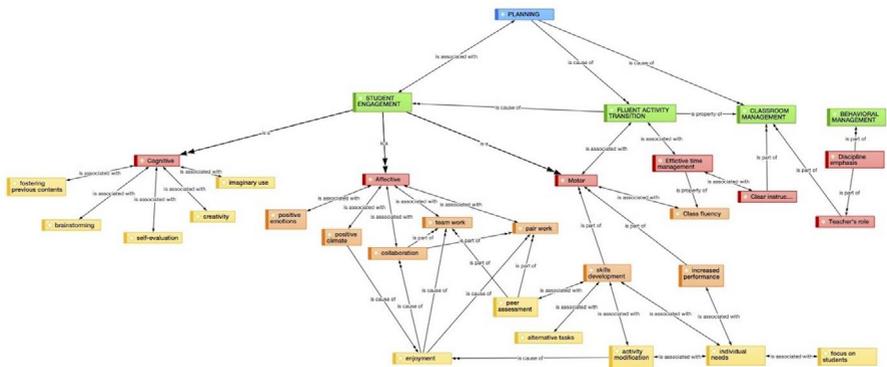
Figure 2: Taxonomical representation of positive classroom events (source: own analysis)

Discussion

In order to understand the changes in PV during our six-month intervention, a total of 370 units was analyzed. In our study, the results showed that both teachers underwent positive changes regarding both SA and KBR on selected classroom events from pre- to post-test. We found that initially teachers' attention was more focused on learning and students respectively, addressing issues predominantly on a whole-class basis. Although some findings indicate that more experienced teachers usually attend classroom events using a more individualized perspective (Jung, 2012), our initial outcomes are in line with those of Reuker (2017), who found different groups of

experts focusing primarily on students' behavior. As the development of the motor domain is one of the principal objectives, PE teachers are naturally more looking at students' actions and learning approaches. However, when looking at teachers' SA overtime, we could see a substantial change and increase in the attention paid to students, indicating that our participants were not only addressing issues related to a whole-group learning, but also started attending more personalized needs of their students. Such a change is a very positive sign, as one of the quality indicators of a PE program is to use instructional practices that are developmentally appropriate taking into account factors such as individual needs, skills, health, gender, as well as past experiences (National Association for Sport and Physical Education [NASPE], 2007). Literature on this issue also suggests that addressing children's individual characteristics leads to a positive maturation and growth at both cognitive and physical level (Kostecka, Bojanowska and Stoma, 2017).

Another important change can be observed in the development of teachers' KBR skills. Previous research on participating in video-based reflection programs has demonstrated positive correlations between the length of a program and teachers' becoming more substantive in their reflections (Walkoe, 2015). Particularly in the area of mathematics, teachers have elaborated more in-depth and detailed analysis of students' thinking over time (Borko et al, 2008). Similar results were found for our participants, whose initial reasoning was more superficial and rather of a simple descriptive and evaluative character, addressing students as members of a unique group. In line with Walkoe's study (2015), as the intervention progressed, both teachers were able to advance in their skills using more substantive and interpretative lens by predominantly applying the 3-step analysis. At the same time, during our discussion sessions they have become more supportive of each other and were able to sustain meaningful conversations.

Lastly, we were interested in understanding the topics that teachers addressed in their reflections, as well as whether these events were perceived as negative or positive. In the beginning, our teachers were found to either perceive or evaluate more negative events than the positive ones. Little or no reflections were related to consequences or proposed alternatives. These results are similar to those of Kleinknecht and Schneider (2013), who found that teachers who reflect on their own videos are less likely to identify consequences and alternatives than those who reflect on someone else's teaching. As the intervention proceeded, our participants were able to free themselves from their regular teaching habits (Kleinknecht and Schneider, 2013) and reason more on consequences and alternatives. Moreover, throughout the intervention most of the issues analyzed in the first reflections and sessions shifted into positive events, suggesting that teachers were not only able to effectively attend these issues and incorporate them in their instructional methods, but also their openness towards different strategies in order to make their teaching diverse and individualized.

Conclusion

Our results support the general assumption that teacher may greatly benefit from video-based intervention programs in terms of the enhancement and development of their TPV. The procedure based on a 3-way reflection cycle with the engagement of experts from PE and educational psychology seemed to have a positive impact on the amount of changes occurred. This approach also produced an increase in teachers understanding of students' individual needs and their attention to potential issues in the classroom, which are particularly important giving the nature and characteristics of PE settings and demands.

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SUCCESS RATE IN EXAMINATIONS: DOES THE DEGREE PROGRAMME MATTER?

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Abstract

The article examines the possible relationship between the success rate of students in examinations and their degree programmes over a four-year time span. The objective of the article is to evaluate the attempts and the grades received by students from selected courses at the Faculty of Economics and Management at the Czech University of Life Sciences Prague and determine if there is a relationship between the grades received at an exam and the degree programme. The results proved a statistically significant relationship between the received grade and the degree programme in two out of the four selected courses. The results also showed that for all selected exams, students in the Business Administration programme are more successful during their first attempt than the students of the Economics and Management programme.

Keywords

Degree programme, quality of education, success rate, study results, tertiary education

Introduction

In recent years, interest in tertiary education has been constantly growing and universities all around the world are now trying to satisfy the ever-higher demand and need for this type of education. The result is not only an unprecedented increase in the proportion of university graduates in the 25–64 years old population and a growing number of public and private tertiary education institutions (Blanco-Ramírez and Berger, 2014), but also an increasing pressure on increasing the quality of services offered by tertiary education institutions (Đonlagic and Fazlic, 2015). The pressing character of this issue is also evidenced by the effort to create a European Higher Education Area as part of the Bologna process and related European reforms (Prisăcariu, 2014). Their main objective is to create a high-quality, transparent and diversified system of European tertiary education and achieve a competitive and strong position in the world (Keçetep and Özkan, 2014). Together with the adoption of a three-cycle system and the creation of a joint framework for recognising qualification to support student mobility (Hutyra, 2008), the system providing quality assurance through common standards represents the main feature of a new approach which guarantees high quality of European tertiary education as a whole (Stimac and Katic, 2015). Jarvis (2014) adds that the main mission of the system assuring the quality of tertiary education is to create a culture of constant organisational and professional self-development and self-regulation that would improve services in tertiary education and would be in harmony with

the needs of the global knowledge economy and a learning society. Despite that, there are still some shortcomings in access to, the quality of, the relevance of, and the investment in higher education, which may even be getting more pronounced over time (Blanco-Ramírez and Berger, 2014).

Education is part of strategic public interest, which is why it is important to pay attention to its quality (Hutyra, 2008; Tilak, 2008; Janík et al, 2013). The issue remains current all over Europe, as confirmed by Bejan et al (2015) who investigated the quality of education at three tertiary education institutions in Germany, Finland, and Romania. The authors determined that all the examined institutions had already introduced some tools and partial measures to analyse the impact of quality assurance, and all of them are trying to improve by using internal and external procedures to assure quality and analyse the impact. According to Bendixen and Jacobsen (2017), institutions must adopt standards in education in order to measure output indicators for benchmarking. Bejan et al (2015) add that the recently revised Standards and Guidelines for Quality Assurance in the European Higher Education Area show that the analysed institutions in Europe are on the road towards joint policies of quality assurance, yet there is still space for further improvement (for example in implementing systematic methodologies of impact evaluation and quality policies in general). According to Stimac and Katic (2015), European tertiary education institutions most often have shortcomings in the active involvement of students in the learning process and in the publication of evaluation reports. Seasons (2003) claims it is therefore important to emphasise objective and subjective forms of evaluation. If quality is replaced by standards and if standards are considered equal in value to the needs of the labour market, this could represent the beginning of an external control of tertiary education (Bendixen and Jacobsen, 2017).

The objective of this article is to evaluate the attempts and the grades received by students from selected courses at the Faculty of Economics and Management at the Czech University of Life Sciences Prague (FEM CULS Prague) and determine if there is a relationship between the grades received at an exam and the degree programme.

MATERIALS AND METHODS

The basic source of data concerning students' performance in examinations in selected courses was the university information system of CULS Prague. To determine the exam success rate of students, two key degree programmes of the FEM CULS Prague were selected: Business Administration (BA) and Economics and Management (EM). This study only includes the results of full-time students in the master's cycle, and only for mandatory courses that are identical and for which the same person is responsible for both programmes for four academic years (2012/2013, 2013/2014, 2014/2015 and 2015/2016). These courses are Econometrics, ICT for Managers, Marketing Management and Business Management. The number of students who took exams in the monitored period (four academic years) and the number of students who studied degree programmes BA and EM in the monitored period are shown in Table 1.

Data was analysed using statistical methods, looking for a relationship between selected qualitative variables - grades received in exams (with four grades: excellent, very good, good, fail) and the degree programme. The four null hypotheses were formulated: There is no relationship between the grade received from the mandatory course of Econometrics ($H0_1$), ICT for Managers ($H0_2$), Marketing Management ($H0_3$), Business Management ($H0_4$) and the degree programme.

The evaluation of the results employed several methods of descriptive statistics according to Hanneman, Kposowa and Riddle (2013), namely absolute and relative frequency, Pearson's chi-square test of independence and the relationship coefficient (Cramer's V). The null hypothesis is a general statement that there is no relationship between two variables. There was calculated the p-value within the testing procedure which was then compared to the significance level α. If the p-value was below the significance level α = 0.05, the null hypothesis was rejected. Cramer's V indicates a measure of the strength of the relationship. To interpret Cramer's V, a scale according to de Vaus (2002) was used. The statistical software used to evaluate the data was IBM SPSS Statistics 24.

Course	Total number of students taking an exam			Total number of enrolled students		
	BA	EM	Total	BA	EM	Total
Econometrics	1,646	1,148	2,794	1,966	1,320	3,286
ICT for Managers	1,171	887	2,058	1,264	970	2,234
Marketing Management	1,331	1,030	2,361	1,341	1,128	2,469
Business Management	1,184	749	1,933	1,231	807	2,038

Table 1: Number of students taking an exam and studying (enrolled) in the monitored period, 2012-2016 (source: CULS Prague, 2017)

Results

According to the latest data published by CULS Prague about the master's cycle at FEM (CULS Prague, 2016), there are 7 degree programmes taught in Czech (4 full-time and 3 full-time and distance) and 3 full-time degree programmes taught in another language. The average drop-out rate in the master's cycle of programmes in 2016 was 11%, regardless of the form of study. Students can pass the exam for each course either on their first, 'regular' attempt, or, should they fail to do so, on their first or second 'remedial' attempt. This means that they have a total of three attempts to successfully pass the exam. Only 30.8% of students in the EM programme and 35.2% of students in the BA programme passed the exam in Econometrics on their first, regular attempt. Another course with a relatively low success rate at first attempt is Marketing Management. In this case, however, there is a marked difference between the two programmes: students in the EM programme passed the exam on their first attempt in 47.9% of cases, while students in the BA programme succeeded in 62.8% of cases. In both programmes, most students pass the exams in ICT for Managers (EM 70.5%, BA 77.7%) and Business Management (EM 78.5%, BA 82.7%) on their first attempt (see Figure 1). In summary, for all selected courses, students in the BA programme are more successful at the first attempt of their exams than the students of the EM programme.
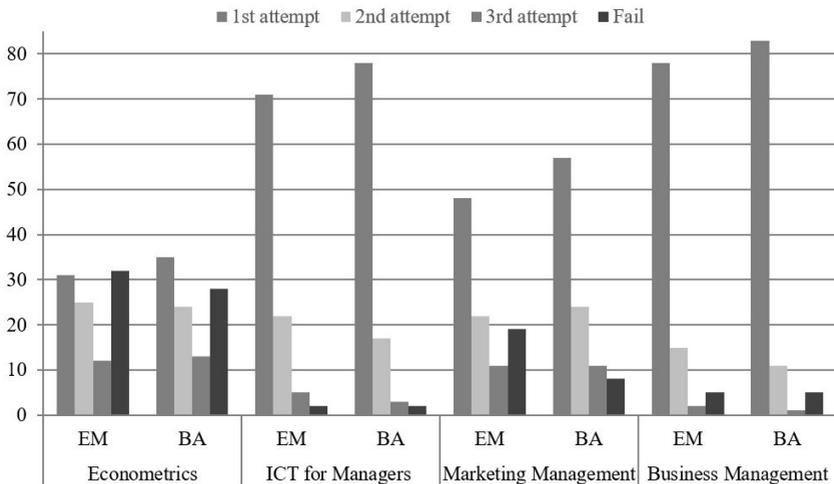
Figure 1: Success rate by the order of attempts (%), 2012-2016 (source: CULS Prague, 2017)

There are three possible pass grades: excellent, very good and good. A student who fails to demonstrate sufficient knowledge receives a fail grade. Figure 2 further shows the grades of students who took the exams in the last four academic years.
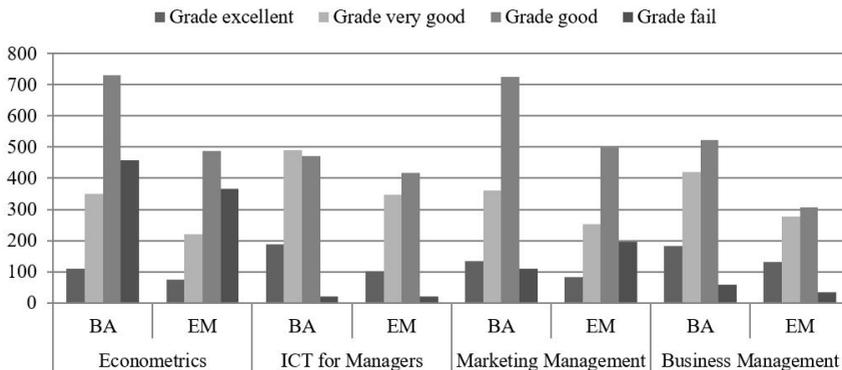
Figure 2: Numbers of students by exam grades, 2012-2016 (source: CULS Prague, 2017)

In each of the examined courses, excellent was the least commonly awarded of the three pass grades. In most courses, more students received a good grade than a very good grade. The only exception - BA students in the ICT for Managers course received a very good grade more often than the good grade (41.93% and 40.22%, respectively). This, however, is a minor difference, and it can, therefore, be concluded that in general fewer students received the better grade. The obtained data showed significant differences between the individual courses, particularly when it comes to fail grades. While only 1.71% of BA students and 2.48% of EM students failed ICT for Managers, in Econometrics the figures are 27.83% (BA) and 31.79% (EM). For the reasons listed above, the analysis proceeded to examine the relationship between the grade received at the selected exam and the degree programme. The results of Pearson's chi-square test of independence for hypotheses $H0_1$-$H0_4$ are shown in Table 2.

No.	Course	Pearson Chi-Square	p-value	Dependency*	Cramer's V	The strength of the relationship
$H0_1$	Econometrics	5.544	0.136	No	-	-
$H0_2$	ICT for Managers	15.939	0.001	Yes	0.088	Low
$H0_3$	Marketing Management	59.505	0.000	Yes	0.159	Low
$H0_4$	Business Management	2.819	0.420	No	-	-

Table 2: Results of Pearson's chi-square test of independence for hypotheses $H0_1$-$H0_4$, 2012-2016 (source: own calculation)

Based on the results of Pearson's chi-square test of independence, two null hypotheses ($H0_1$, $H0_4$) were not rejected. There are no relationships between the received grade in Econometrics and Business Management and degree programmes. The other two null hypotheses ($H0_2$, $H0_3$) were rejected. The relationship coefficient showed a weak strength of the relationship between the grade received from ICT for Managers ($p = 0.001$, Cramer's $V = 0.088$) and Marketing Management ($p = 0.000$, Cramer's $V = 0.159$) and the degree programme, i.e. relationship examination showed a weak strength of the relationship between the grade received from the ICT for Managers and Marketing Management courses and the degree programme.

DISCUSSION

The basic prerequisite for high-quality education is the fulfilment of set goals and standards of tertiary education. Only that can ensure that the people entering the labour market are not just university graduates, but more importantly, people who provide a competitive advantage

to society as a whole (Bendixen and Jacobsen, 2017). An increased quality of formal education also leads to higher satisfaction with the application of the education in practice. However, the numbers of students in tertiary education in the Czech Republic has been on the decline since 2011/2012 (Czech Statistical Office, 2016), especially due to the current unfavourable demographic development. When compared with the development of the numbers of students admitted and registered for master's degree programmes at FEM CULS Prague, it can be seen that the largest increase in the number of students occurs in the same period, i.e. in 2010. Since 2011/2012, there has also been a decline. The percentage of students studying in the distance form in the total student population was lowest in 2015/2016 when it reached only 24.4%, compared to FEM CULS Prague's figure of 38.1%.

In the current situation, every tertiary education institution must be perceived as a provider of services that is trying to fulfil the needs of its customers. The individual customers - students, employers, organisations or society as a whole, are evaluating the quality of these services (Hutyra, 2008). Bhuian (2016), Holm, Sammalisto and Vuorisalo (2015) and Wang (2014) point out that in today's global environment, there is a growing competition between individual tertiary education institutions and it is necessary to pay adequate attention to this issue. It is important to realise that the quality of education provided by tertiary education institutions significantly influences the socio-economic and cultural development of every society (Todorut, 2016) around the world. Tertiary education institutions thus play an important role in the building of a strong knowledge economy not only in the individual states but on the European continent as a whole, determining the global competitiveness of tertiary education graduates (ENQA, ESU, EUA and EURASHE, 2015). From the long-term perspective, degree programmes may be considered to be suitably designed and to provide required knowledge only in cases when tertiary education institutions achieve an adequate level of quality (Bendixen and Jacobsen, 2017). Janík et al (2013) emphasise the importance of information about the quality of education. Blaško (2013) focuses on measuring the quality of education as a determinant of the level of satisfaction with the learning process; he emphasises the importance of evaluating education quality through suitable criteria and recommends preparing measurement tools for all aspects of education quality, such as questionnaires. Despite the importance of this topic, however, there is no universal unified quality standard model that can be used to assess the quality criteria of higher education institutions (Noaman et al, 2015).

In our research, we focused on determining the relationship between the received grades in the exam and the degree programmes where only the same courses were observed. The results showed that there is a relationship between the received grade in two out of four courses and that the students of one of the programme are more successful in all courses. One of the possibilities for explaining these differences is the objective level of students' knowledge, for example, because of the lack of knowledge from previous courses that may be different in the degree programmes. However, the grading differences can also be attributed to the grading system. Although only the same courses were observed in both programmes, it is likely that teachers or examiners differed. According to the results of Protivínský and Münich (2018), differences in received grades can also be attributed to, for example, sex, when the gender effect in grading is sizeable across the whole performance distribution. Malouff (2008) also points out that the biases may also be due to insufficiently specific evaluation criteria.

It is essential that tertiary education institution or the teachers of all courses develop a bias-resistant grading system (Feldman, 2019). The follow-up research will be focusing on the factors that may have an impact on the received grades whether from the students or teachers (institution itself) point of view, e.g. the scores from entrance exams etc.

The theoretical contribution of the article lies in the confirmation of the relationship between

selected qualitative variables - the received grade in ICT for Managers and Marketing Management and degree programme. The practical contribution of the article is based on the analysis of the development of selected indicators of teaching activities of the Faculty of Economics and Management at the Czech University of Life Sciences Prague. The article is limited by the sample. The analysed sample is adequate for obtaining the data and makes it possible for the authors to describe the situation but not to generalise the results.

Conclusions

Because of the growing interest in tertiary education, there is now also rising pressure to improve the quality of services offered by tertiary education institutions. Various procedures were set up on the level of the Czech Republic and the European Union as part of a system for assuring the quality of tertiary education in order to ensure it is transparent, diversified and has a sufficient quality that can achieve a globally competitive position. As part of a four-year study at FEM CULS Prague, we have examined the results of students in the master's cycle in the exams of selected courses. There were four courses in total which are shared by two key degree programmes (BA and EM), enabling comparison of study results between the two. Relationship examination showed a weak strength of the relationship between the grade received from the ICT for Managers and Marketing Management courses and the degree programme. The results also showed that for all selected courses, students in the BA programme are more successful at the first term of their exams than the students of the EM programme. Another conclusion is that regardless of the degree programme, the better the grade, the rarer it is in the student population. This study, however, did not take into account any factors that could impact the exam results of individual students or affect their overall approach to their tertiary studies. These factors will be the subject of our follow-up research.

Acknowledgements

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CAN WE MEASURE PROFESSORS' PRODUCTIVITY OVER LONGER PERIOD? AN INTRODUCTORY ANALYSIS

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Abstract

One of the main tasks of all higher education institutions is to search opportunities how to improve quality of provided education. It is of a high importance that the education satisfies students' needs and prepares students for their future professional careers. The quality of provided education must be constantly evaluated to eliminate possible deficiencies. To find possible areas for quality improvements, techniques of performance analysis can be applied. In this article, we evaluate professors' performance using Window analysis technique on a sample of 59 courses given in Actuarial sciences study program. The productivity is analyzed considering professors' age and seniority and results from an internal evaluation system of teaching. The results indicate a significant drop in productivity during first three to six semesters, as well as significant differences between female and male professors.

Keywords

Data Envelopment Analysis, gender, productivity, seniority, teaching quality, window analysis

Introduction

Nowadays, students demand education that prepares them well for their future professional life. So, higher education institutions (HEIs) must provide meaningful and relevant teaching, which satisfies the demand on the labor market. Authorities of the HEIs must search for opportunities how to secure, or better, how to improve quality of teaching. Quality in teaching can be defined and measured in many ways. For example, Heyneman (2004) measures school quality based on the level of expenditures in non-salary inputs (such as textbooks, computers and learning materials), whereas Hanushek and Woessmann (2008) define quality as the capability of preparing students to perform well on standardized tests. In this article, we extend the later definition and understand quality of teaching as university capability of preparing students to perform well on standardized tests and on labor market.

Teaching quality can be improved by modifying type of teachers, providing financial incentives or through training and professional development (Ome, Menendez and Le, 2017). Quality of teachers is vital in improving students' achievements (Canales and Maldonado, 2018; Meltzer and Woessmann, 2012; Rivkin, Hanushek and Kain, 2005) as professors' experience has an impact on students' performance (Rivkin, Hanushek and Kain, 2005; Hendricks, 2014; Rockoff, 2004). On the other hand, research indicates that teacher training has little to no impact on students' achievements (Canales and Maldonado, 2018; Harris and Sass, 2011). One of the basic sources to obtain information about teaching quality is to get feedback from students as they are in the front line of the interaction with professors. This feedback is usually obtained through an internal evaluation systems (IES) constructed for this purpose. Obtained results from the evaluation are usually used to solve teaching related problems, to motivate teachers for their personal development, as well as for hiring and promotion decisions (Becker and Watts, 1999; Otto, Sanford and Ross, 2008). If we leave apart principal factors that influence the evaluation (such

as professors' gender, attractivity, course difficulty and/or class size), there is a direct relation between professor's age and the evaluation (Zacher, Rosing and Frese, 2011). Instead of a linear effect on the evaluation, this effect has a U-shape relationship with a peak of professor's age between 40 and 50 years (Wagner, Rieger and Voorvelt, 2016). Contrary, experience has linear effect on the evaluation as students evaluate better professors with more years (semesters) of experience (Rivkin, Hanushek and Kain, 2005; Hendricks, 2014; Rockoff, 2004).

Higher education institutions' authorities should use multiple assessing sources (multidimensional analysis) before making administrative decisions based on the evaluation (Linse, 2017; Miller and Seldin, 2014). Furthermore, the authorities should know how robust the results obtained from the evaluation are, mainly with regard to volatility from semester to semester. Therefore, it is vital to use tools that examine results considering longer period (times series). In this article, we introduce Data Envelopment Analysis model to evaluate professors' performance. We use the extension of Window analysis to be able to analyze the performance over a longer period and to minimize the volatility through semester. The principal objective of this introductory analysis is to verify the usability of such model as a part of multidimensional professors' analysis. Moreover, we work with following working hypotheses: First, considering the inverted U-shape effect of age and positive linear effect of seniority on the evaluation, we suppose that professors' performance would (to some extend) follow the U-shape trend. Second, as male professors are usually evaluated better than female professors, we suppose higher performance of male professors.

MATERIALS AND METHODS

Data Envelopment Analysis: Window Analysis

Data envelopment analysis enables to assess various Decision-Making Units (DMUs) with regard to their abilities to cover multiple inputs into multiple outputs (Cooper, Seiford and Zhu, 2011). Each DMU can have various amounts of m different inputs to produce s different outputs. If the model supposes constant returns to scale (CRS), then so-called CCR model can be used (Charnes, Cooper and Rhodes, 1978). The output-oriented CCR model for DMU_O is formulated as follows:

$$\min q = \sum_{i=1}^{m} v_i x_{io} \tag{1}$$

subjected to

$$\sum_{i=1}^{m} v_i x_{ij} - \sum_{r=1}^{s} \mu_r y_{rj} \geq 0, \ j = 1, 2, \ldots, n$$

$$\sum_{r=1}^{s} \mu_r y_{ro} = 1 \tag{2}$$

$$\mu_r, v_i \geq 0 \ \text{and} \ \eth > 0$$

where x_{ij} is the amount of input i of DMU_j, y_{rj} is the amount of output r of DMU_j, v_i and μ_r are weights of inputs and outputs $i = 1, 2, \ldots, m$, $j = 1, 2, \ldots, n$, $r = 1, 2, \ldots, s$, and ε is the so-called non-Archimedian element. DMU is 100% efficient if $q = 1$, i.e. there is no other DMU that produces more outputs with the same combination of inputs. On the other hand, DMU is inefficient if $q < 1$.

To measure the productivity of DMUs over a longer period, Window analysis approach can be used. This approach works on the principle of moving averages to detect performance trends of

DMUs over time (Cooper, Seiford and and Tone, 2007). In this case, each DMU in a different year is treated as if it were different unit. The performance of a DMU in particular year is compared with its performance in other periods in addition to the performance of other DMUs. Thus, there are nk DMUs in each window, where n is the number of DMUs in a given period (it must be the same in all periods) and k is the width of each window (equal for all windows). This feature increases the discriminatory ability of the DEA model, as the total number of periods T is divided into series of overlapping periods (windows), each of width k ($k < T$) leading to nk DMUs. The first window has nk DMUs for the periods $\{1,\ldots,k\}$, the second period has nk DMUs and periods $\{2,\ldots,k+1\}$ and so on, until the last window has nk DMUs and periods $\{T-k+1,\ldots,T\}$. In total, there are $T-k+1$ separate analyses where each analysis examines nk DMUs.

An important factor is the determination of the window size. If the window is too narrow, there may not be enough DMUs in the analysis leading to low discrimination power of the model. On the contrary, too wide window can give misleading results due to significant changes that occur over periods covered by each window (Cooper, Seiford and Zhu, 2011). Thus, the window size must consider the structure of the DEA (mainly regarding the number of DMUs Dyson et al. (2001)) model and characteristics of the analyzed area (education). In our case, we select $k = 3$ (3-semester window) as course modifications usually give results within 3 semesters (1st semester implementation of a change, 2nd semester revision of modifications and 3rd semester full impact of the modification).

Data and sample

Data for the analysis comes from two principal sources. First, we obtain data from the internal evaluation system (IES) managed at the university. For this introductory analysis, we selected bachelor level of Actuarial Sciences study program across 13 semesters from 2010 to 2016[1]. During this period, the evaluation systems records 12,240 students' evaluations of 1,190 courses (in average 91.53 courses per semester). If a course in the same semester was taught by the same professor, then we treat these courses as a one course, where the course evaluation was calculated as an evaluation average. If a course in the same semester was taught by different professors, we treat these courses as different ones. Further, as we use Window Analysis with 3-semester window, we only included courses that were taught by the same professor in at least four different semesters during the period in question (Window Analysis does not require these periods to be consecutive). At the end, we identify 59 such courses which are DMUs of the model.

Second, we obtain data related to gender, age and seniority from the university human resources database (with an official permission). We measure the seniority as number of semesters for which a professor has given courses at the university, without considering other possible teaching experiences outside the university (as the outside experience is difficult to measure). The selected 59 courses were taught by 22 (37.29%) female professors and 37 (62.71%) male professors. The average age of female professors was 45.99 years (SD 9.11) with 7.69 semesters of seniority (SD 6.85), whereas male professors average age was 42.64 years (SD 8.54) with 13.46 semesters of seniority (SD 13.36) in average. Regardless gender, the average professors age was 43.84 (SD 8.89) and seniority of 11.40 semesters (SD 11.79).

The DEA model includes professors' age and seniority as inputs. The internal evaluation system is divided into three basic parts (institutional, educative and pedagogic). The institutional area (INS) evaluates professor's profile from the university concept point of view, the educative area (EDU) evaluates professors with regard the graduates' profile, whereas the pedagogic area (PED) evaluates professors regarding his/her teaching capacities inside the classroom (Flegl et al., 2017).

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[1]   University operates on August-December and January-June semesters.

Therefore, the model has three outputs representing INS, EDU and PED evaluations. To secure the importance of all inputs and outputs in the model, we set $\varepsilon = .3$. In this case, the weight of age is 91.16% and seniority 8.84%, whereas INS has weight of 33.34%, EDU 31.32% and PED 35.34%.

RESULTS AND DISCUSSION

We divide the results into two basic parts. First, we describe the achieved results regardless professors' gender. Second, we divide the analysis consider professors' gender to analyze whether there is difference in the professors' performance.

Figure 1 presents the obtained results regardless professors' gender. On the left side, we can see that the evolution of the average professors' performance has positive trend and the overall performance has grown from 66.706% up to 72.168% (+5.462%). The performance has been growing in an average rate of.455% during 13 evaluated semesters. This would evoke that overall quality of teaching has increased. However, data indicates that there is a high fluctuation of professors during the evaluated period. In general, each professor stays 6.067 semesters (SD 1.972) giving a particular course (less than half of the period). On the right side of Figure 1, we can see the individual performance evolution has negative trend. It means that professors have the highest performance at the end of the first semester. After, the performance drops in average rate of -1.319% every semester, resulting in possible overall drop of -14.508%. Therefore, the growth of the overall performance is related to new incoming professors.

This can have several explanations. As Rivkin, Hanushek and Kain (2005) pointed out, new professors with zero or minimum level of experience may go through a period of adjustment to teaching. This adjustment can take one or two years (Buddin and Zamarro, 2009) and, thus, professors' performance can be negatively affected during the first semesters. The improvements in teaching proficiency commonly occur during the first three to five years (Buddin, and Zamarro, 2009; Harris and Sass, 2011; Rivkin, Hanushek and Kain, 2005). However, Figure 1b does not indicate change in the productivity trend, although there is a little blip at the end of the fifth semester. So, the negative trend can be explained by professors' age. Older professors may have problems with personal motivation resulting in decrease work intensity. This might be the case as the weight of age in the DEA model is 91.16%, compare to 8.84% of seniority. As a result, we cannot confirm the U-shape effect of age on the productivity, nor the linear effect of seniority. Rather the negative effect of age predominates the positive effect of seniority.
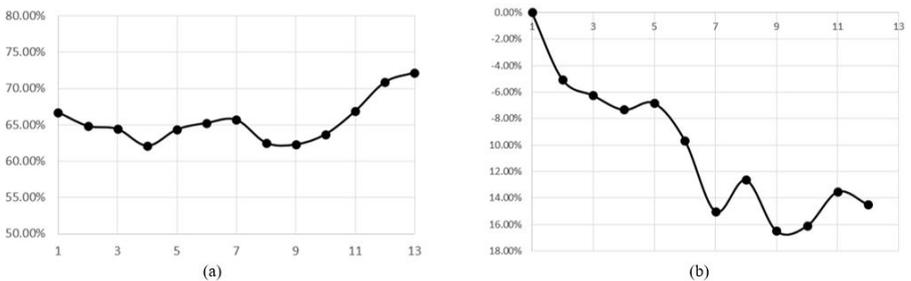
Figure 1: Professors' average performance: a) overall performance evolution, b) individual performance evolution (own calculation)

Further, we analyze professors' performance considering their gender (Figure 2). We can note several differences. First, the initial performance is much higher in case of male professors

(78.638% vs. 60.740%). However, the trend of female productivity is positive (increasing in average by.849% every semester), contrary to negative trend of male productivity which decrease in average by -.491% (Figure 2a). Both productivities are almost identical at the end of the analyzed period (72.748% vs. 70.925% in the last semester). Similarly, as in the overall model, we can track evolution to higher fluctuation of female professors. Female professors stay in average 5.818 semesters (SD 1.967)[2] giving a particular course, whereas male professors 6.216 semesters (SD 1.987). In Figure 2b we can observe a significant improvement in females' productivity in the 5th semester, which may indicate the end of course adjustment period of one or two years (Buddin and Zamarro, 2009). This adjustment is not observable in case of male professors (Figure 2b), although there is a tiny insignificant drop of -.146% between second and third semester. This may indicate that the adjustment period is shorter in case of male professors. However, in average, male professors' productivity drops in a faster rate (-1.544% every semester) compare to -1.376% in case of female professors' productivity. Moreover, males' productivity drop is even higher in absolute numbers as the initial productivity is higher.
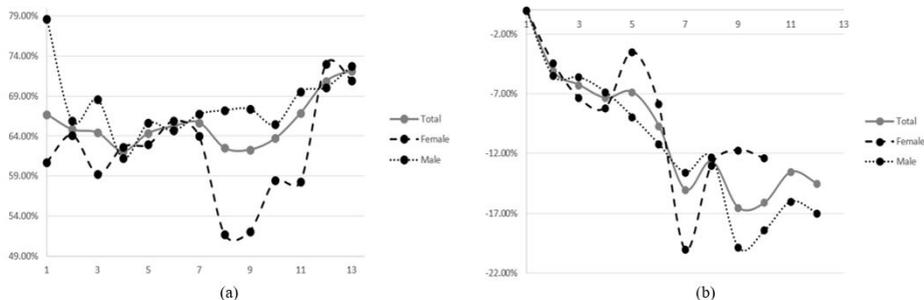
Figure 2: Professors' average performance by gender: a) overall performance evolution, b) individual performance evolution (own calculation)

Considering our second working hypothesis, male professors have higher overall performance than female professors. This is due to the output structure of the DEA model consisting in students' evaluations. Male professors usually get higher students' evaluation (Wagner, Rieger and Voorvelt, 2016). Thus, the ratio of multiple outputs to multiple inputs is in favor of male professors. However, as this ratio decreases, together with the higher volatility of female professors, the performances become similar.

The principal objective of this article was to verify the usability of DEA models in analyzing professors' productivity regarding their teaching. Due to the volatility from semester to semester, we used Window analysis technique. Although the obtained results have several drawbacks (such as the selection of inputs and outputs, and principals of DEA models), the Window analysis demonstrates its usability to be considered as a part of multidimensional analysis of professors' teaching. Presented results in this introductory analysis provide valuable information for HEIs' authorities. There is an evident negative trend in professors' productivity. This might be linked to professors' unwillingness to make changes in course structures in order to adjust courses to market demand (Flegl, Hlavatý and Andrade, 2018). This unwillingness may result in worse teaching quality, which may have negative long-term consequences on the HEI. Thus, the results obtained from the performance analysis can be used in teacher-related problems, such as for hiring

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[2]   As female professors' volatility is higher, the dataset does not report females giving courses for longer period. That is why, Figure 2b does not show longer curve in case of females (only up to 10 semester, which is the maximum length), compare to male curve covering the whole period of 12 semesters.

and promotion decisions (Becker and Watts, 1999; Otto, Sanford and Ross, 2008), as well as for optimization and/or justification of faculty budget distribution (Flegl and Krejci, 2015).

CONCLUSION

In this article, we applied Window analysis technique to evaluate professors' teaching productivity over a period of 13 semesters in Actuarial sciences. The purpose of this introductory analysis was to verify whether it is possible to use this technique in professors' evaluation. Although the technique has several specifics that must be taken into account, the results provide valuable information. The results indicate that the overall productivity has grown, but mainly due to a higher professors' fluctuation. Professors lose their performance rapidly in an average rate of -1.319%. What is more, this drop is greater in case of male professors despite their initial higher performance. HEI authorities can take this observation into account in their decision-making. Future research can extend the application on different study programs and faculties, as well as to analyze productivity across HEIs.

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VALUE OF PROJECT MANAGEMENT EDUCATION: STUDENTS' POINT OF VIEW

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Abstract

This study analyses students' attitude to project management (PM) education, particularly in tertiary education, by using four research questions. This is the pilot study based on quantitative research. The analysis utilises primary data collected by the survey. The sample includes 321 anonymously answered questionnaires. As a result of this study, the distribution of the responses is shown. Students consider modern approaches and workshops to be highly effective training methods for PM education and recommend PM courses to be taught at the bachelor level of tertiary education. These results are discussed in relation to the respondents' work experience and PM course completion. Only one-third of the respondents who passed a PM course use the PM knowledge and competencies acquired in praxis. However, most of the respondents who did not pass a PM course lack PM knowledge and competencies. The conclusions contribute to the debate on the importance and value of PM education.

Keywords

Higher education, project management, tertiary education, training methods, university

Introduction

Project management (PM) skills are taught during tertiary education, which is aimed at preparing qualified specialists in particular fields. University programmes are expected to reflect the requirements of employers and the labour market for such specialists (McGuinness, 2003; Oliver, 2011; Koziel, 2012; Finna and Erdei, 2015; Cruz and Dominguez, 2016). Therefore, PM as a mandatory course is included in the curriculum at most business schools (Cicmil and Gaggiotti, 2018) and in different levels of business administration and management programmes. A unanimous verdict on the appropriate level of higher education for teaching PM does not exist in the academic community. Ríos-Carmenado et al. (2015) present a clear educational strategy for teaching PM and developing the skills and competencies needed for project managers throughout tertiary education: in the graduate (first cycle), postgraduate (second) and PhD (third) programme. PM skills are required at all three levels – for use by graduates as members of PM teams, postgraduates as project managers and PhDs for their research projects.

PM is a growing and dynamic branch of management research and praxis. It is a widely discussed topic in the academic community and an important pillar from the practitioners' perspective (Wirth, 1992; Winter et al., 2006; Berggren and Söderlund, 2008; Lecomber and Tatnall, 2017). This issue deserves greater attention since PM faces a challenge of uncertainty, complexity and chaos (Thomas and Mengel, 2008). Project managers are expected to be high-level experts with specific managerial skills. The International Project Management Association (IPMA) administers certification and abides by the international standard competence minimum (Bartoška et al., 2011; Ríos-Carmenado et al., 2015; IPMA, 2019). However, Bartoška et al. (2012) appeal to PM

education to exceed such requirements and provide complex training for future project managers to be successful while Ramazani and Jergeas (2015) state that a gap exists between PM needs and the education offered in this sphere. Pant and Baroudi (2008) point out that soft skills may be underestimated in PM education and stress that hard and soft skills should be generally balanced in PM and particularly emphasised in PM education. Therefore, the academic community addresses the problem of what to develop in future project managers in different programmes and which educational strategies, models and methods to employ for effective PM education.

Researchers suggest specific teaching approaches and learning models for PM education for linking theory to real business cases and projects (Ríos-Carmenado et al., 2015; Mazzetto, 2018). For example, Berggren and Söderlund (2008) designed six learning models for use in PM education: reflection reports, learning contracts, roundtable examinations, live cases, theses, and knowledge theatres (a performative event at a sponsoring organisation). Furthermore, Cicmil and Gaggiotti (2018) introduce the concept of *responsible PM education* based on four principles: a) theory introduction, which encourages critical thinking and the study of a wide range of existing models and methods, b) critical debates, c) researcher, practitioner and student involvement in the curriculum, d) assessment forms. According to Mengel (2008) and Mazzetto (2019), leadership skills should be developed to improve PM education effectiveness. Ramazani and Jergeas (2015) also emphasise the crucial role of developing critical thinking, interpersonal skills and leadership, and engaging within the context of real projects. Fraga et al. (2018) stress the importance of combining conformity and diversity teaching strategies in modern PM education. For example, the use of role-playing (within a virtual project) in PM education was discussed by Nakamura et al. (2009; 2012), Tachikawa et al. (2013), Yagi et al. (2013), Nakamura and Tachikawa (2014). Some studies refer to a virtual environment (Doloi, 2007; Bourgault et al., 2010). Pfahl et al. (2004), Zwikael et al. (2015), Rokooei et al. (2017), Reed and Angolia (2018) recommend deploying simulation applications in PM education. Calderón et al. (2018) even suggest gamification of PM education concerning the ISO 21500 standard. Distance education (Thomas and Mengel, 2008) and e-learning (Dewi et al., 2012) in PM and their benefits are also discussed in the literature. In this respect, the students' opinion is important because teaching models should be applied with respect to students' learning needs and styles (Kostolányová et al., 2011; Rumeser and Emsley, 2017). According to Ashleigh et al. (2012), students emphasise the role of transferable skills and e-learning environments in PM education.

Thus, the main aim of the study is to investigate students' attitude to PM education, particularly in tertiary education. To achieve the main goal, the following research questions should be answered:

- RQ1: What training methods do students find to be effective for PM education?
  - (a) Does it depend on work experience in the project management field?
  - (b) Does it depend on passing a PM course?
- RQ2: At which level of tertiary education should a PM course be taught?
  - (a) Does it depend on work experience in the project management field?
  - (b) Does it depend on passing a PM course?
- RQ3: Do students who passed a PM course find its learning outcomes beneficial? Do they use the acquired knowledge and competencies in their jobs?
- RQ4: Do students who did not attend a PM course lack knowledge and competencies from this area?

The remainder of the paper proceeds as follows. First, the data collection process and the analytical methods used are described and argued. Second, the authors report and discuss the findings in the same order as the research questions are stated. Ultimately, the authors conclude and refer to the theoretical contribution and managerial implications.

Materials and Methods

The quantitative analysis in this study is based on primary data collected in the questionnaire survey in 2018. This pilot study focuses on just one business school case to examine the relevance of the proposed study. The results should prove helpful in regard to the possible modification of the questionnaire and for the refinement of the research questions in the form of hypotheses. This provides the basis for subsequent extensive research with a representative sample of business schools in the Czech Republic. The respondents were students of the Faculty of Management (FM VŠE), University of Economics, Prague in both full-time and combined form of study. The questionnaire contained 19 questions in total and 339 anonymously answered questionnaires were collected. Multiple-answer and single-answer multiple choice questions, matrix questions and open-ended questions were included. Each respondent was described by the a) form of study, b) attendance of a PM course, c) employment, e) work experience in PM. Respondents who could not be described by these variables (did not answer these questions) were excluded from the dataset. The final sample includes 321 respondents (Table 1).

Work Experience	Passing PM Course					
	No		Yes		TOTAL	
STU – only student	70	(21.8%)	36	(11.2%)	106	**(33.0%)**
EMP – also employee	103	(32.1%)	61	(19.0%)	164	**(51.1%)**
EMP-P – also employee with PM experience	35	(10.9%)	16	(5.0%)	51	**(15.9%)**
TOTAL	**208**	**(64.8%)**	**113**	**(35.2%)**	**321**	**(100.0%)**

Table 1: Number of respondents according to work experience and passing the PM course (source: own calculation)

To answer RQ1 and RQ2, the authors used contingency tables, stacked bar charts and Pearson´s chi-squared tests of independence concerning the categorical type of obtained data. Training methods in PM education were separated into eight groups for the purpose of this study (RQ1): 1) lectures/seminars (professional courses), 2) certified educational programmes, 3) workshops (on specific topics), 4) e-learning (online education), 5) modern approaches (coaching, teambuilding, mentoring, 360° feedback and etc.), 6) skill courses (interpersonal and managerial skills: selling, communication, presenting skills, motivation), 7) self-study (reading academic and professional literature) and 8) others (as specified by respondents). The questionnaire enabled respondents to recommend a (RQ2) PM course to be taught at bachelor level (as compulsory or elective), master's level of studies (as compulsory/elective), in both (with the option to choose a compulsory/elective type for each cycle separately), or not to be taught at tertiary education. Furthermore, the authors deployed the descriptive statistics in the form of frequency tables to answer RQ3 and RQ4. The completion of the PM course at the FM VŠE was essential to divide the sample of respondents into two parts for the purpose of RQ3 and RQ4. To date, the PM course at the FM VŠE is a compulsory 4 ECTS credits course (104 hours of workload) recommended for studying in the second year of bachelor's studies. For statistical calculations and analysis, the authors used the R version 3.5.2 software (R Core Team, 2018).

Results and Discussion

This section is divided into three parts according to the main topics (Training methods, Level of tertiary education, Value and importance of PM education) of the research questions. The last section includes RQ3 and RQ4 as they both refer to the importance of PM education.

Training methods (RQ1)

To compare the individual training methods, a numerical conversion scale (1 – very effective,

2/3 – effective, 1/3 – less effective, 0 – ineffective) on the interval [0, 1], or [0%, 100%] respectively, was used. Table 2 shows the percentages of responses and the related sample means based on our scale and indicates that students consider modern approaches and workshops as highly effective training methods for PM education. Skill courses are in third place. The respondents find self-study to be the least effective method. Traditional lectures or seminars are moderately effective (see the sample mean 48.2% in Table 2). There are no statistically significant differences in the respondents' answers with respect to their work experience in the PM field (Figure 1) or with respect to their completion of the PM course (Figure 2).

The proper way to teach PM is connected to the current trends in education as Calderón et al. (2018) or Cicmil and Gaggiotti (2018) mentioned. Students mostly prefer workshops or modern approaches rather than classical tertiary education approaches. Nevertheless, this may not be suitable for all students. The perception of traditional vs modern approaches within different generations (the combined form students are 20 – 55 years old) can differ. However, these demographic characteristics are not available in the collected dataset.

Training Method	Very Effective (1)	Effective (2/3)	Less Effective (1/3)	Ineffective (0)	Mean (%)	Rank
Lectures/Seminars	8.0	35.7	49.4	7.0	48.2	5
Certified Programmes	22.0	59.7	17.4	1.0	67.5	4
Workshops	59.5	33.2	7.0	0.3	84.0	2
E-Learning	2.6	28.8	48.2	20.4	37.8	6
Modern Approaches	64.3	29.0	4.5	2.2	85.1	1
Skill Courses	32.4	52.1	12.1	3.5	71.1	3
Self-Study	2.3	11.3	48.9	37.5	26.1	7

Table 2: Distribution of effectiveness in percentages for individual training methods, mean effectiveness and rank (source: own calculation)
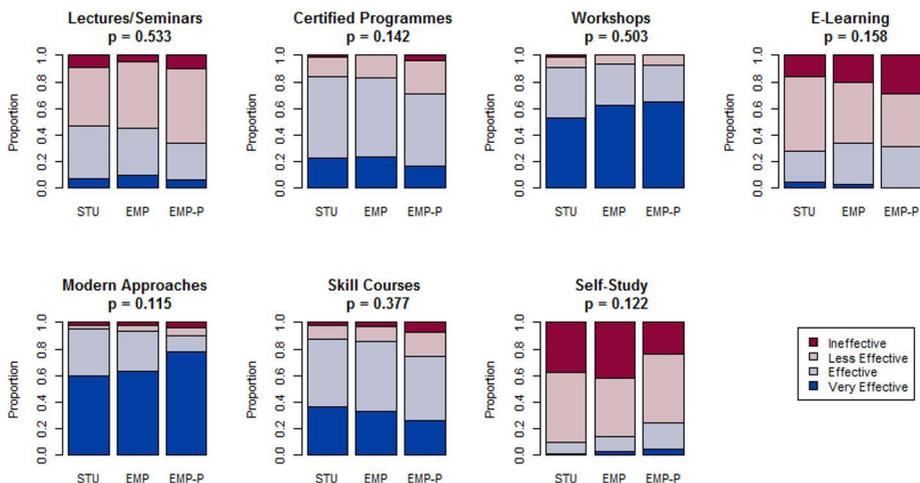
Figure 1: Distribution of responses according to the respondents' work experience with corresponding p values of the Pearson chi-squared test of independence (source: own calculation)

In the case that PM courses have not yet been adapted for modern education approaches, there

is a possible way to contribute to the practical use of PM tools during studies. PM courses can provide PM education in a traditional way; students would learn PM tools (action plan, Gantt charts, 360° feedback, expectations agreements etc.) and use them in practice in other courses for semester projects. This practical application appears to be the correct way of strengthening PM skills if it is not possible within PM courses. Learning by doing appears to be the best way of education. This assumption is supported by the findings of a study by Míková et al. (2017) focused on the effectiveness of training methods for professional education in general and where workshops and modern education approaches were identified as the most effective.
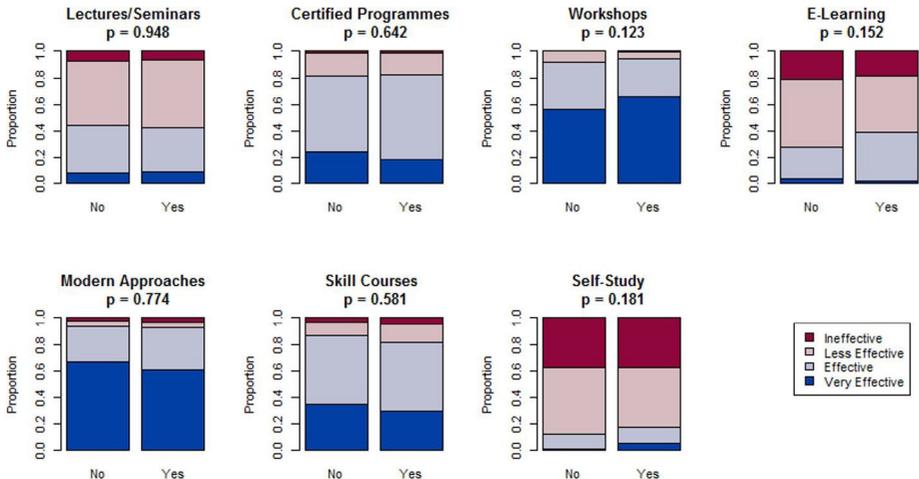
Figure 2: Distribution of responses depending on whether the respondent has already completed the PM course with the corresponding p values of the Pearson chi-squared test of independence (source: own calculation)

Level of tertiary education (RQ2)

Table 3 shows the absolute and relative numbers of responses related to the inclusion of the PM course into tertiary education. The results indicate that students would prefer a PM course to be taught at the bachelor level of tertiary education, especially in the compulsory form (51.4% respondents). Only 6 of the 321 respondents state that a PM course should not be taught in universities at all.

Bachelor Degree	Master Degree							TOTAL
	Compulsory		Elective		No			
Compulsory	25	(7.8%)	28	(8.7%)	112	(34.9%)	165	**(51.4%)**
Elective	18	(5.6%)	16	(5.0%)	63	(19.6%)	97	**(30.2%)**
No	30	(9.3%)	23	(7.2%)	6	(1.9%)	59	**(18.4%)**
TOTAL	**73**	**(22.7%)**	**67**	**(20.9%)**	**181**	**(56.4%)**	**321**	**(100.0%)**

Table 3: Distribution of opinions on the subject type and study degree for PM (source: own calculation)

Figure 3 shows the associations between classifying a subject at a given study stage and experience with work or with the PM course, respectively. Dependence of the subject type on work experience was confirmed for both bachelor's and master's degrees by the Pearson chi-squared test of independence. For example, it was shown that students who also work and have

PM experience much more recommend a master's degree in compulsory form for a PM course in comparison to the others. In the case of the PM course attendance, the differences for a master's degree were statistically insignificant ($p = 0.410$). However, the results imply that bachelor degree students who completed a PM course prefer the compulsory form for PM education. In contrast to the assumptions of Ríos-Carmenado et al. (2015), the results of our study show that a PM course is recommended for the bachelor programme. Moreover, most respondents recommended a PM course as compulsory. One of the reasons could be the requirements and expectations of the labour market (McGuinness, 2003; Oliver, 2011; Koziel, 2012; Finna and Erdei, 2015; Cruz and Dominguez, 2016). The middle or top management positions usually require a master's degree: postgraduates with leadership, conceptual and critical thinking are wanted. However, not all the graduates who apply for master's studies can successfully complete it. Despite the relatively high number of graduates, it is an attempt by the Czech education policy to limit the number of postgraduates to improve the quality of their studies and hence their values in the labour market (MŠMT, 2019b). Many people leave tertiary education with only a bachelor's degree (MŠMT, 2019a) and afterwards work in non-managerial or low-managerial positions. These graduates also need PM skills for their activities as a team member. Another reason may be that students perceive the advantages of PM tools, knowledge and usability during their studies. Regardless, a PM course can be found in the curriculum of most business schools (Cicmil and Gaggiotti, 2018).
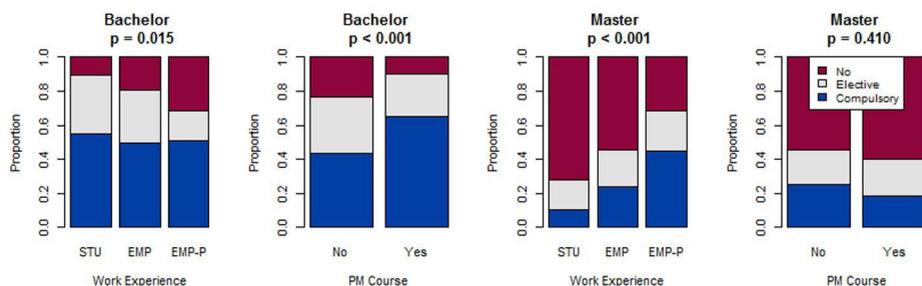
Figure 3: Distribution of responses depending on the respondents' work experience or on PM course attendance by the respondent; there are also related p values of the Pearson chi-squared test of independence (source: own calculation)

Value and importance (RQ3 and RQ4)

The benefits of the PM course at FM VŠE are positively evaluated by 75.5% of respondents (Table 4). The benefit evaluation does not statistically significantly differ in dependence on the respondent's work experience ($p = 0.633$). After passing the PM course at FM VŠE, 35.8% of respondents use the acquired knowledge and competencies (Table 5). Moreover, 80.2% of respondents who did not pass the PM course at FM VŠE feel the need to complete their knowledge of this area (Table 6).

Work Experience	Benefit Evaluation			
	Very Good	Good	Bad	Very Bad
STU – *only student*	19.4	58.3	22.2	0.0
EMP – *also employee*	15.3	57.6	25.4	1.7
EMP-P - *also an employee with PM experience*	26.7	53.3	13.3	6.7
TOTAL	**18.2**	**57.3**	**22.7**	**1.8**

Table 4: Distribution of the PM course benefits evaluation given respondents' work experience (row relative frequencies in %) (source: own calculation)

Do you use the acquired PM knowledge and competencies in praxis? (answer)	Percentage	Rank
Yes, often	3.7	7
Yes, partially	13.8	4
Yes, rarely	18.3	3
No, I don't need PM knowledge and competencies in my position	29.4	1
No, I can't use PM knowledge and competencies because I am not employed	22.0	2
No, PM skills are too theoretical and inapplicable in praxis	5.5	6
No, the course did not provide high-quality education	6.4	5
No, for another reason	0.9	8

Table 5: Distribution of the use of the knowledge acquired in the PM course (source: own calculation)

Do you lack PM knowledge and competencies? (answer)	Percentage	Rank
Yes, often	27.9	2
Yes, partially	45.7	1
Yes, rarely	6.6	3
No, I don't need PM skills at my position	5.1	6
No, I don't need PM skills because I am not employed	2.5	7
No, the PM skills I gained during my praxis	6.1	4
No, the PM skills I gained by self-study	0.5	8
No, for another reason	5.6	5

Table 6: Distribution of PM knowledge necessity (source: own calculation)

The answer to RQ3 is that students who passed a PM course in past are aware of the value and importance of the acquired knowledge and competencies. Most find the learning outcomes of the PM course beneficial. However, only some of them use the acquired knowledge and competencies in their jobs as 22% of the respondents stated that they cannot use such skills because they are not employed. The research for RQ3 also presents some limitations. Various side factors could influence a student's attitude to PM education in general and, in particular, to its benefits. The course evaluation can be impacted by the final grade, the relationship between a respondent and the course teacher, their gender, experience or others (Granzin and Painter, 1973; Marlin and Niss, 1980; Marsh and Hocevar, 1991; Centra, 2003; Isely and Singh, 2005; MacNell et al., 2015). Respondents who passed the course did not attend it in the same year and semester. Over a wider period, the lecturers and the form of the PM course at the FM VŠE have been changed and these variables were not analysed in this study. The purpose of the RQ3 was to investigate the benefits of PM education from the students' perspective but not to evaluate the lecturers and their styles.

The answer to RQ4 is that students who did not have a PM course lack PM skills in their work. The results are limited in investigating the particular knowledge and competencies that the respondents lack. However, this finding shows that students consider a PM course as providing complex training usable in praxis (Bartoška et al., 2012). Although in this phase of the study the job position was not analysed, the results (of RQ3 and RQ4) confirm the assumptions that the labour market (and in particular job duties) requires PM skills (Thomas and Mengel, 2008; Oliver, 2011; Cruz et al., 2016) from most employees. Thus, employees need these knowledge and skills and employees who did not have adequate PM education lack these important competencies.

Conclusion

This pilot study analysed students' attitude to PM education, particularly in tertiary education, and aimed to provide the basis for subsequent extensive research with a representative sample of business schools in the Czech Republic. The results of our study show that students prefer

modern approaches and workshops in PM education. Secondly, the respondents recommended a bachelor's degree as appropriate for PM education. Finally, the students perceive a PM course as valuable for their career and in cases where they did not complete such a course perceive a lack of PM skills.

The study contributes to the academic discussion on education in this specific field. The results support the findings of previous studies (Ríos-Carmenado et al., 2015; Mazzetto, 2018, Míková et al., 2017) that new progressive education methods should be employed in PM education and that students consider them to be the most effective. Further research should verify the actual impact of these methods on students' PM knowledge. From the practical point of view, the Management and Business Administration schools recommended include a PM course in their bachelor programme. This enables to use PM knowledge and competences during their studies and provides PM education to students who will not continue in a master's or PhD programme. As students without a PM course lack specific skills in their work, a PM course should be compulsory in tertiary education and the content should be regularly harmonised with labour market requirements.

The survey was designed to minimise the research limitations of the study. Nevertheless, biased responses cannot be completely detected and excluded. Similarly, the survey was not able to cover all factors influencing the perception of training methods, the benefits of a PM course and the need for PM knowledge and competencies. Furthermore, the results only provide information from the students' perspective. Further research should also fill the gap for employers' requirements in the PM skills of graduates and postgraduates as job candidates. Further research would be more based on qualitative approaches.

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FACULTY SATISFACTION WITH START-UP PACKAGES: GENDER DIFFERENCES IN A PUBLIC UNIVERSITY IN THE SOUTHEASTERN U.S.

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Abstract

Start-up packages are time limited financial and material resources offered by universities to incoming faculty during the hiring process. Previous research findings on gender equity within the start-up packages are mixed. Therefore, this study is exanimating the role of gender on the content of start-up packages, satisfaction with the packages, university honoring start-up packages, and contribution of start-up packages to faculty professional development. Data corresponds to a Start-Up Package Satisfaction Survey of faculty at all ranks (N = 96) administered in an American Southeastern public research university in 2018. Results from this study indicated that there are significant differences between male and female faculty in the overall satisfaction with the start-up packages, and in faculty perception on university honoring their start-up packages offers. Specifically, female faculty were less satisfied with start-up packages and were more likely to perceive that the university did not honor their start-up packages.

Keywords

Benefit satisfaction, faculty professional development, gender equity, hiring process, start-up packages

Introduction

Start-up packages can be defined as time limited financial and material resources offered by universities to new faculty during the hiring process (Hamann, 2013). Universities are competing with each other to recruit the best faculty by providing attractive start-up packages (Callie and Cheslock, 2008; Committee on Partnership for Emerging Research Institutions, 2009; Ehrenberg, Rizzo, and Condie, 2003). Start-up packages should help faculty to establish their research projects until they are able to secure further funding (Rancourt, 2010). Therefore, it is essential that new faculty obtain benefits that help them to be successful and productive (Bralower, 2005). The negotiation of start-up packages is dependent on the administrative structure of the college; the start-up packages are usually negotiated with the department chair or with both the dean of college and the department chair (Reis, 1997). The duration of start-up packages is usually a few years (one to two years), and the specific number of years for which the package is available to the faculty should be negotiated during the interview as well (Bralower, 2005; Hamann, 2013).

Hiring processes are influenced by gender inequalities within organizations (Stamarski and Son Hing, 2015). Research has shown that female faculty perceive more gender discrimination during hiring processes within university settings and are less satisfied with the overall hiring processes than male faculty (Faculty of Arts and Sciences Gender Equity Committee, 2002;

Langley et al., 2013). In addition, female faculty receive less benefits in their start-up packages and are less likely to perceive that departments did the best to obtain resources for them than male faculty (Langley et al., 2013; Van Delinder et al., 2015). Similarly, Layne (2006) showed that female faculty received less average value of start-up packages at all academic ranks at the College of Engineering and the College of Science at Virginia Tech University in the academic year 2005/2006. Analysis conducted by the University of Virginia (2014) showed that male faculty received a higher mean value of start-up packages than female faculty in Science, Technology, Engineering, Mathematics disciplines (STEM) and Social and Behavioral Sciences disciplines (SBS) at the University of Virginia; nonetheless, the mean difference was not statistically significant. However, in the academic year 2004/2005, female faculty received higher average value of start-up packages at all academic ranks at the College of Engineering at Virginia Tech University (Layne, 2005). In addition, the National Research Council (2010) found that start-up packages were comparable between female and male faculty. These findings are in accordance with an experiment conducted by Allen, Smith, and Ransdell (2019) which showed that candidates' gender does not influence the hiring evaluator's decision-making process with regard to the amount of salary, start-up funding, or research space allocation. Therefore, findings on gender differences within the content of start-up packages are mixed.

Overall, female faculty have been found to be less satisfied with their jobs at universities than male faculty (Callister, 2006). Specifically, Rosser (2004) found that female faculty were less satisfied with the quality of benefits and their salary level than male faculty. Additionally, female faculty have been found to be less satisfied with their start-up packages at the time of hire at the University of Southern Maine (Langley et al., 2013). Gender differences within university settings have also been found in the perception of university fair treatment. Female faculty perceive that they are treated less fairly at the institutional level as well as by their superiors than male faculty (Holliday et al., 2015; Jagsi et al., 2017; Martin, 2011). Unfair treatment can also be seen in unfair workload distribution and its effect on faculty professional development. Female faculty were more likely to have less teaching free periods than male faculty; therefore, they had less time to conduct research and to work on publications (Kjeldal, Rindfleish, and Sheridan, 2005).

This paper presents findings of a study that explored the following research question: What is the role of gender on obtained benefits in start-up packages, satisfaction with start-up packages, perception of university honored start-up packages, and contribution of start-up packages to professional development? In addition, the following null hypotheses were tested.

Hypothesis 0_1. Number of obtained benefits does not significantly differ by faculty gender.

Hypothesis 0_2. Satisfaction with benefits at the time of hire does not significantly differ by faculty gender.

Hypothesis 0_3. Satisfaction with benefits at the time of the study does not significantly differ by faculty gender.

Hypothesis 0_4. Satisfaction with the overall start-up packages does not significantly differ by faculty gender.

Hypothesis 0_5. Faculty perception if the university honored the start-up packages does not significantly differ by faculty gender.

Hypothesis 0_6. Contribution of start-up packages to faculty professional development does not significantly differ by faculty gender.

Following, methods and procedures used to conduct the study will be explained including data collection, participants, measures, and data analysis. Further, results are presented, followed by a discussion of the findings, conclusions, and recommendations.

Materials and Methods

Data Collection

The current study utilizes data from the Start-Up Package Satisfaction Survey administered in a Southeastern university from April 2018 to June 2018. The survey focused on faculty attitudes towards start-up package offers, negotiation, satisfaction, and obtained benefits. Prior to data collection, Institutional Review Board approval was obtained. Tenure-track and tenured faculty (N = 989) at a research public university in the Southeastern U.S. received an email, and further a reminder, to participate in the survey using a web-based Qualtrics platform. One hundred and twenty-seven opted for completing the survey; the response rate was 13%. Participants read and signed an informed consent by agreeing to complete the survey.

Participants

Participants who were considered as the sample for this study were participants who obtained a start-up package and also chose to respond to the demographic question about their gender by indicating their gender as male or female. Those who chose "I prefer not to answer", "I don't identify myself with any of the above", or did not answer this question were filtered out of the analyses. To secure participants' confidentiality, demographics questions were voluntary. This study analyzes data from a sample of (n = 96) tenure and tenure-track faculty were 51% (n = 49) males and 49% (n = 47) females.

Measures

The number of overall obtained benefits was calculated based on participants' responses to 34 items from the survey where respondents indicated whether one of each 17 specific benefits were offered to them, or not offered to them, and also if they obtained the benefit through negotiation of their start-up package. The benefits were classified in four groups (i.e., terms of employment, equipment, moving expenses, and other benefits). The response options were "yes", "no", and "I don't know" for 17 items assessing if the benefit was offered to them and "yes", "no", and "N/A" for 17 questions asking if participants negotiated for the specific benefit. The items were recoded as "0" if they did not obtain a benefit through offer or through negotiation and if they did not remember or did not answer the question; and as "1" if they obtained the specific benefit regardless if it was offered to them or if they negotiated for the specific benefit. The final number of obtained benefits was a sum of the recoded 17 variables.

The variable "number of benefits satisfied with at the time of hire" was assessed by summing responses of two sets of questions in regard to 17 benefits. The first set of questions asked if participants were satisfied at the time of hire with the specific benefit which was offered to them; the response options were "yes" and "no. The second set of questions asked if respondents were satisfied at the time of hire with benefits which they negotiated; the response options were "yes", "no", and "N/A". The variables were recoded as "0" if participants were not satisfied with a specific benefit offered or negotiated, when they did not respond, or their response was "N/A"; the variables were recorded as "1" if participants were satisfied with the specific offered or negotiated benefit. The final variable of number of benefits satisfied with at the time of hire is a sum of the 17 recoded items.

The variable "number of benefits satisfied at the time of the study" was computed by summing the two sets of questions across 17 benefits. In the first set of questions, participants indicated if they are now satisfied with the benefit which was offered to them; the response options were "yes", "no", and "N/A". The second set of the questions asked if respondents are now satisfied with the benefit which they negotiated for; the response options were "yes", "no", and "N/A".

The variables were recoded as "0" if participants were not satisfied with the specific offer or negotiated benefit and when they did not respond, or their response was "N/A"; the variables were recorded as "1" if participants were satisfied with the specific offered or negotiated benefit. The final variable of number of benefits satisfied with at the time of the study is a sum of the 17 recoded items.

Satisfaction with the overall start-up packages was measured with two items. Participants responded to items rated on a satisfaction scale from 1 (extremely dissatisfied) to 5 (extremely satisfied). The estimated Cronbach's alfa of this scale was .84. Questions included asked about satisfaction with the original start-up offer and about satisfaction with the result of negotiation for the start-up package.

Honored start-up packages were measured by a single item asking to rate the level of agreement if the university honored all aspects of the start-up package on an agreement scale of 1 (strongly disagree) to 5 (strongly agree).

The variable "contribution to professional development" was a single-item measure on an agreement response scale ranging from 1 (strongly disagree) to 5 (strongly agree). The question asked participants to rate the level of agreement that the start-up package helped or contributed to faculty professional development.

Data Analysis

Collected data were analyzed using IBM SPSS Statistics Version 24.0. Data analyses included descriptive statistics, analysis of variance (ANOVA), and correlation analysis. Descriptive statistics were used for participant demographics. Univariate ANOVA was conducted to compare the means of major study variables to determine if statistically significant differences existed based on gender (Tabachnick and Fidell, 2013). Levene's test for equality of variances was used to test the homogeneity of variance assumption. Pearson correlation matrix was calculated to further examine the relationships between study variables.

Results

Of the 96 faculty who completed the survey, 51% were males, most were self-identified as White non-Hispanic (80.2%), were in the Assistant professor rank (42.7%), and were in a STEM discipline (50%). A summary of the demographic information of the participants can be found in Table 1.

Descriptive statistics were calculated for the number of overall obtained benefits in start-up packages, satisfaction with the benefits at the time of hire, satisfaction with benefits at, overall satisfaction with start-up packages, packages honored by university, and contribution of start-up packages to faculty professional development. The mean value of the number of obtained benefits in the start-up packages was 6.94 (SD = 3.06). In addition, results revealed that faculty in the sample generally expressed that they were overall satisfied with their start-up packages (M = 2.83, SD = 1.26), the university honored their packages (M = 3.60, SD = 1.45), and that their start-up packages contributed to their professional development (M = 3.72, SD = 1.51). A summary of descriptive statistics of major study variables are shown in Table 2.

Results of bivariate correlation analysis of the study variables is presented in Table 3. The Correlation matrix shows that number of overall obtained benefits in start-up packages, satisfaction with the benefits at the time of hire, satisfaction with benefits at the time of the study, overall satisfaction with start-up packages, packages honored by university, and contribution of start-up packages to faculty professional development were significantly and positively associated with each other.

Variable	Categories	n	%
Gender	Male	49	51.0
	Female	47	49.0
Race and/or ethnicity	Asian, Asian-American, or Pacific Islander	5	5.2
	White (non-Hispanic)	77	80.2
	Black or African-American	3	3.1
	Hispanic or Latino	5	5.2
	I prefer not to answer	4	4.2
	Other	1	1.0
Current academic rank	Professor	26	27.1
	Associate Professor	25	26.0
	Assistant Professor	41	42.7
	I prefer not to answer	4	4.2
	Other		
Disciplines*	STEM	48	50
	SBE	11	11.5
	Non-S&E	4	4.2
	Professional/Other	4	4.2
	Other	21	21.9

Categories of disciplines were made based on the U.S. National Science Foundation's requirement for data reporting; STEM (science, technology, engineering, and mathematics), SBE (social, behavioral, and economic sciences), Non-S&E (non-science and engineering), Professional/Other (e.g. communications, parks/recreation/leisure/fitness).

Table 1: The demographics of the sample

Variable	Min	Max	Mean	SD	Skew
Number of obtained benefits	0	14	6.94	3.06	.30
Satisfaction with the benefits – time of hire	0	14	5.47	3.13	.68
Satisfaction with the benefits – time of study	0	12	3.77	3.10	.83
Overall satisfaction with the packages	1	5	2.83	1.26	-.01
Honored packages	1	5	3.60	1.45	-.56
Contribution to professional development	1	5	3.72	1.51	-.83

Table 2: Descriptive statistics of study variables

Variable	1	2	3	4	5	6
1. Number of obtained benefits	-	.84***	.70***	.38***	.44***	.52***
2. Satisfaction with the benefits – time of hire		-	.78***	.52***	.52***	.55***
3. Satisfaction with the benefits – time of study			-	.41***	.50***	.43***
4. Overall satisfaction with the packages				-	.48***	.74***
5. Honored packages					-	.59***
6. Contribution to professional development						-

*** p <.001

Table 3: Pearson's correlation coefficients between variables

Levene's test verified the equality of variances in the samples, in other words, the homogeneity of variance assumption was not violated (p >.05). There was one case of missing data in variables included in the analysis; this one case of missing data was handled with pairwise deletion. The results from univariate ANOVA that exanimated the gender mean differences in the start-up packages are presented in Table 3. Female faculty reported lower number of obtained benefits in the start-up packages (M = 6.45; SD = 3.03) than male faculty (M = 7.50; SD = 3.02). However, the difference

in the number of obtained benefits in the start-up packages between female and male faculty was not statistically significant, $F(1, 93) = 2.88$, $p = .093$, $\eta^2 = .030$. Therefore, Hypothesis 0_1 was not rejected. Female faculty were less satisfied with the benefits at the time of hire ($M = 4.91$; $SD = 2.88$) than male faculty ($M = 6.10$; $SD = 3.25$). Nevertheless, the mean difference between female and male faculty satisfaction with the benefits at time of hire was not significant, $F(1, 93) = 3.56$, $p = .062$, $\eta^2 = .037$. Thus, Hypothesis 0_2 was not rejected. Female faculty were currently less satisfied with the benefits that they obtained in their start-up packages ($M = 3.32$; $SD = 2.94$) than male faculty ($M = 4.23$; $SD = 3.22$). Notwithstanding, the mean difference between female and male faculty current satisfaction with the benefits obtained in the start-up packages was not significant, $F(1, 93) = 2.06$, $p = .154$, $\eta^2 = .022$. Hypothesis 0_3 was not therefore rejected. Female faculty reported lower levels of overall satisfaction with the start-up packages ($M = 2.49$; $SD = 1.16$) than male faculty ($M = 3.21$; $SD = 1.25$). There was a significant mean difference in the overall satisfaction with start-up packages between female and male faculty, $F(1, 93) = 8.45$, $p < .01$, $\eta^2 = .083$. Hence, Hypothesis 0_4 was rejected. Female faculty expressed lower levels of honored start-up packages by university ($M = 3.28$; $SD = 1.49$) than male faculty ($M = 3.92$; $SD = 1.35$). There was a significant difference in the level of honored start-up packages by university between genders, $F(1, 93) = 4.84$, $p < .05$, $\eta^2 = .049$. Hypothesis 0_5 was rejected. Female faculty perceived that their start-up packages contributed less to their professional development ($M = 3.47$; $SD = 1.56$) than male faculty ($M = 4.02$; $SD = 1.39$). However, the mean difference between female and male faculty in contribution of the start-up packages to professional development was not significant, $F(1, 93) = 3.33$, $p = .071$, $\eta^2 = .035$. Therefore, Hypothesis 0_6 was not rejected.

| | Gender | | | | | | |
| | Male (n=48) | | Female (n=47) | | | | |
Variable	M	SD	M	SD	F	η^2	p
Number of obtained benefits	7.50	3.02	6.45	3.03	2.88	.030	.093
Satisfaction with the benefits – time of hire	6.10	3.25	4.91	2.88	3.56	.037	.062
Satisfaction with the benefits – time of study	4.23	3.22	3.32	2.94	2.06	.022	.154
Overall satisfaction with the packages	3.21	1.25	2.49	1.16	8.45	.083	<.010
Honored packages	3.92	1.35	3.28	1.49	4.84	.049	<.050
Contribution to professional development	4.02	1.39	3.47	1.56	3.33	.035	.071

Table 4: Mean differences by gender

DISCUSSION

Gender inequality can influence hiring processes and faculty careers (Carr et al., 2019; Stamarski and Son Hing, 2015). However, little is known about how gender influences start-up packages within academia and findings about gender differences in start-up packages are mixed. Results from this study indicated that there are significant differences between male and female faculty in the overall satisfaction with the start-up packages and in faculty perception if university honored their start-up packages. Specifically, female faculty were less satisfied with the start-up packages and were more likely to perceive that the university did not honor their start-up packages. These findings are consistent with previous research which showed that female faculty are less satisfied with the overall hiring processes (Langley et al., 2013), and that female faculty are less likely to perceive that the university treats them fairly (Holliday et al., 2015; Martin, 2011). However, the findings are not consistent with the study conducted by Robst, VanGilder, and Polachek (2003) that found that majority of male and female faculty believe that female faculty are treated fairly. The implication for the universities is that they should offer packages that are attractive for new faculty and would satisfy them. In addition, universities should offer only packages which they can deliver to prevent the perception of unfair treatment, especially by female faculty. Even though, in this study, male faculty

obtained higher number of benefits in their start-up packages, the difference was not statistically significant. Therefore, research which concluded that there are no significant differences between female and male start-up packages was supported (Allen, Smith, and Ransdell, 2019; Layne, 2005; National Research Council, 2010; University of Virginia, 2014). In addition, although there were no significant differences between male and female faculty on the number of obtained benefits in the start-up packages, satisfaction with the packages at the time of hire, satisfaction with the packages at the time of study, and contribution of the start-up packages to the professional development; all the study variables were positively correlated with contribution of the start-up packages to faculty professional development. Future inquiry on these relationships by accounting for a bigger sample size would potentially yield significant results portraying the hypothesized differences in this study.

Conclusion

The present study showed that females are significantly less overall satisfied with start-up packages and start-up packages are significantly less likely to perceive that the university honored their start-up packages. On the other hand, there were no significant differences between female and male faculty in terms of number of obtained benefits in the packages, satisfaction with the benefits at the time of hire, satisfaction with benefits at the time of study, and contribution of the start-up packages to faculty professional development. In addition, the study revealed positive correlation among all study variables. Therefore, future research should examine the directionality of those relationships, by considering a bigger and more diverse sample.

Acknowledgements

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CLOUD COMPUTING SERVICES ADAPTION ON SECONDARY SCHOOLS IN THE SELECTED REGION

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Abstract

Many secondary schools use cloud computing services art present. The benefits of cloud computing for institutions and students include factors such as mobility, scalability, security, availability, and end-user satisfaction when using software applications (e.g., Office 365) and other cloud computing resources (e.g., One Drive). However, some school institutions do not still use these services. We use the technology-organization-environment framework (TOE) and examine the factors that determine the decision process concerning the adoption of cloud computing by regional secondary schools. We conducted an online survey. The results served to test the relationship between cloud computing and predictor variables which were in our research model relative advantage, complexity, compatibility, organizational readiness, technological readiness, perceived barriers, regulatory policy, and service provider support. The results showed that complexity, organizational readiness which is connected also to institution size, technological readiness and regulatory policy were statistically significant when determining the use of cloud computing. The other predictive variable had small effect when deciding about cloud computing services adaption.

Keywords

Cloud computing, secondary schools, technology adaption, TOE framework

Introduction

The use of cloud computing services is beginning to grow at secondary schools. It enables students, teachers and administrative staff to have access to various services that are otherwise difficult to access with regard to the price and the need to purchase the expensive hardware. Cloud computing virtualizes resources such as software applications and laboratories, becoming an important source of remote education and online education. The problem explored in this study was to understand the factors that determine the adoption of cloud technologies by secondary schools in South Bohemia region. Cloud computing acceptance from a user perspective was studied both in post-secondary education and in companies (Behrend et al., 2011; Park & Ryoo, 2012). However, the factors determining the admission of cloud computing by secondary schools in different regions of the Czech Republic were not investigated.

Cloud computing services are increasingly being applied in secondary school education in the Czech Republic. There are many of the services that can be available free of charge or for a small fee. Schools use cloud computing for a variety of reasons (Sultan, 2011), mostly economical (Goel, 2011) or other. Cloud computing technology is becoming ubiquitous and exploited increasingly by organizations to leverage the information technology (IT) opportunities and to stay competitive and innovative. This technology has been claimed as being able to provide economic advantages, such as reducing computing costs, scalability, and flexibility. These advantages are becoming

the major drivers for the increasing use of cloud computing not only in organization but also in schools (Katzan, 2010; Drlik & Beranek, 2015). The pressure to reduce costs and rapid advances in technology are convincing arguments for adopting cloud computing in these organizations. Cloud computing can be used to create virtual computer environments, particularly in the areas of science education and distance learning or online education (Al-Zoube et al., 2010; Beranek & Remes, 2013; Beranek, 2015). A further question is data security, where cloud computing can solve some problems (Sultan, 2011).

Materials and Methods

Research model

The research model we used to study the use of cloud computing was the TOE framework developed by Tornatzky and Fleischer (Tornatzky & Fleischer, 1990). The TOE framework was used by other researchers to analyze the adoption of various information systems (IS) and technical innovations, including c-commerce, online retail, e-business and ERP (Oliveira & Martins, 2010). The TOE framework is used by researchers to study the adoption and deployment of technology innovation businesses. The model contains three main elements: the technological context, the organizational context and the context of the environment (Tornatzky & Fleischer, 1990). The technology element includes availability and technology features. The organization element deals with formal and informal link structures, communication processes, sizes and slack. The external task environment element examines the characteristics of the industry and market structure, technology support infrastructure, and government regulation. Our study is based on the modified TOE framework by the authors Low, Chen and Wu (Low et al., 2011). The proposed model includes variable relative advantages, technological readiness, complexity and compatibility as part of a technological context; variable organizational readiness and barrier perception as part of the organization context; and regulatory policy variables and service provider support as part of the environmental context. The research model is shown on Figure 1.

Relative advantage, complexity and compatibility are the most significant impact on the acceptance of technology innovation (Tornatzky & Klein, 1982). Complexity is perceived as the difficulty of a company to understand and use innovation (Rogers, 2003). Compatibility of innovation is the extent to which innovation is in line with the values, experiences of the past, and the needs of the learner. Organizational readiness two factors: number of employees (institutional size) and the amount of IT budget (Low et al., 2011). Technical readiness has two factors: IT infrastructure and IT human resources (Oliveira & Martins, 2010). Perceived barriers to adopting an innovation range from the appropriateness of business innovation and lack of security. Barriers may also vary from company size to legal issues (Oliveira & Martins, 2010). Regulatory policy issues range from government regulations on education to security and privacy (Sultan, 2011). Levels of service or support agreements with cloud computing service providers have a direct impact on the school's decision to adapt to cloud computing (Katz et al., 2009). The following hypothesis file was derived from a cloud computing literature review and were used to test a research model which includes the technological context, the organizational context, the environmental context, and the adoption of cloud computing.

H1: Relative advantage (RA) is positively associated with cloud computing adoption (CCA).

H2: Technical complexity (TC) is negatively associated with cloud computing adoption.

H3: Technical compatibility (TCO) is positively associated with cloud computing adoption.

H4: Organizational readiness (OR) is positively associated with cloud computing adoption.

H5: Technology readiness (TR) is positively associated with cloud computing adoption.

H6: Perceived barriers (PB) are negatively associated with cloud computing adoption.

H7: Regulatory policy (RP) is positively associated with cloud computing adoption.
H8: Service provider (SP) support is positively associated with cloud computing adoption.
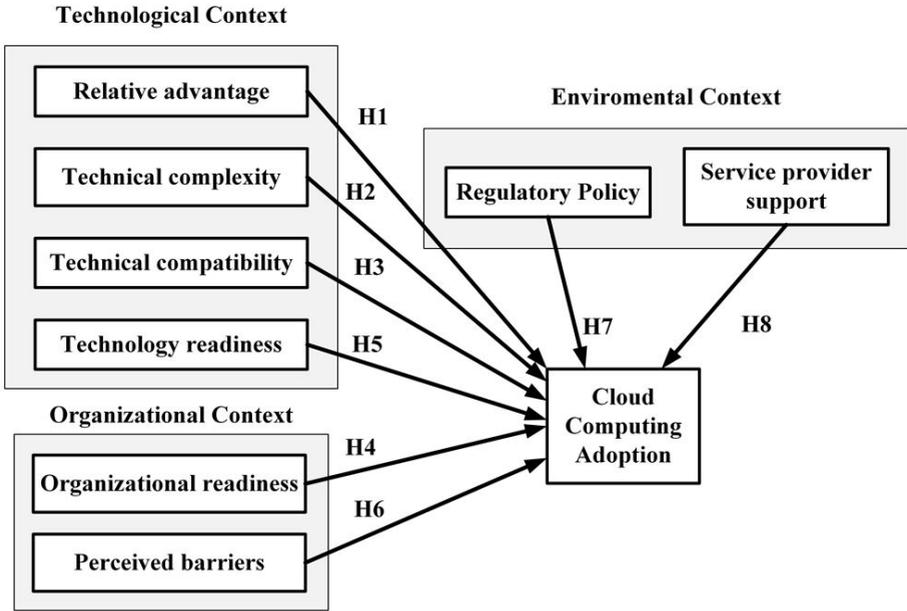
Figure 1: Research model

Sample and Data Collection

The questionnaire for this study was developed by following these steps: Before data collection for the study, pretesting of the measurement was conducted with five respondents, secondary school teachers. We also interviewed them to get some additional notions about cloud computing used in the secondary schools. The pretest respondents were asked to evaluate the relevance of the questionnaire items for each variable of the study. The questionnaire was modified in accordance with the pretest feedback.

The data was collected using online questionnaires, a link to an online survey was included in an individual e-mail sent to each potential respondent. Forty-five questionnaires were distributed, 38 were returned, which gives a response rate of 84.4 percent. Two questionnaires were discarded because of a lack of integrity in some of the answers, giving a final sample size for the analysis of 36. All the items in the survey were measured on a seven-point Likert scale. The survey consisted of 28 items. Four items were used to collect demographic data. The remaining 24 items were used to evaluate the eight predictors in the research model. Research items were based on literature reviews (sources) and adapted to fit the context of this study.

Of the 38 respondents, 82.7 percent were male, and 17.3 percent were female. The average age of respondents was 29.2 years.

Results

For our study, we decided to use variance-based (also known under the term partial least squares (PLS) analysis) approach (Reinartz et al., 2009). In contrast, the latter approach performs a multiple regression analysis independently for each endogenous variable with a bootstrapping

estimation process (e.g., partial least squares, PLS). This approach is appropriate if the research objective is prediction and hypothesis development (Hair et al., 2017). In addition, this method is robust to data deviations from normality (Kock, 2016). Hence, we applied the PLS approach for further analysis; we used SmartPLS software (Hair et al., 2017) in our analysis. The sample, we carried out our experiments on, had 36 respondents. The values of the factors loaded heavily (> 0.7) on their respective factors, cross-loadings were relatively small.

Table 4 presents the values of reliability coefficients. Cronbach's α and composite reliability (CR) show the reliability of reflective constructs (Peterson and Kim, 2013). The values of Cronbach's α coefficients for all constructs achieve values from 0.725 to 0.946. It indicates (values are greater than 0.7) that all measures have adequate internal consistency. The CR values of all seven constructs are above 0.80 (Table 1). Hence, all constructs are reliable and valid. Values of average variance extracted (AVE) are bigger then the threshold of 0.5 which indicates that convergent validity is adequate (Bagozzi et al., 1991). In addition, square root values of AVE exceed correlations between the construct and any other construct; it means that discriminant validity is confirmed. For further verification of structural model, R2, and Q2, techniques were used. Their values also indicated a good strength of suggested structural model.

	Mean	S.D.	AVE	CR	Alpha	RA	TC	TCO	OR	TR	PB	RB	SP
RA	5.586	1.010	0.704	0.877	0.790	0.839							
TC	5.167	1.352	0.687	0.868	0.772	0.675	0.829						
TCO	5.601	1.058	0.714	0.882	0.799	0.759	0.726	0.845					
OR	4.761	1.064	0.845	0.942	0.908	0.779	0.611	0.631	0.919				
TR	5.824	0.917	0.815	0.946	0.924	0.727	0.521	0.712	0.640	0.903			
PB	4.774	1.156	0.804	0.925	0.878	0.702	0.629	0.586	0.776	0.553	0.896		
RB	5.639	1.091	0.644	0.844	0.725	0.650	0.679	0.715	0.581	0.577	0.608	0.802	
SP	4.261	1.051	0.720	0.868	0.756	0.698	0.685	0.694	0.683	0.598	0.703	0.795	0.843

Notes: Off-diagonal elements are the correlations among latent constructs; the values on the diagonal elements (shaded) are the square root of the AVE; CR=composite reliability; Alpha=Cronbach's alpha.

Table 1: Reliability and Discriminant Validity of the Measures

Hypothesis	Path coefficient	t-value	Results
H1: Relative advantage -> Cloud Computing Adoption	0.121	1.832	Small effect
H2: Technical complexity -> Cloud Computing Adoption	0.451	4.936	Significant effect
H3: Technical compatibility -> Cloud Computing Adoption	0.149	1.787	Small effect
H4: Organizational readiness -> Cloud Computing Adoption	0.421	7.491	Significant effect
H5: Technology readiness -> Cloud Computing Adoption	0.591	10.211	Significant effect
H6: Perceived barriers -> Cloud Computing Adoption	0.125	1.769	Small effect
H7: Regulatory policy -> Cloud Computing Adoption	0.316	3.342	Significant effect
H8: Service provider support -> Cloud Computing Adoption	0.063	0.987	Small effect

Table 2: Hypothesis verification

Hypotheses verification

H1: Relative advantage (RA) is positively associated with cloud computing adoption (CCA).

The results presented in Table 2 indicate that Relative advantage had small effect when deciding about the cloud computing adaption. The regression coefficient for relative advantage (β = 0.121) was not significant at p < 0.05. The factor "Relative Advantage" tells the extent to which innovation is perceived as better than the existing technology it replaces. The result suggests that current technology is, in the opinion of teachers, quite satisfactory for school needs.

H2: Technical Complexity (TC) is negatively associated with cloud computing adoption. As

hypothesized, Technical Complexity does have significant impact on cloud computing adoption. The regression coefficient for relative advantage ($\beta = 0.451$) was significant at $p < 0.01$. This is one of the most important factors that decides to adopt cloud computing. This means that cloud computing services must be user-friendly and must not burden regular users or administrators.

H3: Technical compatibility (TCO) is positively associated with cloud computing adoption. The results presented in Table 2 indicate that Relative advantage had small effect when deciding about the cloud computing adaption. The regression coefficient for relative advantage ($\beta = 0.149$) was not significant at $p < 0.05$. Complexity is defined as a degree in which innovation is perceived to be relatively difficult to understand and use. Referenced teachers were mostly IT educators. It follows from the research that they are not afraid of changing an IT environment, when they know that this change will save them time and work in the future.

H4: Organizational readiness (OR) is positively associated with cloud computing adoption. The results presented in Table 2 indicate that the factor Organizational readiness had significant effect when deciding about the cloud computing adaption. The regression coefficient for relative advantage ($\beta = 0.421$) was significant at $p < 0.01$. Organizational readiness means mainly that comparing to large organizations, small organizations (schools) face resource poverty and thus difficulties in innovation adoption. Large schools have more people to deal with IT daily operation and development. On the other side, IT teacher are overloaded by IT operation, teaching and other. Hence, it is easier for large schools to adapt to new IT technologies.

H5: Technology readiness (TR) is positively associated with cloud computing adoption. Technology readiness is a construct, which can be viewed as an overall state of mind resulting from a gestalt of mental enablers and inhibitors that collectively determine a person's tendency to use new technologies (Parasuraman, 2000). The results presented in Table 2 indicate that the factor Organizational readiness had significant effect when deciding about the cloud computing adaption. The regression coefficient for relative advantage ($\beta = 0.591$) was significant at $p < 0.001$. Teachers with good technology readiness understand roles of new IT technologies and functions as a resource and catalyst for learning activities. They stimulate change and stand by accepting new technologies. This factor appears to be very strong.

H6: Perceived barriers (PB) are negatively associated with cloud computing adoption. The results presented in Table 2 indicate that the factor Perceived barriers had small effect when deciding about the cloud computing adaption. The regression coefficient for relative advantage ($\beta = 0.125$) was significant at $p < 0.01$. Perceived obstacles were not a factor in deciding to adopt cloud computing.

H7: Regulatory policy (RP) is positively associated with cloud computing adoption. The regression coefficient for regulatory policy ($\beta = 0.316$) was significant at $p < 0.05$. This factor is defined as government strategies or initiatives that encourage schools to adopt new technologies. Schools are sometimes seeing the introduction of cloud computing services as an opportunity for expanding teaching services, and as an option to meet some regulatory requirements. Hence, this factor has medium influence on deciding on the adoption of cloud computing.

H8: Service provider (SP) support is positively associated with cloud computing adoption. The regression coefficient for service provider support ($\beta = 0.013$) was not significant at $p < 0.05$. Support for service providers was unrelated to the decision to accept cloud computing. Although the support of the service provider was perceived positively, this factor was not decisive. Teachers perceive support of a service provider as a matter of course.

DISCUSSION

Embracing new technology in school context relates to multiple different factors. In this paper, we examined the effects of factors within the technological context (relative advantage, technical

complexity and technical complexity), within organization context (organizational readiness, technological readiness), and environmental context (regulatory policy, service provider support) on cloud computing services adoption. The results of the study suggest that there are four factors that have a significant impact on the adoption of cloud computing. Technological readiness has resulted as a significant driver for cloud computing adoption; it has the biggest positive impact on cloud computing adoption. Other important factors are organizational readiness and regulatory policy with positive significant impact, and technical complexity with negative significant impact on cloud computing adoption. From these factors, one factor was related to the technological context (technical complexity), the two factors were related to the organization of the environment (technological readiness, organizational readiness) and one factor was related to environmental context (regulatory policy).

CONCLUSION

In this paper, we examined the factors that determine the decision-making process regarding the adoption of cloud computing by regional secondary schools. we conducted an on-line survey and used the TOE framework and structural equation modeling as a method. Conclusions from this paper can help to optimize cloud computing adoption, for example, smaller schools can solve the problem gradually, and, for example, take a cloud solution, such as e-mail, in the first phase. Larger schools can then accept a wider range of cloud computing services such as online collaboration tools or e-learning systems.

Limitations and directions for future research

The goal of this study was to take a step forward in the research of cloud technology acceptation in school organization, and to present the model, integrating the factors influencing cloud computing services adoption. The limitation of our model was not too large amount of respondents. Future research will include more respondents, and will continue with testing and comparing factors on an individual level. Also, it is advisable to undertake qualitative interviews to explore other factors in this future research

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THE INFLUENCE OF SELECTED FACTORS ON LEARNING OUTCOMES WITHIN TRANSFERRING KNOWLEDGE THROUGH TEXTS

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Abstract

The paper aims at the evaluation of effectiveness in providing knowledge to readers by the educational texts of two different styles. The first style, so called knowledge-structured text, is based on the language form of knowledge unit as an explicit representation of the procedural knowledge. The other style is a common-structured text written in a natural language with no purposeful structuring. In this research, we focus on comparing the learning outcomes between two groups of university students working with differently-structured educational texts. By our results, the students who worked with the knowledge-structured texts reached significantly better results than the others, who worked with the common ones.

Keywords

Didactic experiment, efficiency, knowledge-structured texts, knowledge transfer

Introduction

Education is a process, which is among others based on knowledge transfer from educators to their learners. During this process, text materials are very often used, i.e. textbooks. In these days, it is not hard to find practically any information. The problem is elsewhere, there are huge amounts of information available and it requires many efforts to find relevant and right answers. Today's limitations are mostly in available time or costs for searching, analysing and retrieving knowledge. In our research, we distinguish among data, information and knowledge from the knowledge engineering point of view. The knowledge is on the top of the hierarchy, i.e. above data and information.

Knowledge transfer through text is not realized only in education environment (schools, universities, etc.), but also in business, state administrative etc. Instructions, directions, guidelines and much more types of texts are used there. So, it is useful to focus the research on the quality of texts and efficiency of the knowledge transfer through them. We decided to work the text structure.

There are many research works dealing with this topic, mostly they are focused on the complexity of the text. Target groups are mostly children (under age 15) or a particular group of people (e. g. soldiers, medical personnel and others). There are also research studies focused on the reading process in a different environment and comparison of reading process and processing of data, information, and knowledge from computer screens and virtual materials and textual/paper materials (Coniam, Falvey and Yan, 2016; Conian and Yan, 2015). The focus of measuring differences between print and on-screen materials is increasing as the increased number of digital reading devices (Mangen, Walgermo and Brønnick, 2013). More researches of this type of comparison are based on psychological view or even physiological (Johnson et al., 2011; Kintsch, 1994). There are many changes not only in the learners' reading process but also in a different environment, which has an impact on their psychological state (Wästlund et al., 2005; Yan et al., 2008).

Our research team focuses on two main aspects of that issue in a long term perspective. The first aspect is how to compose textual materials (mostly educational, but also can be different directives, guides, etc.) to provide the required knowledge. It means, that the text contains the knowledge in a specific form. The second part of the matter is to evaluate the effectiveness of providing knowledge to readers from these texts. We measure this effectiveness in the time needed to read or study. We also assume better results when verifying the acquired knowledge.

We work mainly with university students, they are used to work with text materials and those materials represent a significant tool in their learning process. Also, we know their needs and we are in daily contact with them. The slight increase in the effectiveness of the work with educational textual materials can lead to a significant improvement of the educational process in general.

The aim of this paper is generally focused on the efficiency of knowledge transfer through educational text. The goal of the paper is narrowed to the evaluation of pedagogical aspects in the study. Also, we built and described the research question of the experiment to this article as:

RQ: Are there any significant differences in final test results between users, who worked with common or knowledge structured texts?

Materials and Methods

The framework: An eye-tracking experiment

The main goal of the experiment was to observe how participants can read and work with different structured texts and solve ask according to them. We are focused on the way of reading and eye movements and didactic characteristics during the reading. This article presented only the part dealing with didactic characteristics.

The procedure of the experiment consists of the following parts:

1. Introduction, instruction, participant consent
2. Questionnaire (gender, age, prior knowledge, native language, study language, eye disorders, preferred laterality, etc.)
3. Eye calibration by Tobii Studio
4. Eye tracking recording

Participants received 7 questions in Moodle (presented in a notebook). The aim was to find the correct answers in the text (knowledge-structured or common-structured one) presented on the PC screen (Tobii tracker tracked respondents' eye movements). Respondents aimed to answer questions as best as possible and gain at least 6/7 points (correct answers). Respondents have 45 minutes for the reading and answering the questions in total. For the test in Moodle, they had 3 attempts.

The experiment finished:

a) When 45 minutes had been over, or
b) when the respondent´s 3rd attempt had been over, or
c) respondent had already gained at least 6/7 right answers (in that case he/she could finish earlier).

If respondents needed more than one attempt in Moodle, they could use as a helpful tool the raster for their notes, i.e. for recording the correct answers from the previous attempt. In that case (2nd or 3rd attempt) respondents could only concentrate on these answers where they did not gain any point. Respondents worked under identical conditions, with factually identical texts, these differed only in their structure (knowledge-structure text vs. common-structure text).

Knowledge-structured texts vs. Common-structured texts

Knowledge-structured texts are educational texts that can express explicit knowledge by using knowledge representation so-called knowledge units (Dömeová et al., 2008). Texts that contain

knowledge in the implicit form are classified as common-structured text (Horáková and Houška, 2016). Both structured texts presented in the experiment were identically the same except that parts were the knowledge was captured. The common-structured text we have used in the experiment is a standard education material for IT companies, without any changes. The knowledge-structured text was intentionally rewritten from common-structured text according to the methodology by Houška and Rauchová (2013). Both texts were written in English and dealing with *Call recording architecture*, i.e., IT problem domain.

In the common-structured text, the total number of words was 1944, a total number of unique words was 597, the total number of repeat words was 1347. In the knowledge-structured text, the total number of words was 1944, a total number of unique words was 594, the total number of repeat words was 1350. Based on 8 readability formulas, the common-structured text have scored as suitable for 17-18 years old (US twelve graders) readers. Readability level was classified as difficult to read, Flesch-Kincaid Grade Level: 11.7. The knowledge-structured text has scored as suitable for 18-19 years old (US college level entry) readers. Readability level was classified as difficult to read, Flesch-Kincaid Grade Level: 12.6 (Automatic Readability Checker, 2019).

Research hypotheses and statistical analysis

Hypotheses for factors type of text/generation/gender:
There are no differences between Total gained points for knowledge-structured and common-structured text/generation X and generation Z/males and females.
There are no differences between Total time for knowledge-structured and common-structured text/generation X and generation Z/males and females.
There are no differences between Total first attempt gained points for knowledge-structured and common-structured text/generation X and generation Z/males and females.
There are no differences between Total second attempt gained points for knowledge-structured and common-structured text/generation X and generation Z/males and females.
There are no differences between Total third attempt gained points for knowledge-structured and common-structured text/generation X and generation Z/ males and females.
Based on data distribution (normal distribution was tested by Shapiro Wilk W test) we have used statistical two-tail parametric test (T-test, for normally distributed) or non-parametric test (Kolmogorov-Smirnov test, for non-normally distributed variables) for testing hypotheses mentioned above (Lindsey, 2009).

Sample description

In total 41 (17 male, 14 female) participants attended the experiment mentioned above. 19 participants worked with knowledge-structured text and 22 with common-structured text. Grouping of respondents was random, each group had a different text (i. e. one person did not have both texts). Differences in respondents' cognitive options were not addressed, the group is homogeneous and the texts were randomly assigned. 14 participants were classified as participants from generation Z (born after 1995), 27 participants from generation Y (born before 1995). Age median is 28. All participants were students at School of Computing, University of Portsmouth, UK.

RESULTS

We observe the influence of 3 factors (*Type of text, Generation and Gender)* on variables: *Total time needed for the experiment, Total number of obtained points, Points obtained in the first attempt, Points obtained in the second attempt, Points obtained in the third attempt.*
There are the basic descriptive characteristics of variables and Shapiro Wilk W test *p* value.

Variable	Units	N	Mean	Min	Max	Shapiro Wilk W test p value
Total time	sec	41	1695.51220	446	2740	0.8082
Total gained points	points	41	6.04878	5	7	0.0000
Total 1st attempt	points	41	3.70730	1	6	0.0171
Total 2nd attempt	points	35	5.65710	3	7	0.0001
Total 3rd attempt	points	13	5.76920	5	7	0.0009

Table 1: Descriptive characteristics, Shapiro Wilk W test (source: own calculation)

The influence of factors on pedagogical variables is following.

Factor 1: Type of text

Variable	Mean K	Mean C	t-value	df	p value
Total gained points	6.2632	5.8636	2.1085	39	0.0415
Total 1st attempt	3.8947	3.5455	0.7727	39	0.4444
Total time	1725.6320	1669.50000	0.3408	39	0.7351

Table 2: T-tests; Factor: Type of Text (source: own calculation)

Variable	Mean K	Mean C	Max Neg Difference	Max Pos Difference	p value
Total 2nd attempt	5.9375	5.4211	0	0.2336	> .10
Total 3rd attempt	6.5000	5.4444	0	0.6389	> .10

Table 3: Kolmogorov-Smirnov tests; Factor: Type of Text (source: own calculation)

Only for variable Total gained points (table 2) the p value is greater than the level of significance alpha. In that single case, we reject the null hypothesis. Based on the type of text (Knowledge-structured text (K) vs. Common-structured text (C)), there are statistically significant differences in the distribution of total gained points.

Factor 2: Generation

Variable	Mean Y	Mean Z	t-value	df	p value
Total gained points	5.9630	6.2143	-1.2176	39	0.2307
Total 1st attempt	3.4810	4.1430	-1.41587	39	0.1648
Total time	1701.8890	16683.214	0.10767	39	0.9148

Table 4: T-tests; Factor: Generation (source: own calculation)

Variable	Mean Y	Mean Z	Max Neg Difference	Max Pos Difference	p value
Total 2nd attempt	5.4580	6.0910	-0.3258	0	> .10
Total 3rd attempt	5.6360	6.5000	-0.6364	0	> .10

Table 5: Kolmogorov-Smirnov tests; Factor: Generation (source: own calculation)

In all cases, the p value is not greater than the level of significance alpha. In all cases, we do not reject the null hypothesis. Based on the generation (Generation Y (Y) vs. Generation Z (Z)), there are not any statistically significant differences for all variables.

Factor 3: Gender

In all cases, the p value is not greater than the level of significance alpha. In all cases, we do not reject the null hypothesis. Based on gender (Female (F) vs. Male (M)), there are not any statistically significant differences for all variables.

Variable	Mean F	Mean M	t-value	df	p value
Total gained points	6.2857	5.9259	1.7789	39	0.0831
Total 1st attempt	3.7860	3.6670	0.2487	39	0.8049
Total time	1675.2860	1706.0000	-0.1771	39	0.8603

Table 6: T-tests; Factor: Gender (source: own calculation)

Variable	Mean F	Mean M	Max Neg Difference	Max Pos Difference	p value
Total 2nd attempt	6.0000	5.4780	0	0.2246	> .10
Total 3st attempt	6.3330	5.6000	0	0.46667	> .10

Table 7: Kolmogorov-Smirnov tests; Factor: Gender (source: own calculation)

Discussion

Firstly, we discuss our results with ours' previous ones. In Rauchová and Houška (2013) we found out, that there is no statistically significant difference between a number of the correctly-solved tasks and the prior knowledge of the algorithms tested. Also, there is not any statistically significant difference between a number of the correctly-solved tasks and the subjective evaluation of the understandability of knowledge and standard texts. We had the same conclusion for differences between the subjective evaluation of the understandability of knowledge and standard texts and the prior knowledge of algorithms tested. Now, we reached quite different results; there is a statistically significant difference between correctly-answered questions in the test by users, who worked with knowledge- and common- structured text. Results of knowledge-structured text users are better. We see the cause in the better understandability of knowledge-structured text for users. Knowledge units in text form, which were used, provide a more useful structure of problematic parts of the text, even if they make the whole text a little bit difficult as explained at the Materials and Methods.

Secondly, we discuss our results with other relevant authors. During our study, we had to make many decisions. One of them was about the form of texts. Even if, e.g. Mangen et al. (2013), who worked with the effects of the technological interface on reading comprehension and found out that students who read texts in print scored significantly better on the reading comprehension test than students who read the texts digitally, we decided for digital form. The topic of our text comes from IT (it deals with Call Recording Architecture), and the original form of the text was also digital. Users of the original manual are used to find information on the Internet and in electronic texts. We can agree with Mangen et al. (2013), that there are differences caused by the form of text, but we see the differences in formulations, they see them in the technical interface.

On the other hand, Amadieu et al. (2009) reached quite similar results for a non-linear electronic document. They worked with a hierarchical and network structure of texts and involved learners with low and high prior knowledge. One of their conclusion is, that whereas low prior knowledge learners need much guidance (e.g., hierarchical format), high prior knowledge learners seem to be able to deal with the complexity of a network structure. Some effects between document structure and learners performance were found. Shen (2017) found out that the text types significantly affected the EFL learners'(English as a Foreign Language) lexical inferencing performance, in which the EFL learners performed better for the narrative excerpt than for the expository texts. Bartholomé and Bromme (2009) tested students' knowledge after learning under four different support conditions. They were interested in numerical labels, highlighting and giving or not giving the prompting. Their results indicate the need to work with such aspects to reach better cognitive load, confidence in learning, and knowledge by learners. Our conclusions are generally in concordance with them, the efficiency of the learning process can be increased by improving texts structure or format, even if the volume of provided information and knowledge is the same.

Turcotte et al. (2018) analyzed how students can identify and understand text structure, but they were focused more generally. Besides, they dealt with the comprehension of gist and main ideas. Their students' results were, as authors say themselves, questionable. However, Turcotte et al. (2018) still see the text structure as a fundamental element of discourse required in oral and written expression and comprehension in all disciplines.

Jian and Ko (2017) investigated children's cognitive processes and comprehension when reading illustrated science texts. They were focused on the prior ability of children to read and its influence on the way how children read science texts with varying difficulty. They found differences the low-ability group was inclined to read what seemed easier to them and read the text more. The high-ability group attended more to the difficult article and made an effort to integrate the textual and pictorial information. We collected data about the previous study results of our respondents, but our group was homogenous from this point of view. So we can say, that our results are not influenced by the level of prior knowledge.

Conclusion

Presented results are part of long term research, which is realized on a broader team. This particular experiment was involved in an eye-tracking study, so there are 2 main directions in our future research. One of them is focused on the evaluation of all knowledge units parts, which are marked as so-called Areas of Interest. We want to investigate if there are some differences in users' results regarding them. Another direction is concentrated on eye-tracking metrics, which were obtained during the study. Eye activity during the knowledge-seeking process will be analyzed.

For further research, we decided to work also with visual representations as are pictures, tables, graphs, etc. Study texts are usually enriched by them, so we should deal with this fact. There is a research issue on how to convert knowledge units in structured or text form to graphic one, and also how to it can help readers. This topic is solved e. g. by Jian (2018), who worked with 3 different forms of science texts. Even if her results did not confirm significant differences among students, who worked under different conditions (e. g. with or without signals), is her research good inspiration for us.

Acknowledgements

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SEARCHING FOR THE FUTURE CREAM OF THE CROP IN THE CZECH MILITARY

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Abstract

The paper presents a case study on gaining data and monitoring study results of military university students with the aim of suggesting a method for identifying prospective candidates for the field of Cyber Security. Two crucial competences of paramount importance in Cyber Security specialists, mathematical and English language competencies, have been monitored, compared and evaluated in fifty first-year students at the Faculty of Military Technology at the University of Defence. The results show that students' English language competencies are more satisfactory than their competencies in mathematics. Based on the survey and research, the authors also discuss the relevance of current entrance examinations and suggest reintroducing entrance examination in Mathematics for the potential candidates for the Cyber Security study programme. In addition to that they have proposed a rating scale based on study results of potential candidates, and applied it to their research sample.

Keywords

Correlation, Cyber Security, English, Mathematics, military, NATO STANAG 6001

Introduction

Cyber Security as a part of national security requires strong attention. The Czech Republic has its own Cyber Security Act from 2015. There are 110 Critical Information Infrastructure Systems, 153 Significant Information Systems, and 30 Core Service Providers (Novinky.cz, 2019). All these 293 systems, which are owned by 160 different state and private entities, need appropriate maintenance; however, there is a lack of professionals in this field.

The Faculty of Military Technology (FMT) of the University of Defence (UoD) naturally reacts to security demands and challenges by incorporating study programmes tailored to the security needs. One of them is the Cyber Security study programme which has to be implemented since the academic year 2019/2020. Future Cyber Security specialists need to possess specific skills, such as strong IT, mathematical and English language skills, meticulous attention to details and ability to use logical reasoning. The paper focuses on students' mathematical and English language skills. The current state of the students' interest in Mathematics and English at Czech secondary schools can be illustrated by the figures presented at the Official pages of School leaving examination (Oficiální stránky maturitní zkoušky, 2018). Only 23 % of all candidates opted for the exam in Mathematics and up to 77 % of them passed it. The average score was 52.9 %. In terms of English, 72.3 % of candidates chose English. Up to 93.6 % passed the exam with the average score 75.0 %. Thus the percentage of students that opted for English was significantly higher, and the students were more successful in English than in Mathematics. Being aware of this situation, the authors decided to monitor first year students' mathematical and English language competencies to find out whether they would be prospective candidates for studying Cyber Security.

Monitoring study results and study support in Mathematics

From the authors' point of view Mathematics plays the most important role in contemporary technical education. Good knowledge of the secondary school Mathematics is an unavoidable prerequisite for successful study at any faculty of technology. It is a reality that students' mathematical competencies differ significantly not only at different types of Czech secondary schools, but also at various Czech schools of the same type.

Educating students entering technical universities with insufficient mathematical competencies requires enormous effort on the sides of both teachers and students. Keeping this fact in mind, the FMT UoD pays strong attention to improving first-year students' mathematical skills. All military students at the FMT UoD have their mentors. Permanent monitoring of the development of their competencies in Mathematics is considered the main base for their successful study at the FMT UoD.

The research made by Cihlář et al. (2018) on the total of 180 14–15 year old pupils from the Czech Republic show that school performance in Mathematics correlates with the indicators of culture of problem solving and the scientific reasoning. Smetáčková (2018) focused her attention on students of grammar schools from 4th to 9th grade, and she states, among other things, that Mathematics is a crucial factor for career choice.

Monitoring study results and study support in English

Since the fall of Communist regime in Eastern Europe, the English language has been gaining on its importance in all affected countries. In the military the English language has become de facto the operational language allowing the countries to participate actively and effectively in NATO missions and wider Alliance activities. To ensure linguistic operability, NATO provides agreed standard for language curriculum, test development, and for recording and reporting Standardized Language Profiles (SLP), called NATO STANAG 6001 Edition 5, Language Proficiency Levels. The document (NATO, 2014) provides descriptors for 5 Language Proficiency Levels. The state of language competence in the Czech army is presented by Adámková, Procházka and Čechová (2016).

At the UoD, teaching English is provided by the Language Training Centre. The main objective is to prepare students for their careers by implementing NATO recommendations stated in the Bureau for International Language Co-ordination (BILC, 2019). Currently, students at the UoD study general, military and specialized English language for 5 semesters, which is about 120 teaching hours. They have to reach at least lower intermediate level in four language skills, listening, speaking, reading and writing, expressed as SLP 2222. This level is comparable to B1 within The Common European Framework of Reference for Languages (Council of Europe, 2018).

Unfortunately, some students do not fulfil this requirement; consequently, they have to repeat a year of study or leave the UoD, which is highly undesirable. So, both the UoD management and English language teachers are trying to find ways of eliminating the number of these unsuccessful students. Recently, similarly to Mathematics courses, new measures have been taken to assist the students in gaining appropriate knowledge and skills to pass the examination, and raise their awareness of a potential danger of failing, such as:

- Allowing the UoD students to take the exam according to NATO STANAG 6001 in each semester until reaching the SLP 2222;
- Re-grouping students into classes at the beginning of each semester according to their latest result in SLP with the aim to focus on the skills that need to be practised;
- Providing students with extra practice by tutoring, students Discussion club, and an effective

electronic study support tailored to the examination requirements – 'English for the Armed Forces of the Czech Republic' (Staňková, Beránková and Čechová, 2017);
- Improving the quality of teaching and testing by observing lessons and gaining feedback from students;
- Emphasising research objectives leading to the students' success in reaching SLP 2222.

Research questions

Based on the expected requirements for studying Cyber Security the authors formulated the following research questions:
- What are the first year students' skills in Mathematics and English, the key competencies for studying Cyber Security?
- How do the results of current entrance examination (EE) tests correlate with students' skills in Mathematics and English?
- What criteria should the prospective candidates for the Cyber Security study programme meet in terms of their competencies in Mathematics and English?
- What percentage of the first-year students would meet these criteria?

Materials and Methods

To monitor the students and their competencies, the authors used a research sample comprising 50 military students studying in their first year at the FMT UoD. The dataset includes data gained from the following sources:
- Results of the entrance examination encompassing the Learning Potential Test (LPT), and Entrance Examination in English: listening and reading comprehension (April 2018);
- Results of three progress tests in Mathematics (September – December 2018);
- Results of the examination in English according to NATO STANAG 6001 (BILC, 2019), (October – November 2018).
- Questionnaire survey on respondents' gender, their previous studies, IT skills and work experience (October 2018).

Microsoft Excel was used for data collection, analysis, calculations and presentation of graphs. For identifying relationships among entrance examinations and study results in the first semester, Pearson product-moment correlation coefficients were calculated using the Excel PEARSON function (ExcelFunctions.net, 2008-2019). The outcomes were interpreted at the .05 significance level, customarily set for educational research (University of Connecticut, 2009).

The authors' hypotheses were stated as follows:

H1: There is a strong correlation between the results in the Maths tests and LPT.
H2: There is a strong correlation between SLP and the EEE in English.
H3: There is no correlation between the results in the LPT and SLP.
H4: There is no correlation between the Maths tests results and SLP.

Results and Discussion

In the surveyed group of 50 military students were 88 % of men and 12 % of women. Up to 28 % of respondents had worked or studied at another school between leaving the secondary school and entering the FMT UoD.

Study outcomes were compared in individual students using their entrance examination results in the Learning Potential Test (LPT) and Entrance Examination in English (EEE), and current state of knowledge and skills in Mathematics (arithmetic mean of two progress tests) and English (SLP). The number of students in the following graphs is not always 50 because the data of a few students were incomplete.
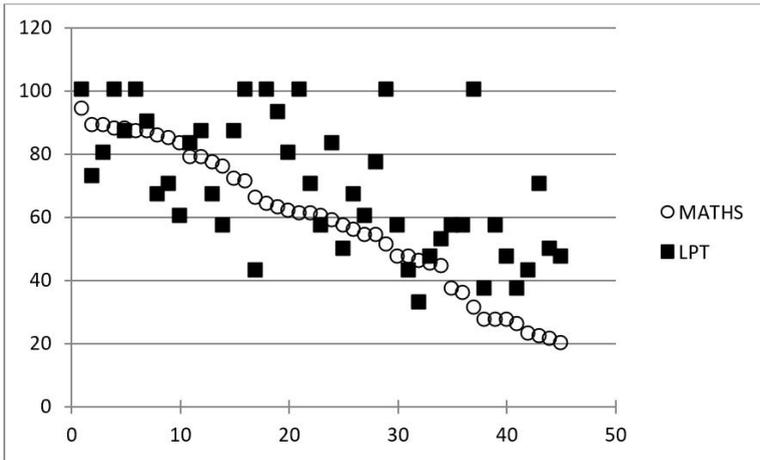
Figure 1: Relationship between the progress tests results in Maths and LPT in 45 students at the FMT UoD, 2018-2019; x – number of students, y – test score percentage; Pearson correlation coefficient: 0,571648 (source: own calculation)

The graph in Figure 1 and Pearson correlation coefficient demonstrate moderate correlation between the LPT and knowledge and skills in Mathematics. Considering the fact that the LPT consists of mathematical, logical and spatial imagination tasks, showing only moderate correlation might be a bit of surprise.
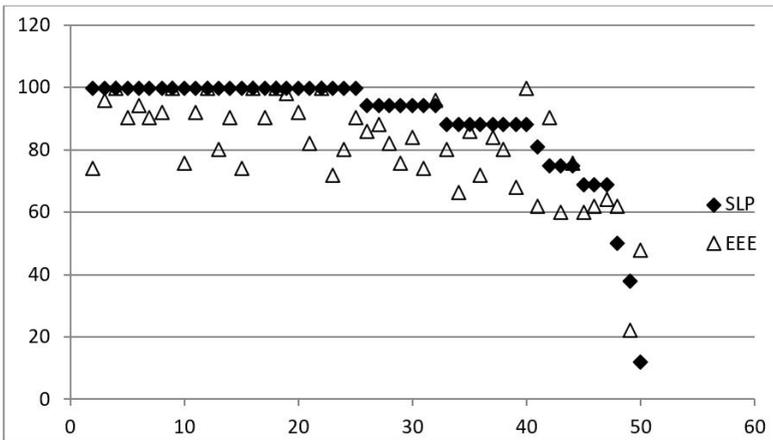
Figure 2: Relationship between SLP and the Entrance Examination results in English (EEE) in 50 students at the FMT UoD, 2018-2019; x – number of students, y – test score percentage; Pearson correlation coefficient: 0,76328 (source: own calculation)

The graph in Figure 2 shows a strong relationship between both exams (EEE and SLP), which has been also confirmed by Pearson correlation coefficient: 0,76328. The graph demonstrates that up to 47 students scored 60 % or more in the entrance test and reached satisfactory results in SLP

(69% or more). Only three students gained unsatisfactory results (50 % or less in SLP) and might have problems to comply with the army requirements in mastering English. Comparing the graphs referring to SLP and Math, we can conclude that students reached higher scores in English than in Mathematics.

Apart from comparing the entrance examinations with the knowledge and skills in Mathematics and English measured by different tests, the authors also intended to find out the relationship between the scores in the LPT and SLP, and Mathematics and English competencies. All calculated correlation coefficients are presented in Table 1. The significant ones are in bolt print.

Relationship between exam results	Pearson correlation coefficients
Math tests – LPT	**0.572**
SLP – EEE	**0.763**
LPT – SLP	0.220
Math tests – SLP	0.109

Table 1: Pearson correlation coefficients – level of significance 0.05, 2018-2019 (source: own calculation)

The calculations in the table show that hypotheses H2, H3 and H4 have been confirmed. However, since the correlation between the LPT and Mathematics competency is only moderate, H1 has been rejected.

Discussion

Monitoring students' progress has become a common practice at the UoD, as aptly described by Čechová, Neubauer and Sedlačík (2019). In their long-term longitudinal study the authors provide statistical analysis of the students' study results at the Faculty of Military Leadership (FML). They concluded that there are no significant relationships among students' study results in different subjects. Their statistics have shown relationships among students' results in entrance tests and their study results at the university. The outcomes of this research at the FMT are only partially in line with their findings. In both cases, a strong correlation has been found between the entrance examination results and study results in English, and no significant relationship has been found between English language and mathematical competencies. However, this research results have not confirmed their finding about a significant relationship between LPT and mastering the English language.

The test scores in Mathematics, both in maturita exam and this research (compare Figures 1 and 2), have proved that students' mathematical competencies are worse than English language competencies. This fact deserves attention and further research. Literature research indicates so far, that mathematical learning can be predicted by number competencies in young children. For example, Jordan, Kaplan and Locuniak (2009) show the importance of early number competence for setting children's learning trajectories in elementary school mathematics. Lyons, Price et al. (2014) published a concrete approach to prediction of success in grades 1-6. LeFevre, Fast et al. (2010) described a model of the relations among cognitive precursors, early numeracy skill, and mathematical outcomes, using a research sample of children from the age of 4.5 to 7.5. Peters and De Smedt (2018) focused on the role of mathematics in brain development in children. The researchers agree that math skills in childhood can permanently affect brain formation later. Thus it is desirable to develop number and mathematical competencies in children from early childhood.

Recommendations

• Based on the results the authors suggest assessing the applicants for admission to the Cyber Security study programme as shown in Table 2.

Score% in both M and E	% of students in the sample
>= 80 appropriate	20
>= 70 rather appropriate	8
>= 60 rather inappropriate	18
< 60 inappropriate	54

Table 2: Suggested rating scale for selection procedure and the corresponding percentage of students in the sample (source: own calculation)

- The entrance examinations serve as quite a reliable predictor; however, as there is only moderate correlation between LPT and mathematical competencies, the UoD management might like to consider reintroducing the entrance examination in Mathematics.
- As the students' mathematical competencies are worse than their competencies in the English language, more attention should be paid to Mathematics at all stages of educational process.
- Further research should focus on promoting Mathematics in contemporary education.

Summary of findings

The answers to research questions summarize the authors' findings.

- Students admitted to the UoD in the academic year 2018/19 possess sufficiently developed English language skill, but less satisfactorily developed mathematical skills.
- There is a strong correlation between the results of current entrance examination tests in English and students' English level competencies in English measured by Standardized Language Profiles. There is only a moderate correlation between the LPT and knowledge and skills in Mathematics measured by progress tests.
- The prospective candidates for the Cyber Security study programme should score at least 70 % in the tests in English (SLP) and Mathematics (progress tests) in their first year of study at the UoD.
- The percentage of the first-year students who meet these criteria is 28 % in the 2018/19 academic year.

CONCLUSION

The authors believe that a high-quality entrance examination, mentoring and systematic monitoring of students' progress enhances educational performance at universities and prepares ground for decision-making in choosing the right field of study. They try to contribute to the process of selection and preparation of desperately needed human resources, future experts on Cyber Security. From their perspective, the key element for the selection process is the assessment of study results in Mathematics and English; therefore they suggest a possible method for carrying out this assessment. However, they are aware that it does not capture all the required qualities and desired performance of these specialists. Since the presented research has shown that the correlation between LPT and Mathematics is only moderate, a question might be raised whether the entrance examination in Mathematics would not be a better solution than LPT. Comparing the students' knowledge and skills in Mathematics and English, it can be stated that students entering the UoD are better prepared in English. Thus primary and secondary schools in the CR should pay more attention to Mathematics.

The research indicates that the current entrance examination in English is a suitable form of testing English at the UoD, in line with the Ministry of Defence requirements. It can be concluded, that students finish secondary schools with appropriate knowledge and skills in the English language.

The outcomes of the research show that up to 28 % of students of the research sample would be eligible for studying Cyber Security study programme. The authors assume that the method suggested for the selection procedure might be transferable to other attractive fields of study, and might assist educators in their decision making in looking for the cream of the crop.

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INTERNALITY AT FEM CULS STUDENTS OVER A DECADE – PREDICTOR OF ACADEMIC SUCCESS?

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Abstract

There has been a noticeable change in university student population, its academic success rate, and retention over the last decade, so there have emerged some hypotheses on the shift of the nature of the ground it stems from. This paper focuses on the personality characteristics - Internality, which was earlier found to play a crucial role in dealing with obstacles and exert a strong influence on academic achievement. Its possible change over years could be seen as an important variable influencing the shift in the student's population. Authors try to describe present students in terms of Internality as well as to compare it to the results from the student's population of the same faculty a decade previously. The findings are applicable for the improvement of study programmes, based on the different and more individual approach, especially during the seminars and psychological counselling.

Keywords

Academic achievement, academic retention, IPC Scale, Internality, Locus of control

Introduction

The success rate and retention of the university students belong among the most important criteria, which receive particular attention at evaluation of the quality of the educational institution. It is often perceived as a tool describing the effectiveness and efficiency of a university (Mantz and Bernard, 2004), or it can be right away seen as a significant economic indicator (Ozga and Sukhnandan, 2004).

Even though there has been a considerable change in a demographic curve of university student's population over the last decade (Statistical Yearbook of the Czech Republic – 2018, czso, online, 2018), the overall academic success rate and retention have not changed considerably. The most unsuccessful ones are still the first year's bachelor students. Their drop-out reaches 60 percent all over the country (Dropout.czu.cz, 2019). At two major economic universities - University of Economics, Prague and Czech University of Life Sciences, Prague they commented on the same problem as follows: At the University of Economics, the percentage share of unsuccessful students in 2016 (in the 1st year of study) was 35.18% by bachelor students, 14.26% by master students and 11.61% by Ph.D. students (Annual report UE, 2017); whereas in 2017, the number of unsuccessful students in the 1st year of study was 40.82% by bachelor students, 21.30% by master students and even 19.87% by Ph.D. students (Annual report UE, 2018). Even though at CULS the number of unsuccessful students in the last three years decreased a little, the overall percentage of unsuccessful students in the last decade increased (from 15 % to 20%), while the number of admitted students is decreasing (Annual report CULS, 2018). Koláčková and Švec

(2014) compared the retention of the Czech business students' cohorts within ten years distance. They have identified barriers which may cause students dropouts, as well as the shift in the causes between 2006 and 2013 cohorts in the appearance of new study problems and the inability to deal with them.

Problems are dealt differently by different people, an important role plays a personality characteristics, which has a unique relation towards the coping with troubles and difficulties (např. Křivohlavý, 2001; Blanchard-Fields and Irion, 1988; Levenson, 1981). It may play a significant role in overcoming the barriers causing the students dropouts, as well. Rotter (1966) named it Locus of Control (LOC) and divided people according to its intensity into two distinct groups: people with external and people with internal locus of control. LOC explains the perception from which the individual determines the causes of life events. Křivohlavý (2001) remarks that people with internal LOC try to solve a difficult situation with the use of their own abilities and initiative whereas people with external LOC believe that the difficult situation would solve itself and expect the initiative to come from the situation. LOC therefore naturally plays an important role in a preference of stress coping strategies. An internal orientation predicts help-seeking and positive thinking, whereas external orientation predicts avoidance, resignation and alcohol use (Gianakos, 2002). Subjects scoring high on the Internality scale evaluate life events more positively, use active coping strategies, and also express their anger more often (Brosschot, Gebhardt and Godaert 1994).

LOC is also considered to be an important factor influencing the student's achievement. Its relationship with academic achievement was studied for example by Chýlová, Kolman and Natovová (2007). More internal beliefs are usually associated with greater academic achievement. The relation is mediated by participants' characteristics – age and gender: it tends to be stronger for adolescents than for adults or children. The relation was more substantial among males than among females (Findley and Cooper, 1983). In the same fashion, Abid et al. (2016) concluded their research, that learning performances of the students with an internal locus of control are high, they are more proactive and effective during the learning process. On the other hand, the ones with an external locus of control are more passive and reactive during this.

Some of the studies followed the Rotter's concept (e.g. Prociuk and Breen, 1974) demonstrated that the original distinction between the internals and externals was too simplistic, considering especially the academic achievement. They set up three groups: internals (with better academic achievement than the two other groups), defensive externals - powerful others orientation and the third group: congruent externals - chance orientation (connected with the worst academic achievement). Following this reasoning, Levenson (1981) created an improved questionnaire on the base of LOC - IPC Scale (abbreviation of dimensions: Internality, Powerful Others, Chance) which is used for the purpose of this study.

The present study aims to explore and analyse the distribution of Locus of control, with a special focus on Internality, at Faculty of Economics and Management at Czech University of Life Sciences students. Authors of this paper find the enlarged concept of LOC - IPC Scale beneficial and believe that it could reveal more detailed information about our students, than offered the previous method. Next to the descriptive analysis of our students' LOC in comparison to the students groups' results published by the author of the IPC, the comparison of present results will be compared to the ones obtained at FEM CULS students eleven years ago. A certain shift in this characteristic is expected, as the cohort of students has changed in many ways over the last decade. In order to reach this objective, authors postulate following hypotheses, which will be tested:

H1: The results of IPC of FEM CULS students in the year 2018 are the same as the results of the students from the sample published in Levenson (1981).

H2: The frequency of Internality in a group of FEM CULS students in the year 2018 and the sample of students from the same faculty in the year 2007 do not significantly differ from each other.

Materials and Methods

Participants

We have used an opportunity sample that comprises full-time university students of Bachelor and Master Degree at the Faculty of Economics and Management, CULS. The data were gathered during the winter semester 2018/2019. The group consisted of 146 students - 112 females (77%), 31 males (21%), 3 students did not state the gender (2%). Mean age of the participants was 21.6 years (ranging from 20 to 25 years).
Participants cooperated voluntarily, with no benefits.

Method

The data were collected with the use of Internality, Powerful Others, and Chance Scales – IPC (Levenson, 1981), which was extended by few basic demographic questions.
IPC scales questionnaire broadens Rotter's concept of LOC by studying more deeply the Externals and dividing them into Powerful Others and Chance oriented people. The questionnaire consists of 24 items, equally filling the three 8-item subscales of the reconceptualization of LOC – IPC. The answers are indicated on a 7-point Likert type scale, ranging from -3 to +3.
The psychometric qualities of the questionnaire were thoroughly addressed in Levenson (1981). Reliability of the scale is considered to be favourable (for a student sample: 0.64 for I Scale, 0.77 for the P Scale and 0.78 for the C Scale).
One of the most important remarks on Validity of the IPC are considering the relationship to Rotter's I-E scale, which repeatedly correlates positively with both P and C Scales (0.25; 0.56) and negatively with the I scale (-0.41). These findings add to the convergent validity of the P and C Scales as measures of externalism.

Statistical analysis

Descriptive statistic methods were used to describe the features of a group of respondents and the results obtained by the IPC questionnaire, mainly the measures of central tendency and measures of variability and dispersion.
The normality of the distribution of the IPC dataset for males and females was tested by the Shapiro-Wilk test of normality (Table 1).
The hypotheses on the relationship between variables were tested, with the use of inductive statistics method. The t-test was applied to determine whether there is a significant difference in the mean of the two sets of data, comparing the FEM CULS 2018 students and LOC at students described by Levenson (1981) - referred to as Test Value in Table 3.
Chi-square test of the hypothesis, that the Internality is equally distributed in cohorts 2007 and 2018, was administered (results are displayed in Table 4.
All the data were analysed with the use of IBM SPSS software.

Results

The normality of the distribution of the IPC dataset for males and females was tested, in order to ascertain the nature of the distribution of the data and the methods to use for successive statistical analysis. As is described in Table 1, the p-value for all the subgroups is greater than the chosen alpha level of 0.05, therefore the null hypothesis that the data came from a normally distributed population cannot be rejected.

	Shapiro-Wilk test of normality					
	Statistic		df		Sig.	
	Male	Female	Male	Female	Male	Female
Internality	0.96	0.99	25	94	.46	.37
Powerful Others	0.98	0.98	25	94	.86	.29
Chance	0.97	0.99	25	94	.67	.88

Table 1: Tests of normality, 2018 (source: own calculation)

The hypotheses on the relationship between variables were tested, with the use of the one sample t-test, to determine whether there is a significant difference in the mean of the two data sets – FEM CULS students 2018 and the students in Levenson, 1981 (Test Value in Table 3).

In our sample of 2018 FEM, CULS students, the descriptive statistics revealed certain negligence in the questionnaire's completion, so the three characteristics of the IPC don't get an equal number of fully completed scales. The measures of central tendency and measures of variability of the IPC Scale shows Table 2.

Gender	LOC	N	Mean	Std. Deviation
Female	Internality	108	33.80	4.38
Male	Internality	29	36.21	4.20
Total	Internality	137	34.28	4.37
Female	Powerful Others	97	19.69	6.29
Male	Powerful Others	28	22.46	6.27
Total	Powerful Others	125	19.93	6.13
Female	Chance	107	24.18	7.06
Male	Chance	27	23.89	6.44
Total	Chance	134	23.79	6.96

Table 2: Results – descriptive statistics of the sample, 2018 (source: own calculation)

The first hypothesis states as follows:
H1: The results of IPC of FEM CULS students in the year 2018 are the same as the results of the students from the sample published in Levenson (1981).

	IPC of CULS 2018 students (Levenson's students' results = Test Value)	t	df	Sig. (2-tailed)	Mean Diff.	95% Confidence Interval of the Difference	
						Lower	Upper
Female	Internality (Test Value=34.8)	-2.38	107	.02	-1.01	-1.84	- 0.17
Male	Internality (Test Value=36.11)	0.12	28	.90	0.10	-1.50	1.69
Female	Powerful Others (Test Value = 20.19)	-0.78	96	.44	-0.50	-1.77	0.77
Male	Powerful Others (Test Value = 20.33)	1.80	27	.08	2.13	-0.30	4.57
Female	Chance (Test Value=18.56)	8.23	106	.00	5.62	4.27	6.97
Male	Chance (Test Value=17.33)	5.29	26	.00	6.56	4.01	9.11

Table 3: Results – One sample t-test, 2018 (source: own calculation)

From the results of t-test, it can be seen that the two populations differ significantly in most of the three variables, divided into subgroups according to the gender of the respondents. Less significant results on Internality of the males could relate to a limited number of male respondents in our sample. We could expect our female students to express a lower level of attribution of the events around them to internal sources, including those at the academic settings. The orientation to Powerful others is by our females also lower than in the group of students described by Levenson (1981), while in the males' group it is higher (even though it cannot be interpreted largely in light of limited sample size). Both gender subgroups expect the Chance to play a significantly more important role in their lives than students from the compared sample.

In above-described comparison, our students seem to display different characteristics in LOC. The second hypothesis was concerned with a comparison of our present students to a group of students from the same faculty a little more than a decade ago. The most important factor influencing academic success and retention is considered to be the Internality, so the attention was focused on it. The hypothesis H2 states that:

H2: The frequency of Internality in a group of FEM CULS students in the year 2018 and the sample of students from the same faculty in the year 2007 do not significantly differ from each other.

	Externality (general)	Non-polarised	Internality	sum
2018 (*n*)	20	0	124	144
2007 (*n*)	37	36	47	120

Table 4: Results – Contingency table, 2007-2018 (source: own calculation)

Chi square statistics yielded following results:

$\chi^2 = 63.22$, df = 1, $\chi^2/df = 63.22$, $p(\chi^2 > 63.22) = 0.0000$

The frequency of Internality in groups of students from 2018 and 2007 significantly differ from each other, $\chi^2 (1, N=264) = 63.22$, $p < .01$.

The results revealed substantial difference between the two groups of students (the years 2007 and 2018) in Internality, in which respect the present students (both males and females) appeared to display more effort than it was a decade ago.

DISCUSSION

The results revealed specificities of Internality in our sample of respondents in two ways – it is different than the controlled sample from Levenson (lower level of Internality) while on the other hand quite surprisingly differs from the 2007 sample by the higher level of Internality. The lowest level of Internality associated with low level of exerted effort was, based on our experience, partly expected from the 2018 students. Certain shifts of the results might be also ascribed to the imbalance of the gender distribution of the present sample, while at the sample of a year 2007 there was precisely equal representation of females (60) and males (60) (Chýlová, Kolman and Natovová, 2007). Authors are aware of the limits of the external validity of their findings, any potential conclusions should be drawn very carefully.

Even after a long time since the first time Rotter's original hypothesis appeared, researchers appear satisfied to study it (Coombs and Schroeder, 1988). Although some authors suggest that the locus of control is a natural characteristic of each person (Gable and Dangello, 1994) the study of LOC by Frucot and Shearon (1991) shows that the level of education and culture contributes to the development of locus of control. Such an assertion may be usable for targeted support of higher Internality at students. The researches, even the longitudinal

ones, confirm that internally controlled children of all ages did better academically than their externally controlled peers, even when IQ was controlled for (Kalechstein, Nowicki, 1997). Furnham and Cheng (2017) even proved a relationship between IQ and LOC. In their longitudinal study, respondents with higher measured intelligence at the age of 10 showed 6 years later more instrumental internal locus of control.

Blanchard-Fields and Irion (1988) discussed the possible connection of LOC and the age of the subjects, where quite surprisingly internal LOC at younger respondents was positively related to negative strategies of coping with difficulties (e.g. escape–avoidance, hostile reaction, and self-blame), important to notice strategy which appears to change with the increase of the age of respondents. The influence of age of respondents should serve as an inspiring variable for the consequent study with a wider variety of respondents-students in all years of the study.

Regarding the question of gender differences in LOC, Siddiquah (2019) found higher level of external locus of control by female secondary school students (compared to males), using a Brown Locus of Control Scale (BLOCS). Interestingly, this research revealed also subject-specific characteristics. Students of arts showed significantly higher level of Internality than science students.

Our results are applicable not only into the education practice but could also serve as an indicator of the widely spread attitude of our students for the counsellors, mediating them possible ways of students' reasoning about their competencies to influence their life events.

CONCLUSION

The studied group of the students displayed significant differences to both compared samples. Our students differed in two ways – they reported a lower level of Internality than the American sample, while quite surprisingly reported a higher level of the same characteristic than the group of our students a decade ago. In comparison to the American students, they exert less energy to influence the events around them, as they do not expect it could yield enough benefits. Aside from possible intercultural influences, this finding may be caused also by generational differences, seeing that Levenson's study stems from 1981.

On the other hand, there has been a significant shift in the reported Internality at FEM CULS students over the last decade in the sense of increase. Possible cross-cultural implications of our finding would require deeper insight and better-balanced sample of respondents with respect to gender.

Results could be applied into the educational practices as control expectancies are an important prediction of academic achievement outcomes and stability. The significance of our findings is even higher in terms of psychological counselling, as high Internality usually predicts active and therefore desired coping strategies, while chance orientated individuals tend to be connected with alcohol abuse when distressed, which, while could be predicted should be prevented.

More research is needed to establish the antecedents of individual differences in control expectancies and undoubtedly with the idea of the development of Internality by the individualized approach to the students. As some researchers suggest that the level of education and culture contributes to the development of locus of control there should be attention paid to the increase of Internality in a sense of individual's potential to try and solve the difficulties, overcome the obstacles in a way of proactive coping with problems. This approach should be beneficial not only for the better mental health of the students, better academic achievement but also could add to higher university retention.

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POSING GOOD QUESTIONS – WHY ARE GOOD QUESTIONS POSED NOT ALWAYS GOOD?

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Abstract

Good questions as introduced by Sullivan and Lilburn (2010) are one of the tools for creation of an environment supporting discussions among pupils and between pupils and teachers, which are of key importance in constructivist-led teaching. In the paper, authors focus on the process of posing good questions in mathematics and science. The paper presents a research survey among 44 part-time student teachers at Faculty of Education, Charles University and 33 mathematics and science educators. Analysis of questions posed by this research sample shows that if teachers are to master posing good questions, it is not enough to instruct them on how to do it. The process must also be supported by participants' own creation of good questions. The paper categorizes mistakes that were typical for the questions posed.

Keywords

Activating methods, didactics of mathematics, didactics of natural science, environmental education, good questions

Introduction

Modern educators and teachers look for ways of making the teaching process more efficient. One of the ways is improvement of pedagogical discourse in the classroom. In literature, this problem is often approached in different perspectives. Let us mention here some of them. However, the list is not and cannot be exhaustive.

Heyd-Metzuyanim and Shabtay (2019) focus on teachers' narratives about 'good' mathematics teaching. They examine teachers' pedagogical discourse and their participation in mathematical discourse during problem solving episodes. Moyer and Milewicz (2002) focus on appropriate questioning techniques as an important part of mathematics teaching. Hricova and Pcolinska (2015, 2016) study relationships between knowledge and communication competences during competency-based learning process. They claim that various methods for the development of communication are needed, namely discussion, presentation and activity. Also Slowiaczek, Klayman, Sherman and Skov (1992) focus on information selection and try to find out what a good question and a good answer are during hypothesis testing. They show the importance of behaving in an interactive, multistage process including posing selected questions, interpreting data and drawing inferences.

A good question for us is not a question that is well formulated and communicated to the pupils, but a question that supports constructivist and activating approaches. Our understanding of a good question comes from the idea developed originally by Sullivan and Clarke and their team (Sullivan and Clarke, 1988, 1990, 1991; Clarke and Sullivan, 1990; Sullivan, Clarke and Wallbridge, 1991; Clarke, Sullivan and Spandel, 1992; Sullivan and Lilburn, 2010 etc.). The main characteristics of this type of questions are content-specific focus and the opportunity for answers at different levels of sophistication (Clarke, Sullivan and Spandel, 1992: 209).

Sullivan and Lilburn (2010) introduced the use of good questions in mathematics education of

young pupils. We (Jančařík, Jančaříková and Novotná, 2013; Novotná and Jančaříková, 2018) extended the use of good questions to higher grades of primary and secondary schools and to didactics of natural sciences, environmental education or education to sustainable development and other sciences.

Good questions are a specific type of open questions. If an open question is to be a good question, it must meet the following criteria (Sullivan and Lilburn, 2010):

- There exist several answers that can be accepted.
- It requires more than mere reference to known facts.
- It provokes discussion.
- It has a motivational function in lifelong education.
- Students may learn something when they answer it and/or discuss it.
- Teachers can learn something about their pupils from the pupils' answers.

In this text, we mean by ordinary questions such questions that are closed and can be answered conclusively. Albeit intentionally or unintentionally, ordinary questions test pupils' knowledge of facts (the pupil either knows the answer, or does not). We do not say that ordinary questions are bad; they are a good tool for checking pupils' knowledge. However, the teacher should use these questions with consideration. The teacher should be only testing clearly defined and already taught subject matter in a limited period of time (an in advance announced exam) to give their pupils a chance to be successful if they revise for it properly. However, ordinary questions are overused in Czech schools. Pupils and students have to put up with almost continuous testing at any time from any, unspecified or unlimited subject matter. Teachers test their pupils at random to keep them alert. They are convinced their pupils will study harder and prepare better under constant threat of being tested. This is very stressful. And stress is a notoriously well-known obstacle to learning. What happens is the pupil prepares for being tested the next day and may even get a good mark but will not remember the information in a longer-term horizon. Moreover, stress is a demotivating factor for lifelong learning (individuals do not learn to love to learn new things). Some teachers even select for oral testing those pupils who misbehave. Testing then becomes a form of punishment. Needless to say that associating asking questions to punishment is unsuitable (Jančaříková, Jančařík and Novotná, 2012).

All the above results in a loss of self-confidence, which happens even faster in sciences and mathematics where the pupil cannot be expected to know the answer to most of the questions asked (e.g. wildlife and nature are too extensive and even a professor in biology will fail to determine all species if transported to some unknown destination). How could a pupil or student determine everything that they are presented by their teacher? How could they answer all their teacher's closed questions? That is why it is crucially important that teachers should clearly define the areas that will be tested by ordinary questions, e.g. make lists of products of nature that will be subject to testing (Jančaříková, Jančařík and Novotná, 2012).

In Table 1, comparison of the use of ordinary and good questions is presented.

Asking good questions can develop pupils' innate playfulness, creativity and their will to discover hidden and covert patterns in the surrounding world. If the teacher decides to use good questions in the educational process, development of favourable psychosocial climate can be expected. If there is not just one correct answer but almost any pupil's answer can be perceived as seminal and interesting, victory and primacy of a particular pupil seizes to matter. Pupils are calmer and relationships among them are not corrupted by rivalry and competition (Jančaříková, Jančařík and Novotná, 2012).

Without any doubt, use of good questions is beneficial and functional. That is why this concept has become part of undergraduate pre-service teacher training at Faculty of Education, Charles University. In this paper, we focus on posing and formulation of good questions. More precisely,

we inquire into the extent in which pre-service teachers and educators are able to pose good questions after theoretical introduction to the method and studied the most common mistakes typical for unsuccessful attempts to pose them.

Pupils	Ordinary question	Good question
Experience success	Who answers as first. In the class, a group of Successful students" is created = these who learn to answer quickly.	Everybody who makes effort.
Experience failure	Absolute majority (all but one). In the class, a group of Weaker students" is created = these who hardly ever answer correctly.	Hardly anybody. Failure is linked with low attention and insufficient attitude to work.
Mutual students' relationships	Disrupted by concurrence, rivalry and elitism.	Can flourish. Students cooperate.
Feelings	Stress, fight, inferiority.	Contentment, respect to personality, self-confidence.
Lifelong learning	Placed at risk.	Supported.
Ability to present one's own opinions	Suppressed.	Supported and developed.
Ability to critically evaluate presented information	Not developed.	Developed.

Table 1: Comparison of good and ordinary questions
(according to Jančaříková, Jančařík and Novotná, 2012)

Materials and Methods

We have been interested in posing and in using good questions in mathematics and science education for several years. In this paper, we focus on the process of posing good questions by part-time student teachers (i.e. practicing teachers extending their qualification) and by researchers in subject didactics. We asked the following two research questions: What problems do teachers encounter when posing good questions? What are the most common mistakes when posing them? We believe these two questions are crucial in the area of good questions. Good teachers plan their lessons purposefully with a goal and for these ends they need to have prepared questions in the area they are working on with their pupils on the level that is appropriate for the given group of pupils. Although they might use some questions formulated by another author, if their teaching is to bear fruit these questions must be adapted to their and their pupils' own needs. If they fail to find suitable questions in available materials, they should be able to generate these questions on their own.

Participants

The research study was planned in 2017. The research data were collected at Faculty of Education, Charles University, in summer semester 2018 in three courses for part-time student teachers of mathematics and of pedagogy (with the total of 44 students) and in August 2018 on an international conference for mathematics and science educators (the total of 33 educators).

Materials

The respondents (student teachers and educators) were introduced to the method using the same methodology of introducing it. Then they were asked to pose their own good questions they could use in their teaching practice at school or at university.

Method

Questions posed by the respondents were analysed and classified by the research team to good

questions and other questions. Other questions were then classified according to the most frequent mistakes characteristic for the process of posing good questions.

Results and discussion

Overview

Respondents (N = 77) posed the total of 288 questions. 192 of them were good questions. Part-time student teachers (in-service teachers extending their qualification) posed 125 good questions out of 210 attempts; participants on the international conference (mathematics and science educators) posed the total of 67 good questions out of 78 attempts (see Table 2).

	Attempts (number of all questions)	Success (number of good questions)	% of success
Student teachers	210	125	60%
Educators	78	67	86%
Total	288	192	67%

Table 2: Questions posed

It turned out that student teachers find posing good questions more difficult than expected.

There were major differences among the respondents: Some respondents (namely four) did not manage to ask a single good question, other (namely nine) managed to pose more than one question and all their questions were good questions. Many posed several good and several not-good questions. Some respondents posed both types of questions in one line, e.g. "What can be encyclopaedia of plants used for? Have you ever used it?" or "Which from the following numbers 4/3; 5/2; 15/15; 5/8 are greater than 2? Do you know any other fractions that are greater than 2?" One student teacher from the research sample did not even formulate questions (she formulated indicative sentences). Another student asked her pupils to "draw", i.e. she did not realize that good questions were related to communication, verbal activity, not drawing.

Some questions were formulated as good questions, i.e. allowed more possible answers, but the author seemed to be expecting one particular answer, e.g. "What advice would you give to your friend who has dropped candy paper in the woods?"

Some good questions were posed in a way that contradicted the didactical goals of natural science education. They make pupils speculate and ignore natural laws. For example the wording of the question "Tell me what animal could have horns." allows a nonsensical answer due to the word "could". Even a frog "could" have horns. These problems were not present in questions in mathematics.

The most frequent problems when posing good questions in the research sample

The problems that occurred when posing good questions by respondents in our research sample can be divided into two groups: A. The questions posed are not good questions, B. The questions posed are formally good questions but are not formulated well for various reasons (these are referred to as seemingly good questions in the following text).

A. The questions posed are not good questions in the sense they are introduced by Sullivan and Lilburn (2010)

a) Respondents asked yes/no questions

An example is the questions "Can the given triangle be divided into two right triangles?" The only possible answer is yes/no.

A similar situation can be observed in questions "Can you see the two ants carrying needles?" or

"Have you ever considered why it is important for nature to be covered by snow when it freezes?" or "Children, do you remember why frogs have their colour?". These are yes/no questions. A pupil either can see or cannot see, has considered or has not considered, remembers or does not remember. The teachers expect their pupils to start discussion but the wording is clumsy.

b) Respondents posed questions that allowed only one answer, or one desired answer.

An example of such a question is "What is the sum of interior angles in a quadrangle?" or "How many times will I have to cut a three meter plank to get fifty centimetre pieces for shelves?". In these cases, only one answer based on the data is possible.

In the question "If you are on a trip with your school and have an empty bag from your sandwich, what will you do with it?", the teacher obviously expects their pupils to answer they will take it back to civilization and put it in a dustbin. Would the teacher praise the pupil who would answer "I will put it on a spruce to protect it from frost." Not very likely.

Similar is the nature of the question "Why do we have containers for plastic?"

B. Seemingly good questions

c) Unreal setting

An example of an unreal context in the question formulation is the following: "Mum baked a rhubarb cake and left a message to her family that she is taking 2/8 of the cake with her for a visit to Granny. What proportion of the cake could Dad and his son eat to leave a sufficiently big portion of the cake to Mum?" This situation is unreal, it does not reflect how families communicate. Moreover, it disregards the fact the Mum could have eaten her piece of cake with Granny etc.

d) Wrong problem formulation

An example of a wrong problem formulation is e.g. the question "Why can't domestic animals live in the wild?" The fact is that many domestic animals can live and reproduce in the wild for a relatively long time, e.g. sailors put ashore goats and pigs on islands deliberately so that they would reproduce and could be eaten next time the sailors came. A genuine good question would be e.g.: "How are feral domestic animals disadvantaged in comparison to undomesticated animals?".

e) Unclear task

An example of an unclear task is the question "How to negate the given functions in a way that de Morgan's rules are used correctly?". The formulation of the question does not make sense. A respondent who understands the topic can deduce what the author probably meant but pupils cannot be expected to be able to do this.

f) Too vague wording

For example the question "There is a 30% sale on shoes in High Street and 40% in Slant Street. In which shop are the shoes cheaper?" formally meets the criteria for a good question. However, it is formulated very vaguely. The author of the question stated that the goal of the question was to make pupils aware of the fact that in order to be able to state the discount, the original price must be given. However, pupils are likely to miss the point and to expect the original price of shoes in both shops to be the same. Then the answer becomes unequivocal and the question becomes ordinary.

The question "How can I divide a rectangle into two equal parts?" lacks specification of what the teacher means by "equal parts", whether he means congruent parts, parts of equal area etc. Although one could say this was an especially good question, as it can be viewed from different perspectives, the high degree of openness may represent an obstacle for pupils when looking for an answer.

Similarly the questions "What can we see in the sky?" is a good question but is so vague that it hardly meets any didactical goals. The teacher must expect their pupils to be more creative than desirable.

g) Questions with too complicated wording

These questions could be classified as good questions that, however, lack their motivational function or lead to demotivation once set in the classroom.

An example of such a question is the question "Change the nine-digit number 123456789 in such a way that you replace two different digits by number 2 and the created number is divisible by 3." The same would be possible with a number with fewer digits. Nine digits may become the reason why some pupils refuse to get involved in the creative search for an answer.

The author of the question "How was the universe not created?" explained his formulation by stating that the question "How was the universe created?" was an ordinary question as "the answer is obvious, big bang". However, creation of the universes is a complex issue, too theoretical and too controversial.

DISCUSSION

When processing and interpreting the data we realized that in some cases the quality of a good question was determined by one single word or expression. For example "What are all the rules we should follow when in a forest?" is problematic only because of the word "all" that signals the teacher expects a definite list and if the pupil fails to mention all the existing possibilities, they will not meet the teacher's expectations.

Similarly the question "My coach told me I had run 100 metres in about 12 seconds. At least by how many seconds would I have to be faster if he was to tell me I had run it in 11 seconds?" would be a good question if the phrase "at least" was left out. In the proposed form it asks for application of some facts in context but when the phrase "at least" is used, the correct answer is narrowed down to one.

Discussion with the involved part-time student teachers showed they were well aware of their insufficient skills in posing good questions. Some of them were interested in getting a "list of good questions" that they could use in their own lessons. Some of them not only posed questions but also added reflection, e.g. "Posing good questions was quite demanding, I realised how often I tended to use ordinary questions."

At the same time, the topic of good questions was appealing to most respondents and they tried hard to learn to pose and use good questions. Many handed in more questions than was requested, the discussion during evaluation of the questions was very lively, after this discussion some respondents sent a new set of good questions (which was not required) or they tested some of the good questions in the classes where they were teaching and described their pupils' reactions. This only shows that good questions do not motivate just pupils but also teachers.

The authors are not informed about any research focusing on the success of posing good questions. In the follow-up study to the here presented research, they plan, for example, to study the ratio between ordinary and good questions in the assignment of the biological and mathematical Olympiads.

CONCLUSION

The paper is based on Clarke's and Sullivan's definition of good questions that they introduced in 1998, 1990. It was further investigated in several works cited in Introduction. Clarke and Sullivan focus on their use in classrooms. In this paper, the focus is on posing good questions by pre-service and in-service teachers. It is highly relevant with respect to the use of good questions at schools. Moreover, exporting the idea of good questions from teaching mathematics to natural sciences and environmental studies opens a new field of interest. It also indicates the potential of their posing and use in other school subjects.

Our society needs citizens that are able to test and verify traditional concepts, individuals who are able to scrutinize "generally acknowledged truths" and critically test them. For example, the

concept of speed of light about which they were taught at school it was constant and nothing could be faster.

If teachers pose good questions, it is without any doubt good for pupils' and students' future lives and careers and thus for all society. However, it will not do only to ask good questions. If good questions are to support creativity, the whole learning process must undergo a change: the teacher must react to pupils' answers appropriately (in a responsible, creative and systematic way), which is far from easy. It requires interest, knowledge of the discipline and also courage, will to fight prejudice (Jančaříková, Jančařík and Novotná, 2012).

Both posing and using good questions in lessons requires teachers to get introduced to the concept of good questions theoretically but also to get some practical experience. A lecture will not equip teachers with the skills needed for posing good questions, will not make them understand characteristic features of good questions and the potential they bear. Only when teachers pose their own good questions and think about appropriateness of their formulation for a particular group of pupils, do they learn to see what to watch out for, what the pitfalls are and what difficulties their pupils might have when trying to answer the questions, possibly even how to prevent these obstacles. The findings from this research study will result in modification of how pre-service teachers are introduced to good questions at Faculty of Education, Charles University.

ACKNOWLEDGEMENTS

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WHY DOES NOT EDUCATION HAVE A POSITIVE IMPACT ON LABOR MARKETS IN DEVELOPING COUNTRIES?

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Abstract

Developing countries face a dilemma about boosting or restricting access to education. On the one hand, they need to raise their educational level to promote economic growth. However, on the other hand, a higher educational level implies negative consequences for employment and wages because their economic structure is not able to absorb more graduates. In this article, we demonstrate this dilemma based on the Mexican case. From an econometric model, we verify the negative correlation between the number of higher education graduates and high salaries level. This negative correlation leads lower people's interest in studying and, consequently, ensnare the country in the underdevelopment. We believe that free market policies are the cause of this distortion and the only correction is through state intervention.

Keywords

Higher education, neoliberal policies, professional wages, unemployment

Introduction

A higher educational level in the population is always a desirable indicator for any country, since a highly trained workforce signifies higher productivity, higher salaries and a guarantee of social mobility. Even, various theories have pointed to education as the most effective way for a nation to escape poverty; it is a priority for organizations such as the International Monetary Fund or the World Bank. However, the relationship between education and economic development is not always linear. Particularly in developing countries, the impossibility of making a leap to development due to impediments to improve educational quality and increase education levels of the population has been demonstrated, generating cumulative loops (Myrdal, 1956). Labor productivity affects the effect of education on economic development (Neycheva, 2010).

These obstacles are due, in large part, to the economic structure of poor countries' dependence on the rich ones (Prebisch, 1959). Jiménez-Bandala and Andrade (2017) have demonstrated the existence of poverty traps (characterized in terms of Mathematics due to the insensitivity of the dependent variable). That is, because it presents a slope of demand curve close to zero. In that sense, an increase in the educational level of the population is not necessarily translated into an increase in well-being. Due to the insensitivity of the demand curve, it could even be that its results were harmful, for example, a drop in wages.

This article aims to analyze the dilemma of the developing countries with respect to raising or not the general level of education of their population from an analysis of the labor market, the incapacity of absorption of the highly formed workforce and the bidding of wages to the bottom.

The labor market and highly trained human resources

Since the labor force is a commodity like any other, in a system of free market, it is submitted

to the forces of supply and demand that determine its price (wages). Thus, when there is a small number of professionals or specialists with a high level of education, market wages will be high. However, as the general education level of the population increases and the number of graduates increases as well (from L to L'), salaries will tend to decrease (from W to W') and the market equilibrium will go from point A to B (Figure 1).

According to developmental theories, a greater number of better trained graduates will promote activities with greater technical requirements and less intensive in work, which will boost productivity and consequently expand the market that requires a greater number of professionals, (from L' to L''). Consequently, wages increase (from W' to W'') and the new market equilibrium will go from point B to C. Thus, the market follows a cycle of expansion from a greater knowledge, and it is the utopia of the society of the economy based on knowledge (Smith, 2002).
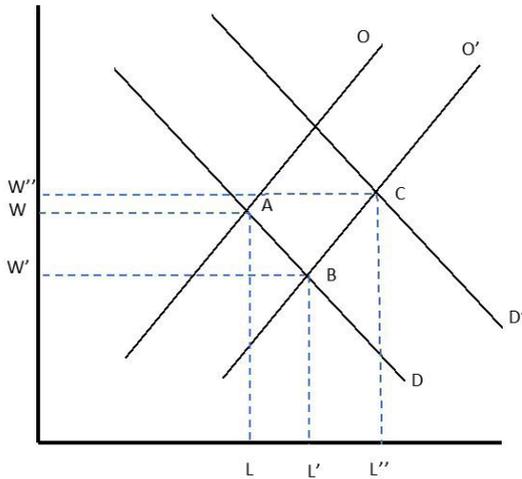
Figure 1: Labor market in developed countries (own elaboration)

Higher education and poor countries, the case of Mexico

However, poor countries do not have the capacity to absorb their graduates with the same speed as developed countries. The high rates of informality are a clear sign of this disability. In such a way, poor countries face the following dilemma: *a country that begins to promote a higher educational level in the population without articulating it with its economic policies will have a labor market with an increasing offer of graduates and a static or even decreasing demand for what the wages will tend to lower.* So, it seems more convenient to restrict education and thereby also condemn the country to underdevelopment. This is the biggest problem where neoliberalism prevents the articulation between education and the labor market, because it requires at least a minimum degree of centralized planning and state's intervention in the economy, as the intervention is prohibited. Mexico is a Latin American country that ranks number 15 in the world economies by the size of its Gross Domestic Product (GDP). However, Mexican GDP per capita ranks 76th out of 123 countries (World Bank, 2016). This fact, along with its social indicators, defines Mexico as an emerging or developing economy. If we analyze the behavior of Mexican educational variables, it can be seen that in the 21st century (2000-2016), the number of students enrolled in high schools increased by 73.5%, at an average annual rate of 4.5%. What is more, in the university level (higher education), the number of enrolled students increased at a faster rate of 5.23% annually or

by 83.73% in the same period in question (SEP-SNIEG, 2017). This educational growth contrasts with the level of growth of the economy that barely reaches 2% in annual average during the same period (INEGI, 2017).

MATERIALS AND METHODS

To verify the negative effects of the increase in the number of highly trained human resources in poor countries, we begin from a conventional market model, where salaries (W) are a function of demand (N) and labor supply (L). So that, *ceteris paribus*:

$$W = f(N, L) \tag{1}$$

Considering the available data for the 32 states of Mexico, we defined the following variables:

W   Wage: Percentage of employed people who earn more than five minimum wages, which is the highest-level equivalent to USD695 per month (INEGI, 2017). Statistics in Mexico group workers by income levels measured in multiples of minimum wages, so we do not have monetary salary expressions, but percentage of the population. The same unit of measurement is used by other researches (Mercado and Planas, 2005; Jiménez-Bandala, 2009; Márquez, 2011).

X_1 Demand: Jobs for highly trained human resources in the period 2005-2017 (INEGI, 2017).

It was calculated considering the difference in percentage between the highly trained unemployed staff in 2005 and the highly trained unemployed staff in 2017. That is, the quotient of the highly educated unemployed population (HEU) and the total highly educated population (HE)

$$X_1 = \frac{HEU_{2005}}{HE_{2005}} - \frac{HEU_{2017}}{HE_{2017}} \tag{2}$$

X_2 Supply (1): Human resources trained with a high school education level in the period 2005-2017 (SEP-SNIEG, 2017)

It was calculated considering the growth of students enrolled in the high school level from 2005 to 2017

$$X_2 = \frac{HRHS_{2005}}{HRHS_{2017}} \tag{3}$$

X_3 Supply (2): Human resources trained with a university education level in the period 2005-2017 (SEP, 2017).

It was calculated considering the growth of students enrolled in the university level from 2005 to 2017

$$X_3 = \frac{HRU_{2005}}{HRU_{2017}} \tag{4}$$

The following model was then proposed

$$W = B_0 - B_1 X_1 - B_2 X_2 - B_3 X_3 \qquad (5)$$

The parameters were obtained by means of the ordinary least squares method that we describe in the following section.

RESULTS AND DISCUSSION

The descriptive analysis of the data (Figure 2) showed us that the percentage of employed persons who earned more than five minimum wages had a downward trend, going from 11.9% in 2005 to 4.8% in 2017. Therefore, the jobs that were created in the period with low wages were higher. At the same time, there was an increase in the number of unemployed people who had tertiary and bachelor education level. This number has been increasing from 32.3% to 46.6%.
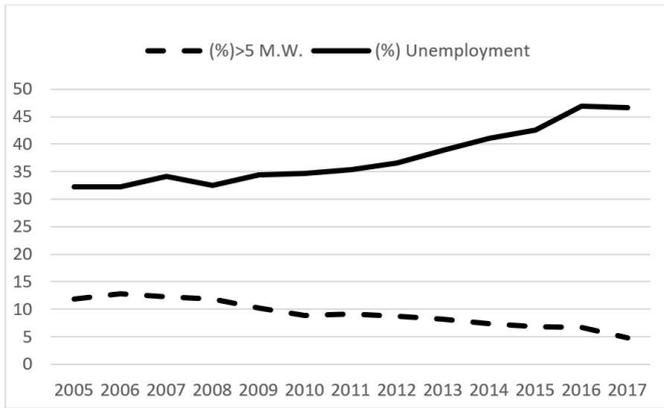
Figure 2: Percentage of workers with higher wages and unemployment rate with a high education level, Mexico 2005-2017 (own calculation with data from INEGI (2017))

In all 32 states of Mexico there was a fall in the percentage of jobs with the highest salary level, on average 7.1% and an increase in unemployment of people with a high educational level, 14.3% on average. On the other hand, at the national level there was a significant increase in the number of students enrolled in the tertiary and bachelor education level. Therefore, the salary drop in people with high educational training is explained by an increase in supply and a contraction of demand in the labor market.

The variables in the proposed model were not significant, but the hypothesis test F was rejected. Therefore, it means that some of these variables should not be ruled out. Therefore, we ran an estimation for 20 states of the country where there was an unemployment rate lower than the national average. Then, we have:

$$W = -5.62 - 0.305 X_1 - 4.00 X_2 + 4.05 X_3$$

$$t = \ (-4.5)\ (-2.51)\ (-1.80)\ (2.33) \qquad (6)$$

$$R^2 = 0.32$$

In this case (6), all the variables are significant at 95% level, except for those enrolled at the upper middle level (X_2), which is significant at 91%. It is considered that a variable is significant in the individual when the value t is greater than 2.2. The signs of the parameter reflect the expected correlations to explain the salary drop, except for the higher education variable. In most of these states, the number of students enrolled in tertiary level was below the average. Thus, the low enrollment helped to stop the salary drop.

Further, we selected 17 states where there was an enrollment at the university level above the national average. For this estimation we get the following results:

$$W = -4.20 + 0.12X_1 - 3.24X_3$$

$$t = \ (-2.7) \ (1.83) \ (-3.53) \tag{7}$$

$$R^2 = 0.48$$

In the model (7), the variable of secondary education (X_2) was excluded because it was not significant. All the other variables are significant at 95%, except unemployment that was 92%. In these states, it is the unemployment that stops the salary drop although with very small effects. Therefore, we can conclude that in Mexico, as a poor country, the increase in the educational level of the population has negative effects on the labor market, i.e. higher unemployment and lower wages. In both models, the correlation coefficient (R^2) is acceptable, although less than 50%, because the significance of the individual variables is high.

A greater amount of highly trained people than the market requires can be described as an over-education problem. This phenomenon has also been found in developed countries. However, the occupational mobility theory (Rosen, 1972) points out that it is a temporary mismatch, while new skilled workers are promoted to higher positions. Before and after the world crisis of 1974-75, several theories were developed that this phenomenon could be persistent and the adjustment of the market would take place more slowly (Spence, 1973; Thurow, 1975; Hartog, 1981). Although in general terms a higher educational level is preferable in the population, over-education would have negative effects on productivity (Tsang and Levin, 1985).

The empirical evidence showed that in developed countries the problem of over-education was not persistent and, therefore, not significant. However, over the past 20 years, the market has balanced these differences (Groot and van Den Brink, 2000). Even, it has been shown that higher educational level improves the salary conditions in developed countries. For example, Marek and Doucek (2016) analyzed the case of the Czech Republic and they verified that higher education really entails a higher wage. Other research shows that the increase in the educational level of the population had greater effects in the developed countries than in the developing countries, mainly due to the structural characteristics of the economies in the developing countries that have to do with the nature of the institutions, the formation of informal sectors, family markets, migration that are more likely to incentivize a surplus of work, unemployment, underemployment and important wage drops (Behrman, 1999; Martins and Pereira, 2004). However, Hanushek and Woessman (2008) suggest that quality of education, and not the quantity, has positive effect on economic growth.

The above suggests a necessary intervention by the state to correct market inefficiencies and achieve a true education-job match (Mocanu, Zamfir and Pirciog, 2014; Hanushek et. al, 2016). However, the current set of neoliberal economic policies dominant in the world will not only not allow the developing countries intervention by the state, but it also maintains an intervention disguised to the detriment of the labor market. This disguised intervention is based on the state containing wage increases since the eighties of the twentieth century, which causes the demand curve to become insensitive to changes in the market and, therefore, has a zero slope (Figure 3),

before an increase in the supply (from O to O') wages remain constant (from point A to B), an education about human resources available in the market has negative effects and causes a contraction in demand (from D to D '). As a result, wages go down (from point B to C). This explains the resulting effects in our proposed model.
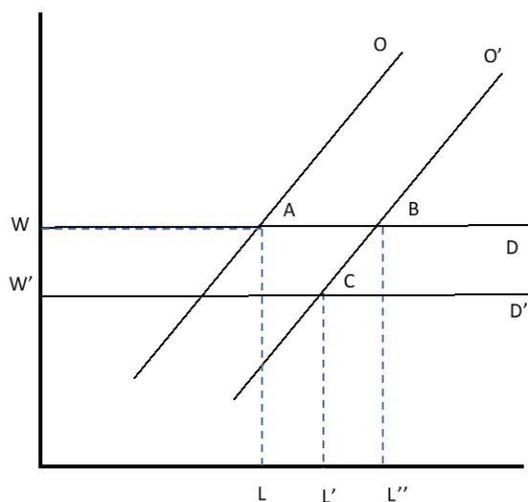
Figure 3: Labor market in developing countries (own calculation)

Conclusion

In this article, using the Mexican case, we have verified the hypothesis that developing countries, when they increase their educational level, face greater negative effects than positive ones. An increase in the number of workers with high school and university levels leads to an increase in unemployment for this sector and a drop in the salary level. This is caused by an inability of the economic structure of poor countries to absorb highly trained human resources. This incapacity is strengthened by an apparently free labor market, but trickily controlled by the state from wage containment (promoted by neoliberal economic policies), which causes the demand curve to work perfectly elastic, with zero slope. This condition ensnares the developing countries to inhibit access to education and prevent the increase of unemployment. If these countries continue to apply neoliberal policies, education will not be a lever for development. It is required that the government modifies its economic policies and allow intervention in the market in order to articulate the productive development with the general increase of the educational level of the population. We recommend the application of labor policies that tend to generate quality jobs, decent wages that recover the loss of purchasing power during the neoliberal period.

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FACTORS INFLUENCING FINANCIAL LITERACY OF YOUNG ADULTS

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Abstract

Main goal of this paper is to inform about results of a research, which examined factors influencing financial literacy levels of young adults from the South Bohemian region. The factors considered were: high school, gender, family background (parent education) and students' study focus. The data was obtained through a questionnaire survey and a didactic test, attended by 310 students aged 18 - 21 (245 students of the 1st year of the bachelor's study program Specialization in Pedagogy at the Faculty of Education at the University of South Bohemia (FE USB), 65 students from South Bohemian Grammar Schools). On the basis of the statistical analysis, it was found that among the factors that had a significant impact on the students' results were students' study focus and type of school. The influence of gender and family background has not been proven.

Keywords

Financial literacy, financial education, young adults, pre-service teachers

Introduction

In the 1990s, the centrally planned economy moved to a market economy. Commercial banks, new insurance companies began to emerge, and the range of financial products/services expanded. Understanding the wide and often unclear offer of products/services assumes a certain amount of knowledge, experience and ability to orientate in the given issue, a degree of financial literacy. Rutledge (2010) states that the positive experience of economically advanced states shows that financial literacy and financial education can be an effective form of consumer protection. Also, within the OECD financial education is accepted not only as an important knowledge of life but also as a building block for global financial stability (Dvořáková et al, 2011). Since 2008, one of the OECD's objectives has been to support member counties in developing their national financial education strategies (Dvořáková et al, 2011 or better www.financial-education.org). As a result, the National Strategy for Financial Education (NSFE) was approved in 2010 in the Czech Republic as a comprehensive systematic approach to enhancing the financial literacy of citizens of the Czech Republic. In the Czech Republic, the two-pillar structure of education i.e. initial education (pre-primary education, elementary education, secondary education, conservatory education and higher vocational education) and further education (i.e. lifelong learning) was chosen (MFCR, 2010).

For several years, students who are to be acquainted with financial issues within the scope of the financial literacy standards defined in the document The System of Building Financial Literacy at Primary and Secondary Schools (MFCR, 2007) have been enrolled at universities for several years. Since 2011, the Faculty of Education of South Bohemia University has been monitoring the level of financial literacy of students of the first year of the bachelor study program Specialization in Pedagogy (program leading to the teaching profession). The aim of this monitoring was to contribute to a deeper understanding of the issue of financial literacy of the young population and

to provide a comprehensive view of the issue of educational change associated with it. In view of the unsatisfactory results of the students in the field of finance, the authors of the article decided to examine factors that could have a major impact on the level of their financial literacy.

The financial literacy of university students is of interest to a number of authors. E.g. Beranová et al (2017) examined financial literacy of university students in relation to financial security in old age, Šíma, Beranová, Navrátilová (2018) dealt with financial literacy of university students in the field of external financing. Ergun (2018) analysed the level of financial literacy among university students in nine countries. The purpose of their study was to determine the level of financial literacy among university students, and to find out the relationship between financial knowledge and demographic characteristics of students.

The study of Garg, N. and Singh, S. (2018), particularly, focus on how socio-economic and demographic factors such as age, gender, marital status and income influence financial literacy level of youth and whether there is any interrelationship between financial knowledge, financial attitude and financial behaviour.

The issues of financial literacy of university students were delt with by authors such as Chen and Volpe (1998), Beal and Delpachitra (2003) or Özdemir et al (2015).

Materials and Methods

Research objective

The authors of the paper focused on factors that can affect the level of financial literacy of young adults (aged 18-21) from the South Bohemian region. In determining the factors, the authors have, among other things, drawn from the results of international surveys (Atkinson and Messy, 2012; Lusardi, 2010)

The factors that were followed were:

- Gender,
- secondary school (categories: grammar schools (G), secondary schools with economic focus (SSE), secondary schools with technical focus (SST), secondary pedagogical schools (SPS), arts schools (AS), others (O)),
- family background (categories: parents with university economic education (PUEE), parents with university technical education (PUTE), parents with other tertiary education (POTE), parents with secondary economic education (PSEE), parents with secondary technical education (PSTE), parents with other secondary education (POSE), parents with vocational education (PVE), parents with primary education (PPE)),
- study focus (categories: student of the last year of grammar school (G1), student of the 1st year of FE USB focusing on: humanities - natural sciences (H-NS), humanities - social sciences (H-SS), humanities (H), natural sciences (NS), natural sciences - social sciences (NS-SS).

The level of financial literacy was measured by the number of points obtained from the didactics test.

Data Collection

Each student received a questionnaire and a didactic test. The questionnaire contained 4 questions aimed at identifying gender, type of school attended, parent education and student's study focus. Questions were of a closed type. The student chose from the answers offered (see above).

Didactics test contained 20 questions with closed answers Test questions were divided into five categories: investment, loans, family budget, money, and insurance. Each category was represented by 4 questions. When scoring the correct answer was assigned 5 points, i.e., the total score ranged from 0 to 100 points. The validity of the test was consulted with experts (the regional

director of the mortgage bank, the director of the Era Financial Center in České Budějovice). The questionnaire›s reliability was determined using the Kuder-Richards formula (its value was 0.802, which is the value for good test reliability).

For each student the following data were obtained: number of points in the test, gender, secondary school, family background, study focus.

Data collection took place at the beginning of the winter semester of the academic year 2017/2018.

Research sample

The research was carried out with 245 students of the 1st year of FE USB of introductory teacher training courses. Furthermore, 65 students from grammar schools in the South Bohemian Region participated in the research. The age of students ranged from 18 to 21 years. Students who participated in the research were acquainted with financial issues in the scope of curricular documents of the Czech educational system (Framework Educational Programmes (FEP) for all types of secondary schools). Students of the last year of grammar school were included in the sample, as it was observed whether the result (the number of achieved points) is not affected by the fact that the students in the first year of university studies start to make decisions concerning the problems of everyday life (payments for accommodation, arranging accommodation scholarships, catering,…).

Data processing

In order to identify the factors and their subsequent use to predict the performance of individual students or listeners (performance = number of test points), regression tree methodology was used (Breiman et al, 1998). Regression trees are based on recursive binary spatial resolution and can be considered as a nonparametric variant of classical regression analysis.

Samples (in our case, students) are classified linearly and hierarchically into a finite predetermined number of classes. This is a sequence of decisions that results in the object being placed in one of the groups based on the object's properties. In each node, a variable (predictor) is determined by which we divide the data file and the boundary that determines where the division is to be performed. The root of the tree contains the entire data file. Two branches grow from each node. Each sheet represents one of the groups.

When creating a tree, there are many ways to select the variables on which the data is divided. However, the general principle is the same: to select a variable that divides the data into as homogeneous subgroups as possible.

In general, the methodology of regression trees is implemented as follows:

First, a large regression tree is grown. Then this tree is gradually "cut back" (towards the root of the tree - are cut off the "branches" that have the smallest effect on the increase in the sum of squares of errors). This creates a "nested sequence of regression trees". Subsequently, the smallest possible regression tree is selected (measured by the number of terminal nodes) which shows the smallest error (measured by the sum of squares, the decrease in the sum of squares of residues is measured by means of a deviation), based on cross-validation, or based on a test set of data.

Further technical details of the regression tree methodology are given, for example, in Breiman et al (1998) or Hastie, Tibshirani and Friedman (2001). Mathematical software R was used for data processing.

In the framework of our research, we asked whether it is possible to find in the data a set of predictors (independent variables) by means of which we are able to classify the data and observe their influence on the dependent variable (number of points from the didactic test). In other words, to find the data structure in the data that suggests what influences the results in the didactic test as much as possible. Predictors are in our case gender, completed school, family background, and study focus.

Results

In the first phase, a "complex" regression tree was constructed, which contained 7 terminal nodes, leaves. The residual deviance of this regression tree was 167 = 50600/303. Unfortunately, in this case, the deviance value cannot be interpreted because we have no other study to compare. It is clear from Table 1 that only the variables: "study focus", "family background", and "secondary school" were used to predict the total number of points earned in the five monitored key areas (money, budget, investment, loans and insurance). Therefore, it can be assumed that the variable "gender" does not affect the learning outcomes, respectively the score obtained in the test. The graphical representation of the regression tree is captured in Figure 1.

Topology	Node - variable	Criterion – factor level	n	Deviance	Prediction of earned points
1)	root	-	310	74250**	57.67
2)	focus	G1	65	10110	44.00
4)*	background	PSEE, PSTE, POTE, PUEE, PVE	49	7246	42.04
5)*	background	POSE, PUTE	16	2100	50.00
3)	focus	H-NS, H-SS, H, NH, NS-H, NS-SS, SS-H, SS-NS	245	48780	61.30
6)	school	O, SSE, SPS, AS	87	18560	56.23
12)*	background	PSTE, PUEE, PVE	35	7886	50.76
13)*	background	PSTE, POSE, PSEE, POTE, PUTE, PPE	52	8925	59.90
7)	school	G, SST	158	26750	64.09
14)*	focus	NS-SS	24	5700	57.50
15)	focus	H, H-SS, NS, NS-H, SS-H, SS-NS	134	19820	65.27
30)*	background	PSTE, PUTE	16	3856	57.55
31)*	background	POSE, PSEE, PSTE, PUTE, PUEE, PVE, PPE	118	14880	66.31

** this deviance basically corresponds to the concept of „Null deviance in generalized linear models (see e.g. logistic regression), * this symbol denotes the terminal nodes - the leaves of the regression tree

Table 1: Basic characteristics and predictions obtained through a regression tree (source: own calculations)

From Table 1 and the course of the regression tree (Figure 1), it is clear that a "study focus" factor can be referred to as a very important factor. In this case, this factor - the variable "discriminates" between the students of grammar school and the students of the university. Looking at Figure 1 for the overall score, we see that university students are better off than grammar school students. One reason may be that university students have to deal with situations that have been resolved by their parents (lodging, canteen, transport, etc.).

In the second division, the „background" variable is applied to the grammar school branch. The prediction of better results (points) corresponds to grammar school students whose parents have a university degree. Completed secondary school plays an important role in university students at the second division. University students who have completed a grammar school or technical school have a higher prediction of didactic test points than other secondary school graduates

Note: The length of the vertical line of the tree is proportional to the deviation reduction. That is, the longer it is, the given decomposition factor is more important for prediction

The resulting tree (Figure 1) that has 7 terminal nodes is too complex. The suitability of this complex regression tree has been verified by cross-validation, more precisely using 10-fold cross-validation. Based on this, it was found that the smallest deviance is achieved in the case of a regression tree that contained only 3 terminal nodes. By cutting a 7-node tree, we

obtained a model that contained only three terminal nodes - leaves / branches. The basic characteristics of this model are shown in Table 2.
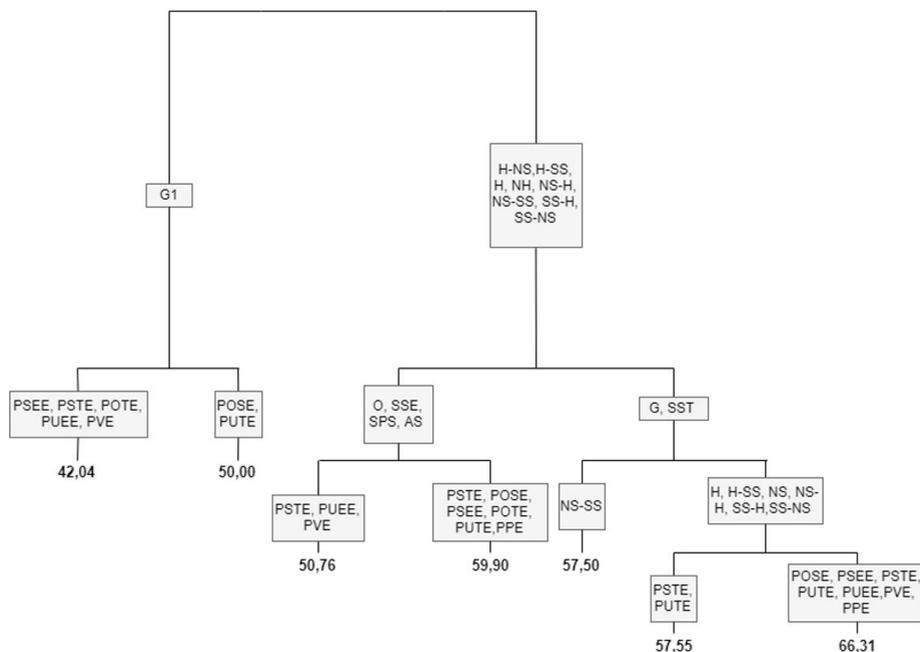
Figure 1: Regression tree - complex (uncut) with resulting prediction (source: own calculations)

Table 2 shows that only the "study focus" and "secondary school" variables are used in this model. In Figure 2, the "study focus" variable is divided into two categories: grammar school students - left branch, university students - right branch. The right branch is further divided by the secondary school to the other two branches. The left branch includes graduates of secondary schools with economic focus, secondary pedagogical schools, arts schools or other secondary schools. The right branch corresponds to graduates of grammar schools and secondary schools with a technical focus. The residual deviations of this regression model are 180.5 (in the original uncut tree with seven terminal nodes this deviation was 167). Thus, there is only a negligible increase in inaccuracies when the model is considerably simplified.

Topology	Node - variable	Criterion – factor level	n	Deviance	Prediction of earned points
1)	root	-	310	74250**	57.67
2)	focus	G1	65	10110	44.00
3)	focus	H-NS, H-SS, H, NH, NS-H, NS-SS, SS-H, SS-NS	245	48780	61.30
6)	school	O, SSE, SPS, AS	87	18560	56.23
7)	school	G, SST	158	26750	64.09

* this deviance basically corresponds to the concept of „Null deviance in generalized linear models (see e.g. logistic regression), * this symbol denotes the terminal nodes - the leaves of the regression tree

Table 2: Basic characteristics and predictions obtained through a "cut" regression tree (source: own calculations)
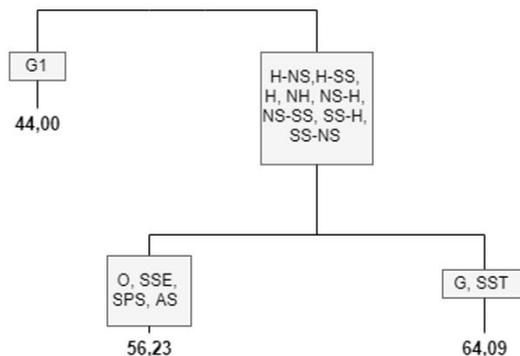
Figure 2: Regression tree - cut with resulting prediction (source: own calculations)

On the basis of the statistical analysis, we can state that among the factors that had a significant effect on the students' results were students' study focus and secondary school. The influence of gender and family background has not been proven.

DISCUSSION

The results of the research show that the students of the universities (1st year) have a better knowledge of financial literacy than students of grammar schools (4th grade), although the age difference of both groups of students is usually only one year. Better results were achieved among university students who graduated from a grammar school or a secondary school with technical focus than graduates from secondary economic, pedagogical and art schools. The surprising result is that graduates of secondary schools with economic focus have achieved worse results than graduates of grammar schools and secondary schools with technical focus, although test questions have been directed towards topics that should be close to the nature of their studies. Kazda, Petrášková and Rosa (2018: 152) came to a similar conclusion in their research: "By comparing levels of financial literacy of the fourth-grade pupils from different types of upper secondary schools it is possible to identify differences. Although secondary vocational schools allocate more time to financial education than grammar schools, their pupils did not score more points in didactic test."

This can have many reasons. Let us state two of them:

- Graduates from secondary schools with economic focus usually choose to pursue higher education with an economic focus for their further education. It is to be assumed that the students of the 1st year at FE USB from these graduates did not show too much interest in the area of economics and finance at secondary school and therefore choose a course other than economic, e.g. teaching.
- At secondary schools with economic focus students are presented with theoretical knowledge that is separated from practice. For example, Remunde (2010: 285) states: „Financial literacy is the ability to use knowledge and skills to manage financial resources effectively for a lifetime of financial well-being. "

Answering the question of why graduates of the secondary schools with economic focus have achieved worse results would require further research that is no longer the subject of this work. The problem of the level of financial literacy among young people (ages 18-26) was also dealt with by Lusardi, (2010), which pointed to the strong relationship between financial literacy and cognitive abilities. In her research, she conducted a sample of 7417 respondents in the

2007-2008 test of knowledge of basic financial concepts (interest rate, inflation and risk diversification in investment decision making). In analysing the obtained data, the author focused on the correctness of responses in the context of some socio-demographic facts such as gender, race, smoking, the level of education of respondents and their parents. One of her conclusions was that financial literacy was strongly related to sociodemographic characteristics and family financial sophistication. Study of Lusardi found an important channel through which young adults acquire financial knowledge: parents. Specifically, those whose mothers had high education or whose families had stocks or retirement savings were more financially literate, specifically on questions related to advanced financial knowledge. In our research the influence of family background has not been proven. We also did not demonstrate the influence of gender on the level of financial literacy. While research by Lusardi (2010) pointed out that there were large differences in financial literacy between women and men. Women were less likely to respond correctly to each of the all questions. These differences between women and men were statistically significant.

A number of studies point to the fact that the level of financial literacy is influenced by numerical skill. Huston (2010: 307) states that "if some individual has rather weak arithmetic skills, this will certainly have a negative impact on his/her financial literacy." Grohmann, Kouwenberg and Menkhoff (2015) found that numeracy mediated the influence of financial socialization, education quality, and economics education on financial literacy. Cole et al. (2015) notes that mathematics training leads to improvements in several indices of positive financial behaviour and outcomes. In a similar context, the conclusions of Skagerlund et al. (2018: 23): "While knowledge of financial concepts, such as inflation and risk diversification, is undoubtedly important for being financially literate, if individuals cannot do basic calculations, understand ratios and percentages, any conceptual knowledge of financial matters acquired will be rendered moot." Kazda, Petrášková and Rosa (2018: 154) states: pupils who used mathematical instruments to solve didactic test tasks were more successful than pupils who took advantage of another approach.

Conclusion

The results of the research showed that the students of the 1st year of FE USB have a level of financial literacy (measured by the number of points from the didactic test) higher than the students of grammar schools (4th year), although the age difference of the two groups of students is only one to two years. We can state that age is one of the factors that can affect the level of financial literacy, because both groups were acquainted with the educational system of the Czech Republic with the given issue in the scope of curricular documents of the Czech educational system (FEP for all types of secondary schools (MEYSCR, 2006)).

Among university students, those who graduated from a grammar school or a secondary school with technical focus reached a higher number of points. Graduates of secondary economic, pedagogical and arts schools achieved worse results. The influence of gender and family background has not been confirmed.

The authors of the paper have been dealing with financial literacy for many years and in their researches repeatedly encounter worse results of students of secondary economic schools compared to the results of grammar school or secondary school students with technical focus students. The open question is why secondary school students with a taught course of economic subjects have worse knowledge of basic financial concepts and a lower degree of ability to apply numeracy skills in simulated financial decision making.

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CONSTELLATIONS OF SIBLINGS AND THEIR IMPACT ON EDUCATION

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Abstract

Family is a primary socialization group that significantly affects the psychological development of an individual. Many theoretical approaches deal with the role of parents, sometimes underestimating the significance of siblings in a family dynamic. Despite having similar biological determination and socialization environment in early childhood, personalities of siblings are often remarkably different. Our paper deals with theoretical explanations of these differences and their impact on education. A cross-sectional pilot study aims at an academic self-efficacy that is observed via a perceived level of school assessment, a learning potential, an effort in the process of learning and a level of aspirations. Our findings demonstrate significant differences in gender and a family-order. Conclusions are applicable in educational theory as well as in praxis of educational counselling with an intention to support equal opportunities in education and professional development.

Keywords

Academic self-efficacy, educational counselling, learning potential, siblings, social determination of education

Introduction

Family plays a crucial role in the psychosocial development of an individual. It is nearly impossible to find scientific arguments that would contradict this fact, representing one of the basic assumptions of developmental psychology and connected disciplines dealing with a psychological growth of a human being (Vágnerová, 2000; Langmeier and Krejčířová, 2006). A great responsibility for these processes is in hands of parents, who ensure a huge variety of needs of their children and almost irreversibly form their personalities (Matoušek, 2003; Čáp and Mareš, 2001) including competencies for education (Fischer and Lipovská, 2013; Lipovská and Fischer, 2016).

Very often, these socializing processes in a family have yet other actors that sometimes stay hidden or marginal to psychological and educational theories, although they significantly influence the development of a child – her brothers and/or sisters. Educators, teachers, social workers, and even scientist face a confusing question: why are siblings, having both similar genetic dispositions and a socializing environment in early childhood, so different? Hetler (2017) studies this issue from a viewpoint of evolutionary biology. According to his findings, a variety of personal traits of siblings is determined biologically and is only stressed by environmental factors like siblings' constellation. This evolutionary mechanism called adaptive diversification should support the adaptability of offspring to various kinds of circumstances and prevent it from lineage extinction. Besides variability in mutual differences of brothers and sisters, we may ask how the pure fact of having/not having a sibling influence a child's cognitive development. Dunifon, Fomby and

Musick (2017) base on highly apparent fact – siblings influence each other because they spend time together. In their study, children actively spent about a half of their free time with their siblings and another 20% of their time with sibling present (brothers more than sisters; siblings with an age difference within three years more than age-distant siblings). Children without a sibling spent significantly more time only with their parents and occupied less with unstructured games. In this manner, children with a sibling may seem disadvantaged for education having less time with parents and enjoying less structured activities. Nevertheless, McAlister and Peterson (2013) proved that having child-aged siblings supports development of theory of mind - 'a representational understanding of others' minds including abilities to comprehend and predict others' mental states of true and false belief, memory, imagination, and the like, even in situations where these mental states are at odds with observable reality' (McAlister and Peterson, 2013: 1442). The authors conclude that these kinds of metacognitive abilities (undoubtedly important for educational processes) develop easier by children with sibling thanks frequent occasion to playful interactions.

It should be noted that there are many other siblings-related influences affecting an individual's academic achievement. Dealing with the effect of maternal age, Kalmijn and Kraaykamp (2005) proved a positive impact of this variable on children's education attainment. However, this effect was almost three times less important than a level of parent's education. The study also examined the effect of birth-order that showed slightly negative impact on education. Considering a mutual interconnection of the variables, the authors conclude that 'later born children have a disadvantage which is compensated by the fact that they are born at a late age of the mother' (Kalmijn and Kraaykamp, 2005: 648). We should state that respondents of the study were the Netherlands born between 1918 and 1974, therefore, the conclusions may not be fully sociologically relevant.

Trying to explain differences between siblings in one family from the paradigm of social determination, Jensen and McHale (2015) researched a role of social comparison (Festinger, 1954) and expectancy (Rosentahl and Jacobson, 1968) in parental attitudes towards siblings. They proved the pure influence of parental beliefs about siblings' educational abilities on their school grades which resulted in higher academic interest of children perceived by their parents as more competent. Paradoxically, differences in parental attitudes were not caused by grades of their children. The authors suppose that these differences in parental attitudes are caused by everyday social comparison of their children that escalates existing small differences between siblings in their early development. In every way, parental attitudes significantly modulate perceived level of self-efficiency of their child that influences radically an academic achievement (Pajares, 1996).

Arising from these findings, our research deals with the role of the siblings in the academic self-efficacy of an individual. The objective of our pilot study was to find if students' perceived school success, educational dispositions and career ambitions are influenced by their sibling's constellation. Because of described mutual differences in siblings' personalities, we presume that the academic self-efficacy will vary from a perceived level of academic self-efficacy of their siblings. The research could reveal gender differences accenting or modulating the role of sibling's order. Our findings will be useful especially for the university counselling services, because sibling constellation may significantly affect a student's self-concept, especially a self-perception of educational and social dispositions that strongly influence both professional and personal growth.

The Introduction of our paper summarizes the current state of the topic using references of articles that deal with the role of siblings in socialization and education. In Materials and Methods, we described our research sample, a structured questionnaire constructed as a research tool and our hypotheses. In Results, we summarize our main findings that are further described and compared

with similar researches in Discussion. In Conclusion, the paper precedes a focus of the following research.

Materials and Methods

In our cross-sectional research, we had a research sample of 146 students of the Czech University of Life Sciences selected by the method of convenience sampling. Having 21 only-children, merely remaining 125 respondents were suitable for an analysis of the sibling's influence. 91 of our respondents have one sibling, 28 respondents have two siblings and the remaining 6 respondents are from 4 or more children families. The data were collected in November and December of 2018.

Whereas a sample of respondents with two and more siblings was insufficient, our analysis mainly includes relations to the oldest sibling of our respondents. In this regard, we had 54 'older children', 67 'younger children' and 2 respondents with a twin.

An average age of our respondents was 21,66 years. The sample consisted of 112 females and 31 males (by one respondent, the information was not available) which may cause certain gender bias of our findings. A gender structure of siblings was better-balanced, including 69 female siblings and 56 male siblings (considering only the oldest sibling of our respondents).

To explore the influence of siblings on students' academic self-efficacy, we created a structured questionnaire asking for the perceived level of school success, energy needed to study something new, perceived educational dispositions and career ambitions. Participants responded to these questions relatively, in comparison with their sibling(s).

The null statistical hypotheses of our research were following:

H0-1: *There are no gender differences in the relative self-evaluation of school success (in comparison with sibling/s).*

H0-2: *There are no gender differences in the perceived level of educational dispositions (in comparison with sibling/s).*

H0-3: *A gender of siblings does not influence the relative self-evaluation of school success (in comparison with sibling/s).*

H0-4: *A gender of siblings does not influence the perceived level of educational dispositions (in comparison with sibling/s).*

H0-5: *An age difference between siblings does not influence the perceived level of educational dispositions (in comparison with sibling/s).*

H0-6: *There are no differences in the perceived level of career ambitions between respondents with different family order.*

The outputs were produced using data analysis software system STATISTICA, version 12. Considering the nature of our research, we used Pearson's Chi-Square test of independence in a contingency table as a tool for analysis of quantitative data, whereas a level of significance was 5%. In a case of a detected dependence, a value of Cramer's V was commented.

Results

H0-1: *There are no gender differences in the relative self-evaluation of school success (in comparison with sibling/s).*

Despite certain gender imbalance of our sample, the exploratory analysis showed that 56 females (45,9% of all respondents answering this question) rated their school success as better compared with their siblings. This finding is statistically significant; nevertheless, the significance is weak (see Tab. 1).

H0-2: *There are no gender differences in the perceived level of educational dispositions (in comparison with sibling/s).*

In this connection, we found a significant relationship between gender and a perceived level of educational dispositions. Female respondents assessed themselves as better-disposed than their siblings significantly more than males, although the significance is weak again (see Tab 1). The relation is even stronger by the second sibling of respondents from 3 and more children families (contingency coefficient =0.463383). We may conclude that the issue of sibling's constellation in education is influenced by the overall gender differences in perception of school success and educational dispositions. This presumption should be verified by subsequent research.

H0-3: *A gender of siblings does not influence the relative self-evaluation of school success (in comparison with sibling/s).*

An influence of the sibling's gender was also an object of our interest. According to the analysis, respondents with a brother perceived their school success as better in comparison with respondents with a sister (see Tab. 1).

H0-4: *A gender of siblings does not influence the perceived level of educational dispositions (in comparison with sibling/s).*

Respondents with a brother also rated better their educational dispositions. Although these findings about certain inferiority of brothers concerning the self-evaluation of school success and educational dispositions were assessed only in a relative comparison (we did not study pure interactions of brothers and sisters), they stress possible importance of overall gender differences in education in the process of mutual comparison of siblings.

H0-5: *An age difference between siblings does not influence the perceived level of educational dispositions (in comparison with sibling/s).*

Considering also non-gender dimensions of a siblings' constellation, we found out that respondents with a sibling in an age-distance between 4 and 6 years rated their relative dispositions (in comparison with a sibling) worse than other groups of respondents. Respectively, the other asses their dispositions mainly as better than their siblings'. By students with a sibling in an age-distance between 4 and 6 years, 'better' dispositions also prevailed; however, these respondents rate their dispositions as 'worse' or 'comparable' more frequently than other groups. However, the statistical significance of findings is not sufficient to reject the hypothesis.

According to Matějček (2005), a 'natural' age distance between sibling is supposed to be 3 years. Langmeier and Krejčířová (2006) state that a child is best-prepared to have a sibling in the age of 3-4 years. This constellation reflects a periodization of human being's development. Smaller age-distance may cause a massive rivalry in early development because of an intensive competence about parents' attention. On the other hand, an age-distance bigger than 6 years means the relationship tends to be more 'parental', the development of siblings is much less interconnected (Matějček, 2005). In the light of these facts, we may infer that our respondents with a sibling in age distance between 4-6 years asses their dispositions in a most realistic way, without a possible influence of early rivalry and jealousy of siblings with smaller distance nor mutual isolation of siblings more 'age-distant' than 6 years.

H0-6: *There are no differences in the perceived level of career ambitions between respondents with different family order.*

Regarding the question of siblings' order, our analysis showed that first-born siblings rated their career ambitions as higher than their siblings, while later-born siblings assigned their ambitions more often as 'comparable'. Surprisingly, the higher career ambitions perceived by first-born siblings was not accompanied by better educational dispositions nor higher school success. These findings emphasized a pure tendency of older siblings to 'accomplish more'. Matějček (2005) states that older siblings use to have more emotional problems, but also better score in tests of intelligence and a tendency to have better educational and career achievements.

	Chi-Square test	Result	Cramer-*V*	*P*-value
H0-1	8.146454	Hypothesis was rejected	.2584071	*p*=.01702
H0-2	7.270884	Hypothesis was rejected	.2441258	*p*=.02637
H0-3	6.971994	Hypothesis was rejected	.2361693	*p*=.03062
H0-4	9.947013	Hypothesis was rejected	.2832275	*p*=.00692
H0-5	4.458691	Hypothesis cannot be rejected	.1346282	*p*=.34747
H0-6	6.534440	Hypothesis was rejected	.2314325	*p*=.03811

Table 1: Siblings' constellations in education – summarization of main statistical outputs, 2018 (source: own calculation)

Discussion

In the interpretation of our findings, it is necessary to consider their restricted ecological validity, because they are plausible only for students of the Czech University of Life Sciences. The internal validity enables their application in counselling services and in support of students' personal growth at this institution, especially in the Career Centre at Faculty of Economics and Management. The external validity of the research is limited; however, our findings bring stimuli for further research at other universities and even in different educational institutions.

The next factors that may limit the validity of our findings are the mentioned gender-inconsistency of our respondents, an insufficient number of siblings from 'bigger families' (three children and more) and the inclusion of half-blood related siblings into the research sample. The last-mentioned factor limits biological interpretations based on shared genetical equipment. Nevertheless, we decided to include the half-blood siblings in correspondence with a statement of Steelman (1985: 355): 'since most social scientists espouse environmental rather than physiological interpretations of the impact of sibling structure, the usual decision is to include any living children present in the household, blood-related or not'.

The main conclusion of our study is an existing influence of siblings' constellation (gender, order, age-difference) on the relative academic self-efficiency (compared with a sibling). These findings reflect possible differences in siblings' personalities explained e.g. by Hetler (2017); however, they also correspond with a study of Jensen and McHale (2015). According to their findings, parental beliefs about siblings' educational abilities determine their school grades and consequently their academic interest. Nevertheless, these differences in parental attitudes were not caused by the grades of their children. The authors suppose that these differences in parental attitudes result from an everyday social comparison of their children that escalates existing small differences between siblings in their early development. Some recent longitudinal studies indicated that sibling warmth may influence academic achievement beyond its impact on school grades. Research has documented links between sibling relationships and other socioemotional outcomes, such as conduct problems and substance use, which also have long-term implications on university completion (Sun, McHale and Updegraff, 2019).

Considering the specification in a siblings' constellation, our results imply gender differences. Females perceived their relative school success and educational dispositions (compared with a sibling) better than males. Moreover, respondents with a brother asses their dispositions and school assessment as better compared with respondents with a sister. These findings seem to correspond with a metanalytical study of Voyer and Voyer (2014) which confirms an overall superiority of females in school marks. This statement agrees with a stereotype about better school assessment by girls that is broadly extended. In the light of findings of Jensen and McHale (2015), we should consider that the existence of this stereotype may influence parental expectation and therefore reinforce these gender differences in education.

The role of family-order in education is an objective of both scientific research and a stereotyping. Kalmijn and Kraaykamp (2005) proved a slightly negative impact of birth-order on education. On the contrary, a metanalytical study of Steelman (1985) questions the perceived superiority of the firstborn child, because the possible advantage of his position consists in non-shared socioeconomical resources of the family. However, Steelman (1985: 381-382) points out that 'the general tendency for families to move upward in economic standing by the time later-born children arrive may counteract this initial advantage'. In our research, we found differences only in the career ambitions of first-born children, assessed more frequently as 'higher' compared with a sibling. The level of perceived school success, educational disposition and needed energy invested in learning were not different (in terms of statistical significance) from later-born children.

Conclusion

Primary socialization radically determines the educational and career trajectory of an individual. Therefore, the influence of parents was the subject of many theoretical studies. Despite their undeniable importance, formal education may be significantly influenced also by siblings. Expectably, this influence is observable in the development of social skills (Vágnerová, 2000). Nevertheless, our research shows that siblings' constellation (namely gender and the family order) may affect also the academic self-efficacy, specifically a perceived level of school success, educational dispositions and career ambitions.

Although our findings are plausible only for the population of students of Czech University of Life Sciences and their broader generalization requires further research with a larger research sample, they may be fruitful for the area of university counselling services and for overall support of students' personal and professional growth. Subsequent research should also reflect the question of overall gender differences in perceived level of academic self-efficacy. Conclusively, siblings' constellations determine a dynamic of the family system and thereby significantly affect a self-perception of an individual (not only) in education.

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ACADEMIC PROCRASTINATION AND CHEATING IN STUDENTS OF ACCOUNTING SUBJECTS

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Abstract

Lay's self-assessment scale was used to measure academic procrastination among students at CULS in Prague, with 180 students from various faculties taking part in the study. Statistical methods were used to process data from anonymous questionnaires. The main subject of the study was the relationship between the degree of procrastination in accounting subjects and academic procrastination, with no statistically significant difference found. Compared with other studies, testing demonstrated no significant statistical difference in the proportion of men and women who procrastinate in accounting subjects. However, women and men differ in their attitude to study obligations when it comes to timeliness in accounting subject assignments. One consequence of academic procrastination is cheating. When analyzing the forms of cheating on the selected sample, it was found that 30.56% of students never cheated, 69.44% cheated, mostly by attempting to obtain test questions in advance (50.5%), while only 4.5% engaged in plagiarism.

Introduction

The term "procrastination" originates from the Latin, specifically from the verb *procrastinare*, which combines the prefix "pro", meaning forward movement and "c*rastinus,"* meaning "of tomorrow". Simply put, procrastination means to postpone (move forward) something to the next day (DeSimon, 1993). According to Milgram (2000), the fundamental part of the definition is perceived as a postponement of a particular obligation to a later date, whereby procrastination represents a sequence of behaviour that leads to the postponement of an important task, the result of which is often contrary to standard behaviour and leads to emotional irritability. Procrastination causes a considerable mismatch between the original intention and the resulting behaviour or a discrepancy between intention and action (Lay, 1994). This hesitation is caused by the anxiety that the procrastinator feels when thinking about a task he/she believes he/she cannot manage. Procrastination itself is therefore a mechanism for coping with the anxiety associated with decision-making of starting or completing any task (Fiore, 2014). Silver and Sabini (1981) described the procrastinator as someone who "knows what he/she wants to do, in some sense can do it, is trying to do it, and yet, doesn't do it yet". Procrastination most often happens in the early stages of carrying out the intended task (Steel, 2001), when most time is taken up hesitating prior to starting

the work itself. Procrastinators very often substitute working on an important task for less important work. These people are essentially very active, but at the expense of that one important, originally planned task (Schouwenburg, 1992). Compared to the afore-mentioned authors, Milgram and Tenne (2000) have described procrastination as a malady of modern times with a short history, since it is related to the industrial revolution. Technologically-advanced countries demand fixed deadlines and plans of people, whereas underdeveloped agrarian societies reportedly do not have any problem with postponement. The largest group of procrastinators is probably students (Ferrari et al., 1995). Academic procrastination is often associated with characteristics such as anxiety, self-underestimation, fear of failure, depression, indecision, defiance, and parental criticism (Ferrari et al., 1997).

By contrast, according to research conducted by Chýlová and Natovová (2013), self-confidence in one's ability is an important attribute for managing stress during studies. According to Fischer and Lipovská (2014), another important factor which influences students in terms of fulfilling their study obligations is that many of them work while in full-time education. (Passig and Lobo (2010) mention level of intelligence as also being a possible cause of procrastination. Researchers have taken an interest in academic procrastination due to data from studies which demonstrates the highest level of postponing tasks among students with no gender or ethnic differences (Ferrari et al.,1995). Schouwenburg (2004) found the procrastination rate for third-level students to be around 20%, Solomon and Rothblum (1984) found it to be about 50%, and some data even found this rate to be up to 90% (Knaus, 2000). Researchers have different perspectives on the various forms of procrastination. Husáková (2013) distinguishes between situational and chronic procrastination; Ferrari (2001) identifies avoidant procrastination, arousal procrastination and decisional procrastination. Chu and Choi (2005) try to create a concept of beneficial, so-called active procrastination, which is preplanned and becomes the driving force behind accomplishing the task under induced pressure, and the concept of passive procrastination beyond the control of an individual. Schouwenburg (2004) created a typology according to degree of neuroticism and divided procrastinators into two categories: emotionally stable and emotionally unstable. In addition to the above typologies, Knaus (2000) divides procrastination into personal and social procrastination, while Ferrari et al. (1995) distinguish between optimistic and pessimistic procrastination.

Procrastination is often linked to cheating among students. Ferrari et. al (1995) found that students who procrastinate are far more likely to cheat or lie. His research, which examined untrue excuses, claims that in up to 70% of cases, students give excuses that are untrue. When defending cheating, the most frequently reasons cited by students are the excessive difficulty of the assigned tasks, teacher incompetence or that inadequate time was given to complete all their study obligations. As a result of postponing their study obligations, students de-register from examination dates and according to Ječmínek et al. (2018), this in turn increases the number of examination dates announced. Vašáková (2017) found that nowadays plagiarism is one of the most widespread forms of cheating. Her research has confirmed the positive correlation between procrastination and plagiarism in college students, demonstrating a statistically significant dependence of plagiarism on academic procrastination. Mareš (2005) introduces what is known as unconscious plagiarism, where an individual does not know that he/she is cheating, which is due, for instance, to insufficient awareness of citation standards. The result of procrastination is not only plagiarism, but also cheating in examinations and written tests, the use of unauthorized aids, copying, lying, etc. Due to poor time management, the student is unable to complete all his/her study obligations within the designated time and turns to deceptive behaviour to resolve the situation.

MATERIAL AND METHODS

Self-assessment scale

The rate of procrastination was determined using a self-assessment scale, based on questions from the Procrastination Scale for Student Populations (Lay, 1986) and the Aitken inventory of procrastination (Aitken, 1982), where scores are evaluated on a five-point scale. Both approaches were validated for the Czech population by Gabrhelík, Vacek and Miovský (2006). At the same time, other authors (Ferrari et. al, 1995; Morin and Solomon, 2000) have also validated these scales as being sufficiently effective and suitable in determining academic procrastination. The scale created for the purposes of this research comprises ten items, five of which are positive regarding procrastination (for example, "I often start working on an assignment shortly after it has been set") and five are of which are negative (e.g. "I put off starting on my assignment until the last minute"). Positive questions are scored positively and negative questions negatively. The statements used in research were selected so that they could be used as statements related to both procrastination in accounting subjects and to academic procrastination in general. For each item on the scale, it was possible to obtain one to five points from "false" to "true". The sum of the points from all the items is the total score, indicating the level of procrastination. For a ten-item scale, the minimum score is 10 points and the maximum 50 points. A categorization system was created to give a final interpretation of the scores obtained, with procrastinators categorized as follows:

Light procrastinators – students with a score of ≤ 25,
Average procrastinators – students with a score of 26-34,
Heavy procrastinators – students with a score of > 35.
The range was chosen in accordance with Gabrhelik (2008), whereby these values were recalculated for the narrowed scale used in our research.

Data collection

Data collection was conducted through a voluntary anonymous online questionnaire survey in February-March 2018. Respondents were students of all faculties of the Czech University of Life Sciences (CULS) in Prague, who took an accounting subject during their studies. Some 334 respondents participated in the survey, but only 180 responded to all the questions. The questionnaires that were completed fully were used for the purposes of this research. The questionnaire comprised ten questions concerning the issue of procrastination in accounting subjects, and the same ten questions in relation to general procrastination. Other supplementary questions related to forms of cheating and the identification markers of respondents. Most of the answers were obtained from Faculty of Economics and Management students (58%), the second largest group was made up of Faculty of Engineering students (21%), followed by Faculty of Forestry and Wood Sciences students (8%), Faculty of Environmental Sciences (6%), Faculty of Agrobiology (4%) and Faculty of Tropical AgriSciences (3%). In the sample of 180 respondents, the majority were women (64%).

Purpose of the research

The following hypotheses were determined and verified for the purposes of the research:
- More than half the students will be in the upper half of the procrastination scale in accounting subjects (they will score P> 30).
- The values recorded for procrastination among students in accounting subjects are higher than for general academic procrastination.

- Procrastination in accounting subjects is related to the difficulty of the subject.
- Procrastination in accounting subjects is gender-based.
- The most frequent form of cheating is plagiarism.

Methods used for analysis

The underlying data obtained through an anonymous questionnaire survey was analyzed using statistical methods. For this purpose, we used:
- a two-sample test to determine the difference between relative frequencies.
- A two-sample-t-test for dependent files,
- X^2 Independence Test for Qualitative Characters,
- Spearman's rank correlation coefficient.

The statistical programming system Statistica 13 was used for data processing.

RESULTS

The data acquired in the first part of the research is presented on Lay's procrastination scale. Table 1 presents the structure of the respondents in accordance with the afore-mentioned scale, including the result of testing the difference between the relative frequencies of both categories of procrastination ($\alpha = 0{,}05$).

Procrastinator	General procrastination (%)	Procrastination in accounting (%)	Test criterion $|U|$
Light	35.0	25.0	2.0702*
Average	38.9	33.3	1.1061
Heavy	26.1	41.7	3.1266*

*Statistically significant differences (α=0.05)

Table 1: Proportion of procrastinators in the categories of general academic and accounting procrastination (source: own data)

The results presented in Table 1 led the authors to change the upper limit for evaluating procrastination. Depending on their score, respondents were divided into two groups only, one with a total score of up to 30 points inclusive, and the other with a score of over 30.

By setting a score of P> 30, the relative rate of student procrastination for both categories is over 50%. In accounting subjects, some 56.67% of students had a score of over 30 points, with 55.56% of respondents for academic procrastination. In terms of the proportion of students with a score of above 30 on the scale, no significant difference was found between general academic procrastination and accounting procrastination ($\alpha = 0.05$). Table 2 shows the descriptive statistical characteristics of procrastination scores for both categories in a group of 180 students, including the t-test difference between means.

Type of procrastination	Mean (score)	Standard deviation (score)	Variance coefficient (%)	p-value for difference between means
Procrastination in accounting subjects	31.63	8.40	26.56	
Academic procrastination	31.51	7.79	24.72	0.737

Table 2: Descriptive characteristics of the overall score for accounting subjects and academic procrastination (source: own data)

By means of testing (Table 2) it was found that there is no significant statistical difference between the degree to which students put off their study obligations in accounting subjects from their general academic procrastination.

Gender was an important classification in the research. A number of authors (e.g. Grunová, 2015) believe that men are more likely to postpone obligations. Table 3 focused on procrastination in accounting subjects. Testing has shown that that there is no significant statistical difference between the proportion of males and the proportion of females in terms of procrastination in accounting subjects ($\alpha = 0.05$). Both men and women have the same relationship to their study obligations in accounting subjects in terms of both carrying out assignments and timeliness.

Procrastinator	Women (%)	Men (%)	Test criterion | |
Light	30.2	15.6	2,1565*
Average	31.9	35.9	0.5504
Heavy	37.9	48.4	1.3691

Statistically significant differences (α=0.05)

Table 3: The division of women and men into categories of procrastinators for procrastination in accounting subjects (source: own data)

A significant part of the research focused in detail on a comparison of the procrastination categories by sex based on the individual questions (Tables 4 and 5).

Positive questions (n = 180)

Question in the questionnaire	Test criterion X^2	p-value	Contingency coefficient	Cramer's coefficient
I complete my assignment before the due date				
accounting subjects	2.2505	0.6898	0.1111	0.1118
in general	3.0598	0.5479	0.1293	0.1304
I work regularly, I complete my assignments				
accounting subjects	5.9453	0.2033	0.1788	0.1817
in general	4.9058	0.2971	0.1629	0.1651
I work on an assignment shortly after it has been set				
accounting subjects	4.6044	0.3303	0.1579	0.1599
in general	5.7671	0.2172	0.1762	0.1790
I use all the spare time I've got to work on an assignment				
accounting subjects	3.2859	0.5112	0.1339	0.1351
in general	5.7037	0.2224	0.1752	0.1780
I complete important tasks as soon as possible				
accounting subjects	7.4627	0.1134	0.1995	0.2036
in general	6.9396	0.1391	0.1927	0.1963

Table 4: Comparison of categories of procrastination by sex depending on the questions asked (positive questions). (Source: own data)

No statistically demonstrable difference whatsoever was recorded between categories and sex for the positively formulated questions. Therefore, the subject itself is not the cause of procrastination in the case of organized and diligent students.

The results are similar to those for Table 4 for most of the questions insofar as they reflect that students postpone fulfilling obligations (Table 5). Accounting subjects require regular preparation, complemented by homework and projects as part of the education process. Indeed,

the reluctance to start working, to immerse themselves in the assignment and devote sufficient time to preparation is a consequence of the statistically significant differences found between men and women in terms of procrastination for accounting subjects ($X^2 = 11,1462$, p-value=0,025). The difficulty of accounting leads both men and women to procrastinate in the subject. University students postpone commencing the assignment and then fail to complete it in time ($X2 = 14.6873$, p-value = 0.0054).

Manifestations of procrastination (n = 180)

Question in the questionnaire	Test criterion X^2	p-value	Contingency coefficient	Cramer's coefficient
I put off starting work				
accounting subjects	8.7754	0.0670	0.2156	0.2207
in general	5.3854	0.2500	0.1704	0.1730
I lose time doing other things				
accounting subjects	3.5795	0.4659	0.1396	0.1410
in general	1.5278	0.8217	0.0917	0.0921
I don't want to start working straight away				
accounting subjects	**11.1462***	**0.0250**	**0.2415**	**0.2488**
in general	8.4197	0.0774	0.2114	0.2163
As the date of the exam approaches, I give preference to completing other work instead of studying				
accounting subjects	1.9186	0.7507	0.1027	0.1032
in general	1.8872	0.7565	0.1019	0.1024
I put off doing my assignment so I don't manage to complete it				
accounting subjects	**14.6873***	**0.0054**	**0.2747**	**0.2857**
in general	9.0691	0.0594	0.2190	0.2245

* significant difference to α=0.05

Table 5: A comparison of categories of procrastination in terms how the sex of the respondent influences the answers (negatively formulated questions) (source: own data)

In analyzing the frequency of cheating, it was found that 30.56% of the total number of students surveyed did not cheat at all. The remaining 69.44% admitted that they cheat in some way during their studies. The most common types of cheating include traditional ways in which students try to obtain the exam questions (50.5%) and bring pieces of paper into the exam hall, or the equivalent in their mobile phone (47%). Of the methods of cheating listed, plagiarism was the least frequently used (4.5%).

DISCUSSION

When it comes to classifying students according to their procrastination scores, Grunová (2015) concluded that in the case of third level students, 49% of men and 28% of women could be categorized as heavy procrastinators, which corresponds to the findings of her research on accounting subjects. In accounting subjects, 48.4% of males were in this category, but there was an increase in the level of procrastination among women (37.9%). The procrastination score for third-level students was ranked in this paper according to Lay's scale of procrastination, as well as the research findings. This has confirmed the assumption that half the students will be in the upper half of the scale for accounting subjects and in the case of academic procrastination in general, since the proportion of respondents with a score of above 30 was over 55% for both groups. At

the same time, an analysis of individual procrastination scores (Table 1) also confirmed the results of the research conducted by Stárová et al. (2018), Lee (2005), Patrzek et al.(2015), i.e. that none of the students was found to be non-procrastinators, unlike the research findings of Ferrari et al. (2007). Based on the results in Table 2, it was found that there is no significant statistical difference between the degree to which students put off their study obligations in accounting subjects from their level of academic procrastination in other studies whereby authors such as Escolano-Perez (2017), Grunshel and Schopenhauer (2015), Patrzek et al. (2015) and Procházka et al. (2014) investigate procrastination in students of various disciplines where it was possible to exclude the influence of a particular subject on procrastination.

There is no significant statistical difference between the proportion of female and male procrastinators in accounting subjects. The results do not correspond to the conclusions reached by Steel and Ferrari (2013), who, by contrast, confirmed the hypothesis regarding statistically significant differences in procrastination depending on the sex of the respondent, i.e. that men procrastinate more than women. In terms of the influence of the sex of the respondent, testing has demonstrated that there is no significant statistical difference in the proportion of men and women in the case of general procrastination, as stated by Stárová et al. (2018), while in the case of accounting subjects the reluctance to start working, to immerse themselves in the assignment and devote sufficient time to preparation is a consequence of the statistically significant differences between men and women in terms of procrastination. Men put off starting work, and then they don't manage to finish it. The same conclusion was reached by Khan et. al (2014), who analyzed the impact of demographic variables such as sex, age and education in third-level students. He found a significant difference between women and men, with men procrastinating more than women. Many other comprehensive studies show that men cheat more than women (e.g. Balkis, 2017; Yu, 2016; Hensley, 2013; Tibbets, 1999), but some of the more recent studies found the opposite, finding that women cheat more than men (Antion, 2016). According to Patrzek et. al (2014), one of the most common ways in which women cheat is copying from other students during written tests (22% more often than men). By contrast, women copied homework less frequently than men by 31%.

Attempting to cheat is closely linked to procrastination. Ferrari et al. (1995) found that students who procrastinate are far more likely to cheat or lie. Sattler et. al (2015) state that the degree of cheating in students depends on the university's approach to cheating prevention. Dishonesty among students is also passed on to professional conduct (Ameen et. al, 1996) and leads to ethical and intellectual failure in accounting practice (Gray et al., 1994). The research conducted by Patrzek et. al (2014) at four German universities concluded that the most frequent unscrupulous behaviour among students was copying during written tests (36%), and that plagiarism was the least common form (12%). According to our research, one of the most common forms of cheating is attempting to obtain the exam questions in advance (50.5%) and bringing small pieces of paper into the examination hall, or the equivalent in mobile phones (47%); plagiarism was least common (4.5%). In order to eliminate these findings, educators could work more on the internal and external motivation of students in the future to overcome their reluctance to start studying. Moreover, updating the exam questions on a far more regular basis would reduce the most common form of cheating insofar as students would learn that merely attempting to obtain the questions prior to the exam is futile.

The cross-sectional study presented here is somewhat limited insofar as it only looks at students from one university. This could, however, be the starting point for future work focusing on national or international evaluation. The authors are considering extending future research to students of accounting at the University of Economics in Prague and conducting cross-university comparisons.

Conclusion

Academic procrastination is perceived as unwanted behaviour that is not in line with the ethical status of universities and can cause personal complications during the course of studies itself, but also problems in an individual's academic, professional or political career. Research findings have shown that postponement of duties to a later date is very typical for the academic environment. The research itself focused on the students from the CULS, where the questionnaire survey primarily examined the influence of the difficulty of the accounting subjects on the degree of procrastination, gender influence and also consequences, which simultaneously lead to cheating. The procrastination score for university students was ranked according to Lay's scale of procrastination. Statistical testing has shown that half the students ranked in the upper half of the score range, both in accounting subjects and academic procrastination. In terms of overall self-assessment, the difference between men and women in the postponement of duties related to accounting subjects was not confirmed. However, when analyzing specific manifestations of procrastination, it has been demonstrated that the reluctance to start the task at hand, to immerse oneself in the problem and to devote adequate time to preparation is the result of statistically significant differences between men and women in terms of procrastination in accounting subjects. Following on from previous studies, the negative manifestations of procrastination were also analyzed. Of the survey sample, approximately 69% of respondents admitted that they had cheated in some way during their studies.

Acknowledgements

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MUNICIPAL FINANCE EDUCATION RESULTS AT FEM CULS PRAGUE APPRAISAL

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Abstract

This paper focuses on the exams success rate of students in the subject the Local Finance and Municipality Management. One of the research objectives is to verify whether there is a statistically significant difference between full-time and combined study students in passing the exam. The main goal with a practical impact is to build a model that will estimate the number of places required for the exams period based on the historical data. The data were drawn from the FEM CULS Prague information system from 2015 to 2018. The results of statistical hypothesis testing show that there is no statistically significant difference in the success rate of the examinations among students of different grades and disciplines who passed the test for the first, second or third attempt. The model´s results of the places number show that the need of exam places reaches 1.58 times the number of students enrolled in the subject.

Keywords

Exam, local finance, municipality, student, university

Introduction

Knowledge in the field of finance, local finance and taxation can be included among the basic knowledge of graduates in economic subjects Finance in relation to education are explored by a number of authors. Šíma, Beranová and Navrátilová (2018) evaluated in their study students' financial literacy. With education of students in the field of finance also dealt for example Hoadley et al. (2016) or Macht (2016). Beranová et al. (2017) demonstrated a statistical link between study levels and access to financial security in old age. McCannon and Peterson (2015) examined the impact of financial education on investment decisions. Financing also includes financing of municipalities and regions. Incomes of municipalities and regions in the Czech Republic consist mainly of revenues from taxes. The region's tax revenues amount to 35.47% of the total income, municipal revenues account for 69.32% of the total revenue (Ministry of Finance of the Czech Republic, 2017). The indebtedness of the municipalities in the Czech Republic assess in their contribution Petr, Provazníková and Krupka (2015). Local taxes and their impact on quality of life in Spain are analyzed by Delgado, Lago-Penas and Mayor (2018). Tax instruments for financing local governments are the subject of research in Italy (Bordignon, Grembi and Piazza, 2017), or in Serbia (Anicic, Jelic and Durovic, 2016).

From the point of view of the management and development of municipalities and regions, it is important to know the basic principles of financing, financial management and also the redistribution of tax revenues. This is also related to the knowledge of tax issues. Within the framework of the study program Public Administration and Rural Development, students have the opportunity to get acquainted with the above-mentioned problems in the subjects Tax System

and Administration (bachelor study program) and Local Finance and Municipality Management (follow-up master study program). Teaching takes place in full-time and combined form at the Faculty of Economics and Management (FEM), Czech University of Life Sciences Prague (CULS). The content and way of teaching in the given subject is identical for all students in both full-time and combined form of study. Verification of the acquired knowledge is done in the same way, in the form of a written test and an additional oral exam. The exams results from these subjects have not yet been comprehensively evaluated in any way, so they have become the subject of this research.

In the past, the success of students in some subjects at FEM CULS Prague has already been evaluated. The results of the exams in the subject Accounting Theory in 2014-2017 in the discipline Business and Administration and Public Administration and Rural Development were analyzed by Kuchařová, Pfeiferová and Prášilová (2018). According to research results Ječmínek et al. (2018), there is no statistically significant difference in the exam results in tax courses between students of various disciplines and forms of study. Rydval and Brožová (2017) analyzed the impact of self-test improvement for the course Applied Mathematics for Informatics made in academic year 2015/2016 at the CULS. Svatošová and Pelikán (2017) evaluated, how strong is the impact of admission exam results upon the university study success at FEM CULS Prague. Šánová et al. (2014) evaluated the success rate of students in the Food Goods Knowledge subject in relation to the reduction of teaching hours and placement of the subject among optional subjects. The evaluation of students' success is also done in other studies from other universities such as Měsíček, Petrus and Kovářová (2017) or Moravec et al. (2016). The evaluation of the results also applies to entrance examinations. In their study, Maryska, Nedomova and Doucek (2017) dealt with university entrance exams, Habarta et al. (2016) found that testing of knowledge with multiple choice tests with one correct answer can lead to unnaturally similar results among applicants sitting side by side. Klufa (2016) analyzed differences in the number of points among different test variants from one subject (mathematics).

Our research is aimed at verifying whether there is a statistically significant difference in exam success rate between the students of the full-time and combined forms of study. The main objective with a practical impact is to create a model that based on the number of students enrolled in the subject provides information on the need of the number of places to be opened during the examination period for students of daily and combined study in the subject Local Finance and Municipality Management.

Materials and Methods

Part of the research relates to the success of students in examinations from Local Finance and Municipality Management courses which are taught both in the full-time and combined form of study. The data are drawn from the FEM CULS Prague internal information system for academic years 2015/2016–2017/2018 ($T = 3$). The choice of the period is related to the changes of the lecturers and the unification of the teaching methods and the exams for the full-time and combined forms of study. The data have five cross-sectional units ($I = 8$). Table 1 shows the number of students enrolled in the subject, the number of students completing the exam - of which on first, second or third attempt. The last column is the number of students who have failed the exam. To test the statistical hypotheses, we used relative expressions of student success in the exams (Table 1).

Year	Code	Number of students	First		Second		Third		Failed	
			abs.	rel. (%)	abs.	rel. (%)	abs.	rel. (%)	abs.	rel. (%)
2015/2016	EUE13E	97	60	61.86	19	19.59	7	7.22	11	11.34
2016/2017	EUE13E	137	93	67.88	32	23.36	5	3.65	7	5.11
2017/2018	EUE13E	94	59	62.77	22	23.40	4	4.26	9	9.57
2015/2016	EUE83E	53	28	52.83	11	20.75	6	11.32	8	15.09
2016/2017	EUE83E	33	24	72.73	7	21.21	1	3.03	1	3.03
2017/2018	EUE83E	20	10	50.00	4	20.00	3	15.00	3	15.00
2015/2016	EUE85E	109	68	62.39	9	8.26	1	0.92	31	28.44
2016/2017	EUE85E	64	42	65.63	13	20.31	3	4.69	6	9.38
2017/2018	EUE85E	62	38	61.29	15	24.19	6	9.68	3	4.84
2015/2016	EUEJ4E	54	25	46.30	12	22.22	3	5.56	14	25.93
2016/2017	EUEJ4E	50	40	80.00	5	10.00	3	6.00	2	4.00
2017/2018	EUEJ4E	34	17	50.00	9	26.47	0	0.00	8	23.53
2015/2016	EUEK4E	101	71	70.30	11	10.89	2	1.98	17	16.83
2016/2017	EUEK4E	69	45	65.22	18	26.09	4	5.80	2	2.90
2017/2018	EUEK4E	40	26	65.00	9	22.50	2	5.00	3	7.50
2015/2016	EUEL4E	122	61	50.00	23	18.85	8	6.56	30	24.59
2016/2017	EUEL4E	90	54	60.00	17	18.89	5	5.56	14	15.56
2017/2018	EUEL4E	79	52	65.82	13	16.46	1	1.27	13	16.46
2015/2016	EUES4E	81	43	53.09	13	16.05	5	6.17	20	24.69
2016/2017	EUES4E	33	25	75.76	2	6.06	2	6.06	4	12.12
2017/2018	EUES4E	23	16	69.57	5	21.74	0	0.00	2	8.70
2015/2016	EUET4E	72	42	58.33	16	22.22	1	1.39	13	18.06
2016/2017	EUET4E	50	27	54.00	13	26.00	8	16.00	2	4.00
2017/2018	EUET4E	50	28	56.00	13	26.00	7	14.00	2	4.00

Table 1: Number and success rate of students in the exams, 2015/2016-2017/2018
(source: CULS)

Analysis of Variance (ANOVA)

As a starting point for the analysis, we had to determine whether the data follow basic assumption of normal distribution. This assumption is checked using the Kolmogorov-Smirnov test. If the data are normally distributed, then we are able to use standard analysis of variance (ANOVA for short). ANOVA can be thought of as an extension of the t-test for two independent samples to more than two groups (Ostertagová and Ostertag, 2013). In our case, we divided the students into classes in which the subject is taught. ANOVA therefore tests whether the population means among different classes are equal.

The authors set four statistical hypotheses to test whether there is a statistically significant difference in the success rate of examinations among students of different courses.

- H_{01}: There is no statistically significant difference among the relative frequency of students of different courses who have passed the exam on the first attempt.
- H_{02}: There is no statistically significant difference among the relative frequency of students of different courses who have passed the exam on the second attempt.
- H_{03}: There is no statistically significant difference among the relative frequency of students of different courses who have passed the exam on the third attempt.
- H_{04}: There is no statistically significant difference among the relative frequency of students of different courses who failed the exam.

Model of number of places on exam time table

The model determines the required number of places on the exam time table based on the number of students enrolled in the subject. The panel data has 24 records, based on which the coefficients of overall success rates are estimated. Linear regression through the origin was used for the calculation. If the independent variable is the number of students enrolled in the subject and the dependent variable is the number of students who passed the exam on the first attempt, then the slope of the curve tells the student's success rate on the first attempt. The equation in general form can be written as:

$$y_j = \beta x_i + \mu \tag{1}$$

where y_i is a dependent variable, β is a regression coefficient (slope of the curve), x is the independent variable and μ is a stochastic variable.

Declaration of variables: y_1 is the number of students who passed the exam on the first attempt, y_2 is the number of students who passed the exam on the second attempt, y_3 is the number of students who passed the exam on the third attempt, y_4 is the number of students who failed the exam, x_1 is the number of students who enrolled the subject.

The required number of exam terms is then estimated as follows:

$$z_1 = \beta_1 x + 2\beta_2 x + 3\beta_3 x + 3\beta_4 x. \tag{2}$$

RESULTS

The data were tested for normality distribution using the Kolmogorov-Smirnov test to check the structure of dataset for next steps consideration.

Exam attempt	Kolmogorov-Smirnov		
	Statistic	df	Sig.
First	.095	24	.200
Second	.195	24	.019
Third	.190	24	.025
Failed	.125	24	.200

Table 2: Kolmogorov-Smirnov test of normality (source: own calculation, SPSS)

According to the Kolmogorov-Smirnov test (table 2), the null hypothesis of the normal distribution is not rejected at 5% level of significance for the data on the first exam attempt and students who failed the exam. Null hypothesis can not be rejected at 1% significance level for the second and third exam attempt.

The results of one-way ANOVA implicate that we don't reject null hypotheses (H_{01}, H_{02}, H_{03}, H04) and thus there is no statistically significant difference among relative frequency of students of different courses who have passed the exam on the first, the second or the third attempt. Results are shown in Table 3. The p-value of analysis of variance is greater than set significance value of 5%.

Attempt number	Passed Exams Rate Evaluation	Sum of Squares	df	Mean Squares	F	Sig.
First	Between Groups	340.303	7	48.615	0.536	.795
	Within Groups	1451.398	16	90.712		
	Total	1791.701	23			
Second	Between Groups	195.449	7	27.921	0.797	.601
	Within Groups	560.280	16	35.018		
	Total	755.729	23			
Third	Between Groups	148.713	7	21.245	1.070	.426
	Within Groups	317.804	16	19.863		
	Total	466.517	23			
Failed	Between Groups	361.076	7	51.582	0.722	.656
	Within Groups	1143.801	16	71.488		
	Total	1504.877	23			

Table 3: Results of Analysis of Variance (source: own calculation)

Model of number of places on exam terms

From the course of linear functions, 61.54% of students will successfully pass the exam on the first attempt, 18.88% of students on the second attempt, 4.92% on the third attempt, and 14.65% fail the exam. The results are summarized in Table 4.

	Coefficient	Standard error	p-value	R^2	p-value (F)
Model 1	0.615	0.015	<0.001	0.986	<0.001
Model 2	0.189	0.0112	<0.001	0.925	<0.001
Model 3	0.049	0.0067	<0.001	0.699	<0.001
Model 4	0.146	0.0175	<0.001	0.753	<0.001

Table 4: Results of linear regression (source: own calculation)

All models and coefficients are statistically significant at 1% level of significance, so the confidence interval for predicted values of places for the exam is 99%. The coefficient of determination reaches values ranging from 69.94% to 98.64%.

The practical significance of the given model was verified through a simulated scenario: Determination of the number of places for the exam terms from the subjects Local Finance and Municipality Management (full-time and part-time study forms) in the summer semester of the academic year 2018/2019. In the summer semester 2018/2019 the amount of 394 (x) students is enrolled in the subjects Local Finance and Municipality Management. Based on the number of students and knowledge of the coefficients, an estimate of the need for places for the exam terms was made. The number of places for the exam terms is determined according to the (2).

Of the total number of 394 students, 243 students will pass the exam on the first attempt, 74 for the second attempt, 19 for the third attempt and 58 will fail the exam.

If the success rate is comparable to the previous three years, the required number of places for the exam terms is 623. The number of places for the exam terms reaches 1.58 multiple of the number of students who have enrolled in the subject.

DISCUSSION

Financing of local authorities is an important part of public sector financing. Disciplines in the fields of finance, taxation and other sciences meet here. Education is an essential part of qualified decision-making on municipal and regional funding. This includes a wide range of subjects taught at FEM CULS Prague within the study program Public Administration and Rural Development. The part of the complex approaches to teaching is also the assessment of the success of the

students in the exams. There are a number of studies at FEM CULS Prague, that assess the success of students in the exams.

Šanová et al. (2014) evaluated the success rate of students in Food Goods Knowledge Subjects in relation to the reduction of teaching hours and placement of the subject among optional subjects. Svatošová and Pelikán (2017) evaluated how strong the impact of admission exam results was on university success. Kuchařová, Pfeiferová and Prášilová (2018) ascertained that the results of the oral examination from the subject Accounting Theory were most influenced by the result of the written part of the exam. Based on the analysis of the students› success in exams in the subjects of the Tax System and Administration and Tax System, it was found that there is no statistically significant difference between students of various disciplines and forms of study (Ječmínek et al., 2018).

However, the evaluation of the success rate in the subject Local Finance and Municipal Management has not yet been completed. Therefore, an analysis of differences in exams success was performed. The assessment was aimed at students of full-time study and a number of students of combined forms of study taking place in consultation centres. The results show that there is no statistically significant difference in success between the students who passed the exam for the first, second or third attempt or did not pass the exam.

Based on the results of the statistical testing, a mathematical model was then created to determine the number of places for the exam terms. The model has a practical use in determining the number of places for exams in the subject the Local Finance and Municipality Management. Based on this model in the summer semester 2018/2019 for 394 students 623 places for the exam dates are reserved (1,58 multiple of the number of students enrolled in the course). There is also interesting to compare the need for places for exam periods in tax courses. Here, on the basis of the results of similar analyses, the number of exams places is 1.42 multiple of the number of students enrolled in the subject (Ječmínek et al., 2018). Knowledge about the required number of places in exams terms in tax courses (Ječmínek et al., 2018) and in the subject Local Finance and Municipal Management enables efficient layout of examination terms during the examination period in the summer semester 2018/2019.

CONCLUSION

The main objective was to establish a model that based on the number of students enrolled in the Local Finance and Municipality Mangement course in both the full-time and the combined form of study provides information on the need for the number of places to be opened for the exam period. The model was compiled using data from the internal University Information System of CULS Prague for academic years 2015/2016–2017/2018. Models based on panel data estimate the success rate of the students who passed the test on the first, second or third attempt, or failed the test at all. The reliability interval for predicted places during exams period is 99%. During the summer semester of the academic year 2018/2019, the calculated coefficients for determining the required number of places for the exam terms were created and currently used for the subject Local Finance and Municipality Management. The results show that the total number of places for the exam terms is 1.58 multiple of the number of students enrolled in the subject in both full-time and combined form of study. The result is important for practical application when planning the number of places during the exam period so as to maintain the long-term level of successful examinations.

Testing results of statistical hypotheses show that there is not a statistically significant difference in exams success between students in full-time and combined studies in the subject Local Finance and Municipality Management. Zero hypotheses H_{01}, H_{02}, H_{03} and H_{04} are not rejected at 5% significance level.

Thanks to collaboration with researchers from other universities, where three attempts are also being used for passing the examinations, the results are transferable. The subject of future research is to compare the test results of students from different universities in subjects including potential taxes, accounting and finance, depending on data availability and quality.

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THE SOCIAL RESPONSIBILITY OF UNIVERSITIES IN THE CZECH REPUBLIC: COMPARISON OF THE SITUATION IN 2011 AND 2018

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Abstract

The concept of the social responsibility of organisations was originally created for the commercial sector. However, thanks to changes in the external environment, this is becoming increasingly applicable to non-commercial organisations too, such as public universities. These organisations are a major part of any society and it is expected that they will be the responsible authority to promote the interests of the society in which they operate. This article focuses on identifying the most common socially responsible activities of public universities in the Czech Republic, barriers preventing universities from implementing the concept and factors that should motivate universities to implement social responsibility. In this context, it tracks the change that universities have undergone since 2011 to the present day, through two questionnaire surveys conducted in 2011 and 2018.

Keywords

Comparation, development, high education institutions, social responsibility

Introduction

The concept of corporate social responsibility (CSR) emerged in the 1950s (Moravcikova et al., 2015). During the past twenty years it has gone from being a marginal topic to become part of most multinational enterprises, has found its way into small and medium-sized businesses and is now common in non-profit organisations such as public universities. CSR has become an approach that achieves growth and profit in organisations all over the world (Elobeid et al., 2016) and improves the image of an organisation (Asemah et al., 2013)

In Europe the concept of CSR stems from the triple bottom line theory (3BL), which is based on the idea that an enterprise bears economic, social and environmental responsibility for its activities (Ksiezak and Fischbach, 2017); 3BL also tends to be referred to as the three Ps: people, planet and profits (Slaper and Hall, 2011)

In recent years universities have faced a great social and environmental challenges (Georkagi and Anastasiou, 2019), such as internationalization, the development of IC&T, the knowledge society and commercialisation (Alzyoud and Bani-Hani, 2015; Vasilescu et al., 2010). Universities are expected to provide not only courses and research, but also now to provide services for local communities, requiring partnerships with local communities and other interest groups (Jongbloed, Enders and Salerno, 2008). The implementation of the concept of social responsibility enables universities to cope with the rapidly changing environment (Alzyoud and Bani-Hani, 2015) and thus becomes one of the strategies highly favoured by universities to earn a good reputation and gain a competitive edge (Dahan and Senol, 2012; Asemah et al., 2013). For a university to live up to the expectations of its interest groups, it must adopt a social responsibility strategy just like other organisations (Georkagi and Anastasiou, 2019).

The aim of this paper is to identify the development and changes in the CSR behaviour of public universities, by comparing research conducted in 2018 with research from 2011.

Materials and Methods

According to figures from the Ministry of Education, Youth and Sport MEYS, in 2018 there were 26 public universities and 2 state universities in the Czech Republic (MEYS, 2018). Primary data were obtained through an anonymous questionnaire survey conducted for a dissertation (Kvasnickova Stanislavska, 2013) and diploma thesis (Panikova, 2018). The same questionnaire, due to its comparability, was sent in electronic form to each public and state university in the Czech Republic by email, to the persons whose job title was most appropriate for this area. The return rate of the questionnaire was 39% (in 2011) and 60% (in 2018). A breakdown of the questionnaires received, including the percentage rate of return, is given in Table 1. The data are evaluated using descriptive statistics, specifically statistical ratio indicators. For the purposes of this paper we contacted public and state universities classed as higher education institutions (HEIs).

Type of HEIS	Total number of HEIs	The return rate in year 2011	The return rate in year 2018
Public higher education institutions	26	10	16
State higher education institutions	2	1	1
Total in %	100	39%	60%

Table 1: Rate of return of questionnaires received (Source: Kvasnickova Stanislavska, 2013; Panikova, 2018)

The questionnaire survey determined the socially responsible activities of HEIs, barriers preventing HEIs in implementing social responsibility and factors that would motivate HEIs to implement social responsibility.

Result and Discussion

In 2011 the topic of the social responsibility of HEIs was discussed in the public domain in connection with the so-called Third role of universities. According to the White Book on Tertiary Education (Mateju et al., 2009), the third role of universities is defined as a more general service to society, which implies use of the concept of social responsibility. Since then, the concept of CSR has begun to emerge in projects HEIs (Centralized Project 'Developing CSR Teaching Based on University Experience Sharing', 2014), has become part of the University Strategic Plans (MUNI, 2016) and a Corporate Social Responsibility Center was established (CSR Mendelu, 2019)

The results of the research show that in 2011 activities falling under the concept of CSR were very widely used and from the options available in the questionnaire there was not a single activity not carried out by HEIs. HEIs most often helped handicapped students and organised cultural and social events for employees (identical at 90.9%), implemented the University of the Third Age, taught subjects focused on CSR and offered benefits for employees (identical at 81.8%), and other activities shown in Figure 1. The performance of these activities corresponds to the so-called University Social Responsibility concept defined by Vasilescu et al. (2010).

In 2018 there is a visible increase in the application of CSR in HEIs, with a rise in the number of activities carried out by more than 80% of the HEIs involved, in addition to the aforementioned collaboration with the non-profit sector and the provision of advisory services. As part of the „other" response, the implementation of CSR student projects appears in 2018. Giuffré and Ratto (2016) consider student involvement in the implementation of CSR activities very important. Students acquire new skills while learning to be good citizens.

In contrast, there is a fall in the number of CSR-related subjects, although many authors writing on the topic of CSR consider the teaching of those subjects at universities to be fundamental for future leaders, managers and entrepreneurs (Gonzales et al., 2016; Galvao et al., 2019).

A significant decline (from 46% to 23%) may also be seen in the organisation of requalification courses. This decline is probably caused by the change in the situation on the labour market, where during the period in question unemployment fell from 9% to 3% (CZSO, 2019**)**
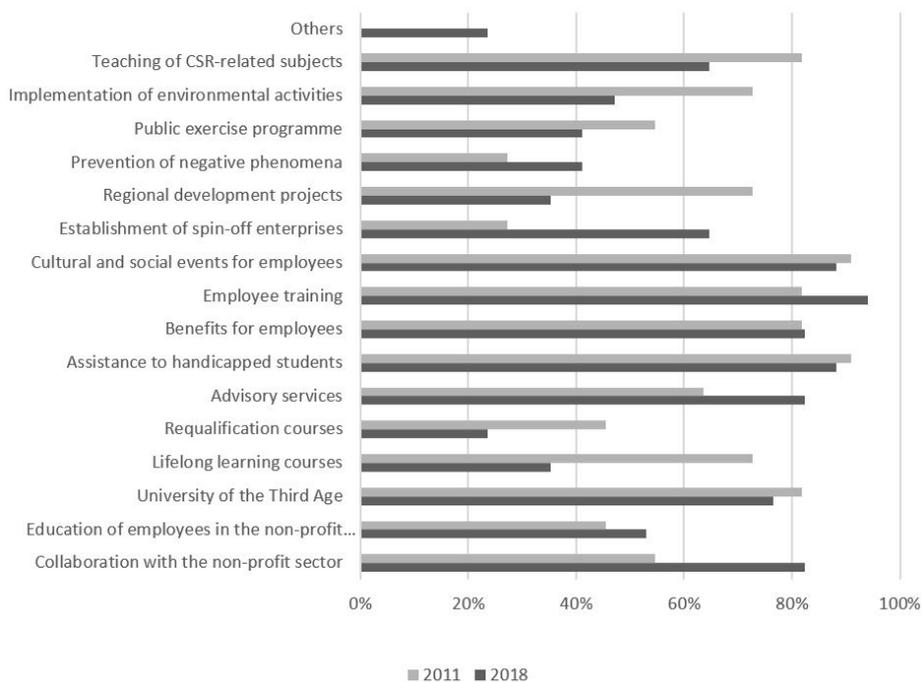
Figure 1: Comparison of socially responsible activities at universities in 2011 and 2018 (own processing)

Although from Figure 1 it might seem that the implementation of the CSR concept at HEIs in 2011 was at a similar level as in 2018, the other results show significant differences in motives (see Figure 2), perceived barriers to implementation (see Figure 3) and factors supporting further development (see Figure 4).

Although in 2011 most of the institutions surveyed stated that their main motive for implementing the CSR concept was ethical and moral reasons (73%), the same number of HEIs stated their effort to improve the image of the university (73%), with more than half (53%) mentioning their effort to attract students. This shows that in 2011 HEIs saw CSR more as a form of marketing that could be used to improve their image in the eyes of their interest groups (Asemah et al., 2013). In 2018 the results of the study show a slight shift in institutions' motives for implementing the concept towards motives stemming more from their own belief in the need for CSR. Ethical and moral reasons increased to 82%, the effort to contribute to the development of the community rose to 47%, while there was a fall in the effort to improve the image of the university (47%), to attract students (35%) and employees (24%) and the effort to increase employee loyalty through CSR programmes (24%). HEIs are also seeing increasing public pressure to behave in a socially responsible manner (from 9% to 18%).
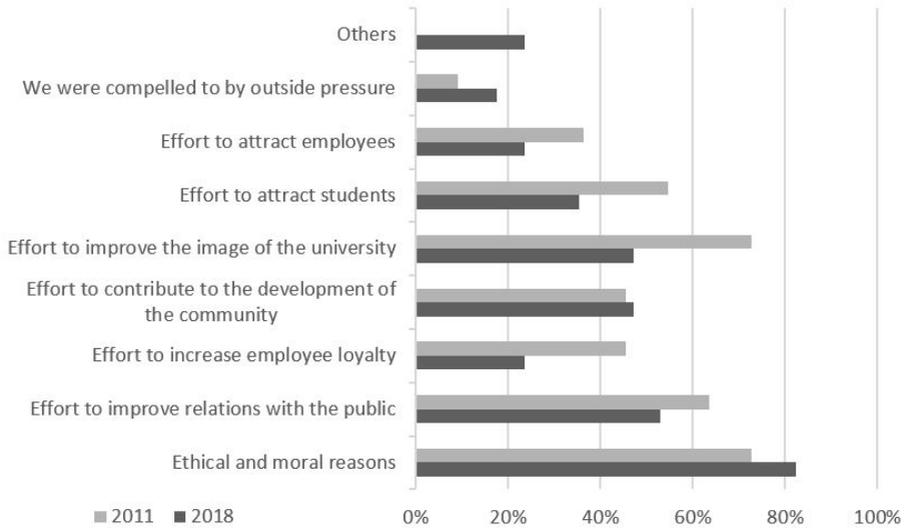
Figure 2: Comparison of the reasons for socially responsible behaviour by HEIs in 2011 and 2018 (own processing)
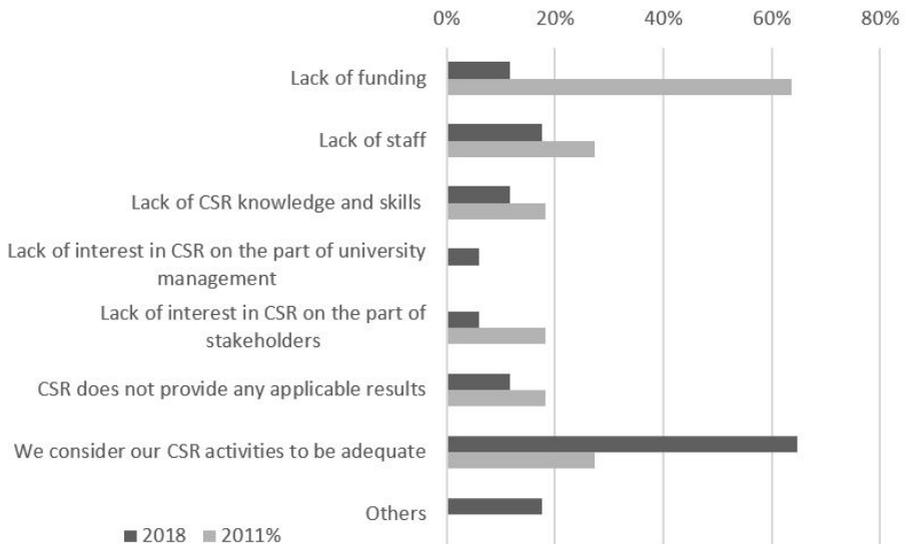
Figure 3: Comparison of reasons hindering HEIs in socially responsible behaviour in 2011 and 2018 (own processing)

The most significant shift occurred between 2011 and 2018 and was in the perception of the reasons that prevent HEIs from implementing socially responsible behaviour. In 2011 the main problem for 64% of HEIs was a lack of funding, the same conclusion see in Wright (2010); however, in 2018 this problem was stated by only 12%. In contrast, 65% of HEIs see their CSR activities as adequate. In accordance with this opinion, compared with 2011

there was also a slight fall in the reasons „Lack of staff" and „Lack of CSR knowledge and skills".
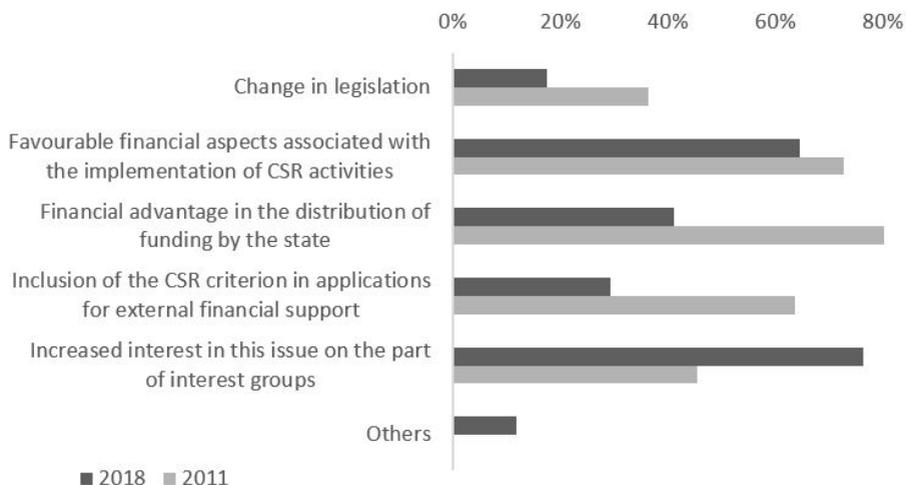
Figure 4: Comparison of factors promoting the development of CSR in HEIs in 2011 and 2018 (own processing)

The results, which compare factors contributing to the development of CSR as shown in Figure 4, also demonstrate how HEIs' perception of the CSR concept has changed since 2011. In 2011, although HEIs did have some experience with CSR activities, for the development of those activities, they would particularly appreciate funding from the state, such as the financial advantage in the distribution of funding by the state (27 %) and the favourable financial aspects associated with the implementation of CSR activities (24.2%). Increased interest in this issue on the part of interest groups was the second least frequent response. However, by 2018 the HEIs understood that the CSR concept is based on communication with their stakeholders and 31.7% of HEIs consider their increased interest as a factor that would benefit the further development of the concept in their organisation. Communication with stakeholders is considered one of the basic building blocks of the CSR concept and HEIs are also emphatically recommended to make an effort to understand stakeholders' expectations (Asemah et al., 2013). One of the possibilities how to find out stakeholders' expectations is offered by Pilař et al. (2015) using a modified SWOT matrix.

However, despite this shift the „favourable financial aspects associated with the implementation of CSR activities" still remains a significant factor (26.8%) for the development of CSR, although its voluntary nature is one the main criteria of the concept of social responsibility (Tuczek et al., 2018)

Conclusion

The results of the study show that there was a change in the perception and implementation of the CSR concept by HEIs in the Czech Republic between 2011 and 2018. From a marginal point of view, it has become a common part of Czech HEIs. This conclusion is also confirmed by the increased number of questionnaires returned. The number of socially responsible activities implemented by more than 80% of HEIs is currently increasing. The shift is also corroborated

by the rising number of CSR-related projects implemented by HEIs. 65% of HEIs consider their CSR activities sufficient.

When assessing the universities' social responsibility according to the triple bottom line concept, it may be said that most socially responsible activities fall under the internal social pillar aimed at supporting employees. Activities relating to students correspond to the focus of each university, with universities clearly showing an effort to connect these activities with students' work in practice.

What is particularly positive for the development of the CSR concept is the fact that HEIs see funding as an obstacle to CSR less and less now. The real advancement in the CSR concept is that fewer and fewer HEIs are seeing CSR merely as a means of self-promotion.

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REFLECTION ON CORPORATE PRACTICE IN THE SUBJECT OF APPLICATION SOFTWARE AT THE UNIVERSITY OF FINANCE AND ADMINISTRATION

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Abstract

Computational and information literacy of students of all universities is a natural thing. This paper focuses on the current situation at the University of Finance and Administration. The aim is to assess the study support of the Application Software subject. Authors will seek an answer to the research question "Does the conception of the study support of the Application Software subject corresponds with the objective needs of practice?" The paper describes the basic structure of the interactive syllabus created by means of the university Information System. The source of information for meeting the objectives of the article is the results of a public inquiry. The inquiry monitors the reflection of the study support structure, i.e. the content of the course itself, to the objective requirements of corporate practice. There is some evidence that the examined study support corresponds to the software products that are routinely used in practice.

Keywords

Application software, Excel, inquiry, company, computational literacy, information literacy

Introduction

At the University of Finance and Administration (VSFS) the EQUIP project No. 80 – "Open Education for the knowledge economy" - was solved successfully in the years 2008 - 2011 supported by the EU Operational Programme Prague Adaptability. The project aimed to facilitation of the creation of e-learning study supports, unification of their form, upgrading the content of study supports and developing a teaching method. Emphasis was placed on the widespread use of modern communication technologies and new multimedia and interactive teaching methods in controlled self-education. (Nulicek, Novakova and Lansky, 2013).

One of the created study supports was the material to the subject Application Software, which is at the University of Finance and Administration part of the curricula of almost all fields. The need for teaching the subject of Application Software corresponds to the social requirement of the era, and particularly to the requirements of the labour market for gaining computational and information literacy in graduates. A number of authors linked to computational and information literacy, along with the concept of Industry 4.0 is, of course, translated into the information needs of managers (Lasi et al, 2014) or (Poor and Basl, 2018). The necessity to get that literacy at the very beginning of the study so that it can be used in other professional subjects is reflected in the curricula. The subject is taught at the VSFS in the winter or the summer semester of the first year of the bachelor's study.

This paper aims to answer the research question which is framed as: "Does the conception of the study support to the Application Software subject corresponds with the objective needs of practice? Answering this question means to carry out comparison of the study support of the

subject Application Software and the requirements of corporate practice. The metrics to formulate the requirements of corporate practice are software products that are commonly used by businesses in practice. The paper should be original contribution to the subject of computational and information literacy, as well as to the issue of transfer of knowledge from academia to the practice of informatics.

MATERIALS AND METHODS

The following part explains basic terms of the paper, and introduces its aims and research methods.

Profile of the subject Application Software

Teaching the subject of Application Software takes place differently according to the study forms. Within the full-time study, teaching is carried out in the form of controlled workshops where students solve specific tasks under the supervision of the teacher. Teaching within the combined studies is based on students working out the tasks. During the semester, teacher has three tutorials with the students, in which he / she seeks to explain the main issues of solving the tasks that students deal with during the self study. Those tasks are after the initial introduction to the VSFS IS primarily oriented to MS Excel and further to PowerPoint in the latest versions of those packages. Tasks are identical for students in the full-time and the distance form of study (Nulicek, Novakova and Lansky, 2013).

Study support

Study support is also referred to as the "interactive syllabus". The interactive syllabus consists of five sections: the introductory section, the latest information on study, the thematic sections and the final section. The introductory section, the latest information on study and the final section are sections of rather organisational nature. The introductory section of the interactive syllabus contains basic information on the subject, instructions for the study and a list of the study literature. Part of the section is the syllabus of the subject, the starting expected skills which are the basic knowledge of the Windows OS and the Internet. Listed below is information about teachers with links to their personal websites. The final section contains information on granting the credit.

The thematic sections are the heart and the major part of the study support. They consist of several parts. Each thematic section has an introductory preamble, which provides basic information on the topic - the expected entry knowledge and skills, the learning objectives, the key words and the estimated time required to complete the section. Next part is called interpretation and contains links to various study texts and instructions for studying the topic in the relevant chapters of the study literature. Study texts have a fixed structure; each comprises Task instructions and Help for the solution.

In the subject Application Software, the form of works drawn up by individual students independently in different MS Office applications is selected accordingly with unified instructions. In solving the tasks, students can use the help that is available to them with the instructions to the assignment. Within the thematic blocks at the beginning of the semester, students become familiar with the information system of the University. The greater part of the curriculum is devoted to basic skills for the work in MS Excel spreadsheet. Gaining literacy in connection with that software environment represents 73% of the study support (the contents of the subject). The end of the semester is designed to work with the MS PowerPoint application and integration of the MS Office applications. Study support contains eleven examples - case studies (Lansky, Hoffmannova and Hajkova, 2013).

Information and computational literacy

The pivotal direction of the Application Software course and its study support as the main teaching tool is increasing the computational and information literacy of students. The concepts of computational and information literacy are often confused, but their meaning is different. Computational literacy is the ability to work with information and communication technologies. Analogous term is digital competence (Shopova, 2014). Grover and Pea (2013) combine computational literacy and computer science. They highlight the key article of Jeannette Wing (2006) who states that computational literacy is: conceptualising, not programming; fundamental, not routine skill; a way that humans, not computers, think; complements and combines mathematical and engineering thinking; ideas, not artefacts; for everyone, everywhere.

Developing information literacy means developing more general skills for the use of modern technologies. Besides technical knowledge related to the knowledge of managing hardware, software and other ICT means, information literacy covers all aspects of working with information. Reznicek, Smutny and Kalina (2013: 920) warn against unprecedented data availability allowed through the internet enhances a false idea of the information literacy and the inutility of using the critical thinking. Information literate students should be able to define information need, locate, process, assess and convey the obtained information (Yu Lin and Liao, 2017). This literacy is sometimes associated with the mission of libraries (Tewell, 2015). In the Czech Republic environment, the concept of information literacy appears in connection with the conceptions of the state information policy in education. There was a breakthrough in the form of a publically political document State Information Policies released in 1999. That is addressed differently by schools, of course, mainly with respect to the contents of individual fields and specialisations. Computational literacy and information literacy are by (Shopova, 2014) crucial for both the efficiency of the learning process and, in particular, for the adaptation of students to the turbulent labour market. This idea is the basis for the logic of our contribution.

Methods

The methodology of solving the aims of this paper is to describe the profile of the Application Software subject and its study supports. The description will be framed into the issue of computational and information literacy. The basic research method is the questionnaire survey itself conducted at VSFS in a three-year period (2017-2019). The purpose of the inquiry was to explore what application software is used in business practice. Respondents were students who study while working in practice which makes them eligible to have an opinion on the problem. The survey was conducted online. The information resource for solving the research question is therefore the results of the conducted public inquiry. Students are asked to fill it in via an e-mail within the feedback on their attendance at the Application Software course. Completing the survey is voluntary. It is attended by students of the combined form of study and by students of the full-time form of study in the so-called called individual form of study. 502 students were asked to complete the questionnaire. The method of data processing is statistical analysis. The evaluation of the study support of the subject Application Software will be carried out in particular in terms of its content structure. In conclusion, the paper will formulate some recommendations for possible future changes to the subject Application Software and for similar courses in general.

Results

The source for getting answers to the research question asking whether the concept of the study support of the subject of Application Software corresponds to the objective needs of practice is the questionnaire survey itself. The survey is conducted at the VSFS. It has been on since 2017 and is still active. The aim of the inquiry is continuous monitoring of what application software

environments are used in the corporate economic reality. Respondents are students of the 1st year of the undergraduate degree courses at the VSFS who are employed while studying. The survey was conducted online. 502 students were asked to complete the questionnaire and so far has been attended by 225 respondents. The overall response is therefore 45%.

The questions in the questionnaire were as follows:

1. The type of business of the organisation you work with
2. The type of employer
3. The size of the organisation
4. Your position in the job
5. How often do you work with PC in your job
6. The type of software used in your job
7. What specific software do you use at work?
8. The internal corporate information system
9. Describe in words the workload with PC

Only a part of the public inquiry was used for the purposes of this paper, specifically the questions number 6 and 7. These questions had the following answer options:

6. The type of software used in your job
a) commercial software (Microsoft Office), b) free alternatives (Libre Office) c) none
7. What specific software do you use at work? For each software, please differentiate:
a) actively - I create something in it, b) passively – I work with files that were created by someone else

Answers to questions 2 and 3 are used to assess the representativeness of the sample. Formulation of answer alternatives looks like this:

2. The type of employer
a) state organisation b) private organisation
3. The size of the organisation
a) small and medium-sized organisation b) large organisation

As we have seen in the introduction to the support in section 2.2, students will gain the ability to orientate themselves in the VSFS IS and especially the ability to use the tools of MS Excel and MS PowerPoint, along with the integration into other MS Office applications. Let's look at the results of the questionnaire for the above listed applications. As concerns question 6, exploring the type of software that respondents use at work, the commercial software (Microsoft Office) came out as a clear winner. This software is used by vast majority of 88% respondents; the smaller part use free alternatives such as Libre Office or a combination of commercial software Microsoft Office and free alternatives; 19 respondents do not use any of the mentioned software packages.

Perhaps the only major issue of the course turned out that not everyone has MS Office licenses purchased for home preparation. From our questionnaire survey we can see that it is not problematic for the majority of students who work at the same time. However, the results of the research showing the benefits of using open source programs for educational purposes cannot be underestimated (Majovska, 2015). At the same time, when discussing commercial software versus free alternatives, we must take into account the future of smaller private businesses and family businesses.

Now let's see what the answers were to other questions. Question No.7 concerning the specific software used at work we were primarily interested in the spreadsheet editor (MS Excel). The results of the inquiry are neatly summarised in Table 1 below.

the form of the answer	spreadsheet editor is used actively	spreadsheet editor is used passively	spreadsheet editor is not used
number of respondents in %	51	29	20

Table 1: The use of spreadsheet editor in practice (source: own calculation)

the form of the answer	PowerPoint is used actively	PowerPoint is used passively	PowerPoint is not used
number of respondents in %	20	20	60

Table 2: The use of PowerPoint in practice (source: own calculation)

It can be traced back that the spreadsheet editor is used actively, i.e. that the respondent creates something in it, by 51% of workers, while passively, when people work with files created by someone else, by 29%. Overall, the spreadsheet (Excel) editor is used by 80% of the respondents in the working process. Compared with the Word text editor it is just by 4% of respondents less. Responses to using the PowerPoint presentation environment are not so clear. 55% of respondents do not use them at all in their work. Then the ratio between active and passive users is balanced (see Table 2).

An interesting issue is the relationship between the use of individual software and the employer in which the respondents operate, i.e. the criteria of the field, employer type and organization size. Considering our research, the relationship between the size of the organization and the way in which MS Excel is used can be considered the crucial. The results may also depend on the respondent's position in the company. These facts were examined using the Pearson correlation coefficient.

When examining the relationship between the size of the organization and the use of MS Excel, it was surprisingly found that these attributes were completely independent. The survey shows that a large proportion of respondents are employees (64% of those surveyed), while about a quarter of respondents (24%) work in management, 12% are interviewed as a private entrepreneur or business owner. Let's suppose that the independence of the work will be based on the scale of employees - management - private entrepreneur. If we accept this assumption, only a slight direct dependence of 0.15 has been demonstrated by examining the links between work autonomy and the level of MS Excel use.

The answers to question 8 regarding the internal corporate information systems shows that practice uses a very broad spectrum of ERP systems and other information systems and applications. This is very important in the context of the competitiveness of Czech companies, as Pisar and Havlicek (2018) show. In conclusion, it is necessary to note that computational to information literacy, the ability to work with spreadsheets and databases are only a part of the skills that are demanded for technical professions by the job market (Sodhi and Son, 2008). Mildeova and Brixi (2011) prove that enterprises are always looking for new and evolutionary solutions and opportunities in ICT and that their limit is not technology but people.

As regards the representativeness of the sample, the questionnaire survey showed that 68.5% of respondents work in private organisations, as opposed to weaker representation of 31.5% of respondents from public organisations. According to the (Czech Statistical Office, 2019), the nationwide employment rate in state organisations is however still significantly lower; it is about 8.7% of the total employment. According to the size of the organisation, the representation of alternatives is equal; 47% of respondents are from small and medium-sized organisations and 53% of respondents work in large organisations. Let's have a look at this ratio in the Czech Republic scale. Small and medium-sized businesses in the Czech Republic employ almost 60% of workers (Ministry of Industry and Trade, 2018). As we can see, even though structurally our specimen of respondents is acceptable, the inquiry from the perspective of statistical measurements can

be considered representative only partially. The questionnaire did not ask the respondent's age or gender, although these questions and especially the gender, are also taken into account in our university surveys (Ulrychova and Bilkova, 2018).

Conclusion

The up-to-now experience with the e-learning form of teaching the Application Software subject at the VSFS is positive and confirms that this form of teaching is effective and beneficial for students. The form of teaching, however, was not the key issue of this paper. It was to determine whether the study support for the Application Software subject corresponds with the objective needs of corporate practice. In the course, students will in particular gain an advanced user knowledge of MS Excel tools with integration into other MS Office applications. The key to our inquiry was whether the choice of the application software and the level of teaching is not just an academic matter, and whether it corresponds to the requirements for knowledge and skills of graduates.

From the above it is clear that the choice of Microsoft Office for educational purposes is right without any doubts; 88% of respondents use commercial software Microsoft Office at work. The results of the questionnaire further indicate that our focus on MS Excel is fully defensible due to the 80% of active or passive users of spreadsheet applications. No significant dependencies were found between the size of the organization, the position of the respondent at work and the use of MS Excel. The results of our inquiry also confirmed the necessity to train students on the ability of integration of individual MS Office applications. As concerns the inclusion of the opening section of the study support to gain the ability to work with the university IS, the concerned cannot be directly related to corporate needs. It can however be concluded that acquiring the skills to work with menus, or better with user interface of the university system, can be beneficial for work with any information system.

Other planned methods of examining the results of our public inquiry will be data mining and text mining. Future research will focus on finding hidden connections between the data, especially the relationship between the employer (its size and type) and the application software used. Another possible direction for the future research is to focus on the content of the case studies and their comparison with the workload of the respondents related to work on PC. All topics covered within MS Excel are in fact based on the economic situations of practice and on the spreadsheet processor being frequently used in the practice of organisations, in particular as a support tool, providing a basis for the decision-making roles of management and making accessible sometimes hardly available information about what is happening within the company.

Through the approach applied in the course from a problem to a tool and back, the desired shift can be achieved, according to the authors, from computational to information literacy, which was also pointed out in the paper, and which certainly does not concern only the course examined by us. Computational literacy includes basic skills of working with hardware and software, and hence should also include active mastery of working with the spreadsheet editor. Information literacy is not based on the "clicking" principle only (i.e. be able to easily click wherever and in whatever order). It requires students having an insight in the topic, knowledge of why and in what situations a particular procedure can be used, puts emphasis on working with information. It fully exploits the fact that Microsoft Office Excel allows you to convert data into information using powerful tools for analysis, communication and sharing the results.

Acknowledgments

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REVEALING STUDENTS' MISCONCEPTIONS ABOUT BASICS OF MOLECULAR BIOLOGY AND GENETICS

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Abstract

Molecular biology and genetics have become very important parts of a secondary education curriculum at the turn of 21st century. However, there is still a limited evidence of how much students understand these topics. Aim of this study was to examine students' understanding of basic concepts of molecular biology and genetics after the end of secondary education and to identify possible misconceptions they hold. Combination of open, open-ended and multiple-choice tasks was utilized for the evaluation. We tested 316 first-year bachelor students from 21 universities in the Czech Republic in autumn 2019. Answers reveal that students struggle to understand life-long role of DNA in the cell and the amount of its control over the living body and its influence on the phenotype. Described misconceptions are crucial for further improvements in educational practice and their possible origin is discussed.

Keywords

Genetics, misconceptions, molecular biology, secondary education

Introduction

Genetics and molecular biology are well-established parts of many National curriculums aimed for secondary schools. Findings of these sciences influence our lives on daily basis in terms of diet, health care and agriculture. They also enable implementation of new technologies that are raising serious ethical questions (e.g. genetically modified organisms). Therefore, it is essential for today's students to understand the basics of these science fields well enough so they will be able to make educated decisions in life.

Unfortunately, many researches have already documented that students often struggle to deeply understand genetics and molecular biology and that they often carry various misconceptions rising from their misunderstandings (Lewis and Wood-Robinson, 2000; Chattopadhyay, 2005; Shaw et al., 2008). Misconceptions, students hold, vary from misunderstanding of purpose of the DNA (Lewis and Kattmann, 2004) to simple confusion of basic genetics terms and misunderstanding of their nature (Lewis and Wood-Robinson, 2000). Also, many school teachers declare genetics and molecular biology to be problematic topics because of their abstract nature and complexity (Knippels, 2002; Havelková et al., 2008). In the Czech Republic, basics of genetics and molecular biology are already well-established parts of National curriculum for secondary schools (Research Institute of Education, 2007; Ministry of Education, Youth and Sports, 2016). There was, however, no broader attempt to evaluate the understanding of these topics among students.

Aim of this study is, therefore, a first broader investigation of how deeply Czech students understand the basic knowledge of genetics and molecular biology they gained during their secondary education and what misconception about these topics, if any, do they hold.

Materials and methods

Development of the testing tool

All current biology textbooks available to schools in the Czech Republic and national curriculum requirements (RVP) were evaluated to determine common basis of knowledge in molecular biology and genetics in secondary education (Machová, 2017).

Based on this evaluation, testing tool, consisting of nine tasks, was prepared. Seven original problem tasks, testing the basics of genetics and molecular biology, were constructed. Two tasks were adopted from collection of TIMSS 8th-Grade Science Concepts and Science Items from 2011 (IEA, 2013). These items served as evaluation of students' achievements in international context. Content validity of the tool was determined by two experts in the field of genetics and molecular biology and two experts in biology education. Finished tool was then a subject of a pilot study in a group of first-year bachelor students of non-biology focused program at Faculty of Education of the Charles University (N = 30) to reveal possible problems with understanding the instructions. These did not occur, so the tool stayed unchanged.

Tool consists of three forms of tasks – 1. open (3 items), 2. open-ended true/false (4 items), and 3. multiple choice (2 items). Open-ended and fully open questions enable deeper evaluation of misconception held by students. Open and open-ended questions gave opportunity for more types of right answers. Open-ended tasks were rated as right only if students chose right option as well as gave a right explanation for it.

Second part of the tool consists of demographic items such as age, sex, year and field of study and type of tertiary education that allowed grouping of respondents.

Respondents

Research aim was to show knowledge of students after the end of their secondary education. To filter out possible short-term impact of final exams at the end of secondary level students were tested after summer break in autumn of next school year.

Searched respondents were first year bachelor students at the beginning or even before the start of their first semester at university. Respondents were addressed via Facebook social network through groups used to gather university freshmen. All groups found were addressed. Simple invitation with link to the tool was posted in open groups. In case of private (closed) groups, group administrators were asked to deliver the message in the group (42% replied, 30% of administrators put the link into to group). Facebook invitation emphasise that also students with poor biology knowledge are really welcome in our research.

Altogether we gathered 404 respondents. We excluded respondents that had different nationality than Czech, study for second year or longer or their age suggest that they did not ended secondary education in previous school year. After corrections, there were 316 respondents left for the analysis.

Respondents came from 21 different Czech universities (19 state universities, 2 private) with female representation 68% and male 31%. One respondent did not state its gender. Age of respondents ranged from 18 to 21 years.

Analysis of the tool

For measuring the reliability of the tool, Cronbach alpha was used (Cronbach, 1951). It shows amount of inner consistency of the used test items to see, if the they measure the same construct. Analysis was computed in R (R Core Team, 2018) using package *ltm* (Rizopoulos, 2006).

Identification of misconceptions

Answers to open and open-ended tasks (group 1st and 2nd) were subjects of further analyses of misconceptions. Using open coding, given answers were categorized into groups according to their main idea. For every open and open-ended task, the number of right answer types differs. If a pattern was visible, wrong answers were categorized as well. This classification of answers enabled quantification of given misconception frequency among students.

Results

Reliability of the tool measured through Cronbach's alpha reached 0,635 (95% confidence interval 0.570-0.682). Though the tool was testing basic knowledge, number of students reaching maximum 9 points is low (mean 4,62 points, median 5 points; Figure 1).
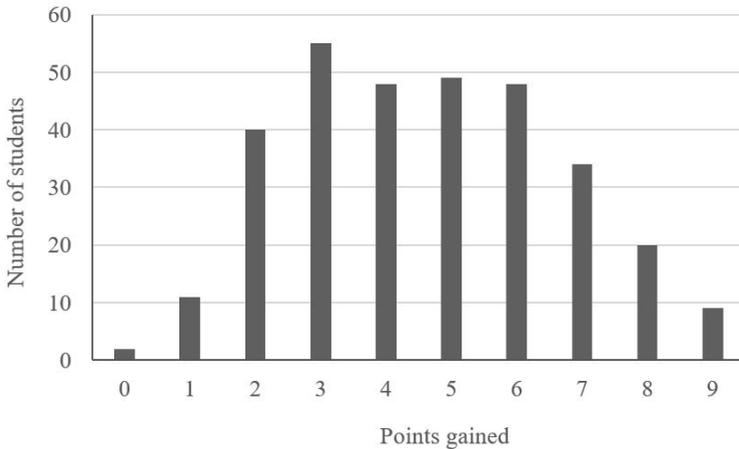
Figure 1: Distribution of student's overall score on point scale 0-9.

In open-ended tasks, students were often able to choose the right answer, but failed to give any explanation. Percentage of students choosing some answer without giving any explanation in open-ended task ranged from 6% to 33%. Success rate of individual author's tasks ranged from 20% to 60% (Tab. 1). Items taken from TIMSS 2011 had success rates – 71% for item 8 and 98% for item 9 (Tab. 1). Classification of students' answers revealed several existing misconceptions. The most common are described:

a) Students show uncertainty about the role of genetic information in the living body. In task number 1, over 2% of students indicate that DNA is a set of phenotype characteristics rather than predispositions for these characteristics, and 17% were only able to describe it indefinitely as an "important information". In task number 5 about 6% of students claimed genetic information to be directly responsible for various behavioural responses and reflexes, stating for example that genetic information enables breathing, swallowing, decision making or basically any behaviour at all. On the other hand, 2% of respondents stated in task 8 that genetic information does not influence number of inner body organs.

b) Process of proteosynthesis seems to be unknown to lot of students resulting in poor understanding of DNA life-long function. In task 4, 15% of students choose answer stating that cells that do not divide do not need the genetic information. Only 26% of students clearly connect DNA and proteins in process of proteosynthesis in task 6. As well as in task 5, where just 15% of students explain that loss of genetic information will stop the crucial processes leading to creation of building parts of the cell.

c) Students tended to forget the importance of DNA processing during the mitosis. In case of cell

division of *Paramecium* (task 2), 17% of respondents stated that cell only splits into two during the division omitting any replication of DNA or cellular content at all.

d) Principles of gene expression do not seem to be very well-known or understood. In task 4 only 8% of student's directly indicated it, while 12% stated that cells with different functions need to have different DNA although they are part of the one same body.

e) Confusion of scientific terms also occurred. In 11% of answers given to task 6, students mistook nitrogenous basis of DNA for proteins or amino acids, claimed that DNA is connected through peptide bond or that DNA consist directly of proteins (possibly misunderstanding of histons).

Tasks Authors tasks	Most common answers (%) (1 – right / 0 – wrong)	Success rate (%)
1/ Explain to person, not familiar with this subject, what a genetic information is.	1 hereditary „body manual" 19% 1 „body manual" 19% 0 important information 17% 1 DNA placed in the cell core 11% 1 proteins recipe 7%	56%
2/ *Paramecium* (*Ciliate*) is unicelular organism which reproduce through celular division. How similar genetic information will Paramecium have with its offspring?	1 only one parental DNA 18% 1 daughter cell is a copy 17% 0 cell just split 17% 1 DNA replication 8% 1 mutation can occur 6%	49%
3/ Neurons are cells of nervous system. Adult neurons do not divide themselves. Do neurons have genetic information?	1 yes, needed for cell functions 60% 0 no, they get information from neighbour cells 21% 0 yes, but they do not need it 15%	60%
4/ Our body consist of many cells creating variety of different tissues with various functions (bones, muscles etc.). Do all cells in our body have same genetic information?	1 one body, one DNA 21% 0 different function, different DNA 12% 1 gene expression 8% 1 division of zygote 8% 1 other cells (germ cells, symbionts) 5%	42%
5/ Can a cell (or even a whole organism, for example you or an elephant) survive for a long time without its own genetic information?	1 no, loss proteosynthesis / building parts 15% 1 cell division cannot occur 5% 0 organism cannot be born 7% 0 DNA in charge of body control 6%	20%
6/ Genetic information is known as DNA (deoxyribonucleic acid). Protein is a chemical compound with various functions (builds muscles, hair etc.). Do they have something in common?	1 proteosynthesis 26% 1 build/help body functions 7% 1 chemical structure 3%	36%
7/ Where is knowledge of genetics and molecular biology used in real life or in industry? Give three examples.	medicine/pharmacy 62% plant 31% / animal breeding 16% genetic engineering 27% parenthood determination 24%	32%
TIMSS 2011 8th-Grade Science Concepts and Science Items tasks (IEA, 2013)		
8/ Kidneys are organs found in the human body. As a young, man had one of his two kidneys removed because of disease. He now has a son. How many kidneys his son has?	1 it does not influence the genetic information 50% 1 normal being born with 2 kidneys 21% 0 organs are not „written in genes" 2%	71%
9/ Twins are born. One is a boy and one is a girl. Which statement is correct about their genetic makeup?	1 both have genetic information from both parents 98% 0 boy has only father's and girl only mother's genetic information 2%	98%

Table 1: Given tasks and students' success rates. Maximum of five most common answers is presented for every task. (Tasks are shortened versions of their originals.)

DISCUSSION

Reliability of the tool measured through Cronbach alpha did not reached levels consider as acceptable (Tavakol and Dennick, 2011). Despite that fact, according to the forms and low number of the questions, and complexity of measured topics reached reliability of 0,635 shows good inner consistency of the tool. Lower reliability can be caused by the focus on the scientific terms rather than their connections during student's education process. This can result in a failure in the tasks that cannot be answered correctly only with exact knowledge of specific definitions of used scientific terms.

Overall results of our survey document that basics of genetic and molecular biology are not well-known and deeply understood among university freshmen. Students struggled to answer even basic questions about the topic, as well as use of genetic knowledge in practice or the role of genetic information itself. There was also no time limit for completing any task, so we assume, that students not filling the answers simply do not have any idea (many stated it directly). As tasks of the tool were constructed to test only basic knowledge of genetics and molecular biology and common basis of national curriculum, average result of 4,62 point from 9 is though lower than expected.

Students do well in multiple-choice tasks and reached better than average international success rate in tasks from TIMSS 2011 (10% above average in task 8 and 15% in task 9) (IEA, 2013). Even in open-ended task, they were often able to choose the right answer, though they were not able to explain their choice. It is clear, they have a basic knowledge of genetics but are unable to synthetize what they have learned to provide justification for their claims. This problem is also visible in results of science part of TIMSS in the Czech Republic through-out the years (Tomášek, 2008; Mandíková and Tomášek, 2017). Though, various studies of genetics understanding worldwide revealed that students fail to connect gained knowledge to reason their answers (Cavallo and Schafer, 1994; Topcu and Sahin-Pekmez, 2009).

From classification of written answers (their types and frequency) we can draw further conclusions about the misconceptions students have about genetics.

Most of misconception found in this study are common among students internationally, for example belief that different types of cell in one body have rather different DNA (Chattopadhyay, 2005; Aldahmash and Alshaya, 2012), that cell during division only split into two parts (Lewis and Wood-Robinson, 2000) or that DNA consists of proteins (Ozcan et al., 2012).

Overall, students understand genetic information as an important part of cell (or living body) knowing it is essential for the life of the organism. Unfortunately, they do not have a clear concept of how genetic information translate itself into visible characteristics of the body. In some cases, they even tend to believe that genetic information is directly responsible for all the processes occurring in the living organisms.

On the other hand, students mostly fail to give any reasons for why genetic information is needed in the body during its whole life. They rather see genetic information as a certain body plan that becomes useless when the body is build and fully grown. The same misconception was already found in similar study among Turkish students (Topcu and Sahin-Pekmez, 2009). This could be a clue to why students do not often connect proteosynthesis with traits and vice versa. It is questionable if they even have a broader concept of the various functions that proteins hold, as they often state only examples of impact of genetic information on hair or eye colour or parent/offspring visual resemblance.

Proteosynthesis is often missing part of genetic lessons in lower secondary schools and it is rarely described in textbooks for this education level (Machová, 2017). Practising teachers in the Czech Republic viewed it in many cases as way too abstract process and hard to understand for students (Havelková et al., 2008). Though there is already evidence, that even lower secondary school

students are capable of understanding link between DNA and proteins (Duncan et al., 2011).

Other reason for poor knowledge of genetics and molecular biology among students might be found in lack of time for these subjects. Teaching of genetics and molecular biology is often scheduled to the end of school year (Machová, unpublished data). Due to often present delay in education through school year, this results in limited time for these lessons or even their omission. Additionally, in many schools these lessons are moved to optional seminars which means that some students might not have been taught them. This can, again, be an explanation for lower level of inner consistency of the constructed tool. Some students simply lack certain part of basic genetics knowledge which makes some given tasks unmanageable for them.

We also have to consider the limitations of our sample. Respondents were not selected randomly, were only university students (from whom 24% enrolled to field of study requiring entrance exams from biology) and their interest in investigated topics can be expected to be higher than in whole population of first-year bachelor students. This all only contributes to the fact that overall results do not shed a positive light on student's knowledge and the state of education of the molecular biology topics in the Czech secondary schools.

Conclusion

Students hold various misconceptions about genetics and molecular biology although according to National curriculum these topics are standard part of secondary school biology lectures. The students clearly gained certain level of knowledge, but they are still confusing the basic terms and struggle to synthetize their knowledge to solve complex problems involving genetics and molecular biology, similarly to students of different countries.

The origin of these problems can be probably found in the way genetics and molecular biology are introduced in secondary schools in the Czech Republic. We can concur that the most common methods of teaching genetics and molecular biology in secondary schools does not to connect genetic information with its real biological functions. This leads students to inadequate conclusions about what role genetic information really plays in the living body. It results in students seeing genetic information as "a magical formula for everything" rather than simply "a cookbook" for proteins that are key components of the organism.

Overall, students understanding is not poor, but there are serious gaps and grey areas. Therefore, the revision of schooling practise is needed to provide deeper insight into topics of genetics and molecular biology and add the interconnectivity to the knowledge students are taught to prevent rise of misconceptions we revealed.

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APPLE MOBILE TECHNOLOGIES APPLIED TO SHARING AND RECORDING OF REMOTE LECTURES

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Abstract

Mobile equipment plays crucial role in the implementation of learning process for the students with special needs, especially for students with locomotive, visual and aural disability who may find it difficult to personally participate in the learning process. The realization of the teacher-students interaction with the support of mobile technologies and its recording that is available on-line or on-demand is also necessary if the educator cannot participate in the lecture process directly in the classroom but interacts with the students from a remote site. Apple mobile technologies used within the services of the classroom of the Apple Authorised Training Centres for Education (AATCe) worldwide program have been successfully deployed in fulfilling these objectives at the Faculty of Economics VŠB-Technical University of Ostrava. The process Petri nets theory was applied at the design and implementation of information barrier-free approach that is determined for the fulfillment of the above goals.

Keywords

FaceTime, MERLINGO, Mobile technologies, process Petri nets, remote group communication

Introduction

Mobile technologies of all kind have been increasingly used in the teaching process at all types of the schools in the Czech Republic. Mobile equipment plays also crucial role in the implementation of learning process for the students with special needs, especially for students with locomotive, visual and aural disability who may find it difficult to personally participate in the learning process. Then it is necessary to create "barrier-free" information access to the lectures for them. Comprehensive multimedia visualization of the educational process that is available on-line or on-demand becomes an absolute necessity for the full mediation of information from the teacher towards the students with special needs. The realization of the teacher-students interaction with the support of mobile technologies and its recording that is available on-line or on-demand is also necessary if the educator cannot participate in the lecture process directly in the classroom for various reasons but interacts with students from a remote site with using of the Internet services.

Apple mobile hardware and software technologies, like iPad (iPad, 2019), Apple TV (AppleTV, 2019), FaceTime (FaceTime, 2019), AirPlay (AirPlay, 2019), etc., have been successfully deployed in the support of students with special needs at the Sunflower Centre of the Faculty of Economics VŠB-Technical University of Ostrava. They all are mainly available within the equipment of the computer classroom of the Apple Authorised Training Centres for Education (AATCe, 2019) worldwide program with its current statutes of IT Focused AATCe and Media Focused AATCe. The AATCe training center has the whole university scope of operation and its main goal is the education and preparation of the certified students and teachers in the areas of the MacOS operating systems, multimedia technologies and the Swift programming language within the "Everyone Can Code" (ECC, 2019) worldwide programme 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, 2019), FaceTime and AirPlay technologies.

An essential technological innovation that currently enables the teacher to realize on-line distance learning through the Internet services and real-time tracking and provides the students with real-time monitoring of the given lesson and the ability to communicate with the teacher in real time without having to attend the AATCe classroom (which is extremely useful especially for students with special needs) is the possibility of realizing group audio and video communication via FaceTime utility simultaneously for 32 participants.

The design and implementation of the hardware and software support of the AATCe lecture room enabling group audio and video communications via FaceTime utility for the remote participants and at the same time also automated central recordings of the teacher's remote presentations and their on-line and or-demand publication was one of the goals of the MRERLINGO (*MEdia-rich Repository of LearnING Objects*) project (MERLINGO, 2019). It was necessary to design and implement the single-purpose programming support based on Apple technologies determined for the generally distributed computing environment with the stated properties. Mathematical theory of Petri nets was chosen (Diaz, 2009) for that reason. The class of low-level process Petri nets (Huang et al, 2012) was used for these requirements and it has been significantly applied at the design, verification and implementation phases of the necessary hardware and software support preparation.

MATERIALS AND METHODS

Process Petri nets and their properties

The class of low-level Petri nets process and its properties is discussed in detail in Huang et al (2012). The original concept of Petri nets process was then extended by the author into the class of process Petri nets whose basic concepts will be described in the following paragraphs.

Let N denotes the set of all natural numbers, $N := \{1, 2,...\}$, N_0 the set of all non-negative integer numbers, $N_0 := \{0, 1, 2,...\}$, $\varnothing$ the empty set. **Process net** (PN) is an ordered 8-tuple $PN := (P, T, A, AF, TP, RP, IP, OP)$, where P is the finite non-empty set of the **places** that express the conditions of the modeled process and that are represented by the circles; T is the finite set of the **transitions** that describe the changes in the modeled process and that are drawn by rectangles, $P \cap T = \varnothing$; A is the finite set of the **arcs**, $A \subseteq (P \times T) \cup (T \times P)$; AF is the **arc function**, $AF: (P \times T) \cup (T \times P) \rightarrow N_0$ such that $AF(x, y) \in N$ iff $(x, y) \in A$, $AF(x, y) = 0$ iff $(x, y) \notin A$, i.e., the arc function AF assigns with each arc the natural number (with the default value of 1, if not explicitly indicated in the PN diagram) that expresses the number of removed or added tokens from or to the place associated with that arc when firing the given transition; TP is the **transition priority** function, $TP: T \rightarrow N$, that assigns with each transition the natural number that expresses its priority (with the default value of 1) and during the transitions enabling and firing process the rule will be followed which determines, informally said, that from the set of enabled transitions that are in conflict the one will be fired whose value of the transition priority function TP is the highest; RP is the finite set of the **resource places**, that is used for expressing conditions of a modeled process containing some initial resources and we use circles with the double line for their representation, $RP \subset P$; IP is the **input place**, $IP \in (P \setminus RP)$ and it is the only one place with no input arc(s), i.e., $\bullet IP = \varnothing$; OP is the **output place**, $OP \in (P \setminus RP)$ and it is the only one place with no output arc(s), i.e., $OP \bullet = \varnothing$; PN is the **connected net**.

Some commonly used notations for PNs are $\bullet y := \{x \mid (x, y) \in A\}$ 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 PN PN is the mapping $M: P \rightarrow N_0$. Marking M then expresses the current status of the modeled

proces and it can be written as the vector $M:= (M(IP), M(P_1),…, M(P_n), M(R_1),…, M(R_m), M(OP))$, where $P:= (IP, P_1,…, P_n, R_1,…, R_m, OP)$, $RP:= \{R_1,…, R_m\}$, $n \in N_0$, $m \in N_0$. The transition $t \in T$ is **enabled** in the marking M of the PN PN if $\forall p \in \bullet t: M(p) \geq AF(p, t)$ and we denote that fact in the form of t **en** M. **Firing of the transition** $t \in T$ results in changing the marking M into the marking M', where $\forall p \in P: M'(p):= M(p) - AF(p, t) + AF(t, p)$, that is denoted by the statement $M [t\rangle M'$. We say that the marking M'' is reachable from the marking M iff there exists the finite sequence $\sigma:= t_1 t_2… t_n$, $n \in N$, of the transitions $t_1, t_2,..., t_n$, such that $M [t_1 t_2… t_n\rangle M''$. The set of all the markings of the PN PN reachable from its given marking M will be denoted by the symbol $[M\rangle$. Let $k \in N$; the following special markings of the PN PN are defined:

- **entry marking** M_e: $M_e(IP) = k$; $\forall p \in (P \setminus (RP \cup \{IP\}))$: $M_e(p) = 0$,
- **exit marking** M_x: $M_x(IP) = 0$; $M_x(OP) = M_e(IP) = k$; $\forall p \in (P \setminus (RP \cup \{OP\}))$: $M_x(p) = 0$; $\forall t \in T: \neg(t$ **en** $M_x)$.

Fig. 1, illustrates the PN $PROC:= (P, T, A, AF, TP, RP, IP, OP)$, where $P:= \{IP, P1, R1, OP\}$, $T:= \{T1, T2, T3\}$, $A:= \{(IP, T1), (IP, T2), (T1, P1), (T2, R1), (R1, T1), (P1, T3), (T3, R1), (T3, OP)\}$, $AF:= \{((IP, T1), 1), ((IP, T2), 1), ((T1, P1), 1), ((T2, R1), 1), ((R1, T1), 2), ((P1, T3), 1), ((T3, R1), 2), ((T3, OP), 1)\}$, $TP:= \{(T1, 2), (T2, 1), (T3, 1)\}$, $RP:= \{R1\}$, $IP:= IP$, $OP:= OP$, in its entry M_e and exit M_x markings where $k = 1$ (note the resource place R1 with the two tokens in the entry M_e and exit M_x markings and the fact that no transition must be enabled in (any) exit marking Mx). The transitions T1 and T2 are enabled in the entry marking M_e of the PN $PROC$ and they form conflict transitions in this marking because $(\bullet T1 \cap \bullet T2 = IP) \wedge (T1$ **en** $M_e) \wedge (T2$ **en** $M_e) \wedge \neg(\{T1, T2\}$ **en** $M_e)$. The transition T1 will be fired in the entry marking M_e according to our rule because $TP(T1) = 2 > 1 = TP(T2)$, i.e., $M_e [T1\rangle M1$, where $M_1:= (M_1(IP), M_1(P1), M_1(R1), M_1(OP)) = (0, 1, 0, 0)$. The transition T3 is enabled in the marking M_1 and firing of this transition T3 changes the marking M_1 into the exit marking M_x of the PN PN, i.e., $M_1 [T_3\rangle M_x$, where $M_x:= (0, 0, 2, 1)$ and $M_x(OP) = M_e(IP) = 1$.
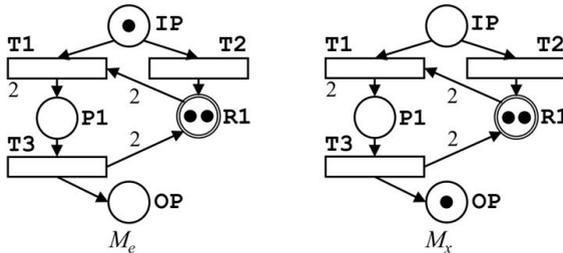
Figure 1: PN *PROC* in its entry M_e and exit M_x markings

Process Petri net (PPN) *PPN* is the ordered couple $PPN:= (PN, M_e)$, where $PN:= (P, T, A, AF, TP, RP, IP, OP)$ is the PN and M_e is the entry marking of the PN PN.

Let $PPN:= (P, T, A, AF, TP, RP, IP, OP, Me)$ be the PPN. Then PPN *PPN* is said to be:

- **deadlock-free** iff $\forall M \in [M_e\rangle \exists t \in T: t$ **en** M,
- **k-bounded** iff $\exists k \in N_0 \forall p \in P \forall M \in [M_e\rangle: M(p) \leq k$,
- **proper-formed** iff $\forall M \in [M_e\rangle: M_x \in [M\rangle$.

It can be easily shown that PPN $PPROC:= (PROC, M_e)$ in Fig. 1, is deadlock-free, 2-bounded and proper-formed.

Apple technologies installed in AATCE training center

FaceTime is the proprietary videotelephony product developed by Apple Inc. with the possibility

of realizing group audio and video communication simultaneously for 32 participants that is based on numerous open industry standards (H.264, SIP, STUN, TURN, RTP, SRTP, etc.) To use such group FaceTime audio and video calls the end user must have an iPhone 6s smartphone or later, iPad Pro tablet or newer, iPad Air 2 equipment or later, or iPad mini 4 with iOS 12.1 operating system installed. Older iPhone, iPad, and iPod touch models supporting iOS 12.1 operating system can only connect to face-to-face group calls via a non-portable audio component without the video component.

AirPlay is a technology that allows wireless streaming of the audiovisual content among AirPlay senders and receivers. AirPlay senders include MacOS and iOS devices, Android phones and other third party devices, AirPlay receivers include AirPort Express, Apple TV and selected third party speakers. **AirPlay Mirroring** is a technology that allows broadcasting of the audiovisual content from most of Apple devices to **Apple TV.**

AATCe training center is equipped with the **iMac** computers, **iPad** tablets, large format multi-touch display **65" NEC MultiSync V651 TM**, **Apple TV** and **AirPort Express** devices. 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 are used as AirPlay senders) on the NEC MultiSync V651 with a large screen or on the teacher's iMac computer (Apple TV equipment connected to these devices is used as AirPlay receiver) and for content sharing to other students. It is also possible to make a real-time recording of a mirrored screen content by the rich-media technology recorder software EduArt (EduArt, 2019) and to publish it on-line or on-demand via RTSP (*Real Time Streaming Protocol) protocol*.

At the Faculty of Economics, VŠB-Technical University of Ostrava, over 60 presentations and their recordings were realized with the support of AATCe training center equipment and the comprehensive collections of the following subjects are available: Introduction to Programming (2nd year of Bachelor studies of Informatics in Economics), Dynamic Web Pages Creation (2nd year of Bachelor studies of Informatics in Economics), Internet Applications Creation (3rd year of Bachelor studies of Informatics in Economics) and Economic Applications of Artificial Intelligence (2nd year of Master studies of Informatics in Economics).

RESULTS AND DISCUSSION

A software solution utilizing the equipment of AATCe authorized training center and enabling the remote presentation of the teacher, his on-line communication with the students both in the AATCe classroom and in the remote locations through the FaceTime utility and MERLINGO portal services, his recording and also on-line publication of this presentation was realized as in the frame of the MERLINGO project. The main principles of this solution can be seen in the Fig. 2. The teacher in the remote location communicates via the FaceTime utility with the selected presentation iMac computer located in the AATCe classroom that is equipped with the FaceTime software, presentation software (e.g., MS PowerPoint) containing the teacher's presentation, rich-media recording software (e.g., EduArt) and it is also used as AirPlay Sender. The teacher in the remote location then uses the features of Apple Remote Desktop software to remotely control actual presentation on the presentation computer and the teacher can also communicate during the presentation via FaceTime utility with the students in the classroom and remote locations. Students can watch the whole presentation on the NEC MultiSync V651 shared large screen or on their mobile devices via FaceTime utility and MERLINGO portal services. With the use of the AirPlay technology, each student who is located in the AATCe classroom can present the content of active computer screen on the NEC MultiSync V651 shared screen while recording and publishing of the entire presentation is performed throughout by the rich-media recorder software. Design and implementation of the generally parallel programming support that meets all the

above requirements required also the use of process Petri nets formal theory. It was necessary to design the **k-bounded, deadlock-free and proper-formed PPN** for the above goals. This research goal was achieved and the simplified PPN that models of the given programming support is shown in the Fig. 3.
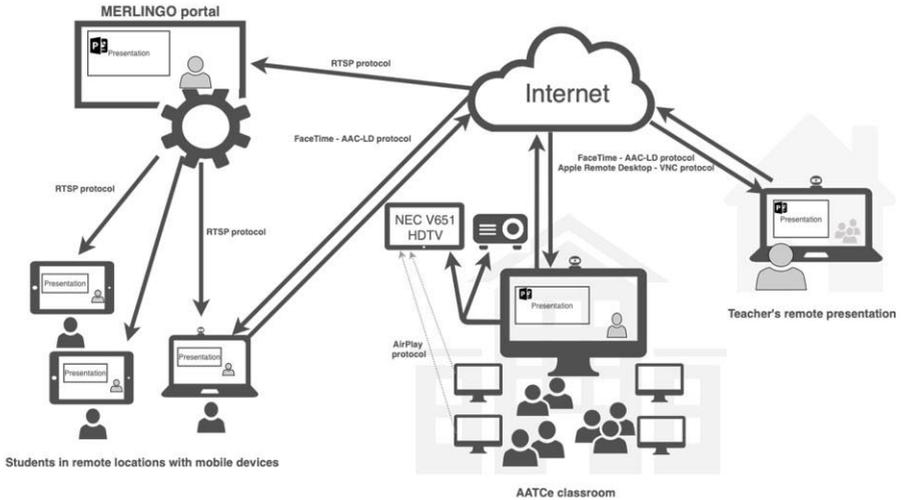
Figure 2: Principle of teacher-students remote interaction

The token in the input place IP of the PPN's entry marking M_e represents the initial state of the lecture. The teacher's computer in the remote location without any active FaceTime video and audio group connections is represented by the single token in the resource place R2, 20 tokens in the resource place R3 represent the student's iMacs or iPads computers in the AATCe classroom and finally 5 tokens in the resource place R1 then represent mobile devices with the installed FaceTime software of the students in the remote locations who can not directly participate in the teaching process in the AATCe classroom. Firing of the transition T1 causes the location of the single token into the place P1 that models the establishing of the teacher's FaceTime connectivity with the presentation computer and also the location of 100 tokens into the place P3 that models the lecture time counter. The transition T5 will be fired after the repeating of 100 firings of the transition T2 and the lecture will then finish by the firing of the transition T10 or the transition T11. The successive firings of the transition T3 model the establishing of the FaceTime group connectivity for the students in remote locations with the presentation iMac computer and similarly the successive firings of the transition T8 then model the establishing of the FaceTime group connectivity for the students in AATCe classroom with the presentation iMac computer. Then there will be 1 token representing the teacher's presentation computer with the on-line recorded and shared on the NEC MultiSync V651 presentation in the place P9, 5 tokens representing the mobile devices of the students in remote locations in the place P4 and 20 tokens representing students' devices in the AATCe classroom in the place P7 after finishing of this process. Firing of the transition T7 allows any student modeled by the chosen token in the place P7 wirelessly project the screen of his device on the NEC MultiSync V651 at any time (i.e., informally said, the teacher's token in the place P9 will be moved into the place P8 and the chosen student's token will be moved into the place P9 that represents active shared and recorded computer screen). Firing of the transition T9 then models the reverse action and it again starts

the teacher's presentation on the NEC MultiSync V651. If the teacher's computer is shared on the NEC MultiSync V651 at the end of the lecture then the transition T11 will be fired, otherwise the transition T10 will be fired. After firing of the transition T12 the PPN will move into its exit marking M_x where 1 token will be located in the output place OP, 5 tokens will be located in the resource place R1, 1 token will be located in the resource place R2 and 20 tokens will be located in the resource place R3. It can be shown that the presented PPN in Fig. 3, is k-bounded (where k = 100), deadlock-free and proper-formed.
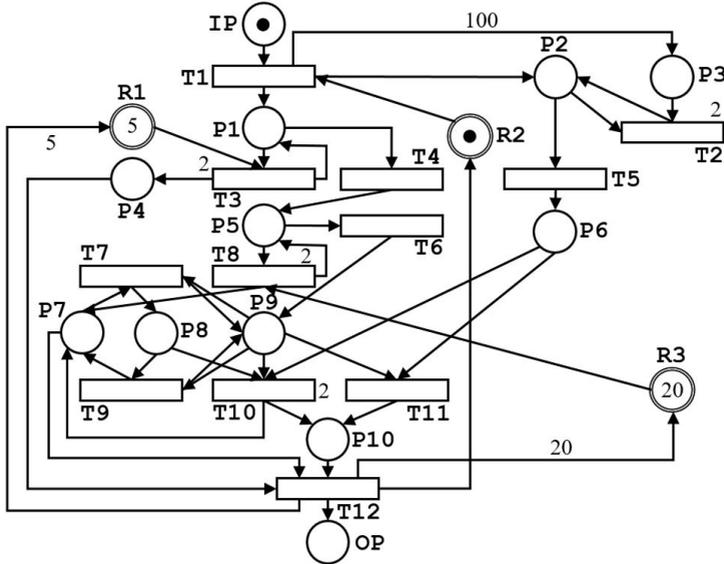
Figure 3: PPN modeling AATCe classroom functionalities in its entry marking M_e

The following significant results in this area were achieved at the Faculty of Economics, VŠB-Technical University of Ostrava:

- the rich-media recordings were published in the on-demand mode through the LMS system *Moodle*; all the rich-media recordings are available as the part of the study materials for more than 50 students of relevant subjects who can replay the topic they did not fully understand again or they can play back the recording from the time when they were absent, for example when they were ill,

- a total of 16 students with special needs are registered at the faculty in this academic year who can use "barrier-free" information access to all the recorded lectures on-line or on-demand;

- one of the main problems experienced by students with special needs during the use of services of the central repository MERLINGO is especially the fact that a lot of study materials in the form of presentation records of teachers are not adapted to their needs (e.g. video recordings do not include their transcription into sign language for those with aural disability, or it is impossible to generate transcription of audio recordings into Braille, lettering is missing, etc.); hence the next pilot activity prepared with the support of AATCe classroom equipment supporting the students with special needs mainly involve automated transcription of spoken text of the lecture recorded by the recording and assistance service into the written text and their availability on-demand,

- various forms of asynchronous communication of teachers with students were initiated; author of this article started pilot recordings of his procedure when correcting written exams via the EduArt programming system and those recordings are available for particular students and they can immediately check the teacher´s objectivity at their assessment,
- asynchronous communication is also 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 and they can study them in detail coming to the particular lesson already equipped with information about the given topic,
- asynchronous communication is used in the pilot activity of the active involvement of students at the recording of their individual presentations especially during the defenses of their annual works in the present time.

Generally it can be stated that implementation of the rich-media technologies at the Faculty of Economics significantly contribute to mobilizing students at the learning process. Through realized recordings of lessons the students (including the students with special needs) can both repeat the theme, and understand it better, which has obviously a positive impact on the overall level of their knowledge and improvement of their study results. Moreover, due to realization of recordings and their synchronous and asynchronous availability, the mutual communication between students and teachers in remote locations is significantly enriched. Hence, asynchronous communication becomes an excellent tool for the support of inclusive education as it enables access to the educational process from multiple points, various time and any number of repetition. Bearing in mind the level of school and student outfit with mobile tools (tablets, notebooks), nothing stops it from its immediate frontal implementation.

Conclusion

Recordings of presentations and their availability on-line or on-demand has been a standard part of eLearning services at most of the universities in the Czech Republic and also in the world (Hladká and Hrdlicka, 2005), (Bos et al, 2016), (Dona et al, 2017). However, the uniqueness of the approach presented in this article is based on the organic blending and deployment of chosen Apple and rich-media technologies in a comprehensive solution to this problem. The presented solution of remote teacher's communication concurrently with the students located in AATCe classroom and with the students in several remote locations then generalizes a significant solution presented in (Martiník, 2018). Software support of the above solution was then designed and implemented with using of the process Petri nets theory.

Acknowledgements

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RELATIONS BETWEEN GENERALISATION AND REASONING IN SOLVING MATHEMATICAL PROBLEMS

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Abstract

The algebraic thinking and reasoning skills are considered as playing the central roles while teaching and learning mathematics. In this article we have investigated specific relations between these two abilities, manifested in solving an open-ended ill-structured problem aimed at mathematical modelling. We analysed solutions received from a group of 33 students, who solved a complex assignment. Such relations were more obvious in solving a complex problem, comparing to more structured closed subtasks.

Keywords

Algebraic generalisation, high-achieving students, mathematics education, open-ended problems, reasoning skills

Introduction

The distinction between arithmetic and algebraic thinking is sometimes oversimplified as a work with numbers, or a work with variables. In contrast, Radford (2008) distinguishes between arithmetic generalisation, algebraic generalisation and naive inductive reasoning based on the distinctive ways of thinking. It is more than clear that algebraic generalisation builds on the observing of commonalities by abduction from particulars. Then, a hypothesis, if formulated, and an expression, are or can be produced. On the other hand, arithmetic generalisation often uses some recurrent relations, and following, pupils, using this way of thinking, are not able to provide a formula for a general case. However, the least sophisticated are the naive inductions based on the probable reasoning. The type of generalisation can be related to the type of problem, however, the students equipped with well-connected problem solving schemas are not surprisingly more successful in transferring their knowledge (Cadez and Kolar, 2015). Algebraic generalisation raises specific problems for almost every student, even in the course while studying on higher grades (Ayalon, Watson and Lerman, 2016). Our recent research findings indicate an ability to produce some general algebraic expression as a crucial factor in solving open-ended non-routine problems in mathematics, even by high-achievers (Medova, Bulkova and Ceretkova, 2018).

For the student it is conclusive the use of justification, proving strategies and technics of various forms of proofs in mathematics, providing him/her with a crucial importance of mathematical reasoning. Such abilities clearly involve obtaining strategic knowledge in the specific areas related to the given problem at hand, as well as a knowledge and norms specific for proving and reasoning (Robinson, 2000), especially in mathematical open-ended problem solving situations. Pedemonte (2008) stresses the structural gap between argumentation and proof. Argumentation inferences are based on the content, while in case of proof they follow a deductive scheme. While working in the classroom environment, usually, students have an experience mostly only with formal proofs, a sequence of formulas in formal language (Andersen, 2018) instead of the factual mathematical reasoning within a complex mathematical inquiry.

Pedemonte (2007) studied certain relations between the level of generalisation and reasoning skills. Generalisation as such and concurrently as a process seems to be required for construction of mathematical induction, although, on the other hand, some relation was pointed out as a structural distance between them. Open-ended problems are considered as suitable ways how to develop required reasoning skills by students. Thus, abductive reasoning serves for passing from the inductive to deductive reasoning. Mathematical modelling has a special role in conceptualising mathematical knowledge (Samková et al., 2015), offering an environment to observe the student's enactment of different mathematical competencies.

The research question was formulated as follows: What are the (implicative) relations between the levels of algebraic generalisation and mathematical reasoning manifested in the course of solving some non-routine mathematical problems by high-achieving upper-secondary students?

Materials and Methods

The Mathematics B-day contest is a unique opportunity for upper secondary students to collaborate on real mathematical open problem solving and demonstrate their mathematical knowledge and competences by conjecturing and proving in mathematics. In the Slovak Republic the Department of Mathematics of Constantine the Philosopher University in Nitra is an organizer of such event, though the origin of this contest was in Netherlands. The essence of Mathematics B-day contest is based on the educational program of mathematics for the prospective university level of technical studies and studies in science and mathematics.

Students, divided into three or four member teams, are solving the assignment created with an intent motivating inquiry in mathematic. The goal of Mathematics B-day 2018 assignment (FISME, 2018) was formulated as follows: *What is the surface of the smallest flat shape that can cover all lines of length 15 cm*? The situation was represented like a story of certain snake with its length of 15 cm, that needs a blanket for every its positions, while this snake is sleeping.

The assignment represents a set of subsequent problems related to one chosen situation composed in the continuous text. The assigned problems were aimed at an explaining specific relations, while generalising and proving, and finally, at mathematical modelling as such. Students could use for their experimenting recommended manipulatives (copper wire, sheet of graph paper, compass, scissors,…) in the first phase of solution process and later the dynamic software GeoGebra was recommended. It is more than obvious, that a success solution requires some elemental pieces of knowledge stemmed from geometry (e.g., planar geometry and trigonometry) as well as combinatorics (e.g., enumeration of combinations to producing a pattern).

The introductory assignments (1-6) are aimed at introducing the main topic of given assignment. In this case, problems aimed at discovering the smallest planar shape represented by several shapes (such circle, rectangle, diamond, etc.) and subsequently, at arranging the smallest area of a blanket by the cutting off any useless parts of shapes. All findings from the introductory assignments should be useful for creating a mathematical model of Final assignments assigned situation: *Design the smallest possible blanket for the 15 cm snake*.

The full text represents 14 pages of continuous mathematical text, containing several kinds of non-routine problems, aimed at the following topics and themes: experimenting, calculations, and then, explanation, generalising, as well as proving some relevant and real relations. This study was focused on some necessary and involved subtasks, requiring some higher-order mathematical thinking skills, vested, especially, in proving and generalising. Thus specifically, we aimed subtasks where the investigated skills were supposed to be manifested, particularly *2a, 5f, 6a, 6b, 6d* (see the Appendix) as well as *Final assignment,* being focused mainly on mathematical modelling. Other subtasks were aimed to experimenting, area calculation, combinatorial problems, optimisation and observations and therefore there were omitted from further analysis.

In 2018, 131 students in 33 teams were solving the assignment of Mathematics B-day contest. The relatively high achievement in mathematics is assumed because only two best reports from each participated school can be submitted for the final national assessment. Actual and real abilities to solving non-routine mathematical problems are one of the basic components of the general problem-solving ability (Pantziara, Gagatsis and Elia, 2009). The non-routine problems will demand a high cognitive load (Schoenfeld, 1992), therefore, the high-achievers' solutions need to be analysed to a greater extent. For this reason, the solvers, who participated in the Mathematical B-day event, can represent an appropriate sample for observing the level of generalisation and proving in mathematics.

Statistical analysis

The level of reasoning skills was assigned to every students' solution of the all investigated subtasks (2a, 5f, 6a, 6b, 6d), and the final assignment (FA) as well. The level of algebraic generalisation was assigned to every student's solution of subtask 5f, and the final assignment (FA). Table 1 shows all data covering assessing the mathematical abilities.

Level	Algebraic generalisation	Reasoning and proving
0	Observing particular examples	Without any argumentation or reasoning
1	Noticing a commonality	Reasoning by one or several particular examples
2	Formulating hypothesis	Correct mathematical evidence, but not formalised in the form of proof
3	Producing the expression of p_n	Formal mathematical proof

Table 1: Description of levels of algebraic pattern generalisation and reasoning and proving

The subsequent statistical analysis of the obtained data was performed, using the software environment R (R Core Team, 2019), applying the packages RVAideMemoire (Hervé, 2018), lsr (Navarro, 2015), and rchic (Couturier, 2018). The success-rates in the subtasks of the given assignment were compared by the Cochran Q test, that is the generalisation of the McNemar test for two independent samples. The partial problems were considered as independent samples. Subsequently, the post-hoc analysis, comparing each pair of problems, was performed by the McNemar test. The levels of reasoning skills and algebraic generalisation in the analysed subtasks were compared, and then, post-hoc analysed by the Friedman test.

The corrected Cramér's V was calculated to measure an association between the levels of generalization and proving. The Spearman's rank correlation coefficient ρ was used to assess the relationship among the reasoning skills and algebraic pattern generalization manifested in particular subtasks.

The statistical implicative analysis (Gras et al., 1996) was applied to explore mutual relations between the defined attributes of assessing and to evaluate relations between the subtasks in the basic assignment and the students' performance in final assignment.

RESULTS

Out of total 33 submitted students' solutions 27 attempted to solve the final assignment. The relative frequency of investigated items differed significantly (Q=5.4, p=0.020), pair-wise comparison by McNemar test is summarised in Table 2. The null hypothesis was formulated for each pair of subtask as follows: "There is no significant difference between the ratio of incorrectly solved subtasks for subtask A and subtask B". The levels of reasoning skills varied between the tasks (chi^2=48.607, p<0.001), contrasting to the level of algebraic generalisation (chi^2=1.316, p=0.251). Surprisingly, one of the parts of assignment with the highest success rate was the final

assignment requiring the high order thinking. However, it is open-ended problem and students were allowed to choose their own objects of investigation according to their involvement and self-efficacy. Furthermore, the analysed materials were not their hand-out versions, but the final report where they present only chosen results

Task	Description	Success rate (n = 33)	Level of reasoning skills (M ± SD)	Level of algebraic generalisation (M ± SD)
2a	Proving the impossibility	66% [a]	2.45 ±1.32 [a]	NA
5f	Generalization	18% [bcd]	1.33 ± 1.53 [bc]	1.15 ± 1.37 [a]
6a	Proving the inequality	39% [b ef]	1.15 ± 1.39 [b]	NA
6b	Proving the impossibility	21% [c fg]	1.18 ± 1.48 [b]	NA
6d	Proving the coverage	9% [d fg]	0.30 ± 0.63 [c]	NA
FA	Mathematical modelling	48% [a e]	0.75 ± 0.90 [b]	0.66 ± 0.92 [a]

M mean, SD standard deviation. Values assigned by the same letter do not differ significantly based on the McNemar test (correctness of solution) and the median test (levels of reasoning skills and algebraic generalisation) ($p \leq 0.05$)

Table 2: Success rate and levels of reasoning skills and algebraic generalisation manifested in analysed subtasks

The three subtasks were aimed at proving inequality/impossibility (2a, 6a, 6b). The subtask 2a was solved correctly, and significantly more often than other two subtasks (p_{2a6a}=0.035; p_{2a6b}<0.001; p_{2a6d}<0.001). Correctness of its solution was associated only with the reasoning skills manifested in solutions of subtask 6b (V=0.4193, p=0.029). Levels of reasoning skills manifested in solutions of the subtasks 6a, 6b and 6d correlated mutually (ρ_{6ab}=0.7937, p<0.001; ρ_{6ad}=0.4372, p=0.023; ρ_{6bd}=0.4936, p=0.008). Reasoning skills in solutions of subtasks 6a, 6b and 6d were associated with correctness of 6a mutually (V_{6aa}=0.5022, p=0.008; V_{6ab}=0.5801, p=0.002; V_{6ad}=0.5032, p=0.007). Furthermore, the subtask 6a was the only subtask which correctness of the solution was related to the level of reasoning skills in FA (V=0.4051, p=0.036).

Out of 6 teams who were able to produce the correct algebraic expression in solution of subtask 5f used inductive approach, one team did not provide any reasoning to it, and one team used abductive reasoning approach. The level of generalisation was related to correctness of the solution of this subtask (V=0.5672, p=0.002). The level of generalisation in 5f was related to correctness of the subtask 6a (V=0.3767, p=0.049). Correctness of the final assignment was related to the reasoning-skills level (V=0.5182, p=0.006), however, it was not related to the level of generalisation (V=0.2365, p=0.235). On the other hand, the reasoning skills correlated with the generalisation level, manifested in the final assignment (ρ= 0.6814, p<0.001).
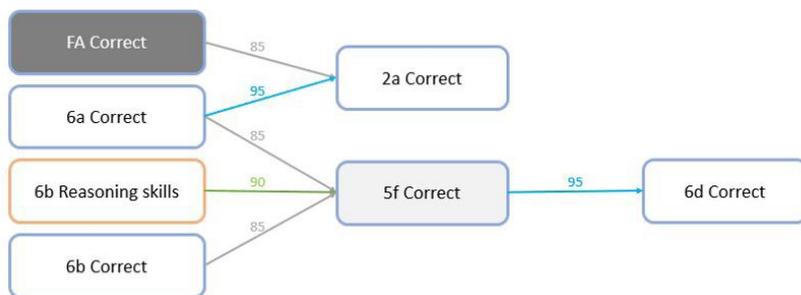
Figure 1: R-rules between observed variables

The results of SIA (see Figure 1) indicate an evident interconnection between correctness of the investigated subtasks. The correct solution of subtask 5f aimed at assessing of an ability to generalise algebraically implied correct solution of reasoning task 6d. Although it was implied by the correct solution of the subtasks 6a, and the high level of reasoning skills manifested in 6b, as well as the correct solution of 6b. Furthermore, the correct solution of 6a implied the correct solution of subtask 2a. The success in 2a was implied also by the correct solution of FA. Direct implications from the subtasks 6a and 6b to success in 6d were not confirmed. It may indicate that the generalisation is a hidden driving ability supporting mathematical reasoning.

DISCUSSION

In this paper we tried to investigate specific relations between the ability to generalise algebraically and to prove mathematically. Certain correlation between these two competencies was confirmed in case when students solved an open mathematical problem requiring both, meaning some reasoning skills as well as some generalisation skills. However, some relation between these two abilities was not confirmed between the all investigated subtasks. The distance between the reasoning skills based on the produced generalised pattern could be an obstacle for students and a possible or probable cause of their failure in the construction of mathematical induction (Pedemonte, 2007).

The manifested reasoning skills were significantly higher as far as to the subtasks 2a, 6a and 6b comparing to the subtask 6d solution. A similar relation can be observed in case of correctness of students' solution. Our results indicate that it is easier to prove that the assigned situation is not possible or equality is not valid than to prove validity of a statement, even though this kind of tasks is usually unknown or even novel for many students (Stein and Burchartz, 2006). Whereas the attitudes in mathematics can result from automatising of a repeated emotional reaction, students with their negative attitude towards geometric proof may attach that same attitude to proofs in other mathematical field (McLeod, 1989), use of above mentioned kinds of proof can reduce negative attitude towards mathematical proof.

The investigated problems were aimed at the reasoning skills and mathematical proving (2a, 6a, 6b and 6d) and at algebraic generalisation as such (5f). The subtasks were structured and strongly focused on the particular students' ability. While solving ill-structured open-ended problem aimed at mathematical modelling, i.e. the final assignment, our students have more freedom to investigate mathematically and incorporate the distinct mathematical abilities. This may fulfil the requirement formulated in Novotná (2016), showing that the students should have a real chance to experience some pleasure while discovering, but also concurrently having a chance to learn, to acquire new knowledge or skills, they would be able to apply in other situations. Thus, to conclude, any mathematical modelling allows and requires both, certain producing of expression, and certain proving validity of the produced result.

CONCLUSIONS

In this study we have explored specific relations between the reasoning skills and the ability to generalise algebraically in case of high-achieving upper-secondary students. We found out that some relations can be observed mainly in the open-ended problem solving that generally requires really a higher-order thinking.

Based on the results of our study, we can suggest to use or utilize more problems aimed at proving inequality or impossibility in the every-day mathematics classroom environment. As students, as it seems to us, are or will be more successful in this kind of proofs, and it might improve both, their reasoning skills as well as their self-efficacy in the field of mathematical proving.

Although our analysis of students' work seems to be not sufficient to investigate all the cognitive aspects in relationship between the reasoning skills and algebraic generalisation skills, and some

underlying variables may perhaps be hidden, some specific relations were observable nevertheless. It seems worth to study how the generalisation and reasoning skills are related to other observable mathematical competencies, e.g., factual combinatorial thinking or factual probability reasoning.

ACKNOWLEDGEMENTS

APPENDIX

2a We will first look at a rectangle measuring 14 cm by 5 cm, and a rectangle measuring 15 cm by 5 cm. Use the copper wire to investigate whether the bending snake fits under these rectangular blankets in all positions. Explain your answers and, if necessary, support them with a calculation.
5f Describe a blanket for a bending tetra snake of length n for each positive integer $n= 1,2,3,…$ Give a formula in n for the area of that blanket. Hint: first try to find the smallest blanket for small values of n (like 1 to 7) and try to make what you find there more general.
6a Suppose the head of the snake lies in point K, the point of the tail in point S and the body also passes through point N somewhere. The sum $|KN| + |NS| \leq 15$. Why?
6b Suppose the snake passes through point A and through point B under the blanket. Line l is an edge of the blanket. The distances are as shown in the picture. Can the snake really lie so that it is on the edge of the blanket?
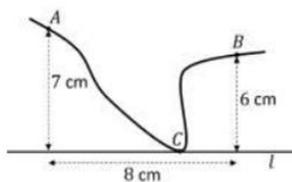
6d Positioning strategy (see the figures below): place the snake with its middle M on the diagonal BD so that the tail part MS of the snake touches line BC (left figure). Then slide M down and rotate around M (so that tail section MS continues to touch line section BC) until the head part KM touches line segment AB (right figure). In the most extreme case, this only happens when M falls on B. Show that the snake always fits.
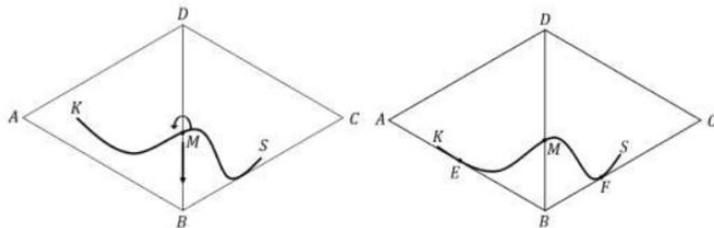
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DO ADMISSION PROCEDURE SCORES CORRELATE WITH UNIVERSITY STUDY RESULTS?

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Abstract

The main objective of this paper is to find out if the number of points awarded during the admission procedure correlate with students' performance during their university study in the bachelor programme of Economics and Management at Jan Evangelista Purkyně University in Ústí nad Labem (UJEP), Czech Republic.

The first source of data was the recorded scores from the admission process of students who decided to send a portfolio. The second source of data was a study by the UJEP information system. Pearson's correlation coefficient showed that there is a strong positive correlation between five courses and final exams, as well as the performance in the last two evaluated semesters of high school.

The paper confirmed that students with a higher Admission Procedure Score performed better in their university studies. It is preferable to continue accepting these students, to enact the admission procedure, and increase requirements for students during the procedure.

The Faculty should consider abandoning portfolios and start using comprehension tests and provide additional support for current students with study problems.

Keywords

Analysis, education, evaluation, management, results

Introduction

Universities in the Czech Republic have to deal with the shrinking number of students in the bachelor study programmes. Despite this, some of them still use admissions and set a minimal quality requirement for accepting new students to their study programmes. They use a variety of criteria and processes to evaluate applicants (e.g. high school study results, results of high school final exams, interests, talents, work experience, etc.).

Smutny and Sulc (2015) have confirmed that the number of applicants has decreased at the University of Economics, Prague (in the years of 2010 and 2014) by 30% of admitted applicants and the applicants' scores have been equalizing across all faculties in those years.

Kucera, Svatosova and Pelikan (2015) in their article described the relation between the results of admission proceedings and the success in university studies. They identified one of the causes of failure in one particular course, which was taught in the first year of the university studies. This is that the students are not yet fully adapted to the lifestyle of university study. Admission exam results could also predict the level of success in university studies.

Wahl and Walenta (2017) studied the program of 'Business Administration & Economic Psychology', (Bachelor). The research showed that successful students achieved better results on the study-related learning test compared to less successful students. The comprehension test

related with studies and the intelligence test are significant predictors of the first term's grade point average. They have found that students who were successful in the first two semesters scored significantly better on study-related comprehension than did less successful students. The score on intelligence tests significantly increased the first semester grade point average.

Mesicek, Petrus and Kovarova (2017) dealt with the test evaluation process. They have found out that in some cases students are able to pass with grade 1 (excellent, or "A") after several failed attempts. This could be seen as an unnecessary load on teachers.

Newberry, Miller and Stevenson (2011) identified that dropout rates of first year students correlate with the individual performance in first-level calculus courses. They have observed that students with strong incoming math skills resented being required to take the course, on the other hand, students with low incoming mathematics scores felt the material was covered too quickly.

Harackiewicz et al (2002) examined the role of achievement goals, ability, and high school performance in predicting the academic success over students' college careers by regression models. Among other results, they have found that ability and high school performance measures predicted academic performance in both the short and long term.

During the admission process to the bachelor programme Economics and Management at the Faculty of Social and Economic Studies (FSE), Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic, students can choose from two possibilities for admission. They can choose to submit their test results of the National Comparative Test or they can send a portfolio. The portfolio consists of 10 criteria:

1. Graduated high school
2. Arithmetic average of grades – graduation (final exams)
3. Arithmetic average of grades in the 4th year (for the first semester)
4. Arithmetic average of grades in the 3rd grade (for the second semester)
5. Participation in competitions and Olympiads (specify area, month / year, result, organizer)
a) Completion organized by the Faculty (specify area, month / year, result)
b) Extracurricular Activity (sports, arts, etc.)
6. Work experience gained (specify from month to year, institution, position)
a) Professional experience (including the field of current employment)
b) Brigades – outside the field of study (specify type, time - month / year of acquisition / completion, where - institutions)
7. Motivation to study – Why do you want to study at the FSE? (max. 100 words)
8. Your idea of future employment in the labor market (max. 100 words)
9. Language skills
a) Language certificates, state examinations (specify type, time - month / year of acquisition / completion, where - institutions)
b) Foreign stays (specify the place, time and length of stay)
10. Interests – hobbies

A committee of teachers will then evaluate these criteria. The awarded points are then summed and their total score sort applicants. According to the current year's capacity, they are then notified about the admission results.

The goal of this article is to find out if there are any significant statistical differences between full-time students who scored differently according to their portfolios (total score is on a scale from 0 to 100, where 100 is maximum, the most important criteria are language skills and grade averages) and their performance during the study.

Materials and Methods

To conduct this study, data from two data sources had to be obtained.

The first source was a record of students' scores from admission process, who decided to send the portfolio. These files included data like name, ID and values of each portfolio criteria. These MS Excel sheets were transformed to CSV format and processed by using C++ programming language (Stroustrup, 2013).

The second source of data was the study using the information system from UJEP. From this system, data about students' study results were exported into MS Excel from an Oracle database. Every student had several rows with results for each course. Every course has its name, last attempt number, results, and year of study. A program created by authors and written in C++ also processed this data. The data was checked for abnormalities (e.g. missing records in the year when the student stopped his/her study).

First of all, descriptive statistics were used to find out more about the portfolios sent by applicants (this is one of the possible ways as to how to apply to the Faculty of Social and Economic Studies; the second one is the result from the National Comparative Test). The number of students who sent their portfolios over past years is described in Table 1: Number of portfolios over years, 2015-2017.

Year	2015	2016	2017
Number of portfolios	89	172	149

Table 1: Number of portfolios over years, 2015-2017 (source: own calculation)

The average quality (number of points) of portfolios has improved from 55.5 in 2015, to 56 in 2016, and to 59.1 in 2017.

The overall average (over years 2015, 2016, and 2017) from final exams is constant (2.3) as well as grades from third (second semester) and fourth year (first semester) results from high school. Over these years it is noticeable that the praxis decreased from a 3.9 average in 2015, to 3.5 in 2016, then to 3.1 in 2017.

Figure 1: Number of students by their score in portfolio and how many attempts they need to pass an exam, 2015-2017 shows the quantiles of students according to their performance in their portfolios and how many attempts they needed to pass subject exams.
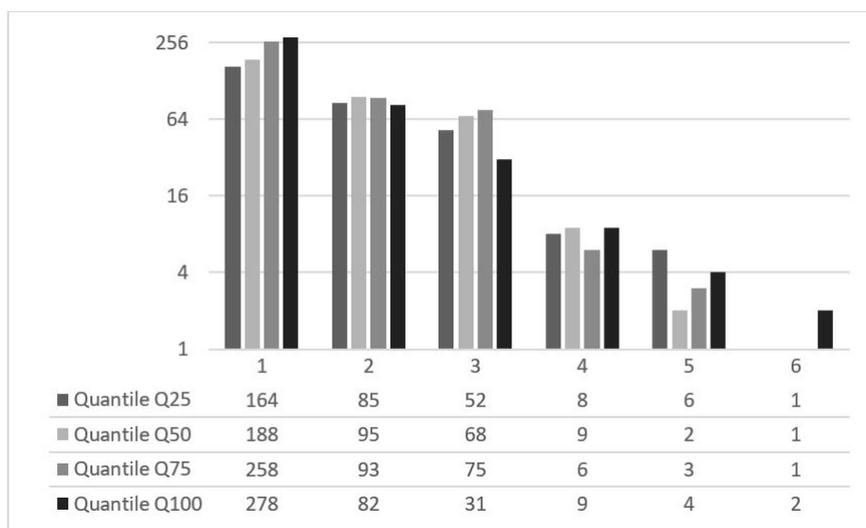
	1	2	3	4	5	6
Quantile Q25	164	85	52	8	6	1
Quantile Q50	188	95	68	9	2	1
Quantile Q75	258	93	75	6	3	1
Quantile Q100	278	82	31	9	4	2

Figure 1: Number of students by their score in portfolio and how many attempts they need to pass an exam, 2015-2017 (source: own calculation)

The data shows that students with better portfolios (the top 25% of them) pass exams on the first attempt more frequently than students from the lowest group (bottom 25%).

Hypotheses were tested:

H0: The final mark in the exams of a student at the lower and upper quartile of the portfolio is not assigned to their portfolio rankings.

H1: The final mark in the exams of a student at the lower and upper quartile of the portfolio is assigned to their portfolio rankings.

RESULTS

Table 2: Number of students according to their previous school types, 2015-2017 shows the number of students according to their previous schools and overall position in portfolio.

Quantile/Type of high school	<25%	25-50%	50-75%	>75%
High School (grammar school)	25	25	39	43
Business Academy	18	21	18	7
Secondary School	12	7	2	0
Affiliate with GCSE	5	0	0	0

Table 2: Number of students according to their previous school types, 2015-2017 (source: own calculation)

Table 3: Pearson's correlation coefficient for subjects and results of high school final exams, average of grades in the 4th year (for the first semester) and average of grades in the 3rd year (for the second semester), 2015-2017 shows Pearson's correlation coefficient for the subjects and results of high school final exams, average of grades in the 4th year (for the first semester) and the average of grades in the 3rd year (for the second semester) (Hendl, 2009).

Course code	Course name	Final exams	Avg. grades in 4th year (first semester)	Avg. grades in 3rd year (second semester)
KMG/PZAPO	Business Basics	-0.23	-0.28	-0.23
KPP/PPV01	Economic History	0.33	0.32	0.28
KMG/PPEKO	Corporate Economy	0.46	0.47	0.47
KMG/PLOGI	Logistics	0.40	0.64	0.78
KPP/PPV02	Management Skills	0.38	0.46	0.69
KMG/PPV03	Quality management	0.59	0.70	0.87

Table 3: Pearson's correlation coefficient for subjects and results of High School final exams, average of grades in the 4th year (for the first semester) and average of grades in the 3rd year (for the second semester), 2015-2017 (source: own calculation)

Six courses with high values from Pearson's correlation coefficient were identified. The negative correlation related with course KMG/PZAPO Business Basics was identified. Conversely, five courses with a positive correlation greater than 0.3 were identified. The course KPP/PPV01 Economic History's success rate correlates with the final exams results as well as with average grades in the 4th year (first semester). The course KMG/PPEKO correlation level is from 0.45 to 0.47 in each criteria evaluated during the portfolio evaluation. The course KMG/PLOGI Logistics has a strong correlation with average grades in the 3rd year (second semester). The course KPP/PPV02 Management Skills correlates with the average grades in the 3rd year (second semester), as well as with grades in the 4th year (first semester). The course KMG/PPV03 Quality management and environment has the strongest correlation with average grades in the 3rd year (second semester) (0.87, as well as with average grades in the 4th year (first semester) (0.70) and final exams (0.59).

Based on these findings it is possible to conclude that students who had better scores in their portfolios score performed better in most courses.

To test hypothesis H0, each final attempt was chosen based on the last mark of the grades that correspond to the subject. Table 4: Observed frequencies of final attempts of students from the lower quartile and upper quartile, 2015-2017 shows the data.

Observed frequencies	1	2	3	4	Σ
the lower quartile	35	74	133	74	316
the upper quartile	84	111	176	35	406
Σ	119	185	309	109	722

Table 4: Observed frequencies of final attempts of students from the lower quartile and upper quartile, 2015-2017 (source: own calculation)

Table 5: Expected values of final attempts of students from the lower quartile and upper quartile, 2015-2017 shows the expected values.

Expected values			
52.08310249	80.96952909	135.241	47.70637
66.91689751	104.0304709	173.759	61.29363

Table 5: Expected values of final attempts of students from the lower quartile and upper quartile, 2015-2017 (source: own calculation)

Table 6: Test criteria of final attempts of students from the lower quartile and upper quartile, 2015-2017 shows the test criteria for Pearson's chi-squared test.

Test criteria			
5.603206737	0.599908833	0.037134	14.49188
4.361116574	0.466924116	0.028902	11.27939

Table 6: Test criteria of final attempts of students from the lower quartile and upper quartile, 2015-2017 (source: own calculation)

Table 7: Results of Pearson's chi-squared test, 2015-2017 shows the results of the Pearson's chi-squared test.

Chi-sq	36.86846388
Number of degrees of freedom	3
Chi critic at alpha = 0.05	7.815

Table 7: Results of Pearson's chi-squared test, 2015-2017 (source: own calculation)

The implementation of test statistics exceeded the critical value; therefore we can reject the zero hypothesis of independence.

Discussion

Data about the applicants and students of the bachelor programme Economics and Management at the Faculty of Social and Economic Studies, Jan Evangelista Purkyně University in Ústí nad Labem were studied. It was observed that students with better performances in the past are more likely to perform better at exams and they need less attempts to pass those exams.

Makransky et al (2017) have found that the predictive validity of a two-step admissions procedure that included a cognitive ability test followed by multiple mini-interviews shows better results than compared to the grade-based admissions procedure. Those results are consistent with the findings of McLaughlin, Singer and Cox (2017). Another possible criteria for the evaluation of applicants is a letter of recommendation. DeZee et al (2014) have found that letters of recommendation in

the case of medical students have limited value and can't predict how students will perform during their study. A study by Reibnegger et al (2011) concluded that admission testing significantly decreased the cumulative probability for dropout over the years 2002-2003 and 2008-2009. Students without any admission requirements are more likely to dropout, as well as older students in the group of openly admitted students.

These results show that it would be efficient to further prefer students who were able to present successful portfolios. The main reason is that they are much more likely to pass courses without several failed attempts. Mesicek, Petrus and Kovarova (2017) showed that some students are able to pass exams without difficulties despite their past failed attempts. This leads to the inefficient use of faculty resources and to the application of strictly limiting those with possible failed attempts. According to Wahl and Walenta (2017) learning tests related with study and the intelligence tests could also be used instead of a portfolio. This solution will be discussed as well at the Faculty.

CONCLUSION

This paper summarized data from the admission procedure and study performance in the bachelor programme Economics and Management at Jan Evangelista Purkyně University in Ústí nad Labem. The focus was on the correlation between submitted portfolios by applicants and their future performance during their study. It was observed that the best 25% of students, according to a portfolio total score, were more likely to pass exams on the first attempt and in contrast, the worst 25% had difficulty passing exams on the first and second attempts.

The Faculty should prefer students with a higher total score in their portfolios and strictly refuse to accept students with low scores. The main reason is that their overall performance is better than the performance of students with lower total portfolio scores or the Faculty should abandon portfolios and start using learning tests.

Additional support for current students with study problems will be proposed (in form of student to student tutoring).

ACKNOWLEDGEMENTS

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THE DEVELOPMENT OF THE CONCEPT OF AXIAL SYMMETRY IN PUPILS AND STUDENTS

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Abstract

This article focuses on whether pupils and students can distinguish between axially and non-axially symmetric shapes and whether they can successfully determine the number of axes of symmetry of a particular shape. In order to research this matter, 1,458 Czech pupils and students of various ages took written tests. The data was analysed accordingly, and further analysed to determine whether the success rate in these tests was higher among older pupils and students. The results showed that the Czech pupils had no difficulty in finishing the standard tasks successfully. A considerably lower success rate in the determination of the number of the axes of symmetry of non-standard shapes can indicate an insufficient understanding of the concept of axial symmetry. In order to determine a possible cause for the occurrence of frequent mistakes, contemporary mathematics textbooks were analysed. Finally, some recommendations for pre-service mathematics teachers are presented.

Keywords

Axial symmetry, circle, isosceles triangle, perpendicular bisector of a line segment, pupils′ concepts, rhomboid

Introduction

In our long-term research the focus has been on Czech students' understanding of various geometric terms, such as a half-line (Moravcová et al, 2018) or a triangle (Robová et al, 2019). In this article, the discussion centres on axial symmetry. Axial symmetry in a plane is part of the basic curriculum that pupils are taught in primary school. According to the national curriculum (MŠMT, 2017: 33), a pupil at the end of the 5th grade should be able to 'identify and depict simple axial symmetry of figures on a quadratic grid and determine the axis symmetry by folding the paper'. Likewise, by the end of the 9th grade, a pupil should be able to 'draft and construct a plane shape in a point symmetry and determine an axially symmetric shape' (MŠMT, 2017: 36). The aim of the curriculum for elementary schools is to teach pupils both procedural knowledge (construction of an image of a point and more complex plane shapes, determination of the axes of symmetry of a particular shape) and conceptual knowledge (features of axial symmetry), which are further developed at grammar schools (MŠMT, 2007). This knowledge is important for understanding subsequent related topics: point symmetry and other geometric transformations; orientation in the Cartesian coordinate system; construction of a graph of a function; solving construction problems; etc. The requirements of the curriculum are reflected in the contemporary line of textbooks for elementary schools. According to these textbooks, the latest the pupils are introduced to the topic of axial symmetry is the 5th grade, for example (Justová, 2012), whereas others do it even earlier, for example (Hošpesová, Divíšek and Kuřina, 2014).

Jirotková (2017) points out that due to the modernisation of school mathematics, the axiomatic approach to the explanation of geometric terms was introduced to primary schools years ago. 'It is not surprising that pupils´ ideas of these concepts were often deformed as they were not anchored in the pupil′s life experience' (Jirotková, 2017: 154). The analysis of pupils' concepts of mathematics is usually supported by cognitive theories, one of which is the Theory of Generic Models (Hejný, 2012): pupils encounter the abstract knowledge via motivation, experience with isolated models and the creation of generic models. During this process, it is also important to show pupils non-models, i.e. objects that are not a model of a given term. From various research studies it is obvious that conceptual knowledge is related to the understanding of a topic, whereas procedural knowledge is related to procedures and algorithms that pupils can adopt without any deeper understanding. These two sides to knowledge acquisition mutually influence and strengthen each other and cannot be entirely separated (Vondrová et al, 2015).

On the basis of their teaching experience, Kratochvílová and Jirotková (2003) point out that although 7th graders know the terminology of axial and point symmetry, they cannot use it and see it in practice. For the pupils, those problems in which they must recognise if a particular shape is axially symmetric along a line are easier than those in which they must determine the axis of symmetry. The difficulty of the problem is also higher if the axis is diagonal (Kösse, 2012; Aktaş and Ünlü, 2017). Deciding whether a shape is symmetrical along an axis is more difficult for pupils if the axis is not vertical or horizontal (Leikin, Berman and Zaslavsky, 2000; Jagoda, 2008). The research studies conducted by Son (2006) and Karadeniz, Kaya and Bozkuş (2017) show that it is not only pupils, but also pre-service mathematics teachers that have not completely adopted the concept of axial symmetry and mainly focus on procedural understanding.

In the research presented in this article, the focus is on pupils' ability to identify an axially symmetric shape, whether they can recognise a non-model, and if they are aware of the existence of all the axes of symmetry of a line segment and a circle. In addition, the issue of whether these possible misconceptions disappear with age is examined.

Materials and Methods

For the purposes of this research, pupils and students in various age groups were given three anonymous written tests (see Table 1), the contents of which were based on the national curriculum (MŠMT, 2017; MŠMT, 2007). The pupils and students that participated were selected purely on the basis of their availability. The tests were only given to those pupils and students who were about to move on to a higher level of education. In addition, Test III was given to pre-service mathematics teachers that were in the last two years of their studies. The comprehensibility of the test, as well as the time limit, were checked and determined on the basis of a pre-test given to a smaller group of pupils and a subsequent semi-structured interview with the researchers.

Test	School type and grade (number of pupils/students)	Typical age	Testing date	Total
Test I	1st grade of LSS (177)	11	2017 Sept.–Oct.	505
	1st grade of GS (328)	11	2017 Sept.–Oct.	
Test II	last grade of LSS (180)	15	2018 Apr.–June	437
	appropriate grade of GS (257)	15	2018 Apr.–June	
Test III	last grade of USS (311)	19	2018 Apr.	516
	1st grade of UNI (161)	19	2017 Oct.–Nov.	
	4th and 5th grade of UNI (44)	22–23	2017 Oct.–Nov.	

Table 1: Overview of tested pupils and students (source: own data) [1]

[1]   LSS = lower secondary school, GS = grammar school (LSS with entrance examination), USS = upper secondary school, UNI = university

The tests were then assessed qualitatively. Each pupil's answer for each task was assigned a code. The tests from every class were coded by different pairs of researchers independently and the data entered into tables. The differences in the coding of a specific task were discussed among the whole research team until a collective consensus was reached.

In each test, there was one task to determine the number of symmetry axes for three given (pre-drawn) shapes. In Test I, we asked for the number of axes of symmetry in an isosceles triangle, rhomboid, and line segment. In Tests II and III, there was a rhomboid, line segment, and circle. For these tasks in Tests I, II and III, the coding of students' answers was uniform. Correct answers were assigned the code *OK*, missing answers assigned the code *MA*, unreasonable answers assigned the code *er* (in meaning 'error')*,* and 'infinite' (if it was wrong) answers assigned the code *inf*. If the number of axes was wrong, the code corresponded to the number of axes the pupil/student wrote down. Codes with a low occurrence were unified under the code 'other answer' (*OA*). From this data, the absolute and relevant frequencies of the codes were determined for all three tests. The data was then processed graphically. For Test I, a contingency table of the absolute frequencies was made for the isosceles triangle and rhomboid. When testing, the pupils and students were differentiated according to gender. However, a preliminary statistical analysis revealed that there were no significant differences between both groups, and therefore this was not taken into further consideration.

RESULTS

Pupils´ thoughts on the number of symmetry axes in the given isosceles triangle (Test I) are summarised in Table 2, which shows the frequency of occurrence (in percent) of each code. The success in determining the axis of symmetry in the given isosceles triangle was relatively high, especially among grammar school pupils.

	Isosceles triangle						Rhomboid					
Code	*OK*	*0*	*2*	*3*	*OA*	*MA*	*OK*	*1*	*2*	*4*	*OA*	*MA*
LSS	30	5	15	21	10	19	8	6	21	32	15	18
GS	77	9	5	3	1	5	41	11	25	12	6	5
Total	60	8	8	10	4	10	30	9	24	19	8	10

Table 2: Number of symmetry axes in the given isosceles triangle and rhomboid, Test I, pupils' answers (source: own data)

		Rhomboid		
		OK	AOC	Total
Triangle	*OK*	141	164	305
	AOC	9	191	200
	Total	150	355	505

Table 3: Contingency table for triangle and rhomboid, Test I (source: own calculation)

The success rate in the task with the rhomboid in Test I was significantly lower (Table 2). We therefore further researched the relationship between the successful solutions for these two tasks. We drew up a table for Test I that compares the pupils' opinions on the number of axes of symmetry for the given isosceles triangle and rhomboid. The results revealed that both tasks were correctly solved by the highest number of pupils (141). For this reason, a 2x2 contingency table (Table 3) was created in which the code *OK* was differentiated from all the other codes (AOC). From the data in the table, it is apparent that out of a total of 505 pupils, 164 pupils solved the triangle correctly, but not the rhomboid; only 9 pupils solved the rhomboid correctly, but not the triangle, and 191 pupils answered both tasks incorrectly. The χ^2 (chi-squared) independence test was subsequently applied to the acquired data. We calculated the test criterion K = 100.737 that had χ^2 distribution for independent characters with one degree of freedom and then compared

with the critical value of 6.635 on the significance level of 0.01. The test criterion came out significantly higher than the critical value. The null hypothesis that the occurrence of the *OK* code in both tasks is not related was therefore rejected. On the contrary, the results showed a significant connection exists.

In all three tests, we asked about the number of the symmetry axes for the given rhomboid and line segment. The results for the individual groups of pupils and students are summarised in the graphs (see Figures 1 and 2).
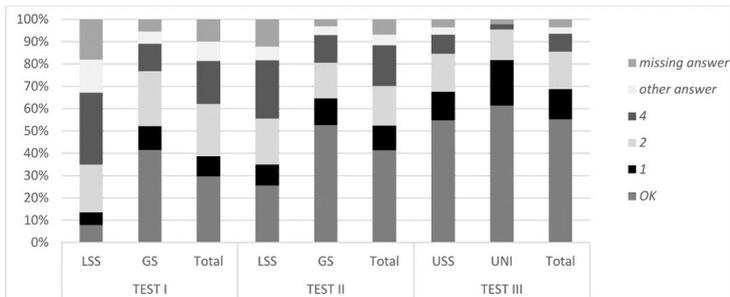
Figure 1: Number of symmetry axes for the given rhomboid – pupils' and students' answers (source: own calculation)
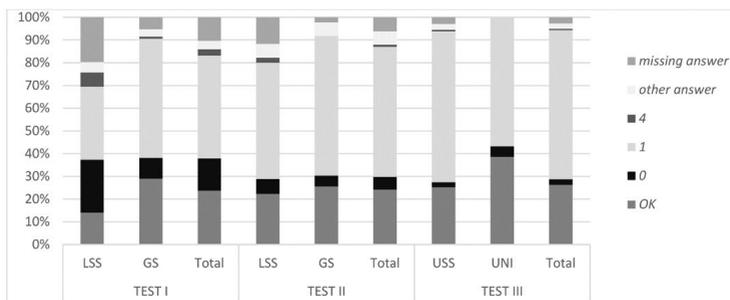
Figure 2: Number of symmetry axes for the given line segment – pupils' and students' answers (source: own calculation)
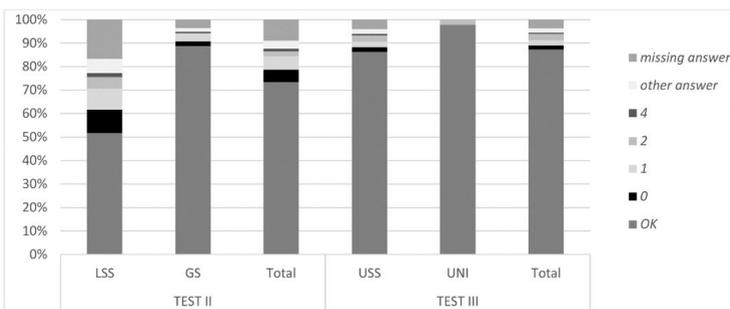
Figure 3: Number of symmetry axes of circle – pupils' and students' answers (source: own calculation)

We only asked about the number of the symmetry axes of the circle in Tests II and III for two reasons. Firstly, because the pupils of primary schools may not have studied circles according to the curriculum (MŠMT, 2017), and secondly, because at their age, the correct answer 'infinity' is not to be expected. The answers of the pupils and the students are presented in the graph in Figure 3.

DISCUSSION

Most of the pupils at the start of lower secondary school correctly determined the number of the symmetry axes of the given isosceles triangle despite the triangle not being placed as usual (base was not in the horizontal position). The most frequent incorrect answer was 'three axes', whereby the pupils in all likelihood mistook the isosceles triangle for an equilateral triangle. Only 30% of the pupils correctly answered that the rhomboid in Test I was not axially symmetric. Based on the research of the relationship between the answers for these tasks, it is possible to state that the pupils who answered the rhomboid task correctly, answered the triangle task correctly as well and therefore in all probability have an adequate idea of axially symmetric shapes. However, a correctly answered standard task (triangle) does not imply a correct answer to a less standard task (rhomboid). These pupils probably stayed at the level of isolated models (Hejný, 2012).
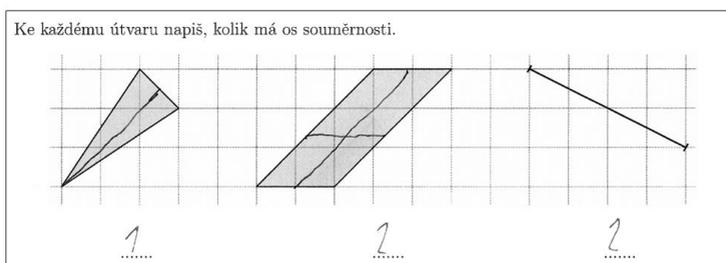
Figure 4:[2] Pupil's answers, Test I (source: own data)

The graph in Figure 1 shows that recognising the rhomboid as a non-axially symmetric shape is difficult even for older pupils and students; similar results were obtained by Leikin, Berman and Zaslavsky (2000) and by Aktaş and Ünlü (2017). The most common misconception among those older in age is that the rhomboid had two or four axes of symmetry. In Tests I and II, almost one fifth of the pupils answered 'four axes'. In Test I, almost a quarter of pupils answered 'two axes', and in Tests II and III, almost one fifth of the pupils and the students answered 'two axes' as well. Some of them tried to draw the axes of symmetry. From these answers, we concluded that the prevailing concept of the axes of symmetry of a rhomboid are the lines that go through the centre of the shape, parallel to its sides (see Figure 4) or eventually its diagonals. The cause of this might be the textbooks for primary schools, which contain an insufficient number of non-models, and which in some cases, for example (Justová, 2012), do not present any non-models at all. This incorrect concept is probably fixed so strongly in pupils' minds that it does not disappear throughout the whole time they attend lower secondary school, despite the fact that the pupils encounter such tasks in most of their textbooks. At upper secondary schools, there are more difficult tasks that focus on the application of axial symmetry and which presume that the pupil has the right concept of axially and non-axially symmetric shapes. However, in newer textbooks for upper secondary schools (e.g. Vondra, 2013), one might encounter tasks prepared for lower secondary schools.

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[2] The task in English: 'Write down how many axes of symmetry this shape has.'

In all three tests, approximately one quarter of pupils/students correctly identified the number of symmetry axes for the given line segment. The results clearly show that the pupils/students mismatch the 'perpendicular bisector of a line segment' and the 'axis of symmetry of a line segment'. It is interesting that the misconception that 'a line segment has only one axis of symmetry' gets stronger with age and at the expense of the missing answers overall and missing answers '0'. Out of the frequent drawings in the tests, it is apparent that they mistake the axis of symmetry only for the perpendicular bisector of a line segment. This misconception may also spring from the formulation found in textbooks, such as 'is the line *o* [perpendicular line running through the centre of the line segment] the axis of symmetry of the *AB* line segment?' (Odvárko and Kadleček, 2011: 36), if there is no indication that a line segment has another axis of symmetry. For Test II, in 5% of cases the relatively surprising answer 'infinity' was given. Based on some of the pupils' drawings, we assume that in this case, the pupils think that the axis of symmetry is any line going through the centre of a line segment. It is possible that this misconception is created when they are introduced to another geometrical transformation – point symmetry.

The success rate for the task with regards to the number of symmetry axes of the circle was higher among those who took Test III than for those that took Test II, in particular due to missing answers. In total, the number of correct answers was relatively high in both tests. The concept that the circle has (exactly) 1, 2, 4 or no axis of symmetry appeared in both tests in the range of several percent. This task or its equivalent is in almost every textbook for the lower secondary school so it can be regarded as a standard task that pupils know.

Our research, as is the case of that conducted by others (Kösse, 2012; Aktaş and Ünlü, 2017; Jagoda, 2008), substantiates the fact that pupils from primary and lower secondary schools are making various mistakes when solving tasks about axial symmetry and that they continue to do so through to adulthood. The pupils' misconceptions about axial symmetry may be connected to the way their teachers educate them. Research studies conducted by Son (2006) and Karadeniz, Kaya and Bozkuş (2017) showed that some pre-service mathematics teachers have a limited understanding of axial symmetry. In both studies, the students of pedagogy focused more on the procedural aspects of axial symmetry, even though the pupils' problems are connected with their conceptual understanding. In the first study, only 76% of future teachers correctly identified the number of symmetry axes of a rhomboid. In our research, only 61% of future teachers in the last two years of their studies correctly answered the same question, and only 39% of respondents knew about the two axes of symmetry of a line segment.

Conclusion

Axial symmetry is important for many technical fields, medicine, etc. From our experience, we know that from the point of view of pupils and teachers it is regarded as a rather simple subject. The research presented in this article showed that the pupils can solve standard tasks (isosceles triangle, circle), but that non-model (rhomboid) or non-standard axially symmetric shape (line segment) poses a problem for pupils, students and future teachers alike. In conformity with Ho and Logan (2013), we therefore think it is important to add more non-standard tasks and non-models and to better prepare pre-service teachers to solve problems concerning axially symmetric shapes. For better pupils' understanding of axial symmetry dynamic geometry software can also be used (Faggiano et al., 2017). The results of our study can be used by the authors/publishers of mathematics textbooks and for the modification of the relevant tasks therein.

Acknowledgements

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THE IMPACT OF THE PERSONALIZED E-COURSE ON THE LEVEL OF KNOWLEDGE IN COMPUTER SCIENCE SUBJECTS

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Abstract

With current e-learning platforms, its unused potential often comes up when creating the educational content. E-courses then look more like an Internet repository than an organized and well structured learning management system (LMS). Many studies mark this type of education as unsuccessful. It instigated the creation of several theoretical principles and methods of creating study materials in LMS environment and the creation of new e-learning environments with the possibilities of personalization. The systems with such function can be marked as "learner oriented" because its content is modified according to the user's interests, expectations, motivation, learning styles and habits, needs, etc. The paper deals with the possibilities of using the adaptive tools of LMS Moodle when creating a personalized e-course. It describes the assumptions of the method's impact on the efficiency of the education and achieved study outcomes. The given assumptions are verified in a selected field of computer science education.

Keywords

Computer science education, e-learnig, LMS Moodle, personalized e-course, the adaptive approach

Introduction

The fast development of web technologies and methods has caused that Internet education is becoming more accessible, more open and more adaptive. It was an impulse for the creation of new techniques, approaches and models. They enabled a bigger and faster human (social) communication, cooperation, and they led to a new form of economic activity that besides other things brought the required changes in education.

With the rising trend of lifelong learning with the support of information and communication technologies (ICT), some of the roles and competences of the teacher are changing. According to the authors Burianová and Turčáni (2016), the digital competences of the teachers represent the bridge between the traditional education and e-learning. The educational process is starting to focus more on the personality of the learner, and the teacher is getting into the role of a tutor. E-learning has become the part of the education of today's time's thanks to its diverse use, from its presentation of the digital content until the LMS (Kostolányová, 2012).

The improvement of ICT and its application influenced the sharing and the transfer of knowledge (Mudrychová, et al. 2018). Today's students can study anywhere and anytime. They use technologies not only for the formal but also for the informal education which they employ in their study lessons in school or at home on any device connected to the Internet. The use of the virtual learning environment (VLE) has an impact on planning, learning, proposition, control and evaluation of the educational process and on providing the educational content. Blended learning is based on such an approach (Burianová, et al., 2018).

The mass education in the class or „classic" e-learning is not able to respond to the individual

needs of the student. Some students are capable to acquire new knowledge faster than the given form of education and it leads to the student's discontent. On the other hand, the pace might be too high for some students, so they are not able to acquire knowledge in the required extent. Those who are interested in the topic might not like the style of the teacher. These students later develop a certain aversion to the teacher or the subject and then the consequences are that the students' study results worsen (Brusilovsky, 2003; Kostolányyová, 2012; Magdin, Turčáni, 2015).

The authors of the paper have been dealing with the issue for a long time now and they recommend solutions that lead to the efforts to personalize the content of e-learning courses according to the characteristic features of users or students. Each student is determined by a set of individual attributes. These attributes can be his expectations, motivation, learning styles and habits, his needs, etc. According to the attributes, the students can be divided into particular groups (Despotović-Zrakić a kol., 2012).

It is possible to perceive the personalization of e-learning from the point of view of authors Klašnja-Milićević et al. (2017) as a process of deciding about the highest value for the individual from the set of possible options. The authors also differentiate two main approaches to personalization. Those are according to user profile and rules-based personalization. The user profile is a decision-making process based on information obtained from the saved user profiles or predefined groups. The rules-based personalization is a process of decision making based on predefined rules that are applicable to the specific parts of users.

Kostolányyová and Nedbalová (2014) claim that dividing the students into various study groups according to their level of knowledge and preferred sensory modality in the e-learning course might bring various benefits such as fast knowledge acquisition and superior preservation of the acquired knowledge.

Currently, there are efforts and propositions made to increase the efficiency of the concepts that would be possible to use in the VLE. The authors of the paper made efforts to use system tools that help to identify the above-mentioned individual attributes of the students. They are convinced that the more attributes are taken into consideration, the better and more precise personalization can be created (Mudrák, Turčáni and Burianová, 2018).

The goal of the paper is to verify the assumptions about the impact of the proposed method on the level of achieved study results in a given field of computer science education. The result would be a data comparison obtained from the control and experimental groups of students and the expression of adequate conclusions. The first part deals with the various approaches in the field of e-learning personalization. The second part deals with a detailed description of the used personalized e-learning method through LMS Moodle. The third part is a presentation of the results and discussion gained from the applied research. Finally, the conclusion contains a summary of the findings.

Materials and Methods

In scientific publications dealing with personalized systems, there is a certain differentiation in the opinions. Unlike the common e-learning that has a tendency to deal with the students as a homogeneous subject, while personalized e-learning characterizes the learners as a heterogeneous mixture of individuals.

To compare the approaches to a personalized education with the support of e-learning, there are two approaches of personalized e-learning: a static and a dynamic approach. An example of a static approach can be a special questionnaire at the beginning of the e-course that the student has to fill in to find out his entry characteristics (learning style, previous knowledge, motivation, etc.). Based on this information, the e-course adapts to the student so that it would comply with his needs. On the other hand, the dynamic approach is based on monitoring the activities of the

user in the VLE in real time. The system saves the data about the user into a database. Immediately after the evaluation, it adapts the content, the layout, etc. to the user (Karagiannis and Satratzemi, 2016).

When designing the concept of the personalized educational process, it was convenient to use the solution through VLE that was applied for a longer time. In this field, two main approaches to implementation were used. Some authors made a decision to create their own VLE according to their own specific requirements. For the solution of the research, it was the most appropriate to use the approach with the already created plugins or module feature adjustments in the selected open-source LMS which was the LMS Moodle.

Despotović-Zrakić et al. (2012) point out the suitability of the chosen LMS. They developed a method to create adaptive educational e-courses for distance education in LMS Moodle. The courses are organized and adapted to three groups of students according to their learning styles. The authors used the Felder-Silverman learning styles model (FSLSM) while they left out the sensing-intuitive dimension. They used only the default function of the LMS Moodle for this purpose.

Zounek et al. (2016) implemented education through LMS Moodle based on constructivist principles, project and group education. The students themselves become the creators of the e-course where they adapt the study content, and they form a working team together with the teacher. The teachers are in the role of tutors or couches of each team and they provide feedback to the learners about their work, etc.

Magdin and Turčáni (2015) modify the book module in LMS Moodle that provides the advanced adaptive behaviour of the original module and called it the *AdaptiveBook*. The authors used an Index of Learning Styles questionnaire (ILS) in order to assign the appropriate learning style for each student.

Methodology description of the personalized e-course implementation

The goal of the methodology was to create an efficient e-course with the features of personalization. Based on the defined requirement, the deficiencies of the used e-course in the subject *Logical Systems of Computers* (LS) needed to be analysed and identified. The subject was carried out for the first year students of Applied Informatics (AI) in the winter semester every week in the form of a lesson and seminar. The students were provided by a didactically elaborated e-course, and their study was carried out in a form of blended learning. The deficiencies were identified in the form of a pre-research, and the results of the findings were applied to the following described methodology.

Based on the introduced findings, to achieve the goal, a questionnaire was chosen as one of the tools of personalized education. When creating the questionnaire being applied in the subject LS, Gavora (2010) introduced the steps that were applied in the research. It was a questionnaire made of ten items with five open and five closed items (three dichotomous and two simple options). The goal of the proposed questionnaire was to obtain specific information about each student. The first year students of AI studying at the Department of Informatics at the University of Constantine the Philosopher in Nitra were the research sample. To create the questionnaire, the tools offered by the LMS Moodle were used. The results were exported into the spreadsheet of Microsoft Excel and then processed.

Two groups were created, an experimental and a control group. In the experimental group, two other sub-groups of students were created. The students in the control group had unlimited access to all the study materials during the semester, and they studied according to the original methodology of the e-course. The students of the experimental group studied according to the proposed methodology in the modified e-course.

A questionnaire and a pretest were provided to the students in both groups on the first introductory lesson. The students of the experimental group were provided by a second questionnaire - the ILS questionnaire, and the results were interpreted into the e-course. The standardized questionnaire was chosen because it is reliable, simple and has a free access at the address www.webtools.ncsu.edu/learningstyles/.

After the ILS questionnaire evaluation, the students of the experimental group were divided into two sub-groups according to the way of acquiring the knowledge: globally (experimental group global – EG_G) or sequentially (experimental group sequential – EG_S). The next step was to register to the course and the pretest. The goal of the ILS questionnaire was to identify the students' learning styles. According to the results, the students were provided by recommendations of study materials and activities according to the FSLSM that correlate the most with their learning styles. The goal of the pretest was to find out the information about the students' entry knowledge. To make this happen, the activity *Test* in the LMS Moodle was used. From the results of the pretest, the zero hypotheses (H0) was verified: *"Among the students in the control and experimental group, there is no statistically significant difference in their entry knowledge."* From the evaluation of the didactic efficiency of the proposed e-course methodology point of view, it would be convenient if the hypothesis was confirmed.

To confirm the assumption that the results of the posttest depend on the type of the used course, the first hypothesis (H1) was determined: *"The created personalized e-course has a proven impact on the efficiency of acquiring knowledge than a standard (non-personalized) e-course."* The confirmation (H1) would signify that the better results in the experimental groups in the posttest, verifying the acquired knowledge at the end of the course (unlike in the control group), were the result of the application of the personalized e-course.

The course content was divided into study lessons according to each week in the semester. With the use of adaptive tools of LMS Moodle, besides the process of personalization of the study content, the aim was also to motivate the students to study regularly. There was the effort to eliminate the so-called procrastination of the students during the semester that might positively influence the efficiency of the study, the quality of the knowledge and decrease of the stress factor before the exam.

The use the possibilities of LMS Moodle were tried in the experimental group of students, such as access restriction, performing activities, gamification (*Level Up!*) and a personalized feedback through activities *Lesson* and *Test* to control the process of education.

The study content was presented in a form of sources such as *Book* with interactive animations, *Lesson*, etc. In order for the student to proceed to the *Test*, it was required from him to study the content of the sources. The activity *Test* was chosen to be the main check point of each lesson that verified the knowledge of the student and provided him with a feedback (Mudrák, Turčáni, and Burianová, 2018). In the case of a sufficient number of scores achieved in *Test*, it was enabled for the student in EG_S to proceed to the next lesson. If the student did not get enough scores in the *Test*, he would be informed about the deficiencies through the results provided by the personalized feedback. After the evaluation display of the successful test of the given lesson, the system referred the student to the place in the e-course or external sources where he could find the information related to the topic of the lesson. After a repeated study, the student could access the *Test* again. In order to keep the test as reliable as possible, it was time limited with the option of generating the questions chosen from the *Question bank* and also limited by the number of attempts. The content of the activity *Test* took into consideration the pedagogical and psychological principles of the process of forgetting. As the student was proceeding in the e-course, the *Test* contained randomly generated questions from previous lessons that supported the systematic revision of the acquired knowledge. In the case the student was unsuccessful more than twice in the *Test*, he was

then recommended to have a consultation with the teacher who would find out the reasons of the student's failure through the method of a discussion. Based on the findings from the discussion, the teacher/tutor would modify the study recommendations for the student in order to remove the phenomenon of the failure in the following lessons.

With the students from the EG_G, the access restriction to each lesson was not used, but they had access to the whole content of the e-course. The teacher required that they needed to fulfil certain activities until a specific date and time.

RESULTS AND DISCUSSION

The selection file was made up of 82 students. A compact group was used selected by the Academic Information System (AIS). The data recovery was 71.95% which means that because of the complexity of the data, the final sample of students was 59 for hypothesis verification. The groups' composition is shown in Table 1.

Group	Students
EXP_S	27
EXP_G	17
CON	15

Table 1: The number of students in each group, 2018-2019 (source: own calculation)

To verify the (H0) and (H1), a two-sample t-test with assuming equal variances was used. A detailed result statistic are shown in Table 2 and Table 3.

pretest	EXP_S	Control_G	posttest	EXP_S	Control_G
Mean	3.074	1.933	Mean	1.574	2.633
Variance	0.898	0.638095238	Variance	0.225	0.552
Observations	27	15	Observations	27	15
Pooled Variance	0.807		Pooled Variance	0.340	
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	40		df	40	
t Stat	3.943		t Stat	-5.644	
P(T<=t) one-tail	0.000157831		P(T<=t) one-tail	7.47219E-07	
t Critical one-tail	1.684		t Critical one-tail	1.684	
P(T<=t) two-tail	0.000315663		P(T<=t) two-tail	1.49444E-06	
t Critical two-tail	2.021		t Critical two-tail	2.021	

Table 2: The comparison of results in the pretest and the posttest of EXP_S and Control_G, 2018-2019 (source: own calculation)

From the indicated results it was evident that the hypothesis (H0) was not possible to confirm, and it could be stated that between the control and the experimental group there was a significant statistic difference in the entry knowledge. Students of the control group had better results in the pretest than the students in the experimental groups. The difference in input knowledge is probably due to the fact that students have attended secondary schools with different study fields. In the future, this should be taken into account when selecting the composition of research groups. On the other hand, the hypothesis (H1) could be confirmed. From the calculated values it was possible to state the conclusion that the students in the experimental groups achieved proven better results in the posttest than the control group. The significant statistical difference found

in the pretest is not so important in this case, because the results are of a reversible nature. The authors assumed that the results might have affected the use of methodology described in the paper to a significant extent. In the case of equal groups, the impact of the used methodology could be even more pronounced.

pretest	EXP_G	Control_G	posttest	EXP_G	Control_G
Mean	3.147	1.933	Mean	1.5	2.633
Variance	0.961	0.638095238	Variance	0.5	0.552
Observations	17	15	Observations	17	15
Pooled Variance	0.811		Pooled Variance	0.524	
Hypothesized Mean Difference	0		Hypothesized Mean Difference	0	
df	30		df	30	
t Stat	3.806		t Stat	-4.418	
P(T<=t) one-tail	0.000324724		P(T<=t) one-tail	5.9915E-05	
t Critical one-tail	1.697		t Critical one-tail	1.697	
P(T<=t) two-tail	0.000649449		P(T<=t) two-tail	0.00011983	
t Critical two-tail	2.042		t Critical two-tail	2.042	

Table 3: The comparison of results in the pretest and the posttest of EXP_G a Control_G, 2018-2019 (source: own calculation)

In the chapter material and methods, there are described e-learning personalization approaches. Karagiannis a Satratzemi (2016) claim that better results are achieved with the dynamic approach because in the static approach, the entry information state is taken into consideration and not the specific state like in the case of the dynamic approach.

Based on the experiences and the results of the research, the combination of the two approaches as solution would be recommended. By the static approach through diagnostic methods, it is possible to find out information that would have been difficult to find from the activities of the user in the e-course. It also enabled to adapt the e-course to new students at the beginning. With a sufficient amount of data about each user (student), the following adaptation in a dynamic way would be appropriate (Mudrák, 2018).

While Despotović-Zrakić et al. (2012) emphasize student's learning styles, their input knowledge was more important in our case. We decided to do so on the basis of previous research, where we found that most students do not have a favorite learning style that significantly influences their way of learning. Modeling of students by using the FSLSM was used only as one of the personalization tools. We are of the opinion that FSLSM should be used to inform students of what type of learning style is best for their study. We agree with Bradáč et al. (2017) who leave students a free choice of the study material.

Unlike Magdin and Turčáni (2015), we used the adaptive possibilities of *Test* activity. This solution is less time consuming and it was achieved equally positive results with appropriate settings.

The data obtained through questionnaires, pretests, and posttests were processed and evaluated for the purposes of increasing the quality of education in the field of study *Applied Informatics*. These findings mean a good direction in the achievement of the better results in the LS subject by students studying through the described methodology. Based on the results obtained, the modification of the used e-course will be conducted for the purpose of further pedagogical research in the following period. As a next issue to be dealt with, the use of appropriate plug-ins to support the personalization in a chosen e-course in LMS Moodle is in consideration.

Conclusion

The issue described in the paper is not a new phenomenon, but it is dealt with on an international level for a longer time now. During the pedagogical practice, teachers come across the insufficient personalization in the education of students with specific features. That is the reason why it is necessary to analyse consistently the state of the learner, the level of his knowledge in the given subject, and also the particular parts of the educational process. For this purpose, e-courses were selected at the Department of Informatics at the University of Constantine the Philosopher in Nitra which underwent a consistent analysis with the goal to find out and to eliminate the deficiencies influencing the quality of the personalized content provided by the e-courses of the selected studied subjects. With the use of the described methodology, it was possible to compare the impact of two different approaches towards learning and the students' results of the given subjects.

As long as the used methodology in e-course is concerned, the most noticeable impact was shown in the activity of the students during the semester. The authors assumed that it became evident in the results of the students in the posttest. However, it was necessary to point out that the final effect of the learning process was influenced by the teacher since it was a form of blended learning. In the future, the authors would attempt to evaluate all the findings related to learning through a personalized e-course and to keep it up to date the used methodology and the study content. The use of adaptive possibilities of the LMS Moodle and the use of the appropriate e-course structure using the options of personalization would be also determinative. By application of the proposed concept, it would be expected that the efficiency of the educational process would increase, and also the knowledge acquired through the proposed e-course would increase in quality.

Acknowledgements

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METHODS OF ENTREPRENEURSHIP EDUCATION IN MANAGEMENT PROGRAMMES AT UNIVERSITY OF SOUTH BOHEMIA

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Abstract

Entrepreneurship education (EE) is becoming more and more important everywhere in the world and research in entrepreneurship are growing and getting legitimacy in the scientific communities. Teaching methods have an important role in entrepreneurship education. The key to a successful entrepreneurship education is to find the most effective way to manage the teachable skills and identify the best match between student needs and teaching methods. The aim of the paper is to find out what types of education related to entrepreneurship would be welcomed by the students at the University of South Bohemia. This paper used a specially designed questionnaire (214 questionnaires) to explore undergraduate students' preferences in teaching methods of EE. The students expected to be taught by active methods, e.g. experts lectures and business simulators.

Keywords

Enterpreneurial education (EE), management, students, teaching methods.

Introduction

"How to raise entrepreneurial spirit and intentions of students?" This is a question which should be solved by universities especially by faculties of economic. The students represent the future of the entrepreneurs' generation; their entrepreneurs' intentions and their future career plans will constitute the future of the society and its economic development entrepreneurs and the way their entrepreneurship intentions are measured. Due to this growing importance of power young student generations, the University of South Bohemia, Faculty of Economic has decided to conduct a survey on facet "Entrepreneurship Education" (EE).

Entrepreneurship education (EE) is booming worldwide (Kuratko 2005; Neck and Greene 2011). Entrepreneurship education includes all activities aiming to foster entrepreneurial mindsets, attitudes and skills and covering a range of aspects such as idea generation, start-up, growth and innovation (Fayolle, 2009). Entrepreneurship education, according to Binks (2005), refers to the pedagogical process involved in the encouragement of entrepreneurial activities behaviours and mindsets. Other interpretation is a collection of formalised teachings that informs, trains, and educates anyone interested in business creation, or small business development (Jones and English, 2004). Therefore the role of entrepreneurship education is mainly to build an entrepreneurial culture among young people that, in turn, would improve their career choices towards entrepreneurship (Deakins, Glancey et al. 2005).

Effectiveness of entrepreneurship education is largely related to the teacher's skills and his (or her) knowledge of using different teaching method, specifically the methods of teaching entrepreneurship (Arasti et al., 2011). Jones and Iredale (2010) suggested that entrepreneurship education demands experiential learning styles, creative problem solving and learning by doing

to arouse the interest of the students. Most of articles report on experiments on teaching methods (see Heinonen and Poikkijoki, 2006; Robertson and Collins, 2003). Many also propose what they consider to work best (see Verduyn et al., 2009; van Auken et al., 2006), and others give a reflection of present teaching approaches (Smith, 2006).

Most authors categorize teaching methods into two groups, which are termed "traditional methods" (comprising normal lectures) and "innovative methods" (which are more action-based), also known as "passive methods" and "active methods", respectively. The traditional or passive (teacher-centred learning) has to do with formal lectures in the classroom while the innovative or active (student centred) is that which involves the participation of both the student and instructor or teacher (Mwasalwiba, 2010). Active methods according to Bennett (2006) are those that require the instructor to facilitate learning, not to control and apply methods that enable students' self-discovery. The three most used methods are: lectures, case studies, group discussions. Traditional methods comprise of normal lectures, seminars, reading, business plan, project works and innovative methods are more action-based pedagogy (Hytti and O'Gormon, 2004; Tasnim, 2012). According to Bennett (2006) are lectures, case studies and group discussions passive and less effective methods in influencing entrepreneurial attributes. Traditional teaching methods do not activate entrepreneurship (Sogunro et al, 2004).

Other active methods used, but not as common as the previous group, include: business/computer or game simulations (Chang and Rieple, 2013), video and filming (Verduyn et al., 2009), role models or guest speakers (Hegarty, 2006), business plan creation, project works, games and competitions, setting of real small business ventures, workshops, presentations and study visits (Keogh and Galloway, 2004), visits and attachments to companies to gain practical experience (Balan, 2014), businnes simulation games, guest speakers, field trips (Ahmad et al., 2018), scenarios, role playing and real business experiences (Corbett, 2005), live projects that combine traditional teaching with talks from business people Heinonen and Poikkijoki, 2006), peer assessment, primary data gathering and reflective accounts (Chang and Rieple, 2013).

Materials and Methods

The aim of the paper is to find out what types of education related to business and entrepreneurship would be welcomed by the students of management at the University of South Bohemia in České Budějovice.

The research is based on 214 questionnaires, which were filled in by the students of the University of South Bohemia in České Budějovice in 2018-2019. The questionnaires classify the following categories:

1. by the gender of the students into: 60 men and 154 women;
2. by the faculty into: 57 students of the Faculty of Health and Social Sciences and 157 students of the Faculty of Economics;
3. by the year of the study into: 87 students of 1st class, 69 students of 2nd class, 28 students of 3rd class and 30 students of 5th class; its means 127 students of other classes.

Questions in the questionnaire were dealing with the methods of education, i.e. which methods of education would they prefer. The participants assessed teaching methods and techniques that they see as useful in the development of business skills. The rating scored from one (least useful) to seven (very useful).

There are many teaching tools and methods used in the management programmes. The researcher intends to find out the appropriate combination of teaching methods and quality development. Simply to find out the better match or suit of teaching method and its applicability for development of entrepreneurial quality. For the research purpose the researcher has considered the best proven 8 number of methods used in the world of management education.

The results obtained were subjected to statistical analysis by the nonparametric Mann-Whitney test. The Mann-Whitney U test is used to compare two unrelated, or independent, samples. The variable under consideration is measured on at least an ordinal (rank order) scale. The interpretation of the test is essentially identical to the interpretation of the result of a t-test for independent samples, except that the U test is computed based on rank sums rather than means. The outcome is after a correction for ties. The formula 1 determine a Mann-Whitney U-test statistics for each of the two samples. The smaller of the two U statistics is the obtained value (Corder and Foreman, 2009):

$$U_i = n_1 n_2 + \frac{n_i(n_i+1)}{2} - \sum R_i \qquad (1)$$

where U_i is the test statistic for the sample of interest, n_i is the number of values from the sample of interest, n_1 is the number of values from the first sample, n_2 is the number of values from the second sample, and $\sum Ri$ is the sum of the ranks from the sample of interest. After the U statistics is computed, it must be examined for significance (Corder and Foreman, 2009). With samples larger than 20, the sampling distribution of the U statistic rapidly approaches the normal distribution. In computations for the Mann-Whitney U test, a continuity correction is applied.

Null working hypotheses, which form the subject matter of verification on the 5% level of significance, are following:

- $H0_1$: There is no tendency for ranks of group of male students to evaluate significantly higher (or lower) learning methods / techniques that are useful for the development of entrepreneurship than group of female students.
- $H0_2$: There is no tendency for ranks of group of students of the Faculty of Economics to evaluate significantly higher (or lower) the learning methods / techniques that are useful for the development of entrepreneurship than group of students of the Faculty of Health and Social Sciences.
- $H0_3$: There is no tendency for ranks of group of students from the first year of the study (first class) to evaluate significantly higher (or lower) the learning methods / techniques that are useful for the development of entrepreneurship than those of the other.

HA: The statistical alternative hypothesis is that the ranks of one group of students are systematically higher (or lower) than those of the other (the difference exists in at least one case). The results are interpreted at alpha significance level 0.05, resp. with 95% reliability. For reasons of clarity, only significant results, including achieved level of significance (p-value), are given in the text. Statistical evaluation of tests was performed using Statistica 12.

After that, significant relations were tested for order variables through correlations. Spearman rank correlation is one of the most common measures. The coefficient is based on the fact that the order a1 is assigned to each value of the variable X and the order b1 is assigned to each variable Y. Spearman coefficient takes values from the interval <-1; 1>. If each respondent is in the same order for both variables, then the coefficient is 1 (positive correlation, known as the direct dependence). Otherwise, there is a negative correlation (Řezanková, 2007).

RESULTS

As result shows above (Figure 1), the students prefer methods of entrepreneurship education, which are connected with „live information". It means, that the most popular are lectures of experts (5.8) where experts in entrepreneurial environment will share their experiences. Other very favourite method is business simulators (5.1) which can prepare very similar condition for business/entrepreneurial carrier. On the very same level is method Special projects (5.1) on particular topic in business area. The next

interesting method is Playing role (4.9) which belongs to active learning. The less popular with less effectivity method which students choose are Psychology counselling (4.6), Case studies (4.6), Tasks and essays (3.7).

At the 5% level of significance, we do not reject the null hypothesis $H0_1$ for the characteristics of students' sex for evaluation of most learning methods. The working hypothesis $H0_1$ was at the 5% level of significance rejected (p-value = 0.0120) only for "special projects". The differences between groups of male students and female students were statistically significant. The results show that the ranks of the groups of female students evaluate the "special projects" significantly higher than group of students of the male students. In other cases (other learning methods), differences according to the gender of the students were not statistically proven.

The working hypotheses $H0_2$ was at the 5% level of significance rejected for learning methods: "tasks and essays, business games, business simulators, lectures of experts". The differences between groups of students from different faculties were statistically significant (see p-values in table 1 above). Results show that these entrepreneurship learning methods evaluate group of students of the Faculty of Economics significantly higher than group of students of the Faculty of Health and Social Sciences.
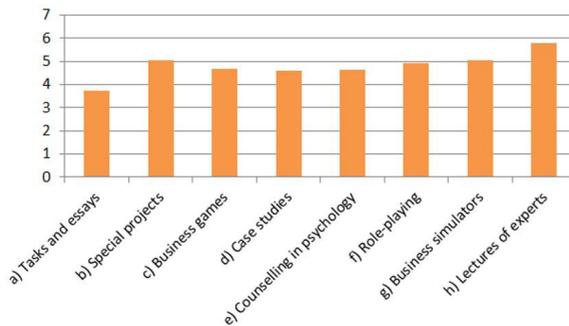
Figure 1: Evaluation of teaching methods for the development of entrepreneurship (source: own calculation)

At the 5% level of significance, we reject the null hypothesis $H0_3$ only for the learning methods: "tasks and essays and business simulators". The differences between groups of students from the first year of study (1st class) and other study years (other classes) were statistically significant. The results show that group of students from the first year of the study (first class) evaluate those entrepreneurship learning methods significantly higher than those of the other. In other cases (learning methods), differences according to the year of the study were not statistically proven.

Evaluation according to gender	U	Z	p-value
Special projects	3727.0	2.2484	0.0245
Evaluation according to faculty	U	Z	p-value
Tasks and essays	3580.5	-2.2679	0.0233
Business games	3472.0	-2.5443	0.0109
Business simulators	3266.0	-3.0882	0.0020
Lectures of experts	3509.5	-2.5433	0.0110
Evaluation according to year of study	U	Z	p-value
Tasks and essays	4430.5	-2.4979	0.0125
Business simulators	4344.5	-2.7137	0.0067

Table 1: Results of testing hypothesis (according to gender, faculty and year of study (source: own calculation)

DISCUSSION

Traditional methods of teaching, such as essays and seminars focused on theoretical knowledge, were ranked by the respondents to the last place. Active teaching methods include lectures by experts, business simulators, role playing, and special projects where students are able to connect their knowledge into practice. These methods can also support student for aims of to run their own business and eliminate fear of failure. A modern approach to teaching and using new methods is exciting and stimulating for students, which also coincides with the results of research in Nigeria, where is adoption of experiential practical activities considered as best practices in entrepreneurship teaching (see Olokundun et al., 2008). The results of Switzerland study suggest that the action learning approach, and in particular, simulation and gaming, may successfully generate cognitive and affective learning outcomes which in turn may affect students' development of critical thinking skills and motivation (see Gatti, Ulrich and Seele, 2019).

As revealed by the correlation, the greatest dependency was demonstrated in simulators and business games, so it is desirable to combine these two methods in entrepreneurship education.

The research did not confirm any differences between the interests in the teaching methods by gender. The observed differences were significant only for the special projects. The interest in the study of entrepreneurial courses was on average higher for men, the students of the Faculty of Economics and students of the first year. Wehrwein, Lujan and DiCarlo (2007) say that male students may prefer multiple modes of teaching more than female students.

The students of the Faculty of Health and Social Studies are more prepared for employment in public and social administration. There are not any subjects involved in business in the offer of the courses at this Faculty. It is clear that in particular business games and business simulators are special teaching methods for economic subjects. The relation of business games and business simulators is seen in Spearman correlation coefficient, which is the highest among the two methods ($r = 0.6340$). The lowest Spearman's correlation coefficient was between lectures from experts, and tasks and essays ($r = 0.1064$). Other statistically significant differences were not found among the students of the sample faculties.

The first-year students are more interested in traditional teaching methods (tasks and essays) and in business simulators, regarding the new methods. This result may not be surprising and is explained by their positive attitude to study. The problem, however, is the declining interest in these methods in the following years of study. The faculty entrepreneurship concept is applied in the teaching and learning process at Universiti Kebangsaan Malaysia (UKM) by providing entrepreneurial courses for first-year students from 12 faculties (Hassan et al., 2017).

CONCLUSION

The importance of entrepreneurship education has increased due to the need to prepare students for running their own business. There are new intentions from state politics of Czech Republic, that the early business can be positively influenced and supported. On the other hand, new start – ups can motivate more beginning young entrepreneurs. Many studies through branches show that entrepreneurship education programs contribute to the development of entrepreneurial intentions and spirit (Izquierdo and Buelens, 2008).

Despite of many studies e.g. Sieger et al. (2011) on this theme in other foreign countries, this issue is not very well researched in Czech Republic. University of South Bohemia, Faculty of economic has decided to find out more continuity between students reaches to set up own business and the education at Universities, which can support the competencies and entrepreneurial spirit. The results of the survey show that students prefer the active teaching methods to entrepreneurship over the traditional methods that currently predominate in the teaching of management. Significant differences in the approach to the teaching methods were found especially among the students of different faculties ($H0_2$).

Present management education system does not have the main focus on entrepreneurship development. The syllabus is mostly focused on understanding of various business functions of the corporate manager. There are very less inputs on new venture creation. Hence a researcher feels that to increase the number of entrepreneurs; present management education system requires substantial changes (as says Mwasalwiba, 2010). The faculty members and the trainers must use the appropriate mix of theory and practical in classroom teaching. There should be a regular use of all proven teaching techniques and tools to develop entrepreneurial quality. Next step how to improve entrepreneurial education on Faculty of Economic at University of South Bohemia can be future cooperation with absolvents which are recently graduated and having current awareness from praxis in business.

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PERCEPTION OF A CAREER IN ACCOUNTING AND ITS PRESTIGE BY STUDENTS OF FEM AT CULS PRAGUE

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Abstract

Due to the competition in the labour market, the effort of universities is to provide the students with the best education to be successful in their work placements. The survey between students of the Master's study programme Business Administration at FEM CULS Prague shows that almost a third of them are positively influenced by the choice of their profession by studying accounting subjects. On the other hand, for about one-tenth of the students, studying accounting has a negative impact on the choice of the accounting profession. By statistical testing of formulated hypotheses, it has been shown that full-time students are more influenced by studies than distance-learning students. Further results show that more than 90% of all students consider the accounting profession to have average or above average prestige. Out of that, the prestige is considered higher by full-time students. The consequences of the results are discussed in the paper.

Keywords

The accounting profession, distance-learning, full-time study, perception, prestige, students, the Czech Republic

Introduction

The trend of recent years – the increase of university graduates in the population – has resulted in the competitiveness at work placements and also in the competitiveness amongst universities. Alongside with the low unemployment rate (2.4% in the 3rd quarter of 2018 – ČSÚ, 2019), there is a demand for quality university-educated professionals who can contribute to the economic growth of companies. Klein (2015) points out that an increased number of university graduates find employment in more diverse positions with lower prestige, therefore losing the relative advantage over employees with a lower level of qualification. The ambition of universities is to attract applicants of study and outdo each other in offers. Students interested in economy education can choose from a wide range of fields of study, which can enhance their prospects of employability. 'The employability and placement of graduates are among the most significant characteristics pertaining to the quality and relevance of universities' educational activities.' (Šálková and Navrátilová, 2018:384).

Accounting is one of the fields where students of the economy find employment. Accounting is a supporting tool for managing a company; senior accountants provide important information for the management of the company and they themselves become decision makers. However, the role of accounting is not always understood and appreciated as such. Misconceived perceptions of accounting may stem from certain prejudices; in the Czech Republic, it may be influenced by the social order before the year 1989, when free entrepreneurship was forbidden and thus accounting

was considered a routine administrative activity. Besides various prejudices, the perception of the accounting profession and the choice of the field of study is influenced by the environment the applicants come from (Dalci and Özyapici, 2018). Accounting professionals and the donor community are convinced that the economic growth of the company is closely connected to the accurate work of the accountants and the quality outputs from accounting. However, Venter, Gordon, and Street (2018) found only limited empirical research evidence regarding this when conducting a review of the academic literature. It is evident that accounting is one of the many areas university graduates can find employment in, but a good knowledge of accounting can be a great competitive advantage in the labour market in general.

The current labour market situation shows that even if the graduates in the field of economics have qualification prerequisites for an accountant work position, they often choose a different profession. This approach of the graduates is apparent in many other countries, such as the United Arab Emirates (hereinafter UAE), where a study carried out by Hammour (2018) tried to remedy the possible false prejudices about accounting amongst the students of UAE. In a fast-growing economy of Indonesia, one of the limiting factors of economic development is a lack of qualified accountants. Suryani et al. (2018) assume as a possible reason for this phenomenon the influence of the background of the potential applicants. The decision making of graduates is influenced by many factors, one of which is their subjective perception of the content of the accounting profession.

For the students to gain a real idea about what is involved in being an accountant and to acquire the needed knowledge and practical skills, it is necessary to not only apply traditional teaching methods but also not to ignore the contemporary trends. With the increasing automatization of the accounting data processing and with the interconnection of accounting, finances, and information technology, the teaching methods regarding the study programmes in economics should gradually change. Al-Htaybat, Von Alberti-Alhtaybat and Alhatabat (2018) also assume that the accounting profession will see a significant change in the future due to technological development. Despite the views of some authors, it is widely presumed that the accounting profession will not be replaced by artificial intelligence. Richins et al. (2017) argue that accountants already excel at a problem-driven analysis of structured data. The authors' team of Natoli, Jackling, and Jones (2018) published a study about the importance of critical thinking of accounting professionals.

The aim of this paper is to identify whether the students of FEM at CULS Prague are influenced by their study of accounting subjects at the FEM CULS when choosing a profession and to monitor their perception of the prestige of the accounting profession. The partial aim of this paper is to determine what damages the most the prestige of the accounting profession according to the students' opinion. The research was aimed at the students of the study programme Business Administration (hereinafter BA) on purpose, as accounting in this programme is amongst the key subjects taught.

Materials and Methods

Empirical research was conducted at FEM CULS Prague during the period of November 2018 to January 2019. A pilot version of the questionnaire was tested before its use. Respondents of the questionnaire survey were students of the study programme BA, where accounting is taught amongst the key subjects. 197 respondents participated in the questionnaire survey. The respondents were students of the Master's study programme Business Administration at FEM CULS Prague, from which 75 students were full-time students and 122 distance-learning students. The total number of accessed students was 252, the return on the questionnaire was 78%. The questionnaire contained 36 questions. For this article, only 11 questions were considered. In regard to the relevancy of the answers, the results of the testing and the limited length of the

article, only 7 questions were analysed in the end – 4 of which were identification questions. Two questions were tested through hypotheses. For the wider monitoring of the perception of the accounting profession, the students answered the question of what damages the prestige of the accounting profession the most. The rest of the questions will be the basis for other studies.

Descriptive statistic methods such as univariate and multivariate analysis of categorical data were used for the evaluation of the survey results. The hypotheses were tested on the grouped data of answers both from the full-time and distance-learning students. The basic analysis of variables included the calculation of relative frequency, which expresses the proportion of the subgroup count of statistical units on the total count and is often expressed as a percentage.

The multivariate analysis describes the relationship between pairs of variables and the interpretation is based on contingency tables. Contingency tables display the multivariate frequency distribution of the variables and provide a basic picture of the interrelation between two variables and can help find interactions between them. For testing, the chi-squared test (χ^2 test) is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. The basic assumption for using this test is that the expected frequencies in the individual cells do not decline below 5 in at least 80% of the cells and at the same time, there will be no theoretical frequencies less than 1 in the remaining cells. When these conditions were not met, Fischer's exact test was used. The significance level (p-value) is 0.05. Pearson's correlation coefficient ρ was used to measure the linear correlation between the variables. It has a value between +1 and −1, where 1 is a total positive linear correlation (strong correlation), 0 is no linear correlation (values near to 0 have weak correlation), and −1 is a total negative linear correlation (Pecáková, 2011; Řezanková, 2007). The method of adjusted residuals was used for testing the correlation at the rejected null hypotheses. The method is a measure of the strength of the difference between observed and expected values. It's a measure of how significant cells with results are to the chi-square value. When comparing the cells, the residual makes it easy to see which cells are contributing the most to the value, and which are contributing the least. The formula for the adjusted residual is:

$$\text{Adjusted residual} = \frac{(\text{observed} - \text{expected})}{\sqrt{\left[\text{expected x}(1 + \text{row total proportion}) \text{ x}(1 - \text{column total proportion})\right]}}$$

If the residual is less than -2, the cell's observed frequency is less than the expected frequency. Greater than 2 and the observed frequency is greater than the expected frequency (Simonoff, 2012; Haberman, 1973).

For the purposes of the paper and its aim, 8 null-hypotheses were formulated.

- H_{01}: The answer of the respondent whether the study at FEM CULS had an impact on their choice to work or not to work as an accountant is not dependent on their gender.
- H_{02}: The answer of the respondent whether the study at FEM CULS had an impact on their choice to work or not to work as an accountant is not dependent on their age.
- H_{03}: The answer of the respondent whether the study at FEM CULS had an impact on their choice to work or not to work as an accountant is not dependent on their form of study.
- H_{04}: The answer of the respondent whether the study at FEM CULS had an impact on their choice to work or not to work as an accountant is not dependent on the region where the respondent has a permanent residency.
- H_{05}: The subjective perception of the accounting profession is not dependent on the respondent's gender.
- H_{06}: The subjective perception of the accounting profession is not dependent on the respondent's age.

- H_{07}: The subjective perception of the accounting profession is not dependent on the respondent's form of study.
- H_{08}: The subjective perception of the accounting profession is not dependent on the region of permanent residency of the respondent.

Used abbreviations: PORC - Public Opinion Research Center, BA – study programme Business Administration, FEM CULS Prague – Faculty of Economics and Management Czech University of Life Sciences Prague, UAE - the United Arab Emirates.

RESULTS

The results of the research are introduced in the following paragraphs. The answers to the question 'Was your choice to work or not to work in the accounting profession influenced by your knowledge and skills in the accounting field (subject) gained by studying at the FEM CULS?' showed that more than a half (59.7%) of respondents were not influenced in the choice of their profession by studying accounting subjects at FEM CULS Prague. This result is probably related to the fact that part of the respondents made a decision about their future profession/staying in their existing profession before they started studying. For a relatively significant part, for almost a third (31.5%) of the students, studying at FEM CULS had a positive impact on their decision to work/stay in the field of accounting. This fact can be certainly affirmative, but the rest of the answers have to be considered as well, where approximately 10 % of respondents were not motivated to apply for an accounting position by studying accounting subjects at FEM CULS and 2% of respondents working as accountants revealed that they are considering leaving their work position in the accounting field or have already decided to leave. The question is, what is the reason? The narrative answers of the respondents revealed that some of them feel not sufficiently prepared by the teachings for a position in the accounting field and on the other side, some of them are surprised by the amount and range of the required study. The null-hypotheses formulated on the topic of the influence of the teaching on the chosen profession H_{01}, H_{02}, H_{03} and H_{04} were tested by Pearson's chi-squared test. Most of the hypotheses were rejected, except H_{03}. It means that dependence was not proven in relation to the gender, age and the region of origin of the respondents. Dependence was proven in relation to the form of study. The results related to the H_{03} hypothesis are presented in Table 1. From the offered answers in the questionnaire, two of the answers were merged into one (see the first row of Table 1), all the other responses are presented separately.

Responses/Form of study	Full-time study	Distance- learning	Total
Yes, it influenced me to decide/consider not to work in the accounting field or leave a position in accounting.	11	10	21
No, it did not influence my decision to choose/change profession.	27	87	114
Yes, it influenced my decision to consider or choose to work in the field of accounting.	25	14	39
Yes, it influenced my decision to stay in my current position in the field of accounting.	12	11	23
Total	122	75	197

Table 1: The decision to choose the accounting profession influenced by the study at FEM CULS depending on the form of study (source: own calculation, 2019)

The statistical value of $\chi^2 = 24.98$ is higher than the critical value $\chi^2 = 7.91$ for p = 0.05 (95% confidence level) with 3 degrees of freedom. The null hypothesis can be rejected. Pearson's chi-squared test showed a dependence on the study form the respondents participate in. The dependence, calculated by using the Cramer's V, is strong ($V = 0.36$). The adjusted residuals

analysis showed a statistically significant difference (compared to the theoretical frequencies) at the responses of students in the full-time study form who are influenced by their knowledge gained by studying BA to a greater extent than it is their representation in the sample.

The overall responses to the question 'How do you personally perceive the prestige of the accounting profession?' seem homogeneous. 93% of all students perceive the prestige of the accounting profession as average or above average. Considering the fact that these students study an economic study programme with an emphasis on accounting subjects, this result is positive and actually logical. Testing the hypotheses H_{05}, H_{06} and H_{08} by Pearson's chi-squared test, no dependency was proven related to the gender, age or the region of origin of the respondents. Testing the hypothesis H_{07} showed that the responses depended on the form of study. The results related to the H_{07} hypothesis are presented in Table 2. For the purposes of testing, the first and the second response (the first row in Table 2) were merged, the response 3 is presented separately (the third row of Table 2) and the responses 4 and 5 were also merged (the third row of Table 2).

Responses/Form of study	Full-time study	Distance-learning	Total
I do not perceive it as a prestigious profession (it does not have a good reputation) and has a below average prestige.	4	5	9
I perceive it as a profession with an average prestige.	36	83	119
I perceive it as a profession with an above average prestige or one of the most prestigious profession.	35	34	69
Total	77	122	197

Table 2: The perception of the prestige of the accounting profession depending on the form of study (source: own calculation, 2019)

The statistical value of $\chi^2 = 7.93$ is higher than the critical value $\chi^2 = 5.99$ for p = 0.05 (95% confidence level) with 2 degrees of freedom. The null hypothesis can be rejected. The perception of the prestige of the accounting profession is dependent on the form of study. However, the dependence, calculated by using the Cramer's V, is weak or medium ($V = 0.20$). The adjusted residuals analysis also showed a statistically significant difference (compared to the theoretical frequencies) in the responses of students in the full-time study form who perceive the accounting profession as prestigious to a greater extent than it is their representation in the sample.

The responses to the question 'What damages the prestige of the accounting profession in the Czech Republic in your opinion?' varied. More than a third of the respondents (37%) think that the prestige of the accounting profession is most damaged by the perceived 'stereotype work routine', followed by the opinions that 'the accounting profession requires a permanent study of legislation' (18.3%), 'it does not allow to use creativity and critical thinking' (17.8%), 'it is not a sufficiently paid work' (13.2%), 'it is overly restricted by a strict legislation' (11.2%). Although the response 'it does not have a future, it will be replaced by artificial intelligence' (2.5%) was the least chosen, it is interesting that 5 students have chosen it as the most damaging to the prestige of the accounting profession.

DISCUSSION

The competitiveness amongst graduates for work placement and amongst universities for students pushes universities to offer students a quality education and to present a variety of study programmes with innovative approaches leading to students' success at the labour market. Financial accounting can be a helpful asset to finding employment. In Adler and Stringer's (2018) opinion, employers have been raising concerns about accounting graduates' business awareness and their understanding of the real world. The effort of FEM CULS Prague is to prepare students for functioning in real-life business. For a significant part of the BA students at FEM CULS, studying of accounting subjects had a positive impact on their decision to work/stay in the field

of accounting. The results of our research may be an impulse to influence positively even more students by making the study of accounting subjects more attractive. Applying modern teaching methods reflecting the real accounting practice could help the graduates have the competencies to meet the requirements of their future employers. Long-Term research on Australian universities shows the effectiveness of providing students with mentors who bring real-world understandings of accounting to the students (Adler and Stringer, 2018). There will be an opportunity to incorporate modern teaching approaches to improve the students' readiness to use their skills in real life, as the BA study programme at FEM CULS will have doubled the teaching hours of seminars by 2021.

The results of our research regarding the opinion of students studying a specific study programme at FEM CULS Prague on the prestige of the accounting profession are similar to the results obtained by the Public Opinion Research Center (PORC) over a period of time. However, the students' opinion is more optimistic compared to the Czech public opinion. The results of the PORC survey show that the ranking of professions is not different across generations and that all age groups perceive most professions similarly. The ranking is therefore not dependent on the age of the respondents. The published research by PORC (2016) examines the prestige of 29 professions as perceived by the Czech public in 5 individual years between 2004 - 2016. The accounting profession is in the middle range, coming the 14th in the rankings in 2016 (with similar results in the previous years, such as 14th in 2004, 15th in 2007, 10th in 2011 and 14th in 2014). As the perception of a profession's prestige may express the values of the public, these surveys show stability in this regard in the Czech population. However, Vough et al. (2013) have identified differences in how professionals of various professions perceive their own abilities and how their clients rank them. These professionals opine that the misguided views of their clients lead to the devaluation of their profession, prevent mutual interaction and as a result may cause unnecessary expenses and emotional distress. Public scandals from previous years involving accountants have certainly influenced the perception of the accounting profession. A study of Permatasari and Surayya (2019) reveals that a student's gender has a significant influence on their ethical perception of accounting while our study does not show such influence.

Conclusion

There is a wide range of professions a graduate with a degree in economics can choose from (such as banking, insurance, statistics, etc). The results of our survey show that nearly a third of the students studying the Business Administration study programme at FEM CULS Prague want to pursue a position in accounting due to their study of accounting subjects at the university. This result can be seen as very positive. The limitations of our research are related to the lack of comparable results as our survey was carried out only at one university in the Czech Republic and involved students of only one study programme, albeit for the accounting profession the most important one due to its emphasis on accounting subjects. Further research would follow the published results. It may include a comparison of our results with those of other universities with similar focus and a comparison with the results of research aimed at other study programmes at FEM CULS Prague. Another line of research would be aimed at the identification of the needs of innovation of methods and approaches used in teaching accounting subjects at FEM CULS Prague. Teaching based on the outcoming innovations could help the graduates to choose their future profession and to be prepared for the competitive labour market environment.

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OBJECTIVE DESIGN IN THE NOVICE PROGRAMMING PROGRAMING COURSE IN THE TERTIARY EDUCATION

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Abstract

In our research, we focused on the issue of the initial phase of teaching assignments in the context of object-oriented programming of beginners in tertiary education, i.e., of the design phase when the most important is the creation of e.g., a class diagram corresponding to the assigned task, etc. Generally, the ability to design and coding is a complex cognitive ability it is not easy to handle and requires a great deal of cognitive effort. Object-oriented programming has been designed to help designers handle complexity and build extensive systems. It was not designed with an emphasis on education. The fact that object orientation is often used as the first paradigm in teaching makes teaching methods and designing model examples for teaching more difficult and more important. In this paper we focus on gaining a deeper understanding of how beginners can learn to program with an emphasis on their cognitive development processes, especially when designing their applications, and to design appropriate examples and procedures for designing suitable examples for teaching newcomers in the field of the programing of some object oriented problem. Suggested procedures are briefly discussed and evaluated.

Keywords

Cognitive learning processes, learning programming, software metrics, SOLO taxonomy, teaching programming, tertiary education

Introduction

At most universities in the world and in the Czech Republic, the teaching an introductory course of programming use similar methodology. At first, the students are familiar with the basics of algorithmizing, get acquainted with the basic syntactic elements of the chosen programming language, with their semantics, and then they are confronted with object principles and models. At the end of the course they learn strategies and patterns that can be used when writing code and architectural design. Object oriented approach is therefore taught in most various programming courses. However, object-oriented programming is focused on creating complex systems with high maintenance, efficiency and reusability, but the situation is somewhat different in teaching. In most cases, the introductory examples are simple. The range of examples is limited due to the limited ability of students to design and create more complex structures due to the limited number of syntactic elements available and the fact that the number of lines of code should preferably be minimized. It is difficult to design examples that show the power of object orientation while avoiding too complex examples that discourage newcomers. If the example does not point to the advantage of object-oriented programming, then beginner programmers can conclude that object-oriented design is more complex than problem solving, while the example is too complex, students do not understand the overall picture.

The aim of our work is to gain a deeper understanding of how beginners can learn to program

with an emphasis on their cognitive development processes, especially when designing their applications. Based on these findings, it is possible to understand students' cognitive schemes and the ways in which students apply these schemes when designing and programming their assigned tasks. This understanding helps in the designing assignments which help with teaching while maintaining object-oriented quality.

The results obtained from the research will be used to modify and extend the existing curriculum of university education programming to enhance students' competencies in application design and programming. The research questions we defined at the beginning of our research can be formulated as follows:

Research question 1: What strategy do beginners have when integrating new design structures (such as design patterns) into their design when solving programming assignments?

Research question 2: How to measure and assess the quality of students' object oriented design when they solve various complex programming assignments?

Cognitive developmental processes that lead to learning have been the subject of many researchers in the field of information education for many years. Several empirical researches have been carried out to find out what problems the students encounter in learning different language concepts (using variables, using cycles, etc.) (Izu, Weerasinghe, & Pop, 2016; Corney, Teague, Ahadi, & Lister, 2012; Beranek, 2015; Kuittinen & Sajaniemi, 2004).

In their study, Spohrer & Soloway (1986) found that even though beginners knew the syntax and semantics of individual commands, they did not always know how to use these known constructs to create a valid code. In their research, the authors conclude that teachers should be able to improve the performance of their students by teaching strategies, how to compile individual parts of the code into the resulting functional program, and by helping them learn the syntactic and semantic constructs of the programming language.

Authors of this study pointed out that the ability of beginners to solve problems and problems in writing code requires the mastering of other skills besides the knowledge of syntax and semantics of the respective programming language. Most of the errors that students make in their programs are related to a lack of organizational knowledge and problem-solving strategies. These can be, for example, the inability to see the internal context between problems or the transfer of a good idea to solve similar problems within different contexts (Muller, 2005).

Other research (Ginat & Menashe, 2015; Whalley et al., 2006) focused on assessing the difficulty of reading and writing code. They have concluded that one of the reasons for students' failure may be inappropriately chosen draft of the course or inadequately chosen difficulty of the assigned program tasks.

MATERIALS AND METHODS

Research model

Within the framework of the proposed research, a group of 28 students are monitored during the first year of programming at the Faculty of Economics. Mixed research methods, both qualitative (for research question 1) and quantitative (for research question 2), were applied. The research was focused on student tracking in code writing and writing, in-depth interviews with students, and analysis of their answers to test and exam questions.

The proposed framework, which combines software metrics and SOLO taxonomy, is used to measure the difficulty of programming tasks. This framework was subsequently used to design a set of tasks that will induce situations that require some form of adaptation or knowledge acquisition. Appropriate programming tasks were identified, and the participants

were individually observed during their attempts to solve the assigned tasks. Data was gathered through direct tracking and interview-based interviews. At the end of each session, each proband participated in a retrospective interview, describing the procedures he tried to create programs that solved the set of tasks, and the problems he encountered in trying to resolve them.

Design of metrics

Object, class, method, instance variable, inheritance, and message system are the main concepts of object-oriented programming approach. Object-oriented approach metrics are primarily the ways of measuring and detecting how these structures are used in the design and application development process. Due to the nature of the tasks assigned, our research is best met with a set of metrics compiled by Kasto and Whalley (2013), complemented by a set of nine metrics further evaluating the quality of the object-oriented design. These are metrics like Class Weight, Class Liability, Method Lack of Coherence, Interconnection between Classes of Objects, Depth of Inheritance Tree, Number of descendants, and more.

One of the obvious problems in using software metrics to inform the design of code writing tasks is that there is no software metric that measures code that has yet to be written and the aim of this work is to develop an objective means of measuring the difficulty of a novice code writing task prior to the students undertaking the task. For this research the choice was made to use the instructor's model of program design from which the metrics are calculated. In theory, the model answer should provide a better-quality solution when the task is sufficient enough for there to be variation in the possible solutions. In many cases an instructor's solution might have less complex design and code than many of the solutions produced by the students. Students, especially students who find programming challenging tend to produce design and code which includes redundant elements. In order to produce a "good" solution, students need to produce a more generalized, connected or integrated solution that reduces redundancy (Whalley et al., 2006).

An alternative to software metrics is a more subjective measurement based on educational taxonomies such as Bloom Taxonomy (Figure 1, Bloom, Krathwohl, & Masia, 1956) and SOLO Taxonomy (Figure 1, Biggs & Collis, 1982). This approach has been investigated and described in the literature with a description of the classification of programming tasks in beginners using both taxonomies (Whalley et al., 2006). Researchers have found that teachers are able to reliably classify problems with beginner programming using the SOLO taxonomy (Lister et al., 2009) and that the cognitive level of the task solved reflects the actual difficulty found.

Evaluation of software metrics to determine the difficulty of a task is purely quantitative and is based on positivistic perceptions. Assigning the appropriate taxonomy level is more subjective and therefore qualitative. The correlation of the assigned level with the observed difficulty of solving the proband task is quantitative. The required cognitive level of proband to solve the problem and the complexity of the code make it more possible to measure, describe and understand the difficulty of creating a program. To ensure the objectivity of research in examining software metrics and taxonomy as potential indicators of difficulty, triangulation was used (Švaříček, Šeďová et al. 2007) to increase the credibility and validity of the proposed research tool. Several programming tasks have been proposed in the research so that individual tasks are gradually built on programming concepts and are more difficult or more complex.
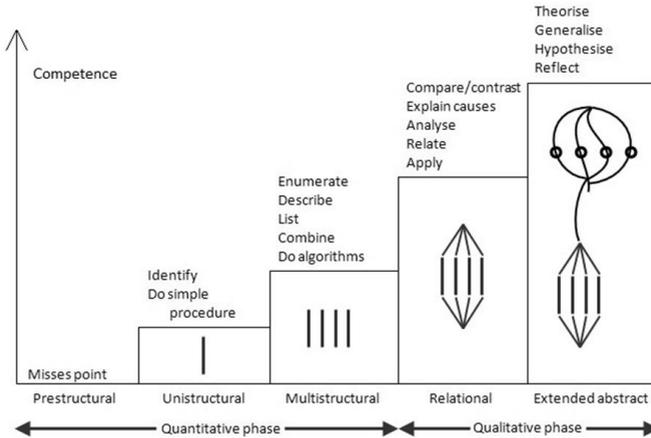
Figure 1: SOLO taxonomy (Biggs & Tang, 2007)

RESULTS

Analysis of the results of assignments

We present here one example of an assignment from more used in the research. The assignment is indicated in the student's work in Figure 2. The task is to propose a model of a possible PC game where different characters (e.g., King, Queen, Knight, Troll, Elf, etc.) can be found. Each character may own only one weapon and can use it. Each weapon is used in a different way (it has different behaviors when the weapon is a stab knife, or a bow shooting arrows, or a sword, or an ax, or magic spells, etc.).
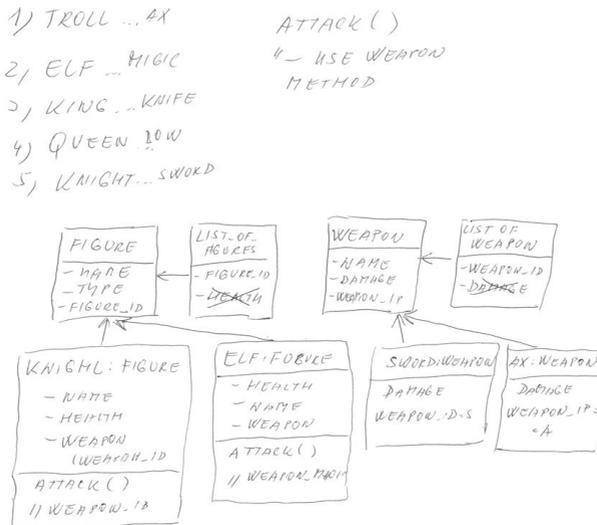
Figure 2: Sample of student's solution

The solution in Figure 2 shows the student's attempt to use inheritance, but the architecture is not appropriately designed. Objects for character and weapon lists are used in the design. If necessary, modification of such code must be applied to these classes and modified.

Construct	Properties	Students								
		1	2	3	4	5	6	7	8	9
Encapsulation used	Present	X	x	x	x	x	x	x	x	
	Missing									x
Coherence of entities	Low			x				x	x	x
	High	X	x		x	x	x			
Used linkage	Low	X	x	x	x	x	x	x	x	x
	High									
Inheritance used	Abstract class	X	x	x						
	Standard class		x	x	x	x	x	x	x	
Interface declaration	Present	X	x	x	x	x		x		
	Missing						x		x	x
Mapping on SOLO taxonomy (1. researcher)		M	R	M	M	U	U	U	U	U
Mapping on SOLO taxonomy (2. researcher)		M	R	R	M	U	U	U	U	U
Final mapping on SOLO taxonomy		M	R	M	M	U	U	U	U	U

Table 1: SOLO taxonomy mapping for task with object design

The use of lists of subjects is also indicated by the effort to identify individual entities (characters, weapons) (perhaps attempting to link knowledge from database objects). Another defect is the definition of method Attack in individual inherited classes (Knight, Elf). Finally, in the Figure 2 we can notice an incorrectly used symbol (arrows) for inheritance and class association. From the point of view of the SOLO taxonomy, the student has reached the multi-structural level. Mapping through the SOLO taxonomy of OO student solution model designs is shown in Table 1.

Results of interviews by the method of thinking aloud

When researching the second research question - How beginners integrate the new programming structures into their current understanding of the design and code, we used the research method of thinking aloud (Drlik & Beranek, 2015). Interviewing with the method of thinking aloud can be uncomfortable for the students at first. However, after a certain amount of training and a certain time when they get used to this method, they usually do not make it difficult for students to express their thought processes.

A sample of transcripts of such records was a valuable source of information.

(1) "So, I do not know what to do now. And I thought I understood that".

(2) "I do not know. Perhaps… I would probably use inheritance the characters and the weapons here. So, I will have one main class and the other characters will continue to inherit from it. Then, I set in each one how they would attack, and that they could change the weapons. That could be the method of throwing the weapon and the weapon".

(3) "That's simple, I have characters there, so I put them on the list and then I can choose what I'm going to need. Everyone sets the ID to distinguish them. Yeah, and let them inherit. So, here's the Character class, and everything else is inherited from her. So, that's it. King, Queen,… what else was there… Troll, Elf and Knight. "

(4) "If I have a few weapons, I will make the first class, that will be the main weapon, and the others will be inherited. In the main guns, the attack method, which all the weapons inherit. Well, and with the characters I will do the same. So, I can add more weapons and characters. No, I know, it'll be like the ducks (remark of author - student mentioned previous assignment). So, the

gun must be an interface. Then, the Sword will be inherited from the Weapon, and there can be set how to perform attacks".

The record (1) represents a student who does not have adopted constructs, and when ranked according to SOLO taxonomy is located at the pre-structural level.

N	Class design
3	
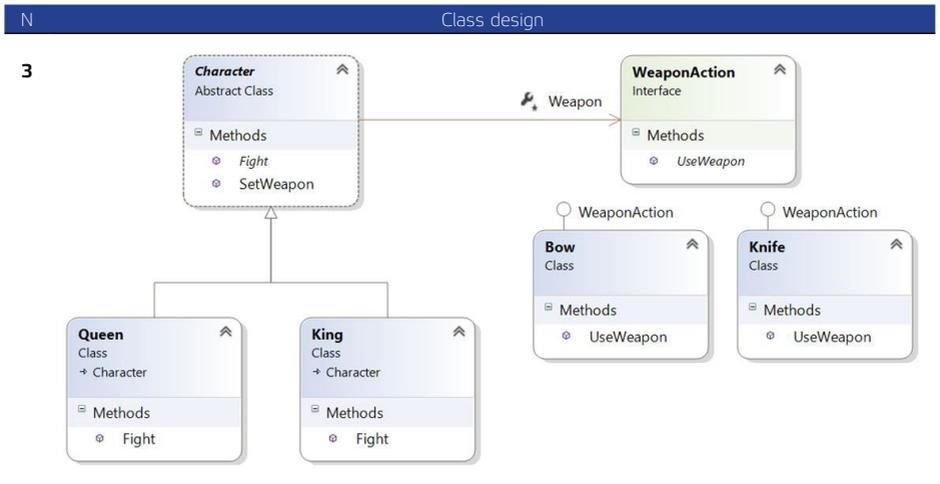
Table 2: Example of a sample solution for a task with an object design

On the transcript (2) the student is a bit uncertain, but the inheritance is used correctly. Other operations are already delaying the intended task (the methods "Put away gun" and "Take gun"). The transcript (3) corresponds to the student with good solution of described task.

The record (4) shows an attempt to automate the process using inheritance (this may not always be desirable). At a certain point, the proband realizes that the situation is familiar to him and is trying to apply the already practiced pattern from the previous lesson (analogy to the demonstrated role, the class characters were designed with ducks). From the point of view of the SOLO taxonomy, this is a relational level, completed by an extended abstraction.

Table 2 presents a possible correct solution when applying the principles and principles of PPE: encapsulation, preference of the interface before inheritance, high coherence of entities and their low linkages.

Discussion

Through the methodology described above, it was possible to identify several strategies of novice programmers (research question 1). The most common strategy was to adopt a step-by-step proposal that solved the problem on manageable sub-parts, and then these subfolders were newly designed to create a new solution. This is not surprising at all, because the assignments were designed in such a way that each task built on programming the scheme of a previous task or planned in some way. This finding has implications for teaching as it suggests that explicit design of programming exercises, which gradually builds on concepts and mental diagrams, improves learning. There is also strong evidence to suggest that if novice programmers could not identify all sub-parts of the problem, they tend to fall back to the known aspect of a task or problem, and then try to create a solution from that point.

Finally, when novice programmers cannot reach a solution in a relatively short space of time, they tend to apply experimental and error-based programming approaches. Participants who could

not retrieve an existing schema tended to make a program design using a trial and error access approach that inevitably led to a failure. In cases where participants were able to recognize that the problem was analogous to the problem previously solved, they were almost always able to reuse their previous knowledge to solve a new task and were able to identify the differences or differences between these tasks. In such cases, she tended to write a solution relatively quickly without prior design of their program or testing, and the often-made errors. The sequence of programming tasks designed for this research encouraged participants to think about new ways of using previously learned concepts.

Some participants were able to develop broader schemes to recognize well-known program structures and to use their knowledge in various programming concepts and contexts. Based on the experiments, we found that the SOLO taxonomy customized for purposes of object-oriented design is an appropriate measure for the measurement of the cognitive complexity of designing and writing code for tasks for novice programmers (research question 2). An evaluation of these metrics has been performed to compare software metrics obtained from the instructor model response to the role of task participants. A simple statistical approach was used to determine the extent to which individual metrics correlated with difficulties. The results of this analysis showed that most of our metrics were strongly correlated with the difficulty of writing a code.

Conclusion

In this work, we have presented some preliminary results of our research. Based on our research findings, we have gained a deeper understanding of how beginners can learn to program with emphasis on their cognitive development processes, focusing on the application design phase, especially the design of the class diagram. The research and analysis of student interviews enabled us to better understand the students' cognitive patterns and the ways students use to solve their assigned tasks. We also proposed some procedures and suggestions for appropriate metrics to evaluate the quality of students' object-oriented design when they solve various complex programming assignments. We will further test and optimize suggested procedures and task in our further research.

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ACADEMIC MOBILITY AS A MEANS OF SOFT POWER

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Abstract

The article is devoted to the analysis of academic mobility through the theoretical prism of soft power. The problem of academic mobility is acquiring particular relevance due to the need to expand access to quality higher education in order to increase the effectiveness of knowledge management and to enhance soft power at several levels: individual, educational system and state. Key perspectives on the discourse of international academic mobility are highlighted and directions of the formation of a country's soft power through educational exchanges are outlined. Two main vectors for the development of academic mobility are identified: Western-centric and Asian. The authors assert that at present these vectors are unevenly manifested, with the Western-centric vector remaining dominant. An initiative to form a SCO network university for balancing these vectors is considered. The authors conclude that academic mobility is a special tool for carrying soft influence in the face of global challenges.

Keywords

Academic mobility, discourse, higher education, Shanghai Cooperation Organization, soft power, student exchanges.

Introduction

Dramatic changes occurring in the system of higher education under conditions of intensified mobility and the formation of the global higher education landscape (Marginson and Van Der Wende, 2007: 16) are of great interest to contemporary researchers. These changes involve an increase in the movement of students and scholars, a growth in the number of exchange programmes, a change in relations between universities and governments, as well as a general change in the nature of the education services market. Under the conditions of the digital transformation of society and the economy, improving the education system by means of personnel training is one of the priority areas. Academic mobility is an important component of the modern educational environment, which integrates elements of e-education with traditional educational practices.

Issues concerning academic mobility have been extensively studied in papers published in the world's leading journals. For example, Van Der Wende, in exploring the question of mobility in European universities, notes that reasons for the increase in academic mobility include economic imbalances between countries and regions and the prospect of an increase in income following graduation. Students and academics are attracted by superior scientific infrastructure and funding, as well as good working and study conditions. These factors, implemented in the framework of national policies, can enhance the attractiveness of the country as a scientific and innovation centre (Van Der Wende, 2015). U. Teichler raises the issue of academic mobility and migration, claiming that the discourse on the internationalization of higher education focuses disproportionately on the international mobility of students, while the mobility of scientists and university professors has not only been insufficiently studied in theoretical terms, but also lacks

a statistical base (Teichler, 2015). In addition, such an aspect of academic mobility as brain drain (or brain circulation) among both students and scientists is extensively explored in scientific discourse (Marginson and Van Der Wende, 2007; Chen, 2017; Pan 2011). An important stage in the preservation and attraction of human capital is the study of return mobility of academics and reverse brain drain (Chen, 2017; Pan 2011; Zweig 2006).

In the context of internationalization of education, the problem of virtual mobility as a form of academic mobility occupies a special place in the scientific discourse. It should be noted that, in the scientific literature, virtual mobility is not only considered as a tool for expanding opportunities for both higher and additional education, but is also seen as contributing to the intensification of international and intercultural exchange of knowledge and experience using the latest information and communication technologies (ICT) (Otto, 2018).

Virtual mobility provides a means by which different social groups (with different levels of education, different ages, people with disabilities, etc.), who may not be able to participate in traditional forms of mobility, get involved in the digital educational environment. Since there is no single definition of virtual mobility, a number of researchers focus on various advantages of this form of educational activity. On the one hand, it is considered as an alternative form of physical mobility, which removes spatial constraints and intercultural communication barriers. On the other hand, it is viewed as a practical way of network learning, complementing and enhancing the effect of traditional higher education (Macek and Ritonija, 2016).

The question of the relationship between academic mobility and the soft power of nation states is of great interest today. M. Karpenko (2016) demonstrated the possibilities of e-learning for the formation of soft power. This author considers education as a means of overcoming the negative effects of interethnic conflicts. In his examination of the influence of academic mobility on international relations, S. Sergeev (2015) analysed the impact of the Bologna process on academic mobility and the development of soft power. V. Bondarenko et al. (2018) discussed the question of improving the university education of foreign students in the framework of the policy of "soft power" taking current trends in the global educational space into account.

It can be seen that the main scientific problem is to identify the features of academic mobility as a tool for the soft influence of states in the context of the intensification of economic, political and socio-cultural challenges and threats.

Therefore, the aim of the present study is to perform a comprehensive analysis of the discourse and practice of academic mobility as an instrument of soft power as well as to identify possible obstacles to its implementation.

This paper is organised into three parts: features and perspectives of the study of academic mobility; the relationship between academic mobility and soft power; and inequality and threats in the field of international academic mobility.

Materials and methods

In order to achieve the stated purpose, we applied the method of secondary data analysis. We collected and analyzed the data from the global rating systems such as Academic Ranking of World Universities 2018 (Shanghai Ranking, 2018), The Soft Power 30, A Global Ranking of Soft Power 2018 (McClory, 2018) and other ratings, as well as OECD statistics.

We used the Spearman's rank correlation coefficient to establish the relationship between the number of international or foreign students (UIS.Stat, 2016) and the number of educational institutions included in the Soft Power 30 index (McClory, 2018) and World University Rankings 2015-2016 (Times Higher Education, 2015-2016). It was revealed that there is a strong and direct relationship between these parameters, since the coefficient is equal to 0.702, and two verification

tests showed the statistical significance of the coefficient and the significance of the correlation relationship between the estimates.

$$p = 1 - \frac{6 * 1333 + 29}{30^3 - 30} = 0.702$$

In our previous research, we have already paid attention to some important aspects associated with academic mobility and soft power. A close relationship between the categories of mobility and soft power was established (Kovba, 2015). Positive consequences, as well as possible challenges and threats, caused by the intensification of mobility in higher education in the current conditions of globalization were discussed. Key resources and strategies of cultural diplomacy used by the SCO as the intellectual capital of soft power were described in detail (Rusakova, Kovba, 2018).

In addition, this study is based on the following works: a study by Bilecen and Van Mol (2017) on inequality in the process of international academic mobility, as well as on the document on cooperation of the SCO universities (Concept of the SCO University, 2010).

RESULTS

Features and perspectives of academic mobility research

In the field of education and science, the concept of mobility is implemented in academic mobility programmes. Here, academic mobility refers to the transfer of students, teachers, scientists and administrators from educational institutions from their home countries to others in order to improve their skills, exchange experience and knowledge, as well as to establish and develop productive contacts (Rusakova, 2014: 249).

The important goals of academic mobility are to internationalize the educational and scientific process as well as to increase transparency. Academic mobility is considered as an effective tool for developing communication and professional skills, expanding the horizons of opportunities for personal growth and for forming an independent way of thinking. In general, academic mobility is designed to adapt the university and academic community to the global labour market. From this perspective, virtual mobility as one of the forms of academic mobility is becoming a priority for training competitive personnel for various sectors of the economy. In the most general sense, virtual academic mobility consists in the movement of information and digital streams, as well as the formation and change of communication channels in the information-educational environment using the latest technologies.

The analysis and systematization of an array of scientific papers on this subject, allowed highlighting the main aspects of academic mobility research:

1. the study of the theoretical discourse of mobility, the consideration of academic mobility and its forms as a desirable or necessary phenomenon in modern conditions;
2. the study of socio-demographic characteristics and policies underlying the international educational market;
3. identifying inequalities in mobility; the study of the dependencies between the country of origin, the socio-economic status of students and the characteristics of mobility;
4. the creation of a common, typical characteristics of a mobile student and its imposition on individual experience;
5. the study of positive consequences, as well as the challenges and threats to which the increase in mobility in the modern world leads; the analysis of the impact of academic mobility on the attractiveness of a country, its "soft power".

Let us consider this last problem in more detail.

Communication of academic mobility and soft power

The issue of academic mobility is of great importance from the point of view of the theory of *soft power*. We define this term as a means of exercising power, implying the creation of a favourable environment for political actions and comprising three dimensions: 1) engagement, leading to agreement or imitation; 2) ability to establish a legitimate agenda, as well as a set of beneficial rules and institutions; 3) formation of preferences in the population. The third dimension is most correlated with educational effects. Thus, from the point of view of soft power, the long-term impact exerted during the educational process is much more effective than short-term propaganda campaigns. In this context, it is virtual mobility that provides the possibility of continuous learning, retraining and advanced training without strict time and place limits.

The link between the educational component and the strategy of soft power is displayed in various indices and ratings of soft power. For example, in the Soft Power 30 Ranking, Education – along with Government, Digital, Culture, Enterprise and Engagement – is among the sub-indices (sub-index) that form the soft power of a particular country (McClory, 2018: 32). 'Metrics in this sub-index include the number of international students in a country, the relative quality of its universities, and the academic output of higher education institutions' (McClory, 2018: 33). Despite the fact that the weighting of *Education* sub-indices is only 16.6%, this is an important indicator affecting the attractiveness of the state for an international audience and especially students.

It was established that the soft power of education is realized in two ways:

1. Training of elites or future leaders of other countries. For example, American research universities played a big role in spreading neoliberal discourse: many foreign specialists were trained on their basis, including those from the former countries of the socialist camp, who became key figures in the process of practical implementation of the neoliberal doctrine.
2. Training of the people not belonging to the elite, who, following the completion of the educational process, favourably assess the country in which they studied. Foreign students often adopt cognitive matrices peculiar to the scientific and educational system of the host country.

Exchanges of scientists, students and teachers contribute to a better understanding of each other by different nations. Independently-obtained perceptions of the country and first-hand educational experience eliminate stereotypes and fears caused by erroneous or lacking information, as well as contributing to the establishment of intercultural relations. At the same time, the increasing number of contacts between different cultures can raise the possibility of cultural conflicts and cause psychological stress. In order for educational programs to become sources of soft power, it is necessary to carefully plan international programmes, take into account international experience and promptly make the necessary adjustments to training programs.

Academic mobility can increase the attractiveness, and hence the soft power, not only of a separate education system or a particular state, but also of an individual. It contributes to the formation of universal and general professional competencies, and also aims to develop professional and intercultural skills. This leads to the development of the student's personal soft power: studying abroad develops such soft skills as teamwork, the ability to communicate effectively, good adaptability, and openness to new things. In addition, virtual academic mobility also contributes to improving the knowledge of foreign languages and enhances students' digital literacy. These qualities, along with technical knowledge and skills, are very much appreciated by employers today.

Inequality and threats in the field of international academic mobility

The European policy in the field of academic mobility, and, consequently, the very discourse

of academic mobility spread by Western countries, is currently subjected to a very critical analysis. It is considered as a tool for promoting the neoliberal globalization project aimed at total marketization and commercialization of higher education. This process in practice can turn into another wave of westernization, i.e. Western-centric formatting of the global educational space. The flows of mobile students, teachers and researchers mostly have a Western vector. The leaders in the field of mass reception of "academic tourists" are the USA, Great Britain, Germany, Austria and France, while the champions of sending students abroad to study are the countries of Eastern Europe and Asia. As a result, the project of academic mobility, originally conceived as a project of internalization of the scientific and educational environment, is transformed into a global marketing strategy for enhancing competitiveness and multiplying soft power resources of Western countries. Behind the gleaming facade of academic mobility can be seen such a negative phenomenon for the sending countries as "brain drain".

Van Der Wende (2015) states that the Map of the 500 best universities in the world shows a strong concentration of the declared best universities in several specific regions: North America (particularly on the east and west coasts of the USA), Europe (especially the north-western part), Asia (mainly Japan and China) and south-eastern Australia. This ability to attract talents from around the world on a highly competitive basis allows these institutions to further strengthen their capabilities, as well as to improve their rating and reputation. In other words, unless additional efforts are made to build capacity elsewhere, current mobility streams tend to be strongly beneficial to the establishment of the institutions in a limited number of regions of the world. The researcher is convinced that until universities in developing countries offer academic culture and facilities that leading scientists expect, including academic freedom and unlimited access to information and laboratories, they will not be able to attract and retain higher scientific talents.

To illustrate the disproportion between academic mobility centers and the tendency for the countries with cumulative soft power to be more attractive for international academic mobility, let us consider Table 1 and Figure 1. Table 1 shows the number of the world's best universities in the countries that occupy the first four places of the Soft Power rating (USA, Britain, Germany, France) and in the SCO countries (China, Russia, India) in 2018. In the other SCO countries (Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, and Pakistan) there are no such universities.

Country	Soft power rating	World University Rankings	Academic Ranking of World Universities
United Kingdom	01	38	28
France	02	9	14
Germany	03	36	20
United States	04	84	95
China	27	7	30
Russian Federation	28	2	1
India	-	1	-

Table 1: The World University Rankings 2018. Top 300 (sources: Soft power rating –McClory, 2018; World University Rankings – Times Higher Education, 2018; Academic Ranking of World Universities – Shanghai Ranking, 2018: 33)

Figure 1 shows the number of international or foreign students (in thousands) in 2016. There is a correlation between the quality of universities and the number of students. However, the example of Russia (in which there are only 1-2 of the best universities in the top 300) shows that other factors can influence the number of foreign students. In this case, it is a single language space and close cultural and economic ties with the countries of the former Soviet Union.
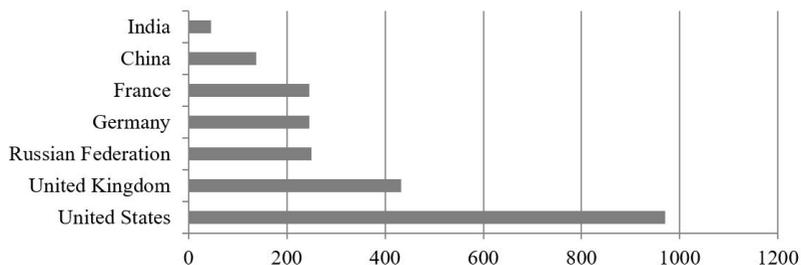
Figure 1: International and foreign student mobility in tertiary education, 2016 (source: OECD, 2018: 228)

In contrast to the Western-centred discourse of academic mobility, the discourse of Asian academic mobility has recently become widely used, acting as a conduit for soft power strategies of such countries as China, India, South Korea, Vietnam, Singapore, Kazakhstan, etc. One of the significant initiatives is the idea of creating a network of SCO University (Concept of the SCO University, 2010). In 2010, the universities of Kazakhstan, China, the Kyrgyz Republic, Russia and Tajikistan signed a memorandum of understanding on the establishment of a university.

The tasks of the university are very ambitious: 'to become an Asian equivalent of the European higher education area'. The SCO Network University is a platform for cooperation between the existing leading national universities, implementing joint Master's programmes, academic exchanges and joint research. Participation in its activities is carried out on a voluntary basis, and the universities concerned decide for themselves which specific projects to take part in. The SCO Network University trains students in the fields of regional studies, ecology, information technology, energy, nanotechnology, economics and pedagogy. It works as a consortium of universities and as such can hardly be compared with the more comprehensive reforms of higher education undergone by the 48 countries participating in the framework of the Bologna process. Nevertheless, the network university can be considered as a project of the initial stage, aimed at testing the compatibility of the systems, which may later lead to the development of a single educational space within the SCO. It is this university that is becoming one of the tools increasing the soft power of the SCO member countries, since it trains highly qualified personnel and contributes to the strengthening of good neighbourly and cultural relations among the organisation's members.

It is necessary to outline a number of restrictions that may inhibit international academic mobility. First, there is a lack of material, technical base, and highly qualified specialists for the implementation of the network form of education. Secondly, the low level of knowledge of foreign languages and the language barrier in the implementation of academic mobility programmes reduce the ability of students to use international virtual educational platforms (Popova, Beavitt, 2017). Thirdly, there remains a regulatory issue, namely the recognition of international degrees and diplomas obtained through distance and network training by employers and other organisations.

Two positions developed in Russia in relation to international academic mobility programmes have been singled out. On the one hand, it is argued that they contribute to the strengthening of mutual understanding, friendship, and cooperation between countries in various fields, as well as promoting business relations. On the other hand, there is a negative or cautious position: the huge financial costs incurred by foreign universities hide serious strategic interests of the main geopolitical competitors. The soft power of education is designed to increase loyalty to

the country that hosts students and young scientists, implicitly introduce new values, promote brain drain, undermine the "cultural core", and embed the required political orientations. In order to move from a wary to a balanced position, it is necessary to actively engage in educational programs, improve their quality and, at a conceptual level, move from the term "brain drain" to "brain circulation" and "brain exchange" between countries.

DISCUSSION

The results obtained make it possible to form a holistic vision of the problems of academic mobility as a tool of soft power and reveal the uneven assessment of such tools in different parts of the world. While western studies mainly concentrate on the positive effects of academic exchanges for the country, Russian scientists typically focus on the negative consequences. This may be due both to cautious attitudes towards Western ideas in general (their neoliberal component), as well as to a number of problems existing in the Russian educational space (the need to adjust domestic standards for the European education system, the underdevelopment of modern mobility technologies, etc.). The vector of academic mobility is gradually shifting towards the Asia-Pacific Region due to the formation of new innovative and educational spaces (for example, the SCO University and others).

A study by the University of Edinburgh (British council, 2017: 47) confirms the results of our research on the relationship between the soft power of a state and a good level of education in a country (in particular, the presence of universities with a good reputation). Its authors, using scatter diagrams, showed that there is a statistically significant relationship between the number of foreign students and the presence of top ranking groups. In addition, they found that the significant factors affecting the attractiveness of a country are the level of democracy, economic prosperity, the state of cultural institutions and civil diplomacy. We believe that in some cases, cultural and economic ties between countries and the absence of a language barrier can be important factors. In order to attract international students to the SCO countries, it is also advisable to provide targeted funding to support and develop key higher education institutions as well as to promote their activities.

CONCLUSION

The study conducted revealed that education today is the most important resource of soft power of a country, as a component that increases the attractiveness of a state and the overall potential of soft power, while academic mobility is a tool of soft power for achieving geopolitical and economic goals, both in the long and short term. As a result of the study, the discourse of academic mobility has been studied; the main views on this subject have been highlighted. The authors defined soft power and emphasized that its component, such as the formation of preferences in the population, correlates with the educational effects. Two ways of forming soft power in the field of education were identified: 1) educating future leaders / elites; 2) training ordinary citizens. It has been found that at present there are two vectors of academic mobility: Western-centric and Asian. As an instrument for balancing educational flows, the initiative to create a network of SCO member states was considered, and obstacles to improving the effectiveness of its activities were highlighted.

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MAJORITY AND MINORITY CORRECT PROCEDURES FOR SOLVING MATHEMATICAL WORD PROBLEMS

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Abstract

The contribution investigates the usualness of correct procedures used for solving mathematical word problems. Participants of the referred qualitative empirical study were future primary school teachers attending a one-year inquiry-based university course on mathematics. During the course they solved twelve open word problems with different difficulty that were based on operations with natural numbers and fractions. Comparison of correct solution procedures revealed two diverse types of word problems: those with various procedures evenly used by the solvers, and those with one procedure used by majority of the solvers and the others used by minority of the solvers. Detailed comparison of the word problems with majority and minority solution procedures revealed two diverse groups of participants: those who tended to use the majority procedures, and those who tended to use the minority procedures. In general, the contribution addresses the issues related to the use of formative assessment in inquiry-based mathematics education.

Keywords

Formative assessment, future primary school teachers, inquiry-based mathematics education, solution procedures, word problems

Introduction

Along with the recently growing interest in student-centered approaches to teaching such as the inquiry-based ones (Dorier and Maaß, 2014), the educational community has also faced the necessity to establish the principles of assessment within these approaches. As reported by Dolin and Evans (2018), one of the possible solutions to this issue seems to be hidden in formative assessment methods (Black and Wiliams, 2009; Shavelson et al., 2008), e.g. in on-the-fly assessment or peer-assessment. As indicated in my own previous research (Samková, 2017), another possible solution to the issue might be obtained by investigating the inquiry-based environment through the problems and tasks that the teacher assigns to students during inquiry-based lessons. In this contribution, I follow my previous findings and explore the issue of formative assessment in inquiry-based education from the perspective of tasks that are open in the sense of open approach to mathematics (Pehkonen, 1997; Nohda, 2000), namely from the perspective of tasks that have multiple correct ways of solving.

The here reported qualitative empirical study focuses on particular correct ways of solving and their usualness among the group of solvers. The participants of the study were future primary school teachers, i.e. teachers learning how to teach students from 6 to 11 years of age. The mathematical topic in the centre of the study was the topic of word problems on operations with natural numbers and fractions, namely the unequal partition word problems and word problems on part-whole interpretation of fractions. Both types of word problems are an integral part of the curriculum in many countries, though many empirical studies report their difficultness for students (MacGregor and Stacey, 1998; Lamon, 2006) as well as for future teachers and teachers (Samková and Tichá, 2015; Depaepe et al., 2015).

The topics that meet behind the referred study have already been discussed at ERIE conferences: formative assessment (Berková, 2016; Hošpesová and Žlábková, 2016), inquiry-based education and open approach to mathematics (Samková and Tichá, 2016), strategies for solving word problems (Novotná and Vondrová, 2017), unequal partition word problems (Novotná, 2018) and word problems on part-whole interpretation of fractions (Samková, 2018b).

The contribution is organized as follows: at the beginning it presents the context of the study, the participants and the diagnostic instrument. Then it describes the course of data collection and data analysis, presents findings, and discusses them.

Inquiry-based mathematics education and open approach to mathematics

Inquiry-based pedagogy refers to a student-centered way of teaching in which students are invited to work similarly as scientists work: observe, pose questions, reason, search for information, collaborate, collect data and interpret them, discuss obtained results (Dorier and Maaß, 2014).

In mathematics, an appropriate inquiry-based learning environment can be achieved through tasks that are open in the sense of open approach to mathematics (Samková, 2017). Such open tasks have multiple ways of grasping, multiple correct ways of solving, multiple correct answers and/or multiple ways of transforming the task into a new one (Pehkonen, 1997; Nohda, 2000).

For assessment of solutions of open problems, Nohda (2000) suggests to refer to fluency (how many solutions the student produced), flexibility (how many mathematical ideas the student employed or discovered), originality (to what extent are the ideas original) and/or elegance (to what extent are the explanations simple and clear). In this study, I discuss another aspect which remotely relates to fluency and originality. This aspect is usualness (how usual among the solvers is the particular way of solving that the student provided).

Formative assessment

In simple terms, formative assessment is assessment for learning, i.e. assessment that helps students to learn. According to Black and Wiliam (2009), formative assessment consists of five key strategies: clarifying and sharing learning intentions and criteria for success, engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding, providing feedback that moves learners forward, activating students as instructional resources for one another, and activating students as the owners of their own learning.

In the classroom, formative assessment may appear in various forms, e.g. as on-the-fly assessment or peer-assessment. The on-the-fly form refers to conversations of the teacher with the students that have not been planned beforehand but take place spontaneously in the classroom as soon as the teacher recognizes appropriate opportunities to support students in advancing their learning (Shavelson et al., 2008), the peer-assessment form refers to written and/or oral feedback given mutually among classmates by judging each other the level, value or worth of the learning outcomes, commenting on strengths and weaknesses, and/or proposing tips for improvement (Topping, 2013).

In inquiry based science or mathematics education, formative assessment naturally penetrates the process of inquiry (Hošpesová, 2018). In case of peer-assessment, the quality of the feedback might be satisfactory but is strongly connected to the extent of students' understanding of the assessed topic (Le Hebel et al., 2018). In case of on-the-fly assessment, the feedback to students is enhanced in classrooms where teachers are able to notice specific solutions, problems or innovative approaches in the inquiry activities and are not afraid to initiate a conversation to highlight what has attracted their attention (Harrison et al., 2018). In this study, I address both the peer-assessment and on-the-fly assessment.

My study aims to answer two research questions: "How varied are correct procedures that future primary school teachers use for solving open mathematical word problems?" and "How usual among the solvers are the procedures used by particular solvers?"

Participants

Participants of the study were 24 future primary school teachers, completely all students of the second year of five-year master degree program at the Faculty of Education, University of South Bohemia in České Budějovice. These future teachers are not math specialists; after graduation they are expected to teach all primary school subjects.

In the time span of the referred study, the participants were attending a course on mathematics conducted in an inquiry-based manner. During the seminars of the course, they often solved word problems that were open. At first, the word problems had a unique way of grasping and a unique correct answer but multiple correct ways of solving. For each of the tasks, I asked the solvers to look for various correct ways of solving and record them *all* on a blackboard. Later on, I started to incorporate also word problems with multiple ways of grasping or/and multiple correct answers. The participants solved the tasks individually, and then they altogether presented, discussed and defended their various solution procedures and answers, looked for relations among them. In such a setting, they had a lot of opportunities to observe and discuss various ways of solving open tasks.

Diagnostic instrument

As a diagnostic instrument in my study I got use of twelve word problems that were assigned to the participants within two standard written tests. The first test focused on natural numbers and operations with them, the second test focused on rational numbers and operations with them. Each of the word problems was based on a different didactical concept (e.g. equal partition with a remainder, equal sharing, unequal partition, equidistant partition).

Similar to my last-year study (Samková, 2018b), the participants had to solve the word problems within the framework of primary school mathematics – they were not allowed to use unknowns and equations in their solution procedures. For samples of the word problems see Table 1.

W1	Tom and Karel have 68 marbles altogether. Karel has 14 marbles more than Tom. How many marbles has Tom?
W2	Edith and Jane bought a book together. Jane contributed 120 crowns to the book, Edith 74 crowns. How many crowns does Edith have to pay to Jane to participate equally?
W3	One big dumpling can be cut into 12 slices. How many big dumplings does the family need for lunch if the father eats 2/3 of the big dumpling, the mother 1/4, the daughter eats 4 slices, and the son 6 slices? How many slices are left?
W4	A breeder keeps rabbits. Currently, 1/3 of his rabbits are white, and the others are grey. The breeder plans to give 3 grey rabbits to his neighbour today, and get 3 white ones for exchange. After this exchange, the proportion of white rabbits will rise to 4/9. How many rabbits does the breeder have?

Table 1: Four of the word problems solved by the participants within the written tests

Data collection and data analysis

Data collection took place in two stages, in the middle and in three quarters of the school year. Each of the research questions included data from both stages.

During data analysis related to the first research question, I registered various correct solution procedures that appeared in data related to particular word problems. I considered as same the

procedures that consisted of the same constituent steps (calculations, employed concepts) provided in the same order. During data analysis related to the second research question, I ascertained the usualness of each correct solution procedure based on relative frequency of the solution procedure among the group of all participants, and then I observed whether there was any tendency in the usualness for individual participants across all word problems.

RESULTS

From the perspective of individual word problems

Initial analysis of data related to written tests showed that there were several different correct solution procedures to each of the word problems. Some of the correct procedures are presented in Table 2. For the task W1, the solvers used two different models of unequal partition to represent the situation of the task: the sum-of-parts model and the division-into-parts model (Samková and Tichá, 2015). One of the solvers with the sum-of-parts model also accompanied her solution by an illustrative picture. For the task W2, there appeared three different solution procedures, two of them based on the same model. The third solution procedure used symmetry and offered an original perspective on the situation. For the task W3, there appeared four different solution procedures, three of them based on the same model. For the task W4, there were only five successful solvers and each of them provided different solution procedure; one of the solution procedures was accompanied by an illustrative picture.

W1	$68 - 14 = 54$ $54 : 2 = \mathbf{27}$	 $68 - 14 = 54$	$68 : 2 = 34$ $14 : 2 = 7$ $34 - 7 = \mathbf{27}$
W2	$120 + 74 = 194$ $194 : 2 = 97$ $97 - 74 = \mathbf{23}$	$120 + 74 = 194$ $194 : 2 = 97$ $120 - 97 = \mathbf{23}$	$120 - 74 = 46$ $46 : 2 = \mathbf{23}$
W3	$2/3$ of $12 = 8$ $1/4$ of $12 = 3$ $8 + 3 + 4 + 6 = 21$ $12 \cdot 2 = 24$ **2** dumplings $24 - 21 = \mathbf{3}$ slices	$2/3$ of $12 = 8$ $1/4$ of $12 = 3$ $8 + 3 + 4 + 6 = 21$ $21 : 12 = 1\ 9/12$ **2** dumplings $12 - 9 = \mathbf{3}$ slices left	father + daughter = 1 whole dumpling mother + son = $3 + 6 = 9$ slices from the **second** dumpling $\rightarrow$ **3** slices left
W4	$1/3 + 3\ldots 4/9$ $1/3 = 3/9$ $3\ldots 1/9$ $4/9\ldots 12$ $5/9\ldots 15$ $12 + 15 = \mathbf{27}$	white grey $1/3 = 3/9$ $2/3 = 6/9$ $4/9 - 3/9 = 1/9$ $6/9 - 5/9 = 1/9$<hr>$1/9 = 3$ rabbits altogether$\ldots 3 \cdot 9 = \mathbf{27}$	 $1/9 = 3$ rabbits $9/9 = 3 \cdot 9 = \mathbf{27}$
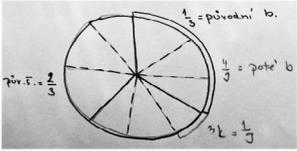
Table 2: Various correct solution procedures to the tasks W1, W2, W3, W4; translation of texts in embedded pictures: kuliček = marbles, pův. š. = grey before (abbr.), původní b. = white before (abbr.), poté b. = white after (abbr.), k = rabbit (abbr.)

Further analysis of data revealed two diverse types among the twelve observed word problems: five of the word problems were with various solution procedures evenly used by the solvers (e.g. W1 and W4; W1 was the only one among word problems on natural numbers), and seven of the word problems were with one solution procedure used by majority of the successful solvers and the others used by minority of the successful solvers (e.g. W2 and W3; in case of W2, all of the solvers were successful and more than 3/4 of them used the majority procedure; in case of W3, 4/5 of the solvers were successful and more than 1/2 of the successful ones used the majority procedure).

The solution procedures used by majority of successful solvers will be called *majority solution procedures*, and the solution procedures used by minority of successful solvers will be called *minority solution procedures*. For the tasks W2 and W3, the majority procedures are the first ones given in Table 2.

From the perspective of individual solvers

From the perspective of individual solvers, I analysed in more details data related to the seven word problems with majority and minority solution procedures. Data analysis revealed four diverse groups of participants: those who used the majority solution procedures in all such word problems (3 participants), those who used the majority solution procedures in all but one (10 participants), those who used the minority solution procedures in all such word problems (7 participants), and those who used the minority solution procedures in all but one (4 participants).

That means that $3 + 10 = 13$ participants tended to use the majority solution procedures (we may call them *majority solvers*), and $7 + 4 = 11$ participants tended to use the minority solution procedures (*minority solvers*).

DISCUSSION

The results of this study enriched the puzzle on "Which aspects may affect the implementation of formative assessment in inquiry-based mathematics education" by another piece of knowledge. In inquiry-based mathematics environment, students are naturally exposed to various solution strategies which may significantly affect their own choice of solution procedures. To illustrate this aspect, I chose a group of students from the Faculty of Education (i.e. future primary school teachers) attending a one-year inquiry-based mathematics course, and explored the variety of correct solution procedures to word problems that appeared in their written tests during the course. In this group, half of the solvers tended to use majority solution procedures, and half of the solvers tended to use minority solution procedures.

The findings about majority and minority procedures and majority and minority solvers are important for on-the-fly assessment as well as for peer-assessment. In case of on-the-fly assessment, the teacher might not be able to notice some specific or innovative solution procedures produced by minority solvers. In case of peer-assessment, the classmates who are majority solvers might not fully understand the solution procedures produced by minority solvers, and vice versa. Even the minority solvers might not understand each other when their solution procedures are based on completely different models.

The above mentioned circumstances raise a question whether and how is it possible to enhance noticing and understanding of different types of solution procedures – in teachers and future teachers as well as in students. A universal answer might be hidden in my previous research on a special form of open tasks that are called Concept Cartoons (Samková, 2018a, 2018b). Concept Cartoons are simple pictures with dialog bubbles that may present various alternative solution procedures or various alternative solutions to a displayed (mathematical) problem.

For teachers and future teachers, the Concept Cartoons pictures may break the stereotype of

"favourite" or "comfortable" solution procedures that the teachers had previously learned for the purpose of their own exams and written tests. They may also help the teachers to get acquainted with various solution procedures that might appear in the classroom, in order to be aware of their existence and thus be abler to notice them (Vondrová, Robová and Pavlasová, 2017). In that sense, Concept Cartoons may be considered as an artificially designed representation of the constituent part of school practice that is related to formative assessment (Grossman et al., 2009), and thus they may serve as a mediating tool between teaching practice and teacher education in the topic of formative assessment methods (Herbst and Chazan, 2011).

For students, the Concept Cartoons pictures may help visibly introduce into the classroom not only the majority but also the minority solution procedures, and elicit discussions on them. The presumable positive role of Concept Cartoons in formative assessment performed by students during science classroom discussions was already reported by Naylor and Keogh (2007). They also pointed out that learning of students often depended on getting students to let go of their existing ideas while providing them with access to more productive ideas, and introduced Concept Cartoons as a tool that enabled such processes by letting students to get to reflect carefully on their own ideas and to take alternative possibilities seriously. However, the usualness of particular alternative possibilities or the tendencies of students towards them were not explored in their surveys.

Besides the results related directly to formative assessment, the results of this study also contribute more generally to the process of assessment of solutions of open problems. In addition to the assessment framework suggested by Nohda (2000) which focused on fluency, flexibility, originality and elegance, the aspect of usualness that emerges from the referred study seems to be another valuable indicator of a solution procedure provided by a solver to an open task. And thus the aspect of usualness should be added to the assessment list.

The description of the inquiry-based mathematics course where the research study took place may serve as a suggestion of how open problems can be successfully presented to students: by starting with word problems that have a unique way of grasping and a unique correct answer but multiple correct ways of solving, by repeatedly recording all possible solution procedures on a blackboard, discussing and defending them, and later on by incorporating word problems with multiple ways of grasping or/and multiple correct answers. When the students in focus are future teachers, such an arrangement allows them to get acquainted with the breadth of possible opinions and solution strategies that they would meet in future during their own teaching practice.

As always with empirical studies of qualitative design, the weak point of the referred study consists in a small size of the sample and in the impossibility to generalize the results. On the other side, I chose as participants all of the future primary school teachers of the particular study year at our faculty – in that sense the study is representative.

CONCLUSION

In this contribution, I investigated usualness of correct solution procedures used by solvers of open word problems during an inquiry-based mathematics course, and its possible role in the implementation of formative assessment in inquiry-based mathematics education. I focused on the issue from the perspective of individual word problems, and from the perspective of individual solvers. Within the observed group of solvers, half of the solvers tended to use majority solution procedures and the other half tended to use minority solution procedures.

My small study confirmed the efficiency of employing open approach in mathematics education, and its close connection to two of the formative assessment methods: peer-assessment and on-the-fly assessment. I also discussed how open mathematical problems can be utilized to enhance noticing and understanding of different types of solution procedures – in case of future teachers

and teachers, and also in case of students. From the perspective of mathematics content, I focused on the topic of word problems on operations with natural and rational numbers.

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PRIVACY PARADOX AT THE UNIVERSITY OF ECONOMICS IN PRAGUE

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ABSTRACT

The article investigates the prevalence of the privacy paradox with the university students. We also researched effects of some reasons for diversion from the privacy rules which have the form of the privacy calculus and biases and heuristics diverting from rationality. Our results show that students stick to the rules of secure behaviour. More careful are women than men.

KEYWORDS

Online environment, privacy, privacy calculus, privacy paradox

INTRODUCTION

The unlimited access to information, 24 hours networking possibility, data aggregation, big data analysis, the ubiquity and use of networked electronic devices created a society that may be called "the uncontrolled electronic panopticism" (Smith and Kollars, 2015: 160). Users are observed and the results analysed and used. Many users prefer popularity, usability and price to security of their information. (Kelley, Cranor and Sadeh, 2013). On the other hand consumers are concerned about their private data and their use. That creates a difference or discrepancy usually called the privacy paradox. Contrary to the claimed importance and worries about personal data, in reality users do very little or not much to protect them. We may explain the paradox by various theories. One of them is the privacy calculus. Another considers the bounded rationality and cognitive biases. Both of them use the cost-benefits calculus where benefits and risks are compared. A special case of the bounded rationality decision making represents the unbalanced decision making process where no risk analysis takes place and decision making uses the prevalent benefits only. (Barth and de Jong, 2017).

This topic is relevant for students as a lot of educational content is provided online, many commercial organisations participate on their education, students use a lot of online websites for the resources and so it is important to know how they behave online and what should be the focus of the education in terms of secure online behaviour.

Privacy calculus

The privacy calculus explains how and why people make privacy-related decisions. It is considered to be the basic rule for the prediction of behavioural outcomes like disclosing private information, intention to use a software or a site.

The privacy calculus is based on the cost-benefit analysis regarding disclosure of private information. Consumers are willing to forfeit some privacy in exchange for a financial benefit or a service. (Hann et al, 2007). Consumers usually compare the possible risks related to the privacy information disclosure and the perceived benefits.

The term "privacy calculus" refers to the expectancy theory or utility maximization according to which individuals maximize positive results and minimize the negative ones. In our research we have focused on the three types of perceived benefits usually related to perceived benefits of personalization: financial benefits, additional services including personalization and social adjustment. (Smith, Dinev and Xu, 2011). It is difficult to measure the real behaviour of respondents in the real environment and that is why more or less artificial and hypothetical circumstances

are produced by most researchers to test the existence of the privacy calculus. For example, Smith, Dinev and Xu (2011) prepared some hypothetical verbal web sites descriptions, presented them to respondents and analysed to what extent the potential benefits and risks included in the descriptions would influence the respondents' willingness to disclose their personal information. Other researchers have found out that people don't always follow the principles of calculative behaviour in privacy decision making and often use some sorts of heuristic behaviour. (Acquisti and Grossklags, 2005); (Wilson and Valacich, 2012). Because the respondents are asked retrospectively they usually rationalize their previous behaviour and so hide their real motivations. Among the heuristics influencing the disclosure of private information in the virtual environment belong reference to the privacy decisions of others, professionalism of the site, amount of information on it, trust in the site provider etc. In our research, we have focused on the previous experience with the web page provider, information about the processing of the personal data on the web page, promise of the web page provider not to pass the data to anybody else, postponement of the private information submission to the web page provider and fatalistic beliefs about the effectiveness of the privacy protecting measures.

The decision-making process may be influenced by biases like time constrains, time inconsistency, immediate gratification or optimism. (Barth and de Jong, 2017). Unfortunately, not all of the biases are conscious. Other biases include too many options, unpredictable consequences or cognitive limitations. The decision is based on experience or trust in the service provider.

MATERIALS AND METHODS

In our research we wanted to find out to what extent the privacy paradox occurs with the students of the University of Economics in Prague and what motivates them to disclose their private information. The respondents study at the Faculty of Informatics and statistics and presumably know the principles of online behaviour; on the other hand, they are young and spend a lot of time online. For that reason, we formulated the hypothesis that the privacy paradox consisting in the negative correlation between knowledge of the principles of safe online behaviour and use of these principles will occur to a low extent with them. As for its reasons we hypothesised that some financial bonus or additional service would motivate students to disclose their private information. We didn't expect other motives and heuristics deviating from the privacy calculus to be relevant. The hypotheses were validated by the correlation analysis at the 5% significance level. Further details are provided below.

We used a random sampling method. A group of 200 students was contacted by email, 90 of them responded to the online questionnaire. The questionnaire consisted of 30 questions. They asked about the respondents' features (age, gender, work). Then questions related to the online environment, privacy paradox and privacy calculus followed. The sample is not representative with regard to gender and age. Men and younger age group of students prevails. The results were analysed by the methods of descriptive statistics and correlation. We used 6-point Likert scale in the questions asking about the students' opinion. The scale ranged from 1 – definitely yes to 6 – definitely not.

We didn't test the privacy paradox on the respondents' real behaviour, we asked theoretically only and so the answers are based on students' reflections and may be liable to ex post rationalization. For the results' analysis we used the methods of descriptive statistics (mean, standard deviation). These measures, especially percentage, describe the results in a comparable manner independent on the sample size and may be used by other researchers. We measured the correlation of ordinal data by means of the nonparametric Spearman rank order correlation coefficient (r_s), the correlation of nominal data with the chi-square test. Correlation was important for us in the analysis of privacy paradox that can be measured by the relationship of variables and in the

analysis of privacy calculus as well as we analysed the willingness to provide some information in exchange or under influence of another factor.

RESULTS

Sample characteristics

In our research carried out at the University of Economics in Prague we asked 90 respondents questions related to the privacy paradox and reasons that support disclosure of their private data. The respondents comprised 24% women and 76% men aged from 19 to 27 years. The biggest group was formed by the students with 22 years of age (36%). Most of them studied the bachelor degree (80%). It is interesting that only 15.6% of respondents don't work, 3.7% work on full contract and 31.1% have half or bigger contract. That is interesting with regard to the fact that they study the regular study programme. 31% of the respondents is focused on the performance, 2.2% on social relations and the majority of 66.8% on the balance between performance and social relations.

Students' online behaviour

Very worried, rather worried or worried with regard to their privacy are 65% of respondents and nobody hasn't any worries with regard to his privacy (M = 2.6, SD = 1.3). The vast majority considers their private data to be highly or very important (73.3%, M = 2.1, SD = 1.2). For 80% of student the privacy is important for their feeling safe. As for the risks related to the privacy disclosure the majority of respondents (66.7%) are afraid of the disturbance of safety and peace, 51% are afraid of manipulation and 51% of reputation harm.

	Definitely yes (1)	Rather yes (2)	A little yes (3)	A little no (4)	Rather no (5)	Definitely no (6)	Mean	Standard deviation
Following the principles of safe online behaviour	22%	53%	20%	5%	0%	0%	2.07	0.776
I have disclosed too much private information	9%	11%	16%	16%	27%	22%	4.10	1.600
Fear of one s privacy in the online environment	27%	24%	16%	24%	9%	0%	2.60	1.300
High value of privacy	36%	30%	12%	6%	6%	0%	2.10	1.200

Table 1: Answers to question related to privacy (Source: author)

We asked if students know the principles of safe behaviour in the online world and if they follow these principles. The students study at the Faculty of informatics and statistics and so we may suppose they know how the internet works. In addition to that their curricula include some information on safe online behaviour. The answers to these two questions (knowledge and following of safe online behaviour) were similar. The knowledge of safe online behaviour can be definitely found at 20% (SE = 1.58) of respondents, 64.4% (SE = 2.84) of them rather know the principles (M = 2, SD = 0.8). Similar results were discovered at responses on the question of following the principles of safe online behaviour, where 22.2% (SE = 1.67) of students answered that they definitely follow the principles of safe online behaviour, 53.3% (SE = 2.58) rather follow them (M = 2.1, SD = 0.8). There was no contradiction between these two questions, they are correlated (r_s = 0.353; p = 0.01). There is, however, a weak negative correlation between the

questions on following the principles of safe behaviour on the internet and the impression that students have disclosed two much private information online. ($r_s = -0.388$; $p < 0.01$). To sum up we may say the privacy paradox was not confirmed within this group of respondents. Students know what they should do to protect their privacy online and behave relatively carefully.

Further questions elaborated on the ways students use to protect their privacy online. We asked if respondents use fake profiles in some applications, if they use anonymizing software, if they use fake profiles and if they allow cookies. The results show that 13.3% (SE = 1.29) almost always use fake profiles, 15.6% (SE = 1.39) very often, 24.4% (SE = 1.75) sometimes, 13.3% (SE = 1.29) rarely, 24.4% (SE = 1.75) exceptionally and 8.9% (SE = 1.05) never (M = 4.5, SD = 1.5). Anonymizing software is always used by 11.1% (SE = 1.18), almost always by 28.9% (SE = 1.9), very often also by 28.9% (SE = 1.9), sometimes by 8.9% (SE = 1.05), rarely by 22.2% (SE = 1.67) (M = 3, SD = 1.3). Cookies are always allowed by 6.7% (SE = 0.9), almost always by 22.2% (SE = 1.67), very often by 24.4% (SE = 1.75), sometimes also by 24% (SE = 1.75), rarely by 11.1% (SE = 1.18), exceptionally by 11.1% (SE = 1.18) (M = 3.4, SD = 1.4). At the 5% significance level there was a significant correlation between the use of anonymizing software and the value of privacy ($r_s = 0,414$, $p < 0.01$) between this question and the fear of the private information ($r_s = 0.324$, $p = 0.002$). There was also a significant correlation between the use of cookies and the impression that students have revealed too much personal information online ($r_s = 0.304$, $p = 0.04$). Other correlations were not significant.

As for the dependence on gender, according to the Chi-square there is an association with the impression that the respondents have disclosed too much information on themselves ($\chi^2 = 16.7$, $p = 0.005$) – women tend to be more careful and think they haven't disclosed too much, there is also an association with following the principles of safe behaviour online ($\chi^2 = 14.2$, $p = 0.003$) – women are again more careful. Women are also more afraid with regard to their privacy online ($\chi^2 = 12.3$, $p = 0.015$). In other questions, there was no association with gender.

Reasons to disclose personal information

As a further step, we analysed the reasons that induce the disclosure of private information. Because we didn't confirm the existence of privacy paradox it may be concluded that students disclose their private information accordance with the rules of safe online behaviour. First the privacy calculus was tested. We asked about the benefits of discounts and additional service including the social adjustment in exchange for private information. The benefits also mean some financial benefits or special additional service. Then we asked questions related to the biases and heuristics influencing private information disclosure. These include rational fatalism, previous experience, communication privacy management, role of the recipient in privacy disclosure, social norms, trust, role of overview. The survey of the issues and questions can be found in table 2.

In exchange for a discount only 2.2% (SE = 0.53) of respondents would definitely provide their personal information, 15.6% (SE = 1.4) would rather provide it, 20% (SE = 1.58) are a little inclined to provide it, 28.9% (SE = 1.9) are a little not inclined to provide it, 33.3% (SE = 2.04) would rather not provide. None of the respondents would definitely not provide it (M = 3.76, SD = 1.145). Students are also quite open towards the exchange of their personal information and an additional service (2.2% (SE = 0.53) definitely for it, 8.9% (SE = 1.05) rather for it, 20% (SE = 1.58) are a little inclined to do it, 11.1% (SE = 1.18) are a little not inclined to do it, 31.1% (SE = 1.97) wouldn't do it, 26.7% (SE = 1.83) would definitely not exchange it. (M = 4.4, SD = 1.413). The design of the web page is not so important for most of the respondents (M = 4.4, SD = 1.413). The knowledge of the web page provider is rather important (M = 1.9, SD = 0,729). Knowledge of the purpose and methods of private data processing is less important, but still quite a lot (M = 2.56, SD = 1.299). The influence of others who provide their personal information is

not important for most of the respondents (M = 4.6, SD = 1.428). The promise that the provided information won't be submitted to anybody else is not so much important (M = 3.49, SD = 1.609). Least important is the delayed provision of private information (M = 4.89, SD = 1.276). As for the rational fatalism, respondents are slightly pessimistic if the instruments protecting online behaviour are efficient (M = 2.64, SD = 0.928), are not sure regarding the power of behaviour to protect privacy (M = 3.47, SD = 1.523), are similarly sceptical about the power of legislation in this context (M = 3.51) and are not sceptical regarding the power of companies to get their personal data anyhow (M = 4.2, SD = 1.567).

Privacy calculus	• Would you exchange your private information in exchange for a financial bonus? • Would you exchange your private information in exchange for an additional service?
Rational fatalism	• Can our behaviour in the virtual environment protect our privacy at all? • Are the current legal norms effective enough in the privacy protection? • Do you consider the measures directed at the protection of private information efficient? • Is it important to protect personal data if companies get them anyhow?
Previous experience	• Do you have experience with the loss of personal data?
Communication privacy management	• Would you disclose your private information to somebody who you don't know if you wanted to build a closer relationship with him?
Role of the recipient in privacy disclosure	• To which organization would you disclose your personal information the most willingly?
Social norms	• Do you disclose your personal information at those sites where many people around you do so?
Trust	• The role of the recipients promise not to provide the personal information to somebody else. • What effects on your decision making would have the professionally designed the web page asking for your personal information?
Role of overview	• Does it play a role if the recipient of personal information tells you how and for what purpose he would use your personal information?

Table 2: Privacy calculus and its biases and heuristics (Source: author)

As for the correlations, interestingly we found a negative correlation between following the principles of secure behaviour online and the role of others who disclose their private information ($r_s = -0.252$, p = 0.017). That means that the more people follow the secure principles, the less they consider the behaviour of others. A similar relationship was found between following of secure principles and delayed submission of private data ($r_s = -0.299$, p = 0.04).

Regarding the question on value of private information, this question was negatively correlated with the additional financial bonus ($r_s = -0.42$, p < 0.01) or additional service ($r_s = -0.446$, p < 0.01). Knowing the purpose of using private data is correlated with the value of private information ($r_s = 0.269$, p = 0.01). Other correlations were not significant at the 5% significance level.

Discussion

We found out that the privacy paradox consisting in the difference between intended or declared and real behaviour does not occur with our group of respondents. Students know what they are doing. Women tend to be more careful and cautious.

As for the motives that drive students to provide their personal information we confirmed that those who know the principles of safe behaviour also follow them or the better they know them the more they follow them. Important and logical is that the more they value their personal data the more they follow the rules. Knowledge of the service provider and

promise that the information won't be provided to anybody else lead to the impression that the rules of safe behaviour are followed. Fortunately, other reasons are not significant and so don't lead to breaking the rules for secure behaviour with the exception of delayed private data submission that would lead to a small decrease in following the principles of secure behaviour. Another possible explanation may consist in the fact that students haven't faced such a requirement.

In the EU research EU kids online (Bedrošová et al., 2018) where kids 9-17 years old were researched focused on risks related to the online behaviour. The results show that kids and adolescents are quite careful. Our results mostly confirmed the results of similar international studies like, Potoglou, Palacios and Feijóo (2015), Weinberger, Bouhnik, and Zhitomirsky-Geffet (2017). These researches confirmed that safe online behaviour depends rather on psychological traits than on technical instruments.

CONCLUSION

The existence of the privacy paradox is a controversial issue. Some researches confirmed its existence while other didn't (Kokolakis, 2015). We didn't confirm its existence by university students. Further, we researched the motives leading to breaking the principles of online safe behaviour. The situation is also not very clear in this area. Some researches support the idea of rational privacy calculus while others deny its validity in favour of various biases and heuristics. We didn't confirm its validity and rather tend to support the sticking to principles of safe online behaviour at our students. To protect their privacy the majority of students uses fake profiles and anonymizing software. Cookies are on the other hand allowed by most of the students. The more students allow cookies the more they think they have disclosed too much of their private information. Women tend to be more careful with regard to their privacy protection.

As for the privacy calculus, students would exchange their private information for some financial benefits or additional service. However, the more they value their private information the less willing they are to exchange their private information. The web page provider is important for them when they provide their personal information. Interestingly, students are quite pessimistic regarding the power of protective measures. They think they can't fully protect their private information.

That said we might conclude that students value and protect their privacy and behave quite rationally in the virtual environment.

ACKNOWLEDGEMENTS

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GENDER GAP IN BURNOUT SYNDROME AMONG CZECH TEACHERS

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Abstract

Teaching is a feminized profession in most countries. In seeking ways to increase gender balance in the teaching professions, different susceptibility to the burnout syndrome among men and women is also taken into consideration. Previous studies do not provide consistent results; however, the predominant conclusion is that female teachers suffer from burnout syndrome more often than male teachers. A recent study at Czech elementary schools (n=2,394) arrived at a different conclusion – the overall rate of burnout does not differ in men and women, but women show more frequently physical burnout while men are more prone to emotional burnout. The study verified the impact of occupational characteristics (length of the teaching practice and the educational level) and personal characteristics (marital status, number of children and household income). A higher prevalence of burnout was found among female teachers living without a partner, in low-income households and with a medium length of practice.

Keywords

Burnout syndrome, teachers, gender, elementary school

Introduction

An emerging body of research shows that the prevalence of stress in teaching occupations ranks among the highest in comparison to other professions (Johnson et al., 2005; Caprara et al., 2006). Long-term stress can result in burnout syndrome, which causes serious problems for both the individual teachers as well as for their students (Maslach, Jackson, and Leiter, 1996). The studies investigating the burnout syndrome show different results for female and male teachers. However, gender gaps in this area have not yet been fully explored and explained. In this study, we use a combination of quantitative and qualitative data analysis methods to obtain a deeper understanding of the burnout syndrome and its causes among male and female teachers. The gender perspective is the main topic of this paper.

Gender gaps and the burnout syndrome

Burnout is defined as permanent exhaustion with physical, emotional, cognitive and social symptoms resulting from long-term occupational stress, particularly in occupations with incessant human interactions and high responsibility (Johnson et al., 2005). The burnout syndrome is considered to be a multidimensional construct. Maslach's theory identifies emotional exhaustion, depersonalization, and reduced personal accomplishment as dimensions of the burnout (Maslach et al., 1996). Shirom and Melamed (2006) stress another three dimensions: physical fatigue, emotional exhaustion, and cognitive weariness.

Many studies have identified a higher prevalence of burnout syndrome among women in comparison to men (Maslach et al., 2001; Purvanova and Muros, 2010; Byrne, 1999). With regard to stress, Antoniou et al. (2006) have identified higher stress among female teachers in comparison to male teachers. It corresponds with the higher level of the overall workload of women than men, including both occupational and domestic demands. Klassen and Chiu's study

(2010) confirmed that "female teachers had higher levels of both classroom and workload stress" (p. 748). Consequently, more women than men experience a stronger conflict between their work and family roles, which increases the stress level. This mechanism is grounded in gender stereotypes and correlates with the level of gender equality in society (Kimmel, 2000). However, there exist opposite findings as well – some studies report higher levels of stress among male teachers (Borg et al., 1991, e.g.) and prevalence of the burnout syndrome among male teachers (Anderson and Iwanicki, 1984).

Some studies provide deeper insight by identifying different patterns with regard to the individual dimensions of the burnout syndrome. In most studies, male teachers reported stronger physical problems and depersonalization, while female teachers reported stronger emotional problems (Arvidsson et al., 2016; Antoniou et al., 2006; Maslach and Jackson, 1986). A meta-analysis by Purvanova and Muros (2010) concludes that "women are likelier to report the emotional exhaustion burnout component than men, whereas men are likelier to report the depersonalization component of burnout than women" (p. 175).

Besides gender, also other determinants of burnout syndrome have been studied. Among them, the length of the teaching practice and educational level are reported most often. However, their effects and interactions with gender are not very clear. With regard to the educational level, most studies conclude that primary teachers are at a higher risk of burnout than teachers at higher educational levels (Kyriacou, 2001). Teaching positions at lower educational levels are more frequently occupied by female teachers, and thus effects of gender and educational level are mixed up (Montgomery and Rupp, 2005).

With regard to the length of practice, most studies show that younger and less experienced teachers are at a significantly higher risk of burnout, mainly due to the emotional dimension (Lau, Yuen, and Chan, 2005). It is interpreted as a result of disillusionment experienced during the first years of teaching and can evolve into a decision to leave the profession (Ingersoll and Smith, 2003). On the other hand, studies report stronger burnout with increasing age because older teachers have less vigor and energy (Stock, 2010). The increase in the occurrence of the burnout syndrome among teachers in the middle phases of their career corresponds to an increasing family and household workload, which is strongly attributed to women (Kimmel, 2000).

Gender in the teacher's profession

There exist the overall gender inequalities on the Czech labor market. According to the Global Gender Gap Report (World Economic Forum, 2015), the Czech Gender Gap Index in 2015 was 0.687 and economic participation and opportunity subindex was 0.636, where 0.000 indicates complete inequality and 1.000 full equality. Teachers' occupation ranks among the most feminized in Czech society. There is a predominance of women among teachers at grammar schools providing education at a level corresponding to ISCO 2 and 3 – in total 75%; in elementary schools and in lower secondary schools, it is 96% and 76%, respectively (Ministry of Education, 2017).

For the Czech society, including the educational system, low awareness of gender stereotypes is typical and thus also a lack of effort to fight against gender inequalities (Smetackova, 2015). This results in limited knowledge about gender bias in many pedagogical situations, including situations relating to the professional career as a teacher and to the threats teachers face. Inequal financial and time treatment by principals based on different expectations from women and men was identified (Ministry of Education, 2015). However, no results assessing the impacts of gender patterns on the burnout syndrome and self-efficacy are available for the Czech teachers. In international studies, a significant relationship between the burnout syndrome and gender was confirmed by many studies (Purvanova and Muros, 2010). The relationships between

the burnout syndrome and gender, with respect to the length of teaching, educational level and characteristics such as marital status or economic standard of living, have not been fully described and explained.

MATERIALS AND METHODS

Our study aims to obtain a better understanding of the level and ways in which female and male teachers experience the burnout syndrome and it maps the links between the burnout syndrome and other characteristics in the specific gendered setting of the Czech educational system. Four research questions have been addressed in this study. Two of them are descriptive, the other two explanatory. Each research question was transformed into a hypothesis.

Our first question was: What is the level of the burnout syndrome among female and male teachers? Based on studies by Klassen and Chiu (2010) and Purvanova and Muros (2010) we create hypothesis 1: *Female teachers report stronger burnout syndrome in comparison to male teachers.*

Second, we followed the research question: What is the level of physical, emotional and cognitive burnout among female and male teachers? The results of previous studies (Antoniou et al., 2006; Purvanova and Muros, 2010) made us formulate the hypothesis 2: *Male teachers experience higher levels of physical burnout while female teachers experience higher emotional burnout.*

The third research question was: Which professional characteristics (e.g. length of teaching, educational level, school size) or personal characteristics (e.g. marital status, economic standard of living, number of children) correlate with the burnout syndrome in female and male teachers? Based on the study by Stock (2010), we assumed that teachers with longer teaching experience reported higher burnout syndrome, irrespective of gender. Based on the study by Kyriacou (2001), we assumed that teachers at lower educational levels (where more women than men teach) reported lower burnout syndrome. And based on the study by Montgomery and Rupp (2005), our prediction was that those female teachers with more children and living in a couple reported stronger burnout syndrome than male teachers, especially if their economic standard of living was lower. Hypothesis 3 was: *Teachers with shorter teaching experience and teachers in primary schools show stronger signs of burnout than teachers with longer teaching experience and teachers in lower secondary schools, regardless of gender.*

Finally, we followed the fourth research question: What is the gendered background for the identified levels of the burnout syndrome? With regard to previous studies (Purvanova and Muros, 2010), we predicted that gender-specific variables correspond to the level of burnout experienced by female and male teachers. Hypothesis 4 was: *The marital status, financial standard of living, and concurrent part-time job correlate with the level of burnout.*

Participants

Teachers were asked to participate in the survey via emails sent to principals at all grammar schools in the Czech Republic (n=3,890) and via educational journals. Our purpose was to get information about the survey to as many grammar school teachers as possible. An online version of the questionnaire was available to the respondents for completion for 13 weeks during two months at the beginning of the year 2017. The sample consists of teachers who were willing to participate in the research, which can cause a bias. However, a comparison of all teachers that worked in grammar schools in the Czech Republic in 2017 (Ministry of Education, 2017) showed that the sample used in the present study is representative in terms of gender and educational levels.

The study included 2,394 teachers working in Czech grammar schools. The set of respondents consisted of 15% male and 85% female teachers. The structure of the sample is shown in Table 1.

Variables		Women	Men
Number		2,036	358
Proportion		85%	15%
Age	M	46.610	45.210
	SD	9.330	10.730
Size of school (number of students)	M	353.300	368.700
	SD	225.890	213.280
Length of teaching practice	M	21.680	19.920
	SD	10.580	11.060
Representation of educational levels	Primary level	45.9%	11.7%
	Lower secondary level	31.4%	61.5%
	Both levels	22.7%	26.8%
Family income (scale 1 „low" – 8 „high")	M	4.590	4.730
	SD	1.315	1.335
Number of children under 15 years in a family	M	.740	.620
	SD	1.011	.920
Marital status	Single	8.1%	15.6%
	Married / In couple	76.8%	77.1%
	Divorce / Widowed	15.1%	20.1%
Concurrent part-time job	Yes	18.9%	33.8%

Table 1: Survey sample structure (source: own calculation)

Measurements

The burnout syndrome was measured using the Shirom-Melamed Burnout Scale (SMBS) (Shirom and Melamed, 2006) which had been validated for the Czech population. This scale conceptualizes burnout along three dimensions: physical fatigue, emotional exhaustion, and cognitive weariness. Each dimension consists of several items. The total scale includes 14 items focusing on different feelings and manifestations of stress. An example of the item is: *I have no energy for going to work in the morning*. Each item is evaluated on a 7-point Likert scale ranging from "never or almost never" to "always or almost always". High summary scores are indicative of burnout. The reliability measured by Cronbach Alpha was .939.

The questionnaire focused on the professional careers of individual teachers and the characteristics of the school where she/he worked were used in the survey. Some items related to socio-demographic information such as marital status, number of children or economic standard of living. Other items were linked to the previous careers such as the type of education, the length of teaching practice or the concurrent part-time job or experience with a non-teaching occupation. An important set of items focused on professional satisfaction.

Data were analyzed using the IBM SPSS analytics software. The structuring of the data allowed to use parametric tests. The mean values on all variables were determined including the total mean values, the sub-scales mean values and mean values in individual sub-groups. Differences between the female and male mean values were determined by performing a t-test. The correlations for all scales were analyzed as well. In specific cases, we performed a hierarchical regression analysis to establish the statistical significance of mutual relationships among variables.

RESULTS

On average, teachers reported mild burnout, M=3.14, SD=1.05. There was no gender gap in the total scores – men scored the same (M=2.56, SD=1.059) as women (M=2.61, SD=1.080). No burnout was reported by 17% male and 16% female teachers, very mild burnout by 32% male and

32% female teachers, mild burnout by 35% male and 32% female teachers, burnout by 13% male and 16% female teachers, serious burnout by 3% male and 4% female teachers and very serious burnout by.8% male and.6% female teachers. Participants were divided into three groups based on the total score according to measurement norms (Shirom and Melamed, 2006). The group where no burnout was reported is referred to as the "no burnout" group, the group reporting very mild and/or mild burnout as the "risk of burnout" group, and the group reporting existing, serious and/or very serious burnout forms the third group referred to as the "burnout" group. Among male teachers, these groups were represented by 17%, 67%, and 16%, respectively, while among female teachers, the representation was 16%, 64% and 20%, respectively. The results show no significant gender gap.

Study variables	M	SD	BUR_PHYS	BUR_COG	BUR_EMO
Female teachers					
BUR_SUM	3.15	1.05	.902	.897	.683
BUR_PHYS	3.57	1.31		.691	.471
BUR_COG	3.05	1.24			.484
BUR_EMO	2.61	1.10			
Male teachers					
BUR_SUM	3.11	1.04	.888	.876	.738
BUR_PHYS	3.42	1.30		.629	.514
BUR_COG	2.93	1.18			.534
BUR_EMO	2.91	1.16			

Note: BUR_SUM – Global Score of Burnout Syndrome, BUR_PHYS – Physical Burnout, BUR_COG – Cognitive Burnout, BUR_EMO – Emotional Burnout. All correlations were significant, p <.001.

Table 2: Means, standard deviations, and intercorrelations; N=2,394 (source: own calculation)

Using the SMBS, three dimensions of burnout were examined. The strongest burnout was reported on the physical scale (M=3.55, SD=1.31), milder burnout on the cognitive scale (M=3.03, SD=1.23) and the lowest on the emotional scale (M=2.66, SD=1.11). Although men and women do not differ in the total burnout score, a significant gender gap was identified on the emotional scale where females scored lower (M=2.61, SD=1.098) than males (M=2.91, SD=1.163); t(2390)=4.688, p<.001. The significant gender gap was found on the physical scale as well, where female scored higher (M=3.57, SD=1.309) than males (M=3.42, SD=1.303); t(2390)=-2.068, p<.05. While male teachers reported stronger emotional burnout, female teachers reported stronger physical burnout. No significant difference was found between primary-level teachers and lower-secondary level teachers both on the total scale and on the physical sub-scale. However, the emotional burnout was slightly stronger among the lower-secondary level teachers, t(1831)=-2.448, p<.05, and the cognitive burnout among the primary-level teachers, t(1831)=2.674, p<.01. There is a dominance of female teachers in both educational levels; however, in the primary level, the female/male ratio is much more imbalanced, which affects the global results. A comparison between female and male teachers was made in both educational levels. In the primary level, no gender gap was identified; in the lower secondary level, a gender gap was identified on the emotional sub-scale, but the other two sub-scales and the total score showed no gender gap. On the emotional sub-scale, females scored lower (M=2.66, SD=1.075) than males (M=2.94, SD=1.165); t(855)=3.218, p<.001.

No correlation between the burnout syndrome and the length of teaching practice was found, with the exception of a weak but significant correlation on the cognitive sub-scale (r=.55, p<.001). It means that older teachers reported higher cognitive exhaustion and vice versa. With respect to gender, the only significant correlation was found for males on the cognitive sub-scale, p<.05.

Although the correlation does not show a linear relationship between the burnout syndrome and the length of teaching practice in total and in female-male comparison, some patterns can nevertheless be identified. In the case of male teachers, the burnout syndrome increases with the length of teaching practice from 2.93 to 3.34, while in the case of female teachers, the strongest burnout syndrome was reported in the middle of their careers – from 6 to 15 years which corresponds to years when the domestic workload is at its highest.

Family relationships and economic family background had a partial impact on the burnout rate. Apart from marital status, we also assessed the number of children under 15 years of age in a common household and the total monthly household income. The analysis showed that among men, neither the number of children nor the household income correlates with the rate of burnout. In women, no link was established between burnout and the number of children but there was a weak negative correlation ($r=.008$, $p<.001$) between burnout and household income both in the overall rating and along each of the three assessed dimensions. In terms of marital status, the composition of the research sample slightly differed for men and women. The proportion of women and men living in partnerships was equal (77%) but the proportion of divorced or widowed research participants was higher among women (15% females, 20% males), while the proportion of unmarried participants was higher among men (males – 15.6%, females – 8.1%). Teachers living in a partnership did not show any gender differences in burnout rates. However, among those living without a partner (single, divorced or widowed), women showed significantly higher burnout rates than men ($p<.01$). In this group of teachers, women´s households had significantly lower incomes ($p<.001$) in comparison to men's households. This also relates to the fact that women living without a partner were more likely to have a part-time job (24% compared to 17% of women living in partnerships) while among men this proportion remained unchanged (33%).

We decided to examine the predictive power of individual variables (educational level, length of the teaching practice, marital status, number of children in the household, and household income) by applying hierarchical regression analysis using the Enter method, where the summary burnout score was used as the independent variable. In Model 1, we used gender as a variable complementing the five dependent variables, but the effect was not significant ($p=.467$). In general, Model 1 provided very little explanation for variability ($R^2=.016$). Therefore, we tested five core dependent variables in Model 2 separately for women and men. For men, none of the variables had a significant influence. For women, the number of children ($p=.017$), household income ($p=.032$) and the length of teaching practice ($p=.045$) showed as significant. Nevertheless, the models provided relatively little explanation for the variability, even though in the case of men the variability was higher ($R^2=.041$) than in the case of women ($R^2=.011$). It is clear from the poorly explained variability that although the tested professional and personal variables contribute to the gender gap, other characteristics are the main predictors of the overall burnout rate (irrespective of gender). In our research, we studied mainly the impact of coping strategies and self-efficacy, in which the male and female teachers did not show a systematic gap (Smetackova et al., 2018).

DISCUSSION

Our study investigated gender patterns in teacher burnout and sought to identify possible dependencies on selected characteristics of male and female teachers. We examined four research questions and four linked hypotheses. Our first hypothesis sounds: *Female teachers report stronger burnout syndrome in comparison to male teachers*. We expected this result based on earlier studies (Klassen and Chiu, 2010; Purvanova and Muros, 2010). However, our hypothesis has not been confirmed. There was no significant difference in the overall burnout between female and male teachers. The gender gap has not been confirmed either with regard to the educational level and the length of the teaching practice. The family background turned out to be a partially

influential factor. For female teachers, a negative correlation between burnout and household income has been found, especially for women not living in a partnership. Women showed a higher rate of burnout compared to men with the same characteristic also because their households had significantly lower incomes and thus they needed to take a supplementary part-time job more often.

There can be several reasons for why the Czech study has identified similar levels of burnout among both female and male teachers and why it is thus not in agreement with the prevailing foreign research which showed higher rates of burnout among female teachers as compared to male teachers. One of the potential reasons are the working conditions in the Czech schools, which are characterized by a high degree of time flexibility for the teachers (except for the actual teaching lessons, the teachers are not required to be present at the workplace for the rest of their working hours) and low financial remuneration (only 105% of the average wage and 78% of the average wage for university graduates). This environment is particularly attractive for individuals (mostly women) who need to avoid problems with balancing their work and family lives and are therefore looking for a job where they would have enough room for taking care of their family and household. This means that women teachers suffer less from burnout and score as high as men. Another cause may be the situation of men in the teaching professions. Czech primary schools show a very low proportion of men compared to many other European countries (Education at Glance, 2017), which is mainly due to low wages. Due to the generally strong traditional gender-based expectations that men should be the breadwinners in the family (Gender Equality Index, 2017)), many male teachers (almost double the number in comparison to the number of female teachers) have part-time jobs, which they are able to take thanks to the time flexibility of the teaching profession. However, having other job responsibilities can be exhausting for the teacher, so burnout may be experienced more frequently.

Our second hypothesis sounds: *Male teachers experience higher levels of physical burnout while female teachers experience higher emotional burnout*. Also, this hypothesis was based on earlier research studies (Antoniou et al., 2006; Purvanova and Muros, 2010). Neither this hypothesis has been confirmed. In our study, contrary to the hypothesis, women scored significantly higher than men in both the emotional and the physical burnout. The probable cause lies in the fact that for female teachers it is more difficult to balance work and family life, which is then manifested in the exhaustion of their energy resources and fatigue. In addition, due to gender stereotypes (Gender Equality Index, 2017), it is more difficult for male teachers to access their emotions, and they are therefore more prone to emotional exhaustion. This becomes particularly likely in Czech schools, which provides only little support for teachers' self-reflection and team sharing.

Our third hypothesis sounds: *Teachers with shorter teaching experience and teachers in primary schools show stronger signs of burnout than teachers with longer teaching experience and teachers in lower secondary schools, regardless of gender*. The impact of the length of the teaching practice on increased risk of burnout among teachers was demonstrated by foreign studies (Stock, 2010). Similarly, previous studies found that teachers at higher education levels show stronger symptoms of burnout (Kyriacou, 2001). This hypothesis has not been confirmed by our study, although in a more detailed view, some influence of the educational level and the length of practice could be identified. The total burnout rate was the same among primary and secondary school teachers and no linear relationship between the length of the teaching practice and burnout could be established. The gender difference was observed only among second-grade teachers along the emotional dimension, where male teachers experienced stronger burnout. With longer teaching practice, male teachers reported stronger burnout, although the dependence was weak. In the case of female teachers, however, the effect of the length of the teaching practice shows an arc-like pattern, with the youngest and the oldest category of teachers showing similar

rates of burnout and the middle-aged teachers reporting the strongest signs of burnout. This is a period in life for which high workload in connection with taking care of children and family is typical, and this poses a risk of exhaustion of life energy resources, especially for mothers in single-parent families.

Our last, fourth research question concerned the family background, both in the relational and material plane. Hypothesis 4 sounds: *The marital status, financial standard of living, and concurrent part-time job correlate with the level of burnout*. We assumed those female teachers with more children and living in a couple would report stronger burnout syndrome in comparison to female teachers without children or to male teachers, especially if their economic standard of living was lower. The association of the burnout syndrome with the family background and the economic level of the household has been demonstrated by a number of studies (Montgomery and Rupp, 2005; Purvanova and Muros, 2010). In our study, the relationship with family background has also proved to be significant, but only in the economic plane and only for women. Women living in low-income households reported a higher rate of burnout. More often, higher rates of burnout were reported by women living without a partner and a substantial part of them were single mothers. Women in this group are more likely to have a part-time job, which, in their overall workload, further exacerbates their life situation and is likely to contribute to the burnout syndrome. For men, no dependence of the burnout rate on household income, the number of children or marital status was proven.

Conclusion

The present study shows that female and male teachers in Czech elementary schools experience similar levels of burnout. Most of the earlier studies, on the contrary, concluded that there is a gender difference in the rate of burnout. In a more detailed view, however, also our study identified certain gender patterns. Female teachers showed a higher rate of physical burnout and, on the contrary, a lower rate of emotional burnout; especially female teachers with an average length of teaching practice, living outside a partnership and in lower-income households.

In further research, more details about the effects of gender-specific factors should be examined. Most of these factors refer to the private life of individual female and male teachers and not to their professional role. The mechanisms of how private/personal and professional/institutional factors are connected with respect to gender should be studied in the future.

For the prevention of burnout, we consider it necessary to take into account these specifics and seek ways to relieve physical exhaustion and support coping with emotionally challenging teaching situations. The gender differences in the level of stress and in the coping strategies among teachers should be discussed both in research and in prevention or intervention activities.

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PRACTICAL DIFFICULTIES AND SOLUTIONS OF KINDERGARTEN LEADERS' MANAGERIAL ABILITY

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ABSTRACT

Professional kindergarten leaders are the key to ensure the quality of kindergarten education. By interviewing the kindergarten leaders of seven kindergartens and conducting a questionnaire survey on 168 kindergarten teachers in the kindergarten in Xinxiang city, Henan province in China, the practical challenges of kindergarten leaders in management activities were analyzed. Combined with the existing management theory and practical experiences, solutions are proposed as follows: a common vision of kindergarten should be built to enhance internal cohesion, the kindergarten culture could be constructed according to their own realities, the administrative intervention should be turned into process evaluation, and the kindergarten leaders should exert learning initiative to become a professional authority.

KEYWORDS

Administrative intervention, internal cohesion, kindergarten leader, management dilemma, professional quality

INTRODUCTION

Preschool education is an important cornerstone of the national education system in China. Running preschool education and realizing "young education" is a development strategy put forward by the 19th National Congress of the Communist Party of China, which can help to promote preschool children's healthy growth (Liang, 2019). Professional kindergarten leaders are the key to ensure the quality of kindergarten education, and their managerial competence could affect the garden culture, system construction, and teacher team construction. After the implementation of the "universal two-child policy" in China, the shortage of preschool education teachers has become more prominent, and it is vital to improve the managerial competence of kindergarten leaders.

Since 2010, it has been a crucial period for the reform and development of preschool education in China. Many experts and scholars have studied the managerial competence of the kindergarten leaders. Liu (2015) interpreted the "Professional Standard of Kindergarten Principals" (PSKP) issued by the Ministry of Education in China from the change of the role of kindergarten principals. Wang and Jiao (2015) proposed the construction of the principal training course based on the PSKP. Xing and Yang (2018) conducted a survey on the current situation of training for kindergarten principals and concluded that the training opportunities for principals are generally few. Liu (2015) divided the principal's leadership into four dimensions: value leadership, interpersonal leadership, educational leadership and structural leadership. Through questionnaires and interviews, the overall situation and promotion strategies of kindergarten principal's leadership were reviewed. Hong et al. (2018) conducted a questionnaire survey on 1,742 principals, and proposed that the self-evaluation of rural principals on professional quality was generally lower than that of urban principals and their managerial competence needed to be improved. Based on literature survey, it is revealed that previous research has focused on the interpretation of

relevant policies, the professionalism of kindergarten leaders, the current situation of training and leadership. After the implementation of the PSKP, there is a lack of empirical studies on the managerial competence of kindergarten leaders. To bridge this gap, this paper aims to analyze the practice dilemma in kindergarten management and propose corresponding solutions through literature review, questionnaire survey and interview.

This paper consists of five sections. After the introduction, the section 2 mainly introduces the research methods. Section 3 describes the research results. Section 4 discusses the corresponding solutions to the management dilemma of kindergarten principals. The final section presents the conclusions.

MATERIALS AND METHODS

The methods of questionnaire and interview are adopted in this paper, which was divided into three stages. *In the first stage,* literature analysis and questionnaire compilation were carried out. Literature collection was conducted by review the articles indexed in WoS, Scopus, Google Scholar, ERIH and CNKI databases. To ensure the review was comprehensive, the articles which are published in core periodicals and peer-reviewed journal over the last 10 years in English and Chinese are selected based on the following keywords: "kindergarten leader", "administrative intervention", "internal cohesion", "management dilemma", "professional quality". In addition, some papers were discovered from the references of selected articles. Based on criterions of the relevance to the topic and the popularity in terms of citations, there are 13 literatures were finally screened for comparative analysis. On this basis, the questionnaire about the development status of preschool teachers was compiled according to the "Professional Standards for Kindergarten Teachers" (PSKT) issued by the Ministry of Education in China, which is divided into three parts. The first part is about the basic situation of preschool teachers, including age, professional qualifications, educational background, salary, training and other content. Secondly, it is about the professional level of preschool teachers, including the concept and ethics, knowledge, and ability. Finally, it is about the current greatest demand for preschool teachers and suggestions for the teacher development in kindergartens. In the first two parts, there are closed questions, while the questions in the last part are open. According to the PSKP, the interview outline for kindergarten principals was compiled, which includes the basic knowledge of kindergarten management, the understanding of the advanced experience of kindergarten management in China and abroad, the establishment of emergency mechanism and the formulation of corresponding plans in kindergarten, etc. *The second stage* is the test phase and formal test stage of the questionnaire survey. The questionnaire was preliminarily prepared in June 2018 and tested. In the course of initial test phase, experts were invited to identify and evaluate the questionnaire, and some of the topics and options with vague or defective expressions were revised. Also, a small range of test was conducted. The results show that the questionnaire test is basically feasible. 4 participants were randomly interviewed, and all of them thought that the questions raised by the questionnaire could be answered, indicating that the questionnaire was of good ethics and the data obtained were true. In the formal test, based on the principle of hierarchy, region and convenience, 3 public kindergartens and 4 private kindergartens in Hongqi district of Xinxiang city, which is a medium economic development city in Henan province, are randomly selected to make the sample selection balanced and representative. There are 14 principals were interviewed about their management dilemma and 168 kindergarten teachers in the kindergartens as respondents were surveyed with paper questionnaires in September 2018. *The third stage* is the data analysis and processing stage. In this study, a total of 190 paper questionnaires were distributed and 180 were recovered, with a recovery rate of 94.7%. Excluding 12 invalid questionnaires, the effective questionnaire was 168, and the effective rate was 93.3%. SPSS19.0 was used for data entry and relevant data analysis for all questionnaires.

Through analyzing the collected data, the results show that the kindergarten principals are mainly trapped in the following aspects in management activities. *Firstly, the proportion of male and female teachers is seriously out of balance in kindergartens, and interpersonal relationships are not easy to coordinate.* Kindergarten is a special organization, which is different from corporate companies. Companies around the world have large gender differences in leadership positions, and the number of men holding senior leadership positions is far more than that of women (Stephen and Mary, 2017). However, more than 90% of the leaders in kindergarten are women. The result of the interview shows that the basic information of the 14 kindergarten principals is as follows: there are 2 principals have the educational background of management, and the other 12 principals are preschool education. All of them have college degrees or above, among whom 13 principals are female and only one is male. This phenomenon is related to the special group of preschool teachers, because the vast majority of principals grew up from front-line preschool teachers.

Information	Category	Number of People	Percentage (%)
Age	<20	10	6.0
	20-30	87	51.8
	31-40	55	32.7
	41-50	13	7.7
	>50	3	1.8
Gender	male	1	0.6
	female	167	99.4
Teacher certification	yes	133	79.2
	no	35	20.8
Monthly salary (China Yuan)	<1500	17	10.1
	1500-2000	70	41.7
	2000-2500	50	29.8
	2500-3000	26	15.5
	>3000	5	2.9

Table 1: Statistical table of basic information of kindergarten teachers

As shown in Table 1, the basic information of kindergarten teachers is collected from the questionnaire survey. Among the 168 teachers in the 7 kindergartens surveyed, the remaining teachers and childcare workers are female except for one male physical education teacher in one kindergarten. Findings suggest that teachers' masculine identity is a combination of charisma, initiative, daring, playfulness and attention to the children's needs (Brody and David, 2015). The serious shortage of male teachers not only affects the development of children's characters such as bravery and adventure, but also affects the management effect of kindergarten. In the course of the interview of the principals, it was found that due to the large number of female teachers in the

kindergarten and the various and trivial work in the kindergarten, the interpersonal relationship between kindergarten teachers was complicated. There are contradictions between teachers of the same class and different classes. When the principal tries to reconcile, some teachers would think the principal has partiality, and then have greater disagreement with them.

Secondly, the professional quality of kindergarten teachers is not high, and the construction of kindergarten cultural system is limited. The questionnaire survey shows that 20.8% of the teachers and caregivers don't have the relevant qualification certificates among the 168 teachers surveyed. That is to say, more than one fifth of the staffs are not in line with the state access conditions for kindergarten teachers and child-care workers. However, due to the shortage of teachers, most of them work in the form of temporary contractors. In addition, by referring to the PSKT, questionnaires were prepared from three dimensions of professional quality of kindergarten teachers，which includes professional concept and morality, professional knowledge, as well as professional ability. In the questionnaire, the answers to each question are given different scores. The mean value refers to the average score of the answers in each dimension, and 4 point is qualified. SPSS19.0 software was used for statistical analysis of the survey data. The result shows that the overall average value of professional quality of kindergarten teachers in the seven kindergartens visited was 4.0285. The three-dimensional scores from high to low are: 4.52 for professional ability, 4.46 for professional knowledge, 3.15 for professional concept and morality.

Professional quality	Mean value	Standard deviation
professional concept and morality	3.1513	0.56861
professional knowledge	4.4600	0.51018
professional ability	4.5265	0.46991

Table 2: Comparison of mean value among the three dimensions

As can be seen from the table 2, the mean value of professional concept and morality is not qualified and much lower than other dimensions and overall average value. Further analysis found that the major reasons were the low professional concepts of teachers, such as the lack of understanding of the significance of children's education and the professional ideals, and the sense of identity with kindergarten teachers is insufficient. The teacher's professional concept and morality will not only affect the attitude and behavior of teachers in the kindergarten one day activities, but also affect their professional growth. More importantly, the low professionalism of teachers is bound to reduce the overall quality of education in kindergartens, and also restrict the construction of the cultural system in kindergartens, which is not conducive to the improvement of the quality of education in kindergartens.

Thirdly, the administrative intervention of relevant administrative departments is too much to play the autonomy of the kindergarten. Through the interview, it was found that both private and public kindergartens indicated that the relevant administrative departments of the higher authorities had excessive administrative interventions and frequent inspections. The principals interviewed stated that the kindergartens should deal with the inspection of relevant education departments at the district and city levels, the assessments from relevant departments at the provincial level, the inspection of food safety for children by the health bureau and other departments, and the organization of teachers to participate in skill competitions and observation class competitions on each semester. These inspections, assessments, and competitions are mandatory administrative interventions that, if not attended, will have a direct impact on the qualifications of the kindergarten. Excessive administrative intervention not only makes some kindergarten teachers tired, but also makes it difficult for kindergarten leaders to exert their autonomy. Against the

background of frequent incidents of child abuse in kindergartens, the issue of early childhood education is the focus of social concern, and serious supervision of kindergartens is necessary. However, the assessment and inspection of various departments will overlap, and it will inevitably affect the normal teaching arrangements of kindergartens, which puts the kindergarten director in a dilemma.

Fourthly, there are differences in the professionalism of leaders themselves, and the post-service training system is not mature enough. Based on the PSKP, we conducted relevant interviews and found that there were differences in their professional qualities of kindergarten leaders. Among the 168 kindergarten teachers surveyed, 68.3% of the 99 teachers in private kindergartens have the idea of moving to other kindergartens or organization. 29% of the 69 teachers in public kindergartens are willing to move. It shows that teachers in public kindergartens are more stable compared with private kindergartens. In addition, the interview of the kindergarten principals once again proves that the public kindergartens are superior to the private kindergartens in terms of internal management, as well as the stability of teachers. Especially in the optimization of internal management, the public garden is generally better than the private garden, the stability of the teachers is better than that of private garden. This may also be related to government policy on the support of public gardens. However, different private kindergartens have different effects due to the different professional quality and managerial competence of the kindergarten leaders. Among the 4 private kindergartens investigated, one provincial-level model private garden has a low attrition rate of teachers, while the other three have a high attrition rate. The managerial competence of leaders is very important for creating organizational value, which has both positive and negative effects (Stephen P. Robbins and Mary Coulter, 2017:5). Despite this, there is still little training related to kindergarten leaders. Since 2015, the ministry of education of China has explicitly encouraged relevant departments to do a good job in the kindergarten training. Although this has certain effects, the content of the training is mostly in the form of special topicsand they could not achieve qualitative improvement because of the lack of a mature curriculum training system.

Discussion

While the society pay extensive attention to preschool education, it is more important to focus on the practical dilemmas encountered by the kindergarten director in management, and to work together to solve the problems. Compared with other relevant researches, this paper proposes the following solutions based on the management practice of kindergarten principals in Henan province and the existing management theories. *First of all, occupational attractiveness is deserved to enhance, and a common vision of kindergarten should be build to enhance internal cohesion.* In view of the serious imbalance between the proportion of male and female kindergarten teachers, it is necessary to increase the salary to improve the occupational attraction of male preschool teachers and attract more excellent talents to the kindergarten. Through the questionnaire survey, it is found that the number of preschool teachers with monthly salary of 1500-2000 Yuan is the largest, accounting for 41.7%, followed by 2000-2500 Yuan, accounting for 29.8%. Even 10.1% of the preschool teachers responsible for conservation work are paid less than 1,500 Yuan. Also, only 2.9% have salaries above 3,000 Yuan. Although material and spiritual incentives are important in stimulating teachers' work enthusiasm, 81% of teachers responded that higher salary can make their occupation more attractive. In addition, the existing preschool teachers should be stabilized to avoid further loss in the event of teacher shortage. The kindergarten leaders can build the shared vision of the kindergarten within the organization. For leaders, the future and destiny of an organization will be directly determined by whether they can come up with a common vision that is inspiring, has broad prospects for development, can

be recognized by followers, and can continuously lead the organization or team forward (Tan et al., 2009). When there is a common vision in the kindergarten, the kindergarten teachers can focus on the future development and have confidence in their careers. Gradually refining and improving the common vision under the guidance of the kindergarten leaders can also enhance the internal cohesion between kindergarten teachers, and can achieve a multiplier effect on improving the internal management level of the kindergarten.

For another, the continuing education of preschool teachers should be strengthened, and also the kindergarten culture should be constructed. The problem of preschool teachers' professional quality is the bottleneck encountered in the management of kindergarten leaders. If only with the help of pre-service training, the overall quality of preschool teachers cannot effectively improve. The reason is that most of the preschool education graduates trained by regular higher normal colleges have entered kindergartens with good conditions in the city, and few of them are willing to go to kindergartens in rural or economically backward areas. Therefore, to guarantee the quality of kindergarten, it is also necessary to rely on post-job training, and more to take advantage of the form of training in the garden. On the one hand, principals or excellent preschool teachers in the garden should be invited to conduct rotation training for other teachers. On the other hand, it is also possible to invite kindergarten principals and teachers of the same type or quality to come to the garden for training. In addition, it can also be combined with universities to train kindergarten teachers in preschool education theory and guide relevant teaching and research activities. It should also be noted that different from the traditional male-dominated bureaucratic organizational model, kindergartens are more in line with the feminine organizational model because their managers and members are mainly female (Jiang, 2012). Kindergartens should create a caring and trustable organizational atmosphere based on the characteristics of women, give full play to the emotional cohesion of flexible management, and enable teachers to obtain a sense of belonging and identity in a harmonious and stable environment. The kindergarten leaders can integrate kindergarten culture into the construction of the kindergarten system, so as to achieve the transformation from management and supervision of teachers to independent development and self-monitoring. When preschool teachers have the initiative to work, their own professional quality can be naturally improved, which will be a virtuous circle.

Furthermore, relevant management departments of kindergartens should reduce administrative intervention and focus on process evaluation. For the phenomenon of excessive inspection and over-evaluation of kindergartens, relevant management departments should reduce administrative intervention and give kindergartens more autonomy in kindergarten management. This kind of common phenomenon also gets Chinese Ministry of Education to take seriously gradually. Chen, who is the minister of education of China, stated that teachers should be freed from all kinds of forms filling, evaluation, competitions and evaluations, and all kinds of social affairs unrelated to education, teaching and scientific research. However, how to implement is still subject to further refinement by relevant departments. In order to supervise the kindergartens, some necessary evaluation may still exist. However, summative evaluation should be turned into process evaluation and daily evaluation, without increasing the additional burden on preschool teachers. As for the evaluation method of the kindergarten, the National Preschool Education Association of the United States published the evaluation standard for high quality kindergarten in 2015, which includes "children", "teacher", "community" and "leadership and management", which has strong operability with the characteristics of child-centered, emphasizing evidence support and comprehensive content system (He, 2016). It can be an important reference standard for self-evaluation in Chinese kindergartens. In addition, kindergarten leaders should strengthen the communication with the superior authorities

to improve the quality of education through effective supervision, rather than hinder the improvement of teaching quality.

Finally, kindergarten leaders should exert learning initiative and strive to become a professional authority. In Ukraine, it is necessary for an administrative director of kindergartens to have Ph.D. degree or above. It is common for a kindergarten principal to be a preschool professor in university or a communications academician of the academy. Attaching importance to education and scientific research is a major feature of Ukraine's cross-century reform (Zhang, 2001). These practices are still worth learning by the Chinese kindergarten director until today. In addition to making use of external learning opportunities for systematic learning, kindergarten leaders also needs to maintain the concept of lifelong learning and give play to the initiative of learning. The combination of theory and practice should be also paid attention to in the course of learning management skills and methods. In addition, kindergarten leaders' reflective, flexible and systems thinking and their willingness in continuous professional and network development are crucial to leading today's kindergartens (Chan and Chi, 2018). The management excellent experience of other leaders should not be copied mechanically, which should be absorbed selectively on the basis of kindergarten-based culture. For the new kindergarten leaders, it is not possible to suppress people by political authority alone. It is necessary to develop high standards and strict requirements, strive to grow into professional authority and an expert in curriculum and teaching, which is also an important way to break through the management dilemma.

CONCLUSION

Based on the analysis of the existing literature, this paper investigates 14 leaders and 168 teachers in Xinxiang City of Henan Province in China. It is found that there are many problems in kindergarten management, such as interpersonal coordination between teachers is not easy to coordinate, the development of garden cultural is limited, the autonomy of kindergarten has not yet been played, and kindergarten leaders' professional qualities are uneven. The kindergarten leaders face much management dilemma in the actual management work. Based on the above problems, this paper expounds how education administrative departments at all levels and kindergarten leaders can joint together to break through the bottleneck affecting kindergarten management, so as to achieve more qualified and even excellent kindergarten educators, leaders and managers, and better improve the overall education quality of kindergartens.

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USAGE AND SECURITY OF EMAIL AS MAJOR MEANS OF ONLINE COMMUNICATION OF PRE-PRIMARY, PRIMARY AND SECONDARY CZECH EDUCATIONAL INSTITUTIONS

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Abstract

Czech educational institutions use email as their main online communication channel. There are two possible implementations of email: freemail services and paid services. This contribution focuses on usage of freemail, factor determining choice of freemail services over other solutions and defines possible pitfalls of such services. From publicly available data and survey concluded on 1268 institutions approximately 50% have freemail account and 25% uses it as main means for email communication and only 34% of institutions not using freemail uses digital signature in their email communication. The higher the level of education and the higher the capacity of school, the lower probability it uses freemail solution.

Keywords

Email, education, security, freemail, digital signature

Introduction

Online communication is taking over classical means of communication such as telephone and post mail. In 2017 about 68.2% people aged 16-74 were using internet daily or almost daily (Český statistický úřad, 2018). This trend is reflected on public institutions and their need to implement and provide online services and online means of communication. Besides numerous benefits online communication brings, it also might be less secure than classical means and more prone to user errors because its correct and secure use is intertwined with IT knowledge and skills. One of more traditional methods of exchanging messages is electronic mail (email).

Our aim is to discover state of this type of online communication in Czech educational institutions, investigate how these institutions use email, what information they communicate, with whom and determine possible factors affecting choice of email solution - either **freemail** or **email with own domain part (EwODP)**. Because of simplicity, low costs and relatively low demanding maintenance, expectations are that majority of institutions will use self-hosted email servers or mail hosting provided by third party as is web hosting regardless of school size and type. Because schools are public institutions, it could be expected that they use digital signature in official email communication. To answer whether these expectations are true to the reality, data from public databases of Ministry of Education, Youth and Sports (MŠMT) and Czech School Inspectorate (ČŠI) were compiled. To determine possible reasons for mentioned solutions and how personnel in charge of IT infrastructure evaluate possible shortcomings and risks connected with those solutions, a questionnaire was sent to all registered educational institutions in Czech Republic with 1311 responses returned.

Freemail can be defined as email service provided free of charge to the public which is financed most commonly by advertising. This means that user does not have to pay for email service itself

and other affiliated services (spam filter, access over IMAP…) provided by freemail provider. Freemail address contains domain owned by the service provider in domain part.

Definition of email with own domain part is included within the name. There are typically two choices for this solution. Either the email server is self-hosted, or the service is outsourced to company which hosts email accounts. In both cases the domain is owned by user.

We consider the latter of those solutions better for several reasons:

1. The downside of freemail is that the user does not really have a full control over the data stored under their account and cannot guarantee its safety or proper storing. For example, one of the largest Czech freemail providers Seznam.cz in its user agreement of service Email.cz, part 3.3 states: "The Provider assumes no liability and does not assume any responsibility for the non-functioning, unavailability and/or security of the Service, the failure to deliver the Email, the delivery of the damaged Email, the failure to send the Email, the sending of the damaged Email, leak of information about User, loss of and/or damage to User data stored or created in the mailbox or other consequences resulting from the use of the Service." (Seznam.cz, a. s., 2018) Similar clauses can be found in user agreements of other freemail providers (Verizon Media, 2019).

2. Some freemail services actively scan customer messages in mailbox in order to provide more accurate targeted advertising. This means that a third party legally eavesdrops on private communication.

3. Users of freemail can only choose the local part of email address because the provider of the service controls the domain part. This creates several issues:

   a. After changing provider, institutions lose their email address and must contact all addresses which happen to use the deprecated address, e.g. with automated response message and possible redirection of messages. Depending on providers terms and conditions, after certain period original email might be available to public and nefarious user can easily obtain it from freemail provider.

   b. If institution wants to have more than one address, it is necessary to split the local part to substitute missing variability of domain part. This might confuse people communicating with the institution. It is much clearer when the domain part denotes the institution and the local part belongs to employee, position, event or department.

   c. It looks unprofessional and less trustworthy when the institution does not use an email address with its own domain part. It is similar as in the case of private company, e.g. bank, which has to have a certain credit in order to get people entrust their money to it. Parents entrust their children to schools and EwODP might be one of the signs of stable, capable and credible institution (Go Daddy, 2016; Nuallain, 2017).

   d. E-mail address with similar local part can be easily obtained (e.g. "zsmikulov@seznam.cz" and "zs.mikulov@seznam.cz") and used for phishing, spreading hoax, spam or other (Dragoun, 2019). This is further complicated by the practice of Gmail which ignores dots put in local part.

4. It is not possible to use a digital signature for employees with freemail address. Even though employee can use their private certificate for signing emails, under regular circumstances the root certificate authority will not issue an employee certificate with email address which is not owned by the organization. Simple private certificate does not affiliate certificate owner with his or her employer and therefore the messages can be viewed only as private and not officially sent by the organization.

5. Because the number of freemail accounts provided by single company vastly outnumbers accounts of any educational institution, freemail is more attractive target for malicious

attacks. In past few years there have been several data breaches on major mail providers such as Gmail (Protalinski, 2014), Yahoo (Price, 2016) and others (Auchard, 2016).

6. Users tend to use the same password across multiple platforms (Ives, Walsh and Schneider, 2004; Wang et al., 2018) therefore if the password leaks from one service, it might be possible to use it in another. These password leaks are quite common (Hunt, 2018; Špaček, 2019). No matter if the password leaks from the freemail or another service, there is no way how to force user to change their password after it is leaked when the organization uses freemail service. This is issue because some studies (Greig, 2018) suggest that users do not change the password even after it is leaked.

7. Terms and conditions of freemail service may change and further usage of service might not be viable but because users do not own their freemail addresses changing service provider means changing the email address as well. This is problematic for reasons mentioned in point 3.

8. Freemail service might not provide key security features such as 2-phase authentication, restricting access from different IP addresses, access logging and others and user has no means of implementing them.

9. Because the institution does not have the rights to administer freemail accounts, it is possible for employees which have been laid off to still use the freemail address and possibly cause harm to the institution because they might be the only ones knowing login credentials to the mailbox in question.

The other point of our view on issues of email communication is usage of digital signatures. The reasons to use digital signature have been known for around 30 years (Merkle, 1990)without the several years delay required for certification of an untested system.","ISBN":"978-0-387-34805-6","language":"en","author":[{"family":"Merkle","given":"Ralph   C."}],"editor":[{"family":" Brassard","given":"Gilles"}],"issued":{"date-parts":[["1990"]]}}}],"schema":"https://github.com/citation-style-language/schema/raw/master/csl-citation.json"}. Digital signature has mainly three advantages: Authentication, Integrity, Non-repudiation.

The first reason is to prevent attacks like email spoofing (Kruck and Kruck, 2006). In case of educational institutions, the best practice is to use personal certificate which is linked to the institution. As of March 2019, the certificates issued by PostSignum may not be suitable as those are included only in Microsoft Trusted Root Certificate Program[1] and Adobe Approved Trust List[2] and therefore appear as not trusted in software which does not use these lists.

The second and third reason prevents possible disputes about content and forgery by third party which might help in conflicts between the institution and parents and/or students.

METHODS AND DATA

As main data source publicly available database Stistko[3] maintained by MŠMT was used. This database contains data about all private, and public institutions registered under MŠMT. Quality of data is poor, especially in case of contact information such as email or website. Because of this other information sources had to be used. Database of ČŠI[4] is richer in all sorts of information which are also more up to date. The data from those two databases have been joined and new database was created. In the end the number of obtained email addresses was 14 309 for all 9922 institutions under MŠMT.

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[1]   https://gallery.technet.microsoft.com/Trusted-Root-Program-831324c6
[2]   https://helpx.adobe.com/acrobat/kb/approved-trust-list1.html
[3]   http://stistko.uiv.cz/registr/vybskolrn.asp
[4]   https://portal.csicr.cz/Search/School

Questionnaire have been sent to all email addresses obtained from mentioned databases. The total of 1311 responses were received from which 15 were not possible to connect to our database and had to be dropped. From some institutions answered multiple times. Some of these answers differed in key questions ("Do you use freemail?"). Therefore, answers by IT specialists or headmasters were selected from these duplicities and the rest was dropped. In total 1268 responses were analysed, 28 were removed for duplicity, 853 were responses for institutions only in pre-primary, primary and secondary educational institution. For analysis of general questions, the sample of 1268 was used and for comparison between different educational levels of education, the sample of 853 excluding institutions with multiple types was used.

Responses are roughly equally distributed among regions with the highest response rate in Prague 19.05 %, the lowest in Zlín region 7.75 % and the average of 11 % of all educational institutions in each region. Majority of responses were from headmasters and deputies with 77% and 12.5% respectively. Minority of responses were from IT specialists with 6.7% share.

Although the sample is big enough it is important to keep in mind that responses are purely voluntary, which might affect the results. From our database it was possible to extract information about domain and local part of addresses in our email list. Even though these addresses are publicly available from numerous sources it is important to remember that these addresses do not have to be used for actual communication with parents and students as a lot of information in official database is not up to date. After comparison of our database with data from questionnaire it can be concluded that the distribution of responses which claim to use freemail is similar to the distribution of freemail addresses from our database.

Another issue that one might be concerned about is that some respondents might have categorized Software as Service (SaaS) solutions like G Suite for Education or Microsoft Office 365 as freemail service when others would categorize them as having own email service. This can be somewhat understandable because they are free for educational institutions. We compared comments left by respondents mentioning this issue with their answers and we found no example of this misclassification.

The main focus was on Czech educational institutions which are specified by ISCED 2011 levels 0, 1, 2 and 3 (*Klasifikace vzdělání (CZ-ISCED 2011)*, 2013).

Results

90.4 % of respondents use email to communicate. In general, 42.82% of schools are using email for communication only with parents, 47% with both students and parents and 8.91% do not use email for this purpose at all. Off course the communication with students is mainly domain of high schools. On the other hand, majority of schools which do not use email are kindergartens. The share of those institutions using email for contacting does not differ drastically when we compare freemail and non-freemail using institutions but 15.54% of the latter does not use email for communication with parents and students at all. This is a difference of +11.87 percentage points from those who use freemail.

Other important online channels that schools use to communicate with parents and students are web site with only 7.3 % not using it, school information system used by 42.8% of schools, social networks 34.2 % and instant messaging 7.4 %. Traditional channels telephone and SMS scored 95.6 % and 71.9 % respectively.

Schools propagate various types of information through an email such as news (44.4%), offers of extracurricular activities and other free time activities (32.3 %), homework (25.1 %), changes in timetable (20.5 %), canteen menu (18.2 %), warnings about states of crisis (14.8 %), changes of passwords in information systems (9.7 %), grades (6.6 %) and 17.3 % sends even information about incidents and injuries of students through email.

Some of that information is send through bulk emailing. Frequency of bulk email is quite surprising: 10.5 % of respondents send bulk email at least once per week, 17.2 % weekly, 18.7 % monthly, 5.4 % biannually, 16.6% less frequently and 31.6% does not use bulk emailing at all.

	Kindergarten	Elementary	High
Has freemail	61.40%	38.90%	19.20%
Uses freemail as main	33.55%	20.60%	12.40%

Table 1: Usage of freemail across different type of schools

The table 1 summarizes ownership of freemail and usage as main manner of email communication among studied school types. It clearly shows that the institutions providing secondary level of education are less prone to use or own freemail. To compare difference in probabilities for different types of institutions logistics regression can be used (Hosmer, Lemeshow and Sturdivant, 2013). Previous stands true after adjusting not just for type but for capacity of institution and there is a significant difference on 5% significance level between high schools and other types, where high school have lower probability of using freemail as main communication channel. Frequency of usage and whether institutions has their own IT department or maintain ICT themselves did not show as significant additional factors determining probability of institution using freemail as main mean of online communication.

To determine factors behind choice of freemail services respondents were asked about their opinions: 81% of them think that freemail is easy to get and use, 22% mentioned not having IT workforce, 17% does not have sufficient funding, 16.7% blames insufficient IT equipment, 8% does not know but whole 42% stated that it is because of previous positive experience.

32.7% of respondents think that with freemail use comes higher security risk, 22.15% does not believe so and 45.13% does not know. Relative majority of users which uses freemail as main mean of communication sided with negative response and on the other hand users which do not use freemail at all quite firmly believe freemail usage is risky.
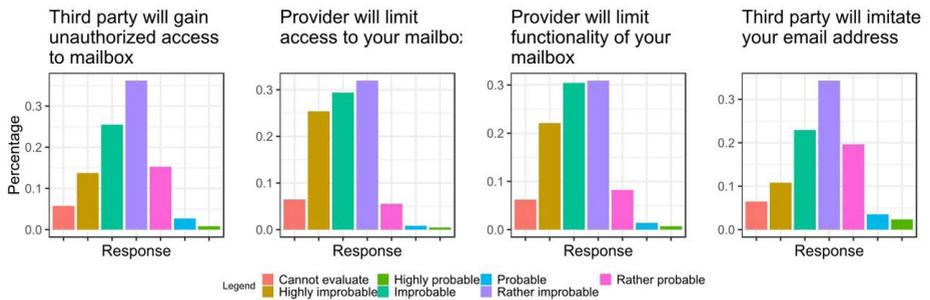
Figure 1: Risk assessment by schools

The figure 1 summarizes risk evaluation of freemail use from the point of view of schools. Schools do not perceive these risks as probable and therefore are not discouraged from freemail use.

We noticed from several freemail hosted addresses that sometimes the address does not contain the name of the institution but only first and/or last name because it is probably a private email of the headmaster/employee. This creates new issue because this means the contact address is not stable but follows HR changes of institution therefore closely intertwined with point 9 from section Freemail.

Relative majority, 51.58% of all respondents, agrees that it is not difficult and 49.23% expensive to obtain digital signature but only 34.4% of EwODP respondents uses it for signing emails.

This corresponds to 35.05% of respondents who think that digital signature should be used in official email communication and 45.6% think it is unnecessary. This is also in contrast with the opinion that vast majority, 70.69%, expressed that digitally signed emails are more trustworthy because of authentication of sender. These data can be therefore interpreted in a way that majority of institutions do not want to bother with digital signature even though they agree it makes the communication more trustworthy. Use of digital signature should not be technically difficult because as of today 67.5% of EwODP respondents already accesses their mailbox through local email client and 19.5% uses smartphone.

The only widespread secure alternative seem to be data mailboxes but these are not considered as suitable because they were not designed for common everyday communication and the user base of natural persons is rather small, only around 125000 of mailboxes at the time of writing (Česká pošta, 2019), considering not all of those users have children visiting educational institution.

DISCUSSION

People responsible for choosing IT services and providers needs more information, better guidelines and foremost help in IT decisions. Getting paid advices from professionals can be financially demanding and it is not effective long-term solution especially for smaller institutions such as nursery schools. More finance for ICT might not be the answer. More expensive solution does not have to be the most efficient one and on the other hand a free solution might not be most sustainable and actually cost-saving especially in a big picture. The missing part is some sort of best practices published by ministry.

Quite high amount of indecisive answers implies that make decisions in IT do not have necessary knowledge. Through our questionnaire we found out that 32.5% of kindergarten, 30.1% of elementary schools and 41.2% of high schools does manage their IT on their own and only 1.3%, 2% and 10.1% respectively have their own IT department. Therefore in our opinion if government wants to increase security and trust of services in question, it should provide optional email service similarly to web hosting services provided through Insip PORTÁL by ČŠI (Česká školní inspekce, 2016). This would immensely help small subjects to fulfil the need for secure enough, easily maintainable email service because nowadays each of thousands of these schools have to solve this issue separately even though their requirements are the same and very modest. Solving this issue would be quite easy task for large government body. This would also meant that new government policy like GDPR and new security recommendations, such as RFC8314 (Newman and Moore, 2018), would be implemented once and would not impose more requirements on small schools which have limited resources.

Schools which have website presentation do use web hosting services which usually also come with email hosting which is in many cases unlimited and for free or with prices in tens of Czech korunas per month. Three of the largest providers provide email accounts in their basic packages/ offers (*Hosting - Statistiky CZ.*, 2019). Therefore, we see no reason why any school should use freemail services instead of better solution, for which they are probably already paying.

We also discourage the use of web interface because it does not support digital signatures and recommend use of email clients installed locally.

CONCLUSION

Current state of email communication of educational institutions is far from ideal. We proposed possible dangers and downfalls of freemail service usage in observed institutions and concluded thorough research of available online sources and responses from 1310 educational institutions. Around 25% of the institution that responded are using freemails as their main mean of email communication and around 50% have freemail account and are actively using it for other

purposes. By absolute numbers the issue is more common for nursery schools. By our results the probability of using freemail as main communication channel is determined by size and type of institution, but it needs to be taken in account that there are examples of such usage among all types of public educational institutions. The main future objective should be to establish trust and maintain security of private information. Schools are public educational institution and as such they should be leading example of correct usage of informational technology.

Further research should include the question of how is freemail perceived from the point of GDPR and if email encryption is necessary for the reason of GDPR compliance. Interesting area is also the usage of other online communication channels such as secure instant messengers, social networks and information systems and possibility of their implementation in education sector.

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IMAGE AS AN IMPORTANT PART OF THE QUALITY EVALUATION OF A FACULTY

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Abstract

The image of a faculty has an impact on its prosperity and success, hence attention should be given to these issues. The objective of this study is to identify whether there are differences in the evaluation of the image of a faculty across groups of students in full-time and part-time study as well as alumni of the faculty. The evaluation of the image was established using a semantic differential. The data were evaluated using Friedman´s ANOVA and Kendall Coeff. of Concordance and the Kruskal-Wallis test. It was established that the evaluation of the groups show statistically significant differences. Full-time students gave the strictest evaluation. Only one item (of a total of 11 questions) showed concordance among the groups in the evaluation - faculty friendliness. The total evaluation of the faculty image was good. Both strong points and areas the faculty can focus on in the future were identified.

Introduction

Great attention is currently being paid to methods of establishing the quality of individual universities. Quality is a notion with a wide variety of meanings, determined and qualified differently. Each university or higher education institution has an Internal Council for Internal Evaluation to supervise the introduction and maintenance of the system which looks into the quality of the educational and creative activities and makes evaluations on a regular basis. Such processes are usually regulated by the internal regulations and documents upon which the internal quality evaluation takes place. External quality evaluation can be provided by the National Accreditation Bureau for Higher Education (NAÚ) subject to the Act on Higher Education Institutions.

The internal quality evaluation involves teaching and creative activities as well as related activities, such as marketing and faculty promotion, internationalization, mobility of students and teachers and international cooperation, functionality of internal information systems and a number of others associated with the above-stated.

As stated above, each university monitors a number of areas within the evaluation of internal quality and collects input data for the evaluation from different sources. Students and alumni, alumni employers as well as the general public are natural stakeholders. This article focuses attention on existing students and alumni and the options of how to establish their rating of the university (or the faculty).

Presently, schools quite frequently look into the opinions of these groups (i.e., students and alumni) mapping the educational quality (Spooren, Mortelmans and Denekens, 2007; Felton et al, 2007; Looney, 2011; Opdecam and Everaert, 2012; Kinash et al, 2015). However, some authors correctly

point out that merely finding out student opinions is insufficient to establish the quality of the school. Wibbecke et al (2015) find student opinions on the quality of teaching to be just supporting material to reflect the work of teachers. Moses Waithanji and Mwangi (2005) also think that student evaluation of teaching effectiveness is only one of the supporting information sources. Apparently, to establish the quality of a higher education institution, attention should focus not just on teaching, although teaching is the priority objective for each education institution and its evaluation cannot be ignored.

Another important area which should be given attention is the evaluation of the general impression an institution creates. Marketing designates such a type of evaluation as the image. The image of higher education institutions was evaluated in the past as well (e.g.,Parameswaran and Glowacka, 1995), but the decreasing number of students and efforts to attract the attention of young people as well as other stakeholders in the marketplace increases the interest of universities in the issue (Aghaz, Hashemi and Atashgah, 2015; Orlov, 2018). The image (reputation) of a university is one of the factors which influences future as well as current students (Ahmad and Buchanan, 2017). Balaji, Roy and Sadeque (2016) state that university branding and the created image play an important role in student-university identification. A high degree of identification positively influences students' activity and their willingness to affiliate with the university. The university's reputation together with high-quality education, good communication and the development of relationships with students are key factors which also influence future relationships and attitudes of the alumni towards the university (Sung and Yang, 2009). Hence, the university's image has a significant influence on both future and current students as well as alumni whose willingness to continue cooperation with the university and to support it generally is then positively influenced.

The objective of this study is to identify whether there are differences in the evaluation of a faculty's image across groups of students in full-time and part-time study as well as among the alumni of this faculty.

MATERIALS AND METHODS

The survey was carried out at the Faculty of Social and Economic Studies of Jan Evangelista Purkyně University in Ústí nad Labem. The semantic differential was selected as a suitable method to meet the goal – evaluation of the faculty's image. The semantic differential is a seven-point bipolar rating scale used to derive a respondent's attitude or opinion. The evaluated criteria were operationalised based on available studies and literature. A list was made to include the items which can influence the image and can be tested using the semantic differential. The list was corrected by the faculty management, i.e., such criteria were selected or redefined and complemented which are important to meet intermediate objectives as well as the overall vision of the faculty management (see Table 1).

Since the objective of this work is to see whether there are significant differences in the image evaluation among individual groups of students, three selection groups of respondents were created. The groups are designated as "Full-time students" (N = 419), "Part-time students" (N = 194) and „Alumni" (N = 97). The selected method was a written questionnaire. The full-time students and part-time students were asked to fill in the questionnaire during classes. To address the alumni, the database being developed by the faculty was used and the alumni were asked to inform their former peers (if they knew their contact details) of the questionnaire, which was available in electronic format (the snow ball method).

The data were collected during 2018, and developed using MS Excel and Software Statistica.

Since the data had no normal distribution, non-parametric tests were used for their analysis. The tests were used: Friedman's ANOVA, which tests the equality of medians of dependent choices, Kendall Coeff. of Concordance, which is a measure of consistency among the order of k variables and Kruskal-Wallis test, which tests the equality of medians of independent choices (Řezanková, 2010).

The main objective was to identify whether t here are statistically significant differences in the evaluation of the faculty's image among full-time students, part-time students and alumni of the faculty. Table 2 shows the average values established for individual items in all three monitored groups, i.e., full-time and part-time students and alumni.

semantic differential items	Alumni	Part-time	Full-time
old-fashioned - innovative	4.40206	4.49485	4.12172
unpromising (unsustainable on a long-term basis) - promising	4.59794	5.20619	4.68258
poor quality of teaching – good quality of teaching	4.57732	5.01031	4.36993
hostile - friendly	5.20619	5.13402	5.04770
useless - useful	4.95876	5.23711	4.84726
adversely – positively perceived by the academic public	4.14433	4.32474	3.58711
focus on theory– focus on practice	3.57732	4.23711	3.26253
has poor reputation – enjoys good reputation	4.24742	4.44330	3.60382
prepares students badly – well for their entry into the labour market	4.11340	4.52577	3.93795
uncompetitive - competitive	4.41237	4.71134	4.24582
I would not recommend my friends to study here – I would recommend my friends to study here	4.97938	5.01031	4.52267

Table 1: Average values of individual semantic differential items (source: own calculation)

Table 1 clearly shows that the monitored groups feature differences when evaluating individual criteria. Friedman´s ANOVA and Kendall´s coefficient of concordance were used to establish whether there are statistically significant differences in the responses to individual questions in each group of students. The following results were established:

The full-time students: p =0.00000 Coeff. of Concordance = 0.20939 Aver. rank r = 0.20750.
The part-time students: p =0.00000 Coeff. of Concordance = 0.11901 Aver. rank r = 0.11444.
Alumni: p =0.00000 Coeff. of Concordance = 0.22001 Aver. rank r =.0.21189

Different responses to individual questions were confirmed in all three groups.

Consequently, the total average values between individual groups were compared. As shown in Table 2, the Kruskal-Wallis test validated that there is a statistically significant difference between the groups of full-time students and part-time students, however, the alumni do not generally display any great statistical differences in their evaluation from the full-time students or part-time students.

total	full-time	part-time	alumni
	R:12.182	R:22.500	R:16.318
full-time		0.036993	0.947271
part-time	0.036993		0.401379
alumni	0.947271	0.401379	

Multiple Comparisons p values (2-tailed); Question 1: Kruskal-Wallis test: H =8.812246, p =0.0122

Table 2: Comparison of averages in individual questions as a whole (source: own calculation)

The specified findings also match the results shown in Figure 1. The progress of individual lines clearly shows that the evaluation given by the alumni is situated between the values of the full-time and part-time students.

The Kruskal-Wallis test was used afterwards to validate which items are statistically similarly evaluated by the alumni as well as the existing students. There the following items: 1. old-fashioned - innovative, 5 useless - useful, 9 badly prepares students for their entry into the labour market - prepares students well for their entry into the labour market, 10 uncompetitive -competitive,

11 respondents would not recommend studying at the FSE to their friends - respondents would recommended studying at FSE to their friends. Despite no differences shown in the evaluation between alumni and students, there are differences in the evaluation between full-time and part-time students.

Evaluation of the FSE image
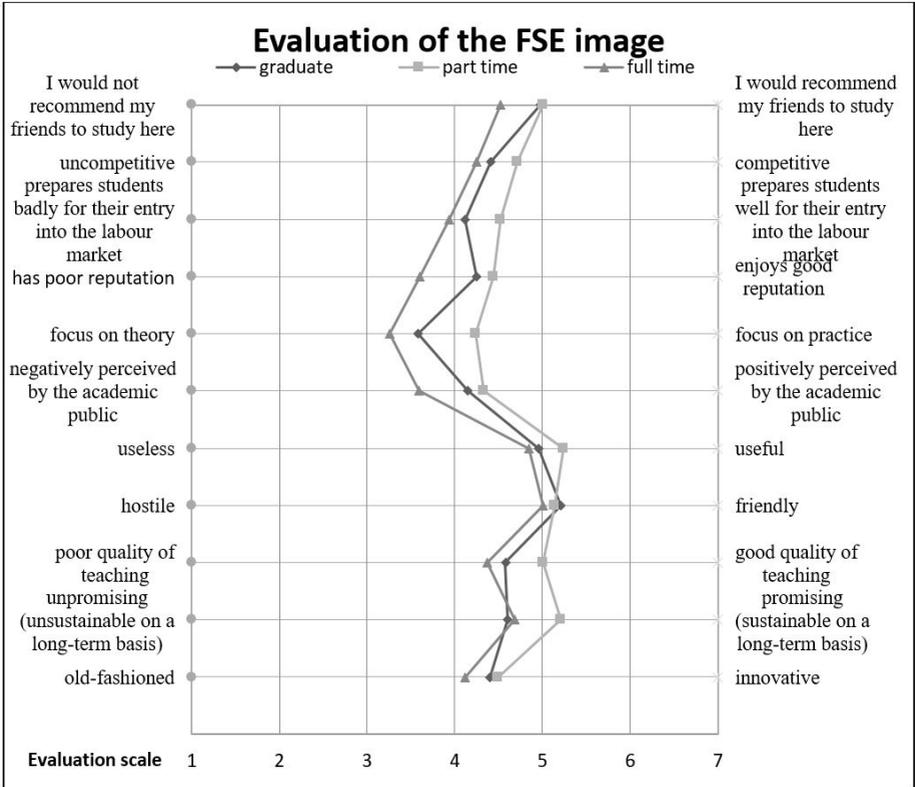
The concordance of evaluation of all three groups was established only in item 4, which looked into the hostile - friendly dimension. All groups marked FSE as more of a friendly faculty.

Question 4	full-time	part-time	alumni
	R:348.57	R:364.45	R:367.52
full-time		1.000000	1.000000
part-time	1.000000		1.000000
alumni	1.000000	1.000000	

Multiple Comparisons p values (2-tailed); Question 4: Kruskal-Wallis test: H =1.237127, p =0.5387

Table 3: Concordant evaluation of all groups – friendly faculty item (source: own calculation)

The full-time students gave the least positive ratings in all items. The strictest rating appeared in two items, i.e., 6 negatively – positively perceived by the academic public and 8 has a poor reputation - enjoys a good reputation. The part-time students and alumni show no differences in responses to these items and the rating is more optimistic than the rating by the full-time students.

Question 6	full-time	part-time	alumni
	R:320.78	R:411.56	R:393.38
full-time		0.000001	0.005043
part-time	0.000001		1.000000
alumni	0.005043	1.000000	

Multiple Comparisons p values (2-tailed); Question 6: Kruskal-Wallis test: H = 30.84218, p =0.0000

Question 8	full-time	part-time	alumni
	R:314.74	R:421.40	R:399.76
full-time		0.000000	0.000702
part-time	0.000000		1.000000
alumni	0.000702	1.000000	

Multiple Comparisons p values (2-tailed); Question 8: Kruskal-Wallis test: H = 42.51641, p =0.0000

Table 4: The least positively rated items by full-time students (source: own calculation)

The last group of items evaluated within this survey shows statistically significant differences between the rating given by the part-time students and that given by the full-time students and alumni, but there were no differences in the rating given by the alumni and that of the full-time students. The respective items were 2. unpromising (unsustainable on a long-term basis) - promising (sustainable on a long-term basis), 3 poor quality of teaching - good quality of teaching and 7 focus on theory - focus on practice.

Discussion

The university's image undoubtedly extensively influences potential students who get positive references from friends and family members. It was established that recommendations to study at a specific faculty from someone who the interested person likes is the most influential factor which creates the impression of the institution (Wilkinsand Huisman, 2015). Hence, it was important to include a bipolar item in the semantic differential to establish whether the respondents would recommend studying at the faculty to their friends or not. The established values around 5 (with a maximum positive value of 7) are a good result for the faculty. It is also positive that the rating given by the alumni is similar in this item as that given by full-time and part-time students.

As for the current students, it is important to monitor how they perceive the quality and value of the university because this is the foundation for the growth of loyalty (Rafik and Priyono, 2018). Interestingly, part-time students rated the faculty's image more positively than full-time students. The findings of Simsova and Reissova (2017) are in conformity with these findings.

Most universities strive to build and maintain a relationship with their alumni. Universities in some countries expect their alumni to be willing to support their alma mater in various forms, including financial support and gifts in kind (McAlexander, Koenig and DuFault, 2016; Gallo, 2018) after finishing their studies. The identified factors which mostly contribute to establishing such a relationship were the image, communication and satisfaction with the social and academic environment (Pedro, Pereira and Carrasqueira, 2018). Taking this into consideration, it was good to establish that all the items indicating satisfaction with the social and academic environment were positively evaluated in this survey (the faculty was evaluated as rather useful, friendly, promising, innovative and having good quality teaching). The rating given by the part-time students was also more positive in these items than the rating given by the full-time students and alumni.

Conclusion

A university's (faculty's) image undoubtedly plays an important role in relation to future and current students, as well as alumni. This survey looked into whether these groups of stakeholders

identically evaluate the image of the faculty where they study or studied. The evaluation of the image was established using a semantic differential. The semantic differential contained 11 items rated by students on a 7-point bipolar scale. It was established that the only concordance in the ratings of all three groups was in one item - friendliness of the faculty. All three groups rated the faculty positively, as more friendly in this item. It is an important finding because positive emotions, undoubtedly evoked by friendliness, play a key role in building positive relationships and loyalty.

It is interesting that full-time students evaluate the faculty more strictly in all items of the semantic differential than part-time students. The worst rating appeared in two items, i.e., evaluation of negative or positive perception of the school by the academic public and evaluation of the school's reputation. This finding is not quite ideal, however, despite the worst rated items in the whole semantic differential, the values are still in the average area.

Generally, the evaluation of the faculty's image is good. It evidently has its strong points on which the faculty can build in the future and it also identifies the areas with the potential to improve the image of the stakeholders.

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EMOTIONAL BURNOUT OF FEMALE TEACHERS AND THEIR COPING STRATEGIES

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Abstract

The paper focuses on the problem of professional burnout among female teachers and the impact of diverse factors on their burnout. The study aims to consider the coping mechanisms of teachers at different levels of burnout and the ways in which their experience and age are factored into their emotional well-being. Based on socio-demographic and psychological questionnaires, the study sampled 209 female teachers. The research pinpointed that as age as experience was inversely related to the indicators of emotional burnout. There were differences in the use of coping mechanisms by teachers with high and low levels of emotional burnout: the former more frequently used the ineffective strategies of "Avoidance", "Asocial action" and "Aggressive actions", while the latter often used the adaptive strategies of "Social joining", "Seeking social support" and "Assertive actions". The results will help to better understand burnout mechanisms and improve the effectiveness of burnout prevention programmes.

Keywords

Age, anxiety, coping strategies, depression, emotional burnout, experience.

Introduction

The term "emotional burnout" describes a psychological state for those who, within the framework of their profession, are obliged to be in very close emotional contact with other people. The so-called 'helping professions' are at risk, with health-care and social workers, teachers, as well as psychologists amongst the frontrunners in regularly affording assistance to other people in their care, with its attendant hazards. According to Maslach and Jackson (1981: 99) 'burnout is a syndrome of emotional exhaustion and cynicism that occurs frequently among individuals who do 'people-work' of some kind.' Three main components of burnout syndrome are emotional exhaustion, depersonalisation, and reduced personal accomplishment as it was identified by Maslach, Jackson and Leiter (1996).

Teacher burnout has been a major concern in psychology and received a great deal of attention from many researchers (Byrne, 1991; Lau, Yuen and Chan, 2005; Unterbrink et al., 2007; Bettini et al., 2017; Kamtsios and Lolis, 2016; Roohani and Dayeri, 2019; etc).

According to the study of Pinel-Martinez, Perez-Fuentes and Carrion-Martinez (2019), MBI "Maslach Burnout Inventory Manual" by Maslach and Jackson (1986) is the most applied medium in the study of burnout. Teachers that are burned out may experience one or more of the three components of this burnout syndrome (Maslach, 1999).

There have been studies to investigate the effects of personal characteristics on teacher burnout levels. According to Pinel-Martinez, Perez-Fuentes and Carrion-Martinez (2019) the Socio-

demographic variables were the most repeated among the publications being gender (91,43%), age (77,14%) and teaching experience (34,29%).

As it was revealed by Maslach, Schaufeli and Leiter (2001: 409), that 'age is the one of all the demographic variables that have been studied, that has been most consistently related to burnout'. Studies on teachers' age and working experience have indicated blended results. Some of the studies revealed age as an effective factor on burnout, especially on any emotion exhaustion component. Byrne (1991: 207) stated that 'burnout is a multidimensional construct, the facets of which are differentially affected by particular background variables; gender, age, and type of student taught are highly salient background variables associated with educator burnout'. According to this researcher, age appears to be a very differentiating variable with respect to the emotional emaciation component of burnout.

In some studies, young teachers showed significantly higher levels of emotional exhaustion than their older colleagues (Anderson and Iwanicki, 1984; Maslach and Jackson, 1981). Findings were less consistent for the other two dimensions of burnout. Maslach and Jackson (1981) found that younger teachers scored considerably higher on the depersonalisation, and lower on the personal accomplishment scales, Iwanicki and Schwab (1981) found no noticeable age differences in these dimensions for teachers. For the burnout dimension, the highest relationship was a positive correlation between depersonalisation and age, and there was a positive correlation between personal accomplishment and age (Sunbul, 2003).

Lau, Yuen, and Chan (2005: 491) also stated that 'teachers who were younger or without finishing their professional training and thus of junior rank were more consistently burned out'. Vodopyanova and Starchenkova (2008) considered that not only elderly people got burned out but also younger ones too. According to Maslach, Schaufeli and Leiter (2001: 409) among 'younger employees the level of burnout is reported to be higher than it is among those over 30 or 40 years old'.

There have also been findings showing no significance between age and burnout. So, Sadeghi and Khezrlou (2014) assume that only the level of teachers' education had a significant, moderate, and positive relationship with burnout from among the factors of age, gender, marital status, and level of teachers' education. Furthermore, it was shown that gender and age were not associated with burnout directly, however depressive symptoms and overcommitment had a substantive relationship with general burnout (Szigeti et al., 2017).

Although years on the job would appear to be an important variable in terms of burnout, research findings do not support this notion. In their studies of teachers, Anderson and Iwanicki (1984); Schwab and Iwanicki (1982) revealed no significant findings with respect to the emotional exhaustion and depersonalisation dimensions (cited in Byrne, 1991). On the other hand, Mo (1991) discovered that 'graduate teachers with less teaching experience, especially those with 5 years or below, showed higher levels of burnout in the emotional exhaustion dimension' as is indicated in the research of Lau, Yuen and Chan (2005: 494). Brunsting, Sreckovic and Lane (2014) updated the literature and reviewed the previous studies on burnout. They found that restricted teacher experience contributed to teacher burnout.

Tymbota et al. (2017: 63) manifested that 'the highest susceptibility to the influence of emotional burnout symptoms was in the age group up to 36.6 years, while the lowest susceptibility to the negative impact was found in the age group above 58.6 years'. This was explained by the phenomenon of emotional shock at the beginning of teaching profession.

On the other hand, Bertel and Weston (2010) state that the incidence of burnout is most prevalent among teachers who are half way through their teaching career, having between 7 and 12 years of experience (middle-aged teachers).

The research of Mousavy and Nimehchisalem (2014) proves that elderly teachers were perceptibly

more faded than their younger colleagues, regarding their depersonalisation and personal achievement mean scores. Brewer and Shapard (2004) also revealed that elderly teachers have higher burnout levels than younger ones.

Interesting results were obtained by Mukundan and Khandehroo (2016), concerning the influence from the factor of four different age groups (younger than 25, 26-35, 36-45, older than 46) on the three categories of the burnout. Teachers of the thirst three age groups encounted with emotional exhaustion, but older teachers did not have a rather high burnout due to this component. Depersonalisation was significantly higher among participants older than 25 whereas for the group of young teachers (younger than 25), it could not be fixed as indicatively higher. Teachers, younger than 25 and older than 45, were characterised by a significantly higher level of reduced personal accomplishment. On the other end, the age range between 26 and 45 confirmed that they did not indicate any substantial sign of dimished personal accomplishment.

It was reported that female staff showed higher emotional exhaustion than male colleagues (Maslach et al.,1996; Lackritz, 2004; Purvanova and Muros, 2010). The high level of emotional exhaustion in women-teachers also was registered by Martin (2000). There is some evidence to link between burnout with anxiety and depression (Schonfeld and Bianchi, 2016)

It is crucial to note that burnout is not an inevitable attribute of a 'helping' profession. Prevention and correction can significantly downsize the exposure of negative psychological factors (Jenaro, Flores and Arias, 2007). Clipa (2017: 125) states that 'there are efficient ways to trace the causes of teachers' stress, and that they have adequate ways of coping with it.

It was reckoned that if adequate coping strategies are developed, then the person will be able to work effectively for many years. Velikaya (2015: 38) highlights the need for 'teacher development and a demand for continuous professional development in a particular university context' as an momentous task.

In the study of Vodopyanova and Starchenkova (2008: 34-36), the group with a low level of burnout was characterised 'by the use of more "healthy" coping strategies: assertiveness, readiness for social contacts, and the search for social support'. Similarly, Vodopyanova and Starchenkova (2008) obtained inferring data that the teachers featured with a high level of burnout, marginally more often utilize their behavioural strategies as "avoidance" and "aggressive actions", and more rarely "search for social support, than their colleague**s**, having a low level.

Smetackova and Viktorova (2018: 336) noted that it is 'necessary to search for protective factors'. Based on previous research, they expected that teacher self-efficacy and positive coping strategies could be two of them. However, the mutual relationship between all three variables, burnout syndrome, self-efficacy and coping strategies, has not been deeply examined yet. The analysis supported the close relationship between burnout, self-efficacy and coping among Czech grammar school teachers. Also, a solid connection was detected between negative coping and burnout symptoms. Austin, Shah and Muncer (2005) outlined significant relationships between ways of coping and levels of distress, proving that technologies such as 'escape avoidance', 'accepting responsibility' and 'uncontrolled aggression' were used as negative coping strategies and the only one strategy, 'exercise', was indicated to be an effective way of coping.

Kamtsios and Lolis (2017) investigated the profiles of burnout in Greek school teachers. It was noted that teachers with high levels of depersonalisation and emotional exhaustion, and low levels of personal accomplishment used maladaptive coping strategies, while the teachers with lower levels of burnout used adaptive coping strategies to get problems sorted. Antisocial and passive strategies tended to be related to lower mastery of teachers. Active coping was related to lower emotional distress for men and women (Hobfoll et al., 1994).

In this paper, attention is focused on the problem of professional burnout among school teachers. Thus, the study aimed to re-examine the coping mechanisms and two socio-demographic factors

(age and years of working experience) for female teachers with varying degrees of severity of the burnout syndrome. The object of the study was emotional burnout with the subject of the study being the factors of emotional burnout in teachers, i.e. coping strategies, experience and age. To maintain or increase stress tolerance, the teacher needs to find and adequately use resources that help to overcome the negative effects of stressful situations. It is also crucial to find out how teachers overcome these stressful situations; what strategies they practise and their behavioural patterns for getting beyond of stresses. In addition, it is necessary to clarify what factors protect them against emotional burnout, and to determine whether experience and age influence the degree of burnout. At the moment, there is controversial data describing the influence of experience and age on the burnout phenomenon.

Two empirical hypotheses were formed. We assumed that indicators of emotional burnout, anxiety, and depression would correlate with the age and the length of teaching experience. It was also surmised that teachers at high and low levels of emotional burnout opt for different coping strategies. The following section liaises with the description of the Materials and Methods implemented in the scientific research. The 'Results' section evokes some data on teacher's burnout and its three components, the impact of age and the duration of their working experience on burnout components and also on anxiety and depression. After that the analysis of the teachers' coping strategies follows. The section entitled 'Discussions' describes the results and the section 'Conclusion' contains an assessment of the achieved results and suggests possible future directions of the work.

Materials and Methods

Participants

The study was conducted at a teachers' Internet forum devoted to the work of school teachers. 750 teachers took part in the work of the forum within a week. An announcement was placed on the Internet site asking for support in research. The participants were asked to complete surveys related to professional burnout of teachers. 226 teachers responded to our invitation to take part in the Internet survey. It should be noted that only a few male teachers (12) responded to the survey. Thus, they were not included in the experimental group. Neither were those respondents who received more than 14 points on the Social Desirability scale. The latter indicated some insincerity. As the study was conducted remotely, it allowed us to involve teachers from all over Russia, as well as from Kazakhstan, Belarus, and the Ukraine.

As a result, the sample covered 209 women-teachers. The work experience of the teachers started from 3 months to 35 years; age spans laid between 20 and 63 years.

Materials

The authors' demographic questionnaire contained questions on gender, age, working experience, marital status and family of the respondents. The MBI questionnaire on professional burnout for teachers and lecturers based on the three-factor model of Maslach and Jackson (1996) in adaptation (Vodopyanova, 2016) was applied. The questionnaire included 22 items divided into three subscales: Emotional Exhaustion (EE - 9 items), Depersonalisation (D - 5 items), and Reduced Personal Accomplishment (PA - 8 items). The items were measured on a 7-point Likert scale, ranging from 0 (never) to 6 (every day). Scores on the scales were added separately. It allowed us to determine the level of professional burnout. The Crowne-Marlowe Social Desirability Scale (CM-SDS) (Crowne and Marlowe, 1960) enabled us to assess the sincerity of the respondents. The hospital Anxiety and Depression Scale (HADS) (Zigmond and Snaith, 1983) was applied to evaluate the levels of anxiety and depression. The research also turned to the questionnaire of

coping strategies for stressful situations by Hobfoll et al., (1994), in adaptation by Vodopyanova (2016). For calculations of integral levels of burnout, we used the data from Table 1.

Subscale	Group	Low level of burnout	Moderate level of burnout	High level of burnout	Very high level of burnout
Points of the scale		1 point	2 points	3 points	5 points
Emotional exhaustion	Men	5-15	16-24	25-34	More than 34
	Women	6-16	17-25	26-34	More than 34
Depersonalisation	Men	2-4	5-12	13-15	More than 15
	Women	1-4	5-10	11-13	More than 14
Reduced personal accomplishment	Men	37-48	34-28	27-23	22 and less
	Women	37-48	35-28	27-22	21 and less

Table 1: The calculation of integral level of burnout (source: Vodopyanova, 2016)

The integral burnout indicators were chosen from the Table 2.

Low level of Burnout	Moderate level of Burnout	High level of burnout	Very high level of burnout
3-4 points	5-6 points	7-9 points	10 points

Table 2: The integral burnout indicators (source: Vodopyanova, 2016)

Instruments

To analyse the differences in coping strategies and clinical indicators in the groups, the H-test of Kruskal-Wallis and the Mann-Whitney test were deployed. To analyse the relationship of age and experience with coping strategies and clinical indicators, the Mann-Whitney criterion and the Spearman rank correlation criterion were applied. The obtained results were processed using the SPSS statistical software package for Windows.

Procedure

At the outset of the study, the survey was carried out remotely in 2018. The teachers, participating in Russian teachers' forums, were invited to take part in the research. They were asked to answer the questions of four surveys and fill in a questionnaire. All participants were informed about the objectives of the research and participated willingly.

The demographic information about the teachers was provided by a demographic questionnaire. After that the participants were requested to answer the questions of The Crowne-Marlowe Social Desirability Scale, The MBI questionnaire, The hospital Anxiety and Depression Scale (HADS) and the questionnaire of coping strategies for stressful situations by Hobfoll et al., (1994), in an adaptation by Vodopyanova. Those respondents who received more than 14 points on the Social Desirability scale were not included into the experimental group. The latter indicated some insincerity. For the interpretation of individual results, tables of test norms were implemented. Based on the analysis of the test results on the burnout questionnaire, 3 groups of respondents were formed, with different levels of their development of burnout – i.e. very high, high, and medium. Then these three groups were compared by following the parameters of the surveys used.

RESULTS

The first experimental subgroup embraced female teachers, amounting to 103 people, with indicators of an extremely high level of emotional burnout (10 points or more), accounting for 49% of the total sample. The second subgroup included female teachers with a high level of burnout (7 – 9 points), working out at 74 participants, or 36% of the total sample. The third subgroup comprises female teachers with a moderate level of burnout (5-6 points), they numbered 32 people, or 15% of the total sample. None of the respondents showed a low level of burnout.

The results (See Table 3) highlight that school teachers had symptoms of burnout. Some female teachers had very high rates of the components of this syndrome. This means that they are at risk.

	The components of burnout syndrome		
	Emotional exhaustion	Depersonalisation	Reduced Personal accomplishment
Moderate level of burnout	1.9	2.3	1.3
High level of burnout	2.5	4.2	1.4
Very high level of burnout	4.1	5	2

Table 3: The average indicator values of burnout for the three groups of teachers, 2019 (source: own calculation)

The leading factor affecting the overall burnout is depersonalisation - 5,0. That implies high emotional dismissal and indifference. It is peculiar to groups with high and very high levels of burnout. They teach formally, without joining the process and not empathising with the students. This can manifest itself as a cynical attitude towards children. The group with a very high level of burnout is also characterised by strong emotional exhaustion - 4,1. They are not interested in working, they do not have positive feedback from teaching, and they are oppressed by general dissatisfaction with life in general. Interestingly, the degree of satisfaction of a pedagogical worker as an individual and as a professional varies insignificantly (Reduced Personal Accomplishment). The characteristics of groups according to their level of burnout is presented in Table 4.

Burning out level	Moderate	High	Very high
Number of examinees:	32 (15%)	74 (36%)	103 (49%)
Middle age:	39.6	36.5	31.8
From 20 to 30 (N = 95)	25%	38%	57%
From 31 to 40 (N = 48)	31%	23%	20%
From 41 to 50 (N = 50)	31%	28%	20%
From 51 and above (N = 14)	13%	11%	3%
Average working experience:	15.6	14.2	9.4
From 0 to 6	22%	28%	48%
From 6 to 10	19%	23%	18%
From 10 to 15	13%	7%	12%
From 16 and above	46%	42%	22%

Table 4: The characteristics of groups according to their level of burnout, 2019 (source: own calculation)

The result revealing the relationship of age and experience with indicators of emotional burnout is presented in Table 5 according to Spearman rank correlation criterion.

	Age	Experience
Experience	0.909 **	1
Emotional exhaustion	- 0.062	- 0.042
Depersonalization	- 0.215 **	- 0.187 **
Personal accomplishment	0.266 **	0.291 **
Anxiety	- 0.036	- 0.049
Depression	- 0.076	- 0.054

** Correlation is significant at a significance level of 0.01.

Table 5: The relationship of age and experience with indicators of emotional burnout, 2019 (source: own calculation)

From Table 5 one can see that the experience correlated with age at a significance level of 0.01. However, the high correlation between the age and the length of experiences is logical and predictable. We also see that as the length of service and age increase, the general indicator on the scales of depersonalisation decreases and the indicators on the scale of professional success grow. That is, the older the teacher is, the more successful they feel. No relationship between anxiety and depression with age or experience was identified.

The results of comparison of the groups with moderate and very high levels of burnout according to the H-test of Kruskal-Wallis and the Mann-Whitney criterion are reflected in Table 6.

	The moderate level of emotional burnout N = 32 M (SD)	Very high level of emotional burnout N = 103 M (SD)	The Mann-Whitney criterion (2-sided)
Assertive actions	16.58 (3.03)	15.28 (3.37)	0.034 *
Social Joining	25.14 (3.14)	21.87 (4.49)	0 **
Seeking social support	26.47 (2.86)	23.91 (3.96)	0.001 **
Cautious action	20.05 (3.53)	20.57 (4.22)	0.719
Instinctive action	16.73 (3.6)	17.51 (3.66)	0.285
Avoidance	16.73 (4.31)	19.33 (4.35)	0.003 **
Indirect actions	17.55 (4.12)	18.73 (4.28)	0.192
Antisocial action	12.85 (3.43)	15.4 (5.56)	0.025 **
Aggressive actions	16.5 (4.09)	19.94 (5.44)	0.001 **

M (SD) - mean (standard deviation)
* differences are significant, p <0.05
** differences are significant, p <0.01

Table 6: Comparison of the groups with moderate and very high levels of burnout, 2019 (source: own calculation)

It can be seen from Table 6 that there are significant (p <0.01) differences between groups with a moderate burnout level and a very high burnout level. In the moderate-level group strategies such as "Social joining", "Seeking social support", "assertive actions" are more often activated. While "Avoidance", "Antisocial action", and "Aggressive actions" strategies are more typical of the group with very high level of burnout.

Discussion

The specificity of our sample was determined by the fact that there were a lot of female teachers with high and very high burnout levels and there were no low levels at all. The limitations of the study should be considered, because the teachers with a higher level of burn out syndrome were probably more reluctant to respond to the questionnaire. The leading factor affecting the overall burnout is depersonalisation - 5,0 and strong emotional exhaustion - 4,1. The result partly supports the previous research findings by Maslach et. al. (1996), Lackritz (2004), Purvanova and Muros (2010) and Martin (2000) about the high level of emotional exhaustion in female teachers. But in our research the female teachers were characterised by a high level of depersonalisation in the first place.

During the study, the first hypothesis that indicators of emotional burnout, anxiety, and depression would increase with the age and the length of teaching experience was confirmed to be the opposite. The result was consistent with that of the previous research findings by Anderson and Iwanicki, 1984; Maslach and Jackson, 1981; Mo, 1991; Lau, Yuen and Chan, 2005; Brunsting, Sreckovic and Lane, 2014.

As teachers age and teaching experience accrued, indicators of professional burnout, anxiety and

depression did not increase in our research. So, we obtained the results: as the length of service and age outgrown, the burnout symptoms on the depersonalisation scale became less pronounced, and the indicator on the scale of professional success increased. Our results are consistent with that of Sumbul (2003), that professional accomplishment correlated positively with age, but our result was different concerning the connection of depersonalisation and age.

Regarding emotional fatigue our results were consistent with the results of Mukundan and Khandehroo (2016), that elderly women teachers suffered less emotional exhaustion. Nevertheless, our results on depersonalisation were opposite to the results of their research. Our results were partly similar to their findings on the connection of personal accomplishment and age. We also reckon that female teachers of the age group from 26-45 (middle aged teachers) were more successful than younger teachers. Also, our research did not denote the reduction of personal accomplishment after the age of 45, but the quantity of the teachers of the oldest group who participate in our research was not extensive enough to validate our final results.

Nevertheless, our results are totally opposed to the results of Mousavy and Nimehchisalem (2014). In their research elderly teachers demonstrated higher levels of depersonalisation and lower levels of personal accomplishment than younger teachers, that is interpreted as that older teachers felt themselves vastly more burned out than their younger colleagues. It can be explained by the specific target group of their research (English teachers in Malaysia).

We witness that a very high level of burnout is typical for young female teachers. This may be due to dissatisfaction with work and unjustified expectations. Teachers encounter with substantial levels of stress and, unable to adequately overcome them, correspondingly very quickly burn out. Most likely, some teachers simply leave the profession due to their inability to run their workflow. Therefore, the group with an average level of burnout is much older. Their average age is 39.6. These are people who have learned to respond constructively to stress. The analysis also showed that the level of anxiety and depression among teachers varied depending on the degree of professional burnout. As teachers dwindle, their anxiety and depression rates increased. That corresponds with the results of (Schonfeld and Bianchi, 2016). The length of service and age according to our research did not correlate with anxiety and depression at all.

It is crucial to note that our sample was still specific. Recruitment was conducted via the Internet. This made it possible to reach teachers from distant regions, but the older group of teachers, turned out to be much less involved than younger people. Therefore, it is relevant to continue the study and engage teachers of older age and being more experienced.

The second hypothesis that there is distinction in the use of coping strategies by women-teachers with high and low levels of emotional burnout has been confirmed. Given the absence of low-burnout groups in our sample, we compared the groups with medium, high, and very high burnout levels. As a result of a comparative analysis, differences between groups with medium and very high levels of burnout were identified with the following coping strategies: "Assertive Actions", "Social Joining" and "Seeking Social Support", "Avoidance", "Asocial Actions" "Aggressive Actions". In the group with a moderate level of burnout, coping strategies were more pronounced: "Assertive Actions", "Entering into Social Contact" and "Search for Social Support". And in the group with a very high level of burnout, the following strategies were more pronounced: "Avoidance", "Asocial Actions", "Aggressive Actions". All differentiations were confirmed at a significance level of 0.01. The group with a high level of burnout took the middle place between the two groups mentioned above. Our result is consistent with that of Hobfoll et al. (1994).

It was revealed that as the emotional exhaustion accrues, the severity of non-constructive coping models, such as "Avoidance", "Aggressive Actions" and "Cautious Actions", increases. The assertive actions use, grounded onconstructive behaviour pattern, was also reduced. As the depersonalisation rate intensified, the involvement of non-constructive models, such as

"Avoidance", "Indirect Actions", "Asocial Actions", "Aggressive Actions" and "Impulsive Actions", increased. At the same time, the exploitation of constructive prosocial behaviour patterns decreased: "Entering into Social Contact" and "Search for Social Support". As the sense of professional unsuccessfulness escalated, the frequency of using constructive strategies "Entering into Social Contact", "Search for Social Support" and "Assertive Actions" downshifted. And the frequency of unproductive models exploited such as "Avoidance" and "Aggressive Actions" increased. These data were similar to the results obtained within other studies (Clipa, 2017; Smetackova and Viktorova, 2018; Vodopyanova and Starchenkova, 2008; Austin, Shah and Muncer, 2005; Kamtsios, 2017).

We acquired similar data in this study. Strategies of avoidance and aggressive actions were not constructive for teachers. The first strategy did not allow effective solutions to the professional difficulties arising. It failed to establish pedagogically expedient relations with students and colleagues, which led to an upgrowth in the level of psychological stress and a risk of burnout. Aggressive behaviour did not contribute to the productive solution of professional concerns. This behaviour adversely affected the overall atmosphere in the team. It is possible that the frequent involvement of the strategy of "Aggressive Actions" was a compensatory mechanism, with teachers at a high level of burnout. In this way, they tried to compensate for an adverse emotional state, as well as negative attitudes towards work.

In the course of the study, scientists came to the conclusion that "healthy" coping represents such behaviours that contribute to the preservation of health and successful (constructive) coping with professionally complicated situations. Such constructive models as active prosocial behaviour can effectively withstand stress and prevent burnout of specialists. At the same time, non-constructive behaviours such as antisocial and passive actions may also lead to burnout. However, the question remains what in this model the cause is and what the consequences are. Do non-constructive models lead to burnout? Or is this behaviour a result of burnout? To clarify the issue, it is necessary to conduct additional research. Moreover, the established link between burnout and the use of non-adaptive strategies can be of practical use. Perhaps, informing teachers of adaptive strategies and learning how to use them in training can reduce the risk of burnout.

Conclusion

An inverse relationship was found between age, experience and burnout symptoms. In the studied sample, the symptoms of burnout were most pronounced among women-teachers from 20 to 30 years of age. No relationship between anxiety and depression with age or experience was detected. The study revealed conspicuous differences in the coping strategies utilizing among groups with different levels of burnout. The group with a very high level of burnout was characterised by the application of non-adaptive (passive, asocial and aggressive coping strategies) and the rare use of adaptive assertive and prosocial coping strategies, in particular, the search for social support. The symptoms of burnout were associated with various coping strategies. Adaptive strategies were directly related to professional success and back to burnout factors such as exhaustion and depersonalisation. Non-adaptive coping strategies (aggressive actions, antisocial actions, avoidance, impulsive actions, indirect actions) had one or two direct links with burnout factors and an inverse link with professional success.

It is substantial to develop psycho-prophylactic measures that could shrink the risk of burnout and neutralise its negative consequences for teachers at the outset of their professional activities. One of the important components of burnout syndrome prevention was the correction of non-adaptive behavioural strategies and the formation of adaptive coping strategies with professional stresses, which embrace confident behaviour and social interaction skills. It is important to increase the sample size of teachers over 50 years of age, because for a more aged group, prolonged stress

factors may stimulate and one may also expect emotional burnout, which will require other preventive recommendations.

It is also impossible to ignore the fact that over the past 20 years new sources of stress have emerged in the teacher's work, which could only but adversely affect the new aspects of the problem of emotional burnout. The practical implications of this study lay within the following concepts. First, the teachers' inclined to understanding that coping mechanisms can help straight out the effectiveness of burnout prevention programmes aimed at increasing the adaptive capacity of teachers; second, teachers develop productive coping strategies that adequately meet the challenges of the profession.

The results can be used by social psychologists, school psychologists and educational psychologists for the prevention and correction of emotional burnout of teachers.

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ENHANCING ATTRACTIVENESS OF SECONDARY AGRICULTURAL EDUCATION IN THE CZECHIA

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Abstract

Introducing innovative teaching methods at agricultural high schools is linked to enhancing their attractiveness for students. The article aims to contribute to addressing this issue. Its framework is the discourse on the knowledge society. Students, who at the same time educate other people, presented their suggestions and ideas about inspired teaching in a questionnaire survey, including lifelong and community education at agricultural high schools. In particular, they emphasized the introduction of new trends and topics that are related not only to agricultural but also to other activities in the management of natural resources. They singled out teaching using practical and activation methods. They considered lifelong and community education in the framework of agricultural high schools as a possibility and as beneficial. The findings will be used in a follow-up qualitative research with the aim to deepen the knowledge of the given subject.

Keywords

The agricultural education, innovations, knowledge society, lifelong learning, school community function

Introduction

Two streams are apparent in the discourse about the knowledge society. The first one can be called rationally optimistic and its main representatives are the authors from the initial periods of the said discourse (Blau and Duncan, 1967, Bell, 1973). Their optimism incorporates the belief that knowledge will push ideological and political prejudices away from the development of society, thus freeing the way for technology as the main factor of economic development. Authors, who also included the social dimension in the development, problematized this point of view. They introduced a different view stating that access to higher levels of education does not necessarily result in a reduction of social inequality (Boudon, 1973, Bowles and Gintis, 1976). They incorporated broader social and cultural environment in the relationship between education and the ability to utilize it (Willis, 1977, Goleman, 1996). At the same time, a group of critics formed in the second stream, pointing out to the functioning of schools as organizations supporting the existing order in society, and thus also the reproduction of inequalities (Bourdieu and Passeron, 1970, Illich, 1973). The critique of education systems in contemporary society has consequently been established. It focuses primarily on the concepts and processes of devaluation, commercialization and market orientation of education (Lohmann and Rilling, 2002). The critical stream culminates in P. K. Liessmann's "Theory of Miseducation" (Liessmann, 2009).

The abovementioned discourse about education society reflects general trends in the development of contemporary society, connected with the globalized economy, troubles the welfare state is

facing, shifts in the nature of labour and conditions on the labour market caused by computerization, stagnation and so-called loosening of the middle class. Due to these and other changes, education has lost the ability to ensure a good job and career. The phenomenon of education, deprived of this former advantage, is trying hard to establish its "utility value". However, we cannot altogether give up on high quality education and the increase in the number of educated people. The subject matter of this paper falls within these issues.

European agriculture is currently facing a number of challenges. Whether it is using up-to-date knowledge and technology, or solving the impact of climate change, it is evident that farming practices will increasingly need to be developed at all levels by appropriately educated professionals who will be able to reflect current development. On the other hand, it is necessary to see that agriculture is currently not a prestigious and sought-after profession. That is why raising the attractiveness of secondary education should be a societal priority, as it ultimately affects strategic objectives such as food security and self-sufficiency or sustainable economic growth. The need to put an accent on new approaches leading to sustainable farming results from several recent studies e.g. The Sustainability in European Agricultural firms (Dos-Santos and Mota 2018).

On a practical level, countries with high number of university students among their population are usually considered education societies. In this respect, the Czech Republic falls behind other European countries. If we take the whole educational structure as an indicator, though, the Czech Republic will move to a better position as it only has a very low number of people with only basic education and one of the highest shares of secondary school students compared to other European countries. In 2014, the percentage of people with the level of education ISCED 0-2 was 6.9%, with the level of education ISCED 3-4 it was 71.1% and with the level of education of ISCED 5-8 it was 22%. For comparison, the average values for EU countries are for ISCED 0-2: 23.6%; ISCED 3-4: 46.4%; and ISCED 5-8: 30%[1] (Eurostat, Population and Social Conditions 2015, 2019).

Compared to OECD countries, the Czech Republic spends a smaller share of the GDP on education (4.4% vs. 5.3% – the average in OECD countries) and of total government spending (8.9% vs. 11.6% – the average in OECD countries). As far as unemployment rates by education level are concerned, the Czech Republic ranks among countries with the most favourable results. At the same time, teachers' salaries at different levels of education are monitored and compared to average wages of workers with similar education as teachers. In this respect, the Czech Republic shows results that indicate that the country does not appreciate the teaching profession appropriately (MŠMT, České školství v mezinárodním srovnání 2015, 2019).

In the framework of the discourse on contemporary education at theoretical and practical levels, lifelong learning is also a fundamental point. This is true for P. K. Liessmann as a representative of theoreticians as well as for the so-called Bologna Process. It can also be found in the national strategic papers on education and education policy, like the Strategy of Educational Policy of the Czech Republic till 2020 and Long-Term Plan for Education and Education System Development of the Czech Republic 2015-2020 (MŠMT, Strategie vzdělávací politiky České republiky do roku 2020, 2019; MŠMT, Dlouhodobý záměr vzdělávání a rozvoje vzdělávací soustavy České republiky, 2019). For this reason, the article also focuses on lifelong learning.

The 2015-2020 Long-term Plan for Education and Education System Development of the Czech Republic 2012-2020 could be an opportunity for schools to re-establish their role as important

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[1]   According to ISCED 2011, a standard classification of education, ISCED 1-2 corresponds to basic level of education (i.e. primary and lower secondary education), 3-4 corresponds to higher secondary and post-secondary education, which in the Czech Republic means earning a maturita degree or a certificate of apprenticeship, and the 3rd ISCED group 5-8 comprises tertiary education (in the Czech Republic this also includes higher vocational schools).

actors. The traditional existence "brick and mortar" schools provides them with an opportunity to become a central place of so-called community-based learning in various forms and segments of educational activities, including lifelong learning programs (MŠMT, Dlouhodobý záměr vzdělávání a rozvoje vzdělávací soustavy České republiky, 2019).

The article limits its scope to secondary education and specifically to secondary agricultural education in the Czech Republic. These processes are framed by the topic of so-called education for sustainable development. Its aim is to provide information that systematically supports the planned realization of the main research event as part of the empirical part of a PhD thesis focused on the process of decentralization, optimization and improvement of secondary agricultural education in the Czech Republic. Expert interviews will make use of the findings about the possible enhancement of the attractiveness of secondary agricultural education. Attitudes, suggestions and recommendations from the representatives of "informed public opinion" will be compared to attitudes, suggestions and recommendations of experts, who will be able to look at them through the lens of their possible realization in relation to the conditions and needs of an institutional solution.

The secondary objective was to assess the findings about Teaching of Practical Subjects (hereinafter as UPV) and Teaching of Specialized Subjects (hereinafter as UOP) students at IVP at the Czech University of Life Sciences Prague, which may contribute to the improvement of how these fields of study are taught, with respect to the fact that these fields of study fall into the Specialization in Pedagogy group, but are taught at an agricultural university

Materials and Methods

The material that was gathered and processed for the purpose of this article forms a basis of a contribution aimed to re-establish the prestigious position of secondary schools that specialize in agricultural education in the above-mentioned context. According to the Registry of Schools and Educational Facilities, there are 185 schools and educational facilities in the Czech Republic that offer disciplines from the group of specializations No. 41, Agriculture and Forestry (MŠMT, Rejstřík škol a školských zařízení, 2019).

The data for this article were collected by means of a questionnaire survey. The questionnaire research was focused on gathering attitudes, suggestions for solutions and recommendations aimed at increasing the attractiveness of secondary agricultural education. The specific research sample consists of people who have a stake in the subject matter of the study UPV and UOP in part-time form of study at the Institute of Education and Communication (hereinafter as IVP) at the Czech University of Life Sciences Prague. These people are self-educated and at the same time have certain experience in educating others and follow public affairs concerning education and schools. A total of 141 questionnaires were distributed between 17 March and 22 April 2018 to 104 UPV students and 37 UOP students.

The data obtained from the questionnaire survey were processed by statistical methods of the 1st degree (absolute and relative frequency) and of the 2nd degree (contingency tables comparing subsamples of respondents UPV and UOP). Descriptive characteristics of the mean and the median were observed for cardinal characteristics. More complex statistical procedures were not used for two reasons. Firstly, the research sample is not very large and secondly, the results of the questionnaire survey are not supposed to be used for verification of hypotheses, but as an inspiration for the follow-up expert interviews that will study the subject matter in depth.

Results and Discussion

The results were divided into following sections – sample description, evaluation of SZeŠ position, recommendations to enhance SZeŠ attractiveness, attitudes and ideas about providing lifelong education at SZeŠ and the role of SZeŠ as a community centre.

Sample description

Profession	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
Teacher	45	43.3	13	35.1	58	41.1
Other	59	56.7	24	64.9	83	58.9
Total	104	100.0	37	100.0	141	100.0

Table 1: Respondents' professions

The share of pedagogical and non-pedagogical staff in the sample is not even, with employees in fields other than education dominating the sample. Students of teaching disciplines at IVP are often people who look for obtaining a university degree, regardless of the field of study, however they have their own experience with educating others. Most respondents (78.1%) have experience with educating other people; 62.5% of them at secondary schools.

Evaluation of agricultural disciplines among other fields of study indicating better and worse position

Position	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
Same	77	74.0	17	45.9	94	66.7
Worse	27	26.0	20	54.1	47	33.3
Better	0	0.0	0	0.0	0	0.0
Total	104	100.0	37	100.0	141	100.0

Table 2: Position of SZeŠ among other secondary schools

Most respondents agree that the position of SZeŠ (Agricultural High Schools) is the same compared to other secondary schools. No respondents claimed it was better.

Recommendations to enhance attractiveness of SZeŠ

A big part of respondents in this area replied "I don't know". This is in line with the result of low respondents´ experience with this secondary school specialization. Table 3 includes answers of respondents who have given some recommendations.

From the content of lessons, respondents often suggested attractiveness could be enhanced by following new trends (mainly using the latest technological findings) and topics (most often organic farming, floristry, fishkeeping) and better connection to practice. Respondents would welcome the use of more practical methods, such as methods that lead to acquiring skills (demonstration and observation, instruction, manipulation, laboratory work, experiments) and activation methods such as heuristic, discussion, stage and didactics games. The respondents believe that it would be helpful if classrooms were better equipped (they mentioned mostly equipment for an interactive teaching) and if schools had more equipment for practical lessons such as well-equipped specialized facilities (laboratories, workshops, school farms and plots or contract with companies for practical lessons.

The teacher as educator should be able to interconnect lessons with practice, organize more field trips and improve continuously his or her knowledge and skills. The role of a teacher includes also creating values and norm, in this respect, an interest about students in the time out of teaching is required by respondents (extracurricular activities, field trips). Another requirement is a better teacher´s communication with students and their motivation. All these recommendations can be meet just by qualified teaching staff. There is evident that an importance of teachers' education and training will be increasing.

Recommendation	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
Content of lessons	50	100.0	26	100.0	76	100.0
New trends, topics	22	44.0	13	50.0	35	46.0
Better connection to practice	12	24.0	10	38.5	22	28.9
Other	13	26.0	3	11.5	16	21.7
No need to change anything	3	6.0	0	0.0	3	3.9
Teaching methods	46	100.0	28	100.0	74	100.0
More practical methods	24	52.2	15	53.6	39	52.7
More activation methods	20	43.5	13	46.4	33	44.6
No need to change anything	2	4.3	0	0.0	2	2.7
Teaching conditions	51	100.0	24	100.0	75	100.0
Better equipped classrooms	30	58.8	10	41.7	40	53.3
Better equipment for practical lessons	7	13.7	7	29.2	14	18.7
New textbooks, materials	6	11.8	5	20.8	11	14.7
No need to change anything	8	15.7	2	8.3	10	13.3
Work of teachers as educators	53	100.0	27	100.0	80	100.0
Connect lessons and practice	33	62.3	15	55.5	48	60.0
Continuous education	17	32.1	2	7.4	19	23.7
Organize excursions, internships	0	0.0	5	18.5	5	6.2
Use specialists from practice	0	0.0	5	18.5	5	6.2
No need to change anything	3	5.6	0	0.0	3	3.7
Work of teachers as instructors	43	100.0	21	100.0	64	100.0
Out-of-school activities (trips)	27	62.8	7	33.3	34	53.1
Organize excursions	7	16.3	4	19.0	11	17.2
Better motivation of students	6	13.9	5	23.7	11	17.2
Other	3	7.0	5	23.7	8	12.5

Table 3: Recommendations to enhance attractiveness of SZeŠ

Post-secondary agricultural education programs should examine their role in providing researched-based professional development events that reengage teachers in the profession and influence implementation of work-life balance strategies (Crutchfield, Ritz and Burris, 2013: 10). Some authors also note that persistent stereotypes concerning teachers´ motivation provide negative images that do little to attract and retain teachers (Watt, Richardson, 2012). This just confirms that an attractiveness of SZeŠ cannot be enhanced without an accent on quality teaching staff. Enabling teacher to continue to grow, learn and be excited about their work depends on both ongoing high-quality learning opportunities and career opportunities that enable them to share their expertise in a variety of ways (Darling-Hammond, 2017).

Attitudes and suggestions for realization of lifelong learning at SZeŠ and their role as community centres

On a 7-point scale (1 = very important, 7 = totally unimportant), respondents assessed whether SZeŠ should be involved in lifelong learning, which is gaining momentum. Respondents' answers make it clear that the prevailing opinion is that lifelong learning is of importance.

In the context of lifelong learning, respondents most often recommend that SZeŠ should present new trends in agriculture and food industry. Respondents recommend also cooperation with local agricultural enterprises, environmental or other relevant organisations. There is evident, modern and professional training within lifelong learning is desired. However modern and professional adult training must be based on modern methods improving organizational and individual

performance creative ability and motivating staff (Dimitrescu, Sarbu and Lacroix, 2015).

Students in both subsamples support the claim that SZeS should take over the role of community centres (mean 1,7; median 2,0). Similar findings are reached by Husák and Hudečková (2016), who accent an importance to determine a main actor to cooperate with local actors and coordinate all participants in education in local municipalities.

Activities	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
Presentation of new trends	18	27.7	1	4.0	19	21.1
Organizing visits to farms	8	12.3	9	36.0	17	18.9
Offering part-time study programmes	10	15.4	3	12.0	13	14.4
Passing findings from practice	12	18.4	0	0.0	12	13.3
Courses of farming and breeding of animals	6	9.2	4	16.0	10	11.1
Presentation of environmental topics	5	7.7	2	8.0	7	7.8
Organization of foreign stays, courses	2	3.1	3	12.0	5	5.6
Extending qualification, driving lessons	4	6.2	0	0.0	4	4.4
Other	0	0.0	3	12.0	3	3.3
Total	65	100.0	25	100.0	141	100.0

Table 4: Possible activities at SZeŠ in the framework of lifelong learning

Activities	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
Organizing courses linked to nature, agriculture	29	41.4	16	48.5	45	43.7
Sports and cultural events at the school premises	29	41.4	12	36.4	41	39.8
Working in the garden, weekend workshops	2	2.8	3	9.1	5	4.9
Organizing camps, trips	4	5.7	0	0.0	4	3.9
Organizing farmers markets	3	4.3	0	0.0	3	2.9
Other	3	4.3	2	6.1	5	4.9
Total	70	100.0	33	100.0	141	100.0

Table 5: Possible activities for SZeŠ as community centres

Suggestions for possible SZeŠ activities as community centres often included the idea that schools could act as organizers of courses related to the particular field of study, which was emphasized by UOP students, while UPV students more often hinted at the possibility of providing space for various sports and cultural activities for the public, which are activities not related to the school's specialization.

Possible activities for SZEŠ	UPV		UOP		Total	
	abs.	rel.	abs.	rel.	abs.	rel.
In the framework of lifelong learning	39	37.5	12	32.4	51	36.2
In cooperation with other organizations	37	35.6	6	16.2	43	30.5
As community centres	34	32.7	4	10.8	38	27.0

Table 6: Comparison of the frequency of neutral answers concerning possible activities or SZeŠ in the framework of lifelong learning and as community centres

Also in case of evaluation of new roles discussed and the co-operation of SZeŠ with other types of organizations, UPV students are considerably more clueless in all three of the observed areas. When compared to UOP students, the smallest difference was observed in the area for which the highest support was expressed, i.e. adopting an active role on the part of SZeŠ in providing lifelong learning.

Conclusion

The results of the survey detected recommendations and ideas, which have a potential to enhance an attractiveness of secondary education. In teaching those subjects (practical part and training part of lessons), topics related to nature and its management as an environment where people live (agriculture oriented towards careful handling of natural resources, production of healthy food, floristry, fishkeeping, zoo therapy, activities related to keeping pets, etc.) should be given a more central position. Processing these topics should be more oriented towards the use of practical and activation methods. This requires building a partnership of secondary schools with representatives of business and relevant organizations. Survey result make it clear that the lifelong learning is perceived as very important for secondary agricultural schools as well as their role of community centres.

Expert interviews with secondary school managements will be deeper performed with regard to findings about the possible enhancement of the attractiveness of secondary agricultural education. Attitudes, suggestions and recommendations from students will be compared with, attitudes, suggestions and recommendations of experts, who will be able to look at them through the lens of their possible realization in relation to the conditions and needs of an institutional solution. Such interviews will take place at secondary schools, where the agricultural education prevails or is equal to other teaching programmes.

A possibility to improve the position of secondary school, including agriculture ones, could consist in a replacement of the existing school funding system based on national norms, which determines the average student expenditure per unit (student). This financing method favors schools with a higher number of students. Schools thus accept students who do not have the prerequisites to study or the motivation, just to secure their funding. The change in funding should guarantee financial resources based on the number of classes taught by the curriculum, starting in January 2020. In such case, school directors will not have to persuade students with no interest in studies, which could increase the quality level of secondary schools. Similar needs has been defined also in Slovakia. Zaťková and Ambrozy (2019) point out that the Slovak education system is still substantially based on the Czechoslovak system as established by a fundamental reform from the 1970s. Changes in teaching methods and introduction of new topics will be better implemented in such schools where students are highly motivated, with a real interest in education.

Acknowledgements

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GENDER PAY GAP AMONG UNIVERSITY STUDENTS AND GRADUATES: THE COMPARISON OF THE EXPECTATIONS AND THE REALITY

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Abstract

The differences in the remunerations of women and men called gender pay gap present thoroughly discussed topic across countries. European Commission, International Labour Organization, individual countries or researchers pay attention to this topic and discuss it thoroughly. The gender pay gap in the Czech Republic reaches 22%. This indicator reflects the overall gender pay gap. The aim of this paper is a closer look into the expectations and then the reality among a specific group of inhabitants, namely university students and graduates. The analysis is based on the data of two surveys – EUROSTUDENT and REFLEX. The results show that the gender pay gap is present in expectations and reality. The highest difference between the expectations and the reality is reached among students and graduates in Technical study field (16.5 percentage points).

Keywords

EUROSTUDENT, gender pay gap, graduates, REFLEX, university students

Introduction

The inequality among women and men presents quite modern topic in developed countries. The effort to equalize the remuneration and employment forces countries and organizations to prepare thorough analyses and acts trying to minimize these differences. To support importance of this topic European Commission published Action Plan on Tackling the Gender Pay Gap (EC, 2017) and another international organization – OECD prepared material helping to analyse and to support the topic with relevant data 'Closing the Gender Gap: Act Now' (OECD, 2012). The gender pay gap is also significant in the Czech Republic. Thus, the Ministry of Social Affairs published the study called '22% to the equality' (MoSA, 2019). Apart from materials of international organizations where the gender pay gap is presented also many other research studies focus to this phenomenon. For example, Kreckova Kroupova and Rezankova (2016) identify the Czech Republic as one of the worst countries in EU from the perspective of gender pay gap. Nedomova, Maryska and Doucek (2017) analysed unequal wage of men and women in ICT in the Czech Republic and they found 17% gender pay gap.

The aim of this paper is not to verify past analysis and results or to develop more detailed models with other factors. This paper focuses on the university students before they fully join labour market. The aim is to measure their expectations of the future wages and salaries[1], divided by sex and study field. The basic research question is if the gender pay gap could be registered before entering labour market as 'expected gender pay gap'.

University students' expectations are some kind of self-evaluation of their abilities. Impact of different gender on future expectations can be found for example in contribution of Krejcova and Horakova (2018), who proved specific gender differences in the way of self-perception and

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[1]   Wage is connected to the private sector. On the other hand, salary is connected to the public sector.

women are defined as 'underestimating themselves' in their abilities. The expectations could also be expressed as some kind of motivation to study particular study field (Krejcova, 2018) as for example future teachers cannot directly influence a level of their finance evaluation. The objective of this article is the comparison of the expected level of remuneration of students when they join labour market, the results are divided by study field where we can measure different expectations of men and women. Those expectations are compared with following surveys among graduates where the real position on labour market of past students can be measured. Fulfilment of the expectations is then measured by wage statistics of graduates shortly after they join the labour market. In article of Kong and Jiang (2013) there is measured gender pay around 6%.

DATA AND METHODOLOGY

The analysis is based on the data from two surveys which were conducted by the Ministry of Education, Youth and Sports. The expectations of the future remunerations were the part of EUROSTUDENT IV survey (Jurikova, 2018) which was held in the year 2009 (MEYS, 2009). The reality is covered by the survey among university graduates called REFLEX 2013 (Koucky, Ryska and Zelenka, 2014). Thus, respondents who were students in 2009 were respondents for the survey held in 2013. We are aware working with such an old data, but we expect that students' and graduates' behaviour does not change over the time or the movement of their behaviour is the same for both groups.

We calculated gender pay gap as the relative difference of average (median) remunerations of man and women that relates to the average (median) of male remuneration. Gender pay gap is estimated not only for the university students as the group, but for the individual study fields as well. The study fields are divided base on the Classification of Educational Programme Types (hereafter: KKOV). Table 1 shows the structure of both surveys according to the gender and KKOV classification. The results differ in individual study fields.

	EUROSTUDENT			REFLEX		
	Male	Female	Total	Male	Female	Total
Natural science	3.7	3.1	6.8	8.9	7.7	16.6
Social science	17.1	30.5	47.6	14.0	43.6	57.6
Technical science	18.7	5.5	24.1	7.7	3.5	11.2
Culture and art	1.1	0.8	1.9	0.5	1.1	1.6
Health, medical and pharmacy science	3.3	9.5	12.8	1.8	8.0	9.8
Agriculture and forestry	2.3	3.0	5.3	1.1	2.1	3.2
Not available	1.0	0.4	1.4	0.0	0.0	0.0
Total	47.2	52.8	100.0	34.0	66.0	100.0

Table 1: The structure of the university students, % (source: EUROSTUDENT IV, REFLEX 2013)

RESULTS AND DISCUSSION

Firstly, we focus on the students' expectations. There were two questions regarding future wages and salaries. The first question asked if students expect their wages and salaries to be over the average in the Czech Republic thanks to the currently studied field of study. Results shows that male students expect their wage or salary to be over the average twice often than female students. The gender pay gap was calculated based on the second question where students determined the specific amount. For the analysis we omitted missing values as well as suspiciously high values. Using data from table 2 we can state that the expected gender pay gap reaches 25%. The result is the same using median wages and salaries. Higher standard deviation for male remunerations depicts that the expected wages and salaries of female student cumulates in the narrower zone than for male.

Gender	Average	Standard deviation	Median
Female	22.6	8.3	20.0
Male	28.3	10.8	25.0
Total	25.3	10.0	25.0

Table 2: Expected monthly wage or salary of the university students, thousand CZK (source: own calculation based on EUROSTUDENT IV data)

Study field	average				median			
	Wage or salary (thousands CZK)			GPG (%)	Wage or salary (thousands CZK)			GPG (%)
	Man	Women	Total		Man	Women	Total	
Natural science	29.8	22.6	26.6	24.3	27.0	20.0	25.0	25.9
Social science	29.2	23.0	25.2	21.3	26.0	20.0	25.0	23.1
Technical science	28.6	24.0	27.6	16.3	27.0	25.0	25.0	7.4
Culture and art	24.8	19.9	22.7	19.7	20.0	20.0	20.0	0.0
Health, medical and pharmacy science	24.2	21.1	21.9	12.7	20.0	20.0	20.0	0.0
Agriculture and forestry	22.5	21.6	22.0	4.3	20.0	20.0	20.0	0.0

Table 3: Expected monthly wage or salary and gender pay gap of the university students, thousand CZK, % (source: own calculation based on EUROSTUDENT IV data)

The overall expected gender pay gap does not reflect differences among individual study fields. Table 3 presents data for the individual study fields and expected gender pay gap using average expected wages and salaries and median wages and salaries. One can see the higher expected gender pay gap for Natural science (24.3%) and Social science (21.3%). On the other hand, the lowest expected gender pay gap records Agriculture and forestry field (4.3%). Not considering study field Army (where females rather receive higher remunerations as they work in the office), we cannot find study field where female expect higher wages and salaries than men. Moreover, when we examine the results, we have to take into account different portion of male and female in individual study fields.

Looking deeper into the second level of the KKOV classification we can find more significant differences between the expectations of female students and male students among study fields. Table 4 displays study fields with the highest expected gender pay gap. On the contrary, table 5 shows study fields with the lowest expected gender pay gap. The highest expected gender pay gap was found for Mining study field (45.9%), following by Philology and Mathematics (27.4% and 27.1%). The lowest expected gender pay gap is recorded for Biology (2.1%) and Geology study field (0.3%). We can see negative gender pay gap for the study fields where female students expected higher wages and salaries than male students. These results are mainly affected by the attraction of the study fields thus these results are possibly distorted.

Study field	Man	Women	Total	GPG (%)
Mining	36.6	19.8	35.7	45.9
Philology	29.0	21.0	22.8	27.4
Mathematics	31.2	22.7	26.6	27.1
Transportation and communication	30.0	23.2	28.7	22.8
Tourism	31.6	25.1	27.0	20.6

Table 4: Expected monthly average wage or salary and the highest gender pay gap of the university students, thousand CZK, % (source: own calculation based on EUROSTUDENT IV data)

Study field	Man	Women	Total	GPG (%)
Biology	23.0	22.5	22.6	2.1
Geology	22.6	22.5	22.6	0.3
Wood processing	23.6	26.3	24.0	-11.6
Philosophy and theology	18.7	23.1	22.3	-23.6
History of art	15.0	18.6	18.4	-23.9

Table 5: Expected monthly average wage or salary and the lowest gender pay gap of the university students, thousand CZK, % (source: own calculation based on EUROSTUDENT IV data)

As respondents of the EUROSTUDENT IV survey are approximately the same as respondents of REFLEX 2013 survey we can compare how the expectations met the reality at the labour market after the graduation (Lorencova, 2019). Comparing results from table 3 and table 6 we can state that the gender pay gap is higher in the reality than during the studies. This is displayed in the total gender pay gap that is higher than the expected (by 3 percentage points). Table 6 shows real gender pay gap of graduates divided into the main study fields. We can see the real gender pay gap to be higher than expected in all study fields. Using these data, we can state that the expectations of female students were little bit optimistic. Or employing different perspective male student expected lower wages and salaries than the reality in comparison with female students. The highest real gender pay gap reaches Natural science study field (28.7%). This goes along with the expected gender pay gap. On the other hand, the lowest real gender pay gap shows Medical study field (15%).

Quite surprise represents the Technical study field where the real gender pay gap measured with median wages and salaries (thus, not influenced by the extreme values) is the highest and it differs with the expectation of 16.5 p.p. This field is mainly studied by man. It means that female students expect higher wage than male students to compare with reality, however the reality differs significantly.

The only study field where expected gender pay gap was lower than real gender pay gap measured with median wages and salaries is found in Natural science. The real gender pay gap is lower than expected by 2 percentage points. Thus, female students set their future wages and salaries in comparison with the reality more pessimistic than male students.

Study field	Average wage or salary (thousands CZK)			GPG (%)	Median wage or salary (thousands CZK)			GPG (%)
	Man	Woman	Total		Man	Woman	Total	
Natural science	25.1	17.9	21.8	28.7	23.0	17.5	20.5	23.9
Social science	24.7	18.7	20.1	24.4	23.0	17.5	17.5	23.9
Technical science	23.3	19.1	22.0	18.1	23.0	17.5	20.5	23.9
Culture and art	19.4	15.3	16.5	21.3	17.5	14.5	14.5	17.1
Health, medical and pharmacy science	22.5	19.2	19.8	15.0	20.5	17.5	17.5	14.6
Agriculture and forestry	19.8	15.8	17.2	20.4	17.5	14.5	14.5	17.1

Table 6: Real monthly wage or salary and gender pay gap of the university students, CZK, % (source: own calculation based on REFLEX data)

Results show and prove that man and woman have not only different position on labour market when we look to the gap of remuneration, but they have different expectations about the level of wages or salaries when they have been studying. It is obvious that all expectations of students were overestimated and very optimistic in all study fields when we compare their expected future remunerations with the reality (except Health, medical and pharmacy science for men). The highest difference is found in study field Technical science for women which

is overestimated by 43 % (measured by median wage or salary). Gender pay gap in expected values was the highest in Natural science. Moreover, this study field is the only one where lower in reality than expected (by 2 p.p.). In some study fields students expected equal remuneration (median wage or salary) and the reality shows differences as we can find in Culture and art, Health, medical and pharmacy science and Agriculture and forestry.

Conclusion

The aim of this paper was to compare real position of men and woman at labour market and their expectations about this when they were studying. Results showed that women are more optimistic than man with an exception of Technical study field. When we compare expectations and reality the difference is more significant than for men. Comparison of results from those two surveys is extending current research focused to gender pay gap which is measured mainly at the labour market directly.

The expected gender pay gap (measured by average expected wage) is around 20 %, which is slightly higher than 22 % published by Ministry of Social Affairs (MoSA, 2019) but it varies by study fields. Results also correspond with studies focused to some specific job branches as for example ICT (see Nedomova and Doucek (2015) or Nedomova, Maryska and Doucek (2017)).

Underestimating of women by themselves is what already Krejcova (2018) mentioned in her article but here we can find that with the respect to the results of following survey REFLEX 2013, their expectations were objective and even more maybe too optimistic as nearly all expectations were overestimated.

For future research which could uncover some deeper relationships between expectations and reality with special focus to position of men and women complex data source would be needed. This article could help to start the discussion about gender differences not only at labour market but at universities as well. University education should encourage women not only to choose study fields where gender pay gap is the lowest (Technical science, Health, Medical and Pharmacy science) – that is maybe problem before students attend the university when as an applicant choose the study field, but also according to results of Krejcova (2018) university should help to women not to underestimated their future position.

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BENEFITS OF THE STUDY PROGRAMME FOR THE DEVELOPMENT OF PROFESSIONAL COMPETENCES FROM THE GRADUATES' PERSPECTIVE

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ABSTRACT

The authors of this paper present the results of an evaluation survey conducted between 2018-2019 amongst graduates of the Guidance in Vocational Education study programme. The aim of this research is to determine how graduates evaluate the benefits of their study for the development of their professional competences. The results are based on a questionnaire (N = 91) and other complementary information sources: meetings with graduates, focus groups and professionally-oriented social webs. An integral part of the project was an expert-led inventory of one´s competence profile, setting "tailor-made" competence clusters according to the graduate´s profile and their partial knowledge and skills specification. The research has revealed an imbalance in the evaluation of the study benefits. It also unearthed the necessity to aim supposed curriculum adjustments at strengthening the field of Guidance Process Management with emphasis on practical professional skills training.

KEYWORDS

Graduates, guidance and counselling, professional competences, self-evaluation, vocational education

INTRODUCTION

The Institute of Education and Communication of the Czech University of Life Sciences Prague (hereinafter named the Institute) offers the bachelor study programme, Guidance in Vocational Education, in a full and part-time form of study. Graduates of this programme should be able to create and evaluate educational programmes and actively participate in their own vocational education. They should also make use of their acquired competences when counselling in the area of vocational education, human resources development and career guidance.

In the current situation of tertiary education, it is quite common for individual universities and colleges to offer creators of curricula the opportunity and tools to develop evaluation processes in all phases of their activity. Even the first methodologically oriented research papers indicated the impossibility to explore only the immediate results of student learning by means of testing. However, as K. Lonka et. al argue (2004), that evaluation must also involve inner processes relating to education (e.g. attitudes of students to learning) and other internal and external parameters of the educational system (time, means, organization, inclusion of training etc.). According to Ghedin and Aquario (2008) the term evaluation is superordinate to the term marking, and research emphasizes more and more frequently its multidimensional or multifactorial approach. Attention is paid more and more beyond the graduation border, that is, to the results of transfer to practice and to the further professional career of graduates.

The necessity to elaborate a good evaluation strategy is common in the case of universities where changes on a larger scale take place, such as when institutions set new business models, meet new legislation requirements, change the organization structure, create new education programmes or

implement modern strategies and teaching approaches (Ezechil 2012). The entrance and running evaluation, which focuses on determining the quality of running education (for more detail see e.g. Liu 2012; Cader, Domiovsky and Groff 2017), and the effort to diagnose the output quality of the educational process is placed at the forefront. To be more specific, what is of interest is the real level of acquired competence, and possibly added value, of graduating from a particular university and field of study with perspective to the future employment of graduates, and to benefits brought on by their education.

The employability survey of the Institutes´ graduates is informally organized both during regular meetings with former students (2-3 students groups make use of this opportunity annually) and through the form of research at schools and workplaces contracted for vocational training. Moreover, students are informed about the possibility of being connected via LinkedIn, of which they are networked with particular teachers. Students are also connected via the Institute´s profile, by means of which their further professional activity is observed, enabling the possibility of observers to get in touch with this target group quickly and efficiently. After passing their final state examinations, graduates are asked to provide their contact information so that they can receive an employability questionnaire 1-2 years after finishing their studies.

Materials and Methods

The aim of this paper is to present an example of the cooperation between an alma mater and its graduates, and to show how a university can make use of such posterior evaluation of acquired learning results for the necessary adjustments of its curriculum, teaching forms and/or methods. The following research is focused specifically on evaluating the satisfaction of 'Guidance in Vocational Education' graduates in regards to their professional preparation and acquired competences´ level.

First, the authors defined the graduate´s profile and their competences clusters based on an official curriculum documents´ analysis, and expert assessment. Next, a self-evaluation of the graduate was conducted in the form of a questionnaire survey, focused on how well the university had prepared their individual capacities. The third phase of the project was focused on proposing possible curriculum adjustments. The authors asked themselves the following questions:

- How did the graduates think the studies contributed to their professional employability?
- Which competences clusters, and which individual items, do the graduates consider the most or least useful in terms of the programme´s benefit?
- How can the graduates´ potential lower satisfaction with competence development be explained?
- Which areas should future curriculum adjustments focus on?

The methodology regarding the research of graduates differs heavily. The most common forms are various questionnaire surveys which take place at different intervals after graduation. It is necessary to point out that the return in these cases tends to be miniscule. It is similarly problematic that respondents evaluate themselves. Therefore, a sufficient level of validity, reliability and impartiality of gained data is not granted. What may solve this problematic nature is a combination of data from more sources, including face to face contact with graduates i.e. during events for which the necessary feedback can be acquired from attendees.

Although discussion on how to define, diagnose and evaluate graduates´ competences in the field of guidance and counselling is very broad, there is not one simple and consensual model of study profiles of future professionals, a researcher (Sultana, 2009) worries before insisting on one permanent framework that could easily become obsolete. Achcaoucaou et. al (2004) recommends to including general (or key), as well as specific, competences into the competence profile. This division corresponds with documents that have been published over more than one decade by

OECD and various European institutions and organizations (see McCarthy, 2004; Wats, Sultana and McCarthy, 2010). These authors list, among specific competences, the following clusters: assessment, educational guidance, career development, counselling, information management, consultation and co-ordination, research and evaluation, programme and services management, community capacity building and placement (McCarthy, 2004).

The European Network for Innovation in Career Guidance and Counselling unveiled the standards for academic training of career practitioners (Schiersmann, 2016). In this case, the whole profile consists of six fundamental clusters, thus divided according to their main working positions. These clusters are: generic professional competences, career counselling competences, career education competences, career assessment and information competences, career service management competences and social systems intervention competencies (Schiersmann, 2006).

In this paper, members of the research team drew up a competence model based on the above-mentioned characteristics of graduate profiles within the Guidance in Vocational Education field of study. This model consists of two levels: (i.) more general clusters which correspond to a broader range of professional performance, and (ii.) a list of particular competences for which can be clustered. There are seven basic clusters and thirty detailed items in total. The distribution of items was irregular; their choice depended on the correlation between a described cluster and a graduate´s profile.

The research worked with these seven basic competence clusters:

- *Key Competences* (e.g. the competences to learn, to cooperate and for the use of a foreign language). This cluster was the only one not specifically embedded in the profile of the 'Guidance' study field. That is why it extends beyond qualification specialization; however, the skills observed at this level are generally considered an important element of university education and thus contribute to the determination of professional success (e.g. foreign language knowledge preconditions, job mobility or the ability to search for up-to-date professional information),
- *Knowledge of the Education System in the Czech Republic,*
- *Educational Process Management* (for instance, the ability to propose and realize educational programmes),
- *Knowledge and Skills in the Area of Learning and Teaching* (e.g. knowledge and use of teaching methods and educational technologies, presentation skills),
- *Knowledge and Skills in the Course of Counselling Process* (e.g. the ability to hold a dialogue. know the counselling methods. apply the career diagnostics),
- *Competence for the Labour Market* (it regarded namely evaluating the ability of one´s own employability of the graduates at the labour market),
- *The Ability to Make Use of Information Resources for Counselling.*

To evaluate these competences, a questionnaire was used and distributed electronically. It included 37 items in total, aimed at unearthing an expansive range of information regarding the examined participants (e.g. age, year of graduation, sex, up-to-date economic status, career/future studies, study satisfaction etc.). There were eight competence clusters in the middle part of the questionnaire. Respondents were asked to indicate – on a 5-grade scale – to which extent their study at the Institute contributed to the development of these competences. Therefore, the questionnaire did not refer to direct self-evaluating assessment of achieved knowledge or skill level, but rather to feedback, indicating the extent at which education is relevant to the goals declared in the respondent´s opinion.

The research population was defined as the graduates of the study field, Guidance in Vocational Education. In total, there were 212 respondents in a full/part-time vice form of study who graduated in period between 2013 and 2018. The deadline for the questionnaire return was March

2018. Therefore, graduates in the running academic year were not chosen. These are going to be researched in the following phases, which are planned for two to three-year intervals.

The questionnaire's distribution was realized in an electronic form. Respondents received an official letter asking them to cooperate in the research. The collection date was also supported on social networks. In general, 91 completely filled questionnaires returned within the set deadline, a 43% return rate. Although the authors had expected more plentiful feedback, the yielded data has been considered adequate for a survey of its kind.

Results

The overall perspective has shown that almost two thirds of the respondents evaluate their study as beneficial in terms of practical preparation. On its own, this result does not necessarily determine the programme's full quality until its perceived positive and negative characteristics are realized.

answers in % of all respondents	1	2	3	4	5	Total
Full-time students	22%	42%	28%	8%	0%	100%
Part-time students	28%	33%	28%	11%	0%	100%
Total	26%	37%	28%	10%	0%	100%

Table 1: Overall Satisfaction with the Study Programme. Question: „How did the study programme prepare you for the practice?", 1 = the best rating, 5 = the worst rating.

When comparing the whole clusters, the researchers had expected that the important areas – i.e. all the competences related to guidance and counselling – would be rated in the top tier in regards to evaluation. This assumption did not prove to be true.

Competence cluster	Mean	Standard Deviation
Education system	1.72	0.82
Learning and teaching	1.87	0.72
Labour market competences	1.92	0.87
Educational process management	2.02	0.81
Information in counselling	2.03	0.79
Key competences	2.08	0.72
Counselling process period	2.15	0.79

Table 2: Average self-evaluation of respondents; seven competence clusters. Values are calculated as the mean on the rating scale where 1 = the best rating, 5 = the worst rating.

Various explanations are possible. Firstly, traditional schooling and education has been a long-term strength of the Institute. Subjects, such as pedagogy or didactics, have operated under the tradition of academic staff having taught before. Thus, gained teaching experience and training takes place more often at institutions designated specifically for education. This explanation does not have to mean a complete miss of the programme´s aims with its output because teaching and didactic competences also belong to a graduate´s profile.

Secondly, another reason of the low evaluation of counselling competences´ development may be the fact that these areas are not sufficiently covered in the curriculum, or that the students were not able to connect the studied subject matter with the consultant´s competences. For instance, practical exercises in psychology are aimed at communication, which may be applied when holding a counselling conversation.

In the following two tables, we have chosen examples of highly rated particular competences, respectively low in terms of the study´s share in their development. All results are detailed commented in the "Discussion" chapter.

I am able to:	Mean	Std. Dev.
look up information necessary for my education	1.48	0.84
make use of didactic technology for teaching and presentation	1.49	0.82
be well informed about the labour market for one's own needs	1.49	0.84
Cooperate	1.51	0.86
make use of presentation and communication skills efficiently	1.73	0.90
make use of technology for e-learning	1.73	0.98

Table 3: Competences with the best evaluation results. Values are calculated as the mean on the rating scale where 1 = the best rating, 5 = the worst rating.

I am able to:	Mean	Std. Dev.
use a foreign language	3.46	1.39
use career diagnostics (tests, cards…)	2.62	1.07
do a private business independently (establish and run a business)	2.58	1.22
create study materials for the part-time education	2.36	1.19
create a financial budget of an educational event	2.27	1.05
be well informed about the counselling system in the Czech Republic	2.12	0.91
find out and analyse educational needs of individuals and groups	2.11	0.95

Table 4: Competences with the worst evaluation results. Values are calculated as the mean on the rating scale where 1 = the best rating, 5 = the worst rating.

What was also of interest to us was why some respondents evaluated their studies as less beneficial for their future career. When analysing the open comments to Question No.14 (see the overall evaluation of the benefit in Table 1), we focused on the opinions of those who consider the benefit average, under-average or even completely inadequate (it should be noted that the worst evaluation 5 on the scale was chosen only once). The answers to open questions were compounded into the following points, discussed in further detail in the "Discussion" section:

A. the respondents were already working during their studies and thus gained the competences at work rather than at the Institute;

B. the respondents were continuing in their studies or were employed in a different field and therefore could not verify the value of gained experience in practice;

C. the respondents appreciated the theoretical basis in the field of guidance and counselling, but they missed practical training in the teaching;

D. the respondents believed that competences are a result of individual abilities, diligence and personal experience rather than a result of teaching process.

The last issue that we focused on was an assessment of difference in the evaluation of study benefit by those respondents who work in the field of guidance or education and those whose work was not related to guidance or education during the time of this survey. We had supposed that direct, professional experience would enable the respondents to evaluate the benefit of the study with more precision and possibly stronger criticism, as well. However, as Table 5 reveals, the experience of working in the guidance field increases the evaluation of the study benefit. There may be more reasons for this. We suppose that the graduates with better preconditions in the field, and therefore with a more developed competence level, tend to choose an employment corresponding to their study programme more frequently. In contrast, the second group is not able to assess the real competence level unless they are given an opportunity to verify their skills in practice. Moreover, these might be students who have more difficulties finding a job due to this lower competence level.

		How did the study programme prepare you for the practice?
Is your work activity related to education or guidance?	Yes	2.16
	No	2.39

Table 5: Relation between the work field and satisfaction with the study programme in accordance to competence acquisition. Values are calculated as the mean on the rating scale where 1 = the most satisfied, 5 = the lest satisfied.

DISCUSSION

When evaluating the results, we also took into account other data resources, namely the graduates´ feedback gained during interim discussion meetings. Generally, it may be prudently argued that the respondents evaluated the study benefit for their competence development rather positively, both in full-time and part-time study. The students´ evaluation remains consistent, with little change. On average, full and part-time students evaluated the study the same. From the comparison of individual clusters of competences and particular abilities, it follows that graduates feel well-prepared in the area of presentation skills and educational theory. One respondent´s comment of how this experience can be developed further is the following:

> Interviewer: "What was in your opinion of benefit during the studies at the Institute?"
> Graduate (finished studying in 2015): "The theoretical knowledge that I keep using in my current job, useful IT skills exploitable in career guidance and last but not least also the ability to present not only a seminar paper or assignment, but oneself as well."

The graduates perceived soft skills as a highly useful asset of education. Another benefit is the ability to process information for programme preparation or for arranging feedback.

> (The same question of the interviewer)
> The graduate (finished studying in 2016): "The ability to process practically any subject matter into a quality material and to present it further on. The ability to set a goal and steps leading to it, focus on them and evaluate everything on the basis of feedback or a potential survey."
> (The same question of the interviewer)
> The graduate (finished studying in 2017): I have benefited from the studies at the Institute a lot. In particular, I have learnt how to work well with people and clients."

Knowledge of a foreign language was evaluated as the least beneficial by the students. This item was evaluated negatively more often by the part-time students, whose initial language level is generally lower. The number of language lessons is also insufficient in this study form. Other items with a low-benefit evaluation were also skills determined essential for future counsellors: making use of career diagnostics, being well informed about guidance and counselling systems or the ability to analyse individual and group educational needs. The reason for this may be a lower representation of these areas in the curriculum. Students must look on their own to acquire these necessary skills elsewhere, frequently while working, as the following example shows:

> (The same question of the interviewer)
> The graduate (finished studying in 2014: The studies enabled me to acquire a theoretical platform in the field of guidance. I had the opportunity to immerse into the context of the field, and thanks to that, I tried to focus all seminar papers on real counselling topics, processing the data which I immediately used in professional practice."

The part-time students often compared the theory with practice, which they are familiar with from their own jobs:

> *(The same question of the interviewer)*
>
> *The graduate (finished studying in 2014: Regarding the fact that I was a part-time student, I often interconnected my professional experience with information acquired at the Institute. It served me an incentive to reflect how different practice and theory are from each other.*

Let us now pay attention to the reasons given for the dissatisfaction of several respondents; these reasons were compounded into points A through D below. In the following table, there is a concise analysis of each of these four points as to the meaning of each rationale.

A. Students already had professional experience during their studies	The study offer cannot probably individualize the needs of learners; it would be appropriate to adapt the curriculum for those with professional experience in a way that they could acquire the added value (e.g. what in particular they need for the practice, what problems they solve etc.).
B. Students do not work in the studied field so they are unable to assess the achieved competence level	The studies probably lack good quality formative and summative evaluation; the students often write tests and get marks at the end of individual subjects; however, that does not suffice to create an unbiased image of individual professional development.
C. Respondents miss training	The ratio between theoretical and practical lessons has been discussed in the long-term in all study programmes; it will be necessary to strengthen the training both at the Institute and real work environments in the future.
D. According to respondents, achieved competences are the result of an individual´s diligence rather than the outcome of education	The respondents´ attitudes indicate mistrust in education in general; these opinions probably reflect the overall attitude to study; these students´ motivation is more superficial (I study to get a degree, not to learn something); the aim in this case may be to transform the students´ motivation from superficial to in-depth.

Table 5: analysis of the reasons for dissatisfaction with the study benefit

It is difficult to compare our results with findings from other similar research projects. One reason is that, at many higher education institutions, most surveys intend to cover a wide variety of study directions, or they analyse a very detailed list of factors that do not coincide with questions discussed in the paper (for an example, see García-Aracil, 2009). With caution, it would be possible to state that graduates, the objects of this research, estimated their received training as satisfactory overall. It corresponds with other national surveys, e.g. REFLEX 2013 (Koucký and Ryška, 2014). However, the purpose of this study was not to compare results with other institutions, but to identify weak parts of a study programme in order to allow improvements in the future. It is paramount in future development to be aware of reasons for dissatisfaction (see Table 5) and to thus arrange an appropriate response.

CONCLUSION

The aim of our research was to assess how graduates of the Guidance in Vocational Education study field evaluate the benefit of the study for their professional competence development. The second task was to suggest recommendations for future curriculum adjustments on the basis of the collected data. Bearing in mind these research results, we can argue that graduates consider the studies beneficial and useful; however, the educational offer can be further improved. Future attention must be aimed at strengthening subjects from the area of guidance so that future graduates will be better prepared to manage the counselling process, as well as the methods and techniques of counselling diagnostics. Moreover, it is worth considering to strengthen the practical part of vocational training e.g. introducing simulation methods and projects using particular counselling

procedures (holding conversations, analysing professional trajectories etc.). Emphasis should also be given to providing students with formative feedback in order to enable them to identify their own learning progress better for an easier transfer of theoretical knowledge into practice.

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EXAMINATION OF JOB FACTORS AND GENERATION GROUPS IN THE SLOVAK INDUSTRIAL ENTERPRISES

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ABSTRACT

The paper deals with research and analysis of job factors and their importance for different generation groups of employees in industrial enterprises in the Slovak Republic. Scientific work has shown that the different generation groups prefer different job factors that affect their job performance. The research sample was composed of (n = 534) employees from industrial enterprises in the Slovak Republic. Questionnaire, developed under the VEGA 1/0348/17 project, was used for data collection. The data and descriptive statistical analyses were performed and evaluated in the statistical program SPSS from IBM. Statistical evaluation revealed significant relationships between selected job factors with correlation (r_s = 0.632, r_s = 0.794, and r = 0.703). Demonstrated and quantified statistically significant relationships can be used for developing skills and knowledge of employees and improving the coexistence of different generation groups in job process.

KEYWORDS

Education, generation groups, industrial enterprises, job factors, statistical analysis.

INTRODUCTION

At present, there are four major generation groups on the labour market. The fifth generation are veterans who can be classified as retired workers. ´Each generation group is different in terms of its positives and negatives and its properties and characteristics´ (Vranakova, et al., 2018: 642, Starecek et al., 2018: 512). ´Generation Z consists of people born between 1992 and 2010. Generation Z members think they are creative, have good communication skills and can quickly learn and adapt. They also claim to be good leaders and do not make the problem of cooperating with employees from older generations´ (Tapscott, 2009, Mladkova, 2016: 383, Chicca, Shellenbarger, 2018, Jaleniauskiene and Juceviciene, 2015, Mladkova, 2017). Generation Z is usually called "the generation of information technology". ´People born from 1978 to 1992 are referred to generation Y. Generation Y is ambitious, performance oriented, and self - confident and speaks foreign language. Generation Y has high expectations from the employer. People yearn for meaningful projects and, where necessary, do not distinguish working hours and leisure time. They like to work in a team, they are pragmatic and capable of multitasking´ (Konickova, year unknown, Greskova, 2018: 25, Bencsik, Horvath, Juhasz, 2016, Mladkova, 2017: 258). "Representatives of generation X were born between 1963 and 1977. Generation X is full of ambition, they are placing great emphasis on the balance between work and personal life. Typical features include their independence, self-sufficiency and independence "(Rehakova, 2009, Wiedmer, 2015). ´Generation Baby boomers includes people born between 1946 and 1962. Generation can be characterized as an idealistic, optimistic and typical feature is strong workload

and morale. Baby boomers are people who work a lot, identify themselves based on their title and job, and they also sacrifice their private life´ (Platek, 2012: 15). The authors agreed with the classification of generation groups according to the author Rehakova. Each generation group has different expectations from the employer because of generational differences. Many authors are concerned with the issue of job satisfaction. Fejfarova and Fejfar (2018) explored in her article employee training and development as one of the important aspects of employee satisfaction. Smetackova and Viktorova (2018) in her article characterized stress as a factor which negatively affects job satisfaction and can cause burnout syndrome. If the enterprises want to be efficient and successful, it is necessary to monitor different job factors and performance indicators of employees (Stachova et al., 2019, Lorincova et al., 2018). So far, scientific studies have also shown the assumptions that have influenced research questions and hypotheses. Investigation of age differences and setting conclusions helps to increase the efficiency of job processes. Overall job satisfaction is the result of a combination of different job satisfaction factors. Based on an article by the author Gazioglu and Tansel (2006) "different aspects of job satisfaction are studied in the literature. These include job satisfaction with gender, wage growth, age, comparison income and unemployment, work environment, work environment and relations with managers, job matching and service sector". Job satisfaction very strongly influences the work performance of employees. "Despite stereotypes about the diminished job performance of older workers, there seem to be relatively small differences between older and younger workers in terms of job performance, and those that do exist seem to favour older workers" (Fisher, et al., 2017).

At present, employers need to be aware of the importance of equal access to employees of all ages. Taqi (2002) characterized three important actions in order to improve the position of the older generation of employees and to ensure cooperation of all generational groups in the labour market: "promoting training, placement and workplace flexibility; changing attitudes through education and information; and prohibiting age discrimination in employment". The authors tend to believe that the management of job and education processes needs to be organized with an emphasis on individual employee preferences and interests. The individual's affiliation to a generation group determines its subjective preferences. Due to the increasing retirement age, pressures are being imposed on industrial enterprises with the importance of cooperation of different generation groups (Stacho, Stachova and Vicen, 2017).

The aim of the research was to investigate and further characterise the job factors and their importance for different generation groups and in educational activities in the work process in industrial enterprises in the Slovak Republic.

Materials and Methods

The research sample was composed of employees of Slovak industrial enterprises. For the greater representativeness of the sample, the authors decided to include in the research all generation groups that are currently on the labour market. The research was conducted from May 2018 to January 2019. The sample of respondents was selected by the authors based on an unlikely quota selection. The quota selection consisted in ensuring the same or similar distribution of one character in the group. The chosen character was the gender of respondents (261 male respondents and 273 female respondents). The questionnaire was distributed physically to industrial enterprises, as well as through and e-questionnaire that employees could fill in. In total, 534 respondents from all over the Slovak were participated in the research. The Table 1 shows the composition of respondents according to the size of the enterprise in which they are employed.

The Table 1 shows that respondents from enterprises with more than 250 employees and respondents from large industrial enterprises have the largest representation. The composition of respondent by gender can be seen in the Figure 1.

Enterprise size	Absolute frequency	Percent [%]
1 -10 employees	32	5.99
11 - 50 employees	66	12.36
51 - 250 employees	105	19.66
251 - 500 employees	68	12.73
More than 500 employees	263	49.25
Total	534	100.0

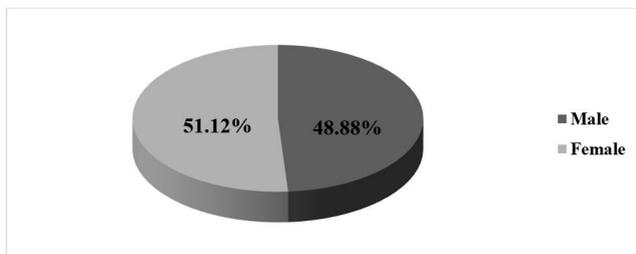Table 1: Composition of the respondents according to the enterprise size (own elaboration, 2019)

Figure 1: Composition of the respondents according to the gender (own elaboration, 2019)

The Figure 1 shows that the respondents were approximately half divided according to the gender. This fact is related to the effort of the paper authors to follow the gender differences in further publication. The composition of the respondents on the basis of generation groups can be seen in The Table 2.

Generation group	Absolute frequency	Relative frequency
Baby boomers	36	6.74
Generation X	153	28.65
Generation Y	323	60.49
Generation Z	22	4.12
Total	534	100.00

Table 2: Composition of respondents by the generation group (own elaboration, 2009)

It is clear from the table that the composition among generation groups is unequal, but the authors can say that the composition of the respondents corresponds to the composition of generation groups in the labour market. In the Table 3 can be seen the composition of respondents according to their level of education.

Generation group		Frequency	Percent	Cumulative percent
Baby boomers	primary	3	8.3	8.3
	secondary	18	50.0	58.3
	higher	15	41.7	100.0
Generation X	primary	1	.70	.7
	secondary	68	44.4	45.1
	higher	84	54.9	100.0
Generation Y	secondary	101	31.3	31.3
	higher	222	68.7	100.0
Generation Z	secondary	16	72.7	72.7
	higher	6	27.3	100.0

Table 3: Composition of respondents according to the level of education(own elaboration, 2009)

It is clear from the table, that the composition of generation groups in area of achieved education is significantly different. Progress in science and technology, as well as social progress has made education more accessible and more desirable. For mentioned reason, the structure of achieved level education is changing (increasing the proportion of employees with higher education).

The data collection tools: In the research was used a questionnaire which was developed by a team of experts in the field of psychology, sociology and human resources management in the framework of the project VEGA 1/0348/17 „The impact of the coexistence of different generations of employees on the sustainable performance of organisations ". The questionnaire contains 40 questions, of which 8 were with the possibility of free answer and the others contained a range of response options that respondent could label. The data collection tool was evaluated as valid and reliable. For the purposes of this paper, only some questions were selected and evaluated. Mentioned questions can be seen in the research sample section and in the results and discussion section.

The research methods: The authors used a number of methods for statistical evaluation of the collected data: descriptive and quantitative statistical methods (histograms, pie charts and supplementary analyses in table form). Furthermore, the authors of the paper used parametric and nonparametric statistical tests, which serve for better processing of obtained data and determination of relevant conclusions within the researched issue.

Research questions (RQ):

RQ 1: What is the current state of potential fluctuation of the employees in the Slovak industrial enterprises?

RQ 2: How important are the selected job factors for employees in the Slovak industrial enterprises?

RQ 3: What is the current state of implementation and effectiveness of educational training in the Slovak industrial enterprises?

Research hypotheses (RH):

RH1: There is a statistically significant relationship between the job factor "success" and "career growth" perceived by employees of industrial enterprises.

RH2: There is a statistically significant relationship between the factor "relationship with the superior" and "relationship with subordinates" perceived by employees of industrial enterprises.

RH3: There is a statistically significant relationship between job factors "personal growth" and "the possibility of further education" perceived by employees of industrial enterprises.

Results and Discussion

The evaluation of research questions:

RQ 1: What is the current state of potential fluctuation of the employees in the Slovak industrial enterprises?

In order to evaluate the first research question, the authors used question 10 from the questionnaire: "To what extent are you likely to try to find a new job in another organization over the next 12 months?" The Table 4 shows respondents' answer without selection into individual generation groups.

Option	Absolute frequency	Relative frequency
Very likely	85	15.92
Likely	119	22.28
Unlikely	205	38.39
Very unlikely	125	23.41
Total	534	100.00

Table 4: Respondents' answers to question 10 (own elaboration, 2019)

It follows that the most common answer for all respondents is „unlikely ". On the contrary, the least frequent answer is „very likely ". From the used scale, the authors can conclude, that 61.8% of respondents will not leave their current job. The mentioned finding can be considered as positive due to the growing trend of fluctuation at all job positions in the Slovak industrial enterprises in the last two decades. In the Figure 2 can be seen the frequency of answers according to the generation group.
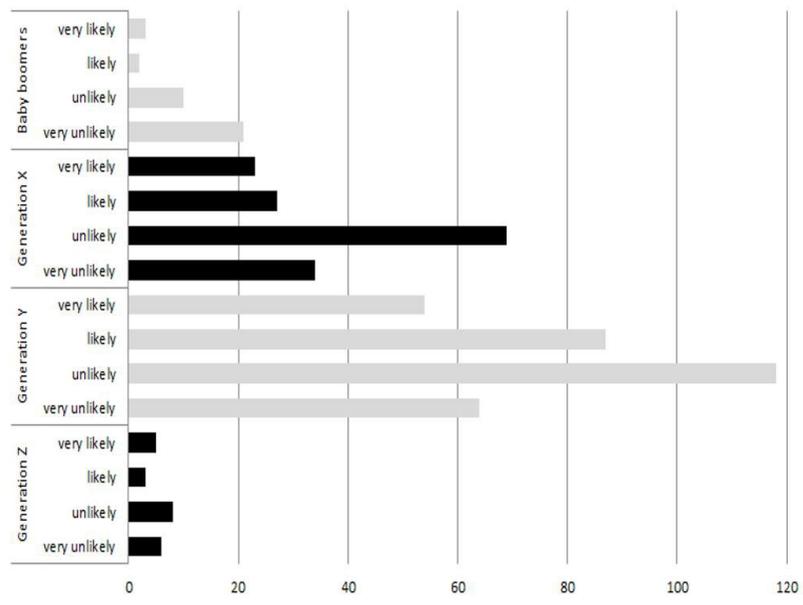

Figure 2: Respondents' answers to question 10 according to the generation group (own elaboration, 2019)

It is clear from the figure, that the baby boomers are before retirement and they do not plan a job change. Similar results were obtained for generation X. On the contrary, generation Y (141 of 323 respondents) declared that they would likely and very likely leave their jobs in the following months.

RQ 2: How important are the selected job factors for employees in the Slovak industrial enterprises?

In order to evaluate the second research question, the authors used question 7 from the questionnaire: "How important are the following job factors for you?" The respondents had the opportunity to select the value on scale from 1 to 5, where 1 symbolized the minimum importance and 5 the maximum importance. The results of the performed analyses can be seen in the Table 7. The Table 7 shows that respondents of different generation attach different importance to different job factors. The factor "success" is most important for employees from generation Y. On the contrary, the least importance of factor "success" is attributed to the respondents from baby boomers. The "career growth" factor is the most important for the generation Y and mentioned factor is the least important for baby boomers. Another finding was that the factors: "interesting job", "relationship with superior", "good salary" and "relationship with subordinates" consider generation Z as the most important and baby boomers consider them as least important. Job factor

"relationship with subordinates" consider respondents from generation Z as the most important and mentioned factor is the least important for generation Y. Job factor "possibility of further education" is the most important for generation Y. On the contrary, mentioned job factor considers the respondents from baby boomers as least important. ´It follows the importance of education as a motivating factor that supports the further development of the individual, but also whole organization´ (Stacho et al., 2017: 311).

Job factors	Generation groups							
	Baby boomrs		Generation X		Generation Y		Generation Z	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
success	3.61	1.070	3.89	.936	4.12	.829	4.05	.950
career growth	3.47	1.050	3.80	.920	4.28	.812	4.00	1.110
interesting job	4.36	.931	4.44	.760	4.38	.735	4.68	.894
personal growth	3.78	1.040	4.14	.890	4.44	.713	4.23	1.020
relationship with the superior	4.03	.910	4.16	.823	4.15	.820	4.36	1.130
good salary	4.14	.683	4.31	.772	4.28	.786	4.32	.894
relationship with subordinates	4.19	.951	4.10	.867	3.98	.939	4.32	.839
possibility of further education	3.67	.799	3.98	.914	4.65	.963	4.08	1.180

Table 7: Job factors and generation groups (own elaboration, 2019)

RQ3: What is the current state of implementation and effectiveness of educational training in the Slovak industrial enterprises?

Two questions from the research questionnaire were used to evaluate the third research question. First question: "Did the enterprise provide formal education to employees over the past two years, either at or outside of the enterprise (excluding workplace instruction and compulsory legal training)? Figure 3 presents the results in percentage.
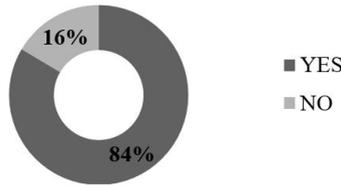

Figure 3: Percentage of respondents' participation in education (own elaboration, 2019)

The Figure 3 shows, that 84% of employees from industrial enterprises have attended educational activities in the last 48 months. The authors appreciate this fact and we can say that industrial enterprises consider education as an important part of human capital development.

The second question from the questionnaire focused on education was: "Overall, how would you say that these formal trainings are effective?" An evaluation of the above question can be seen in the Figure 4.

It follows that up to 15% (80 respondents) think that educational activities are inefficient. On the contrary, 24% (128 respondents consider educational activities as highly effective. Overall, the current situation can be regarded as undesirable due to the fact that 61% (326 respondents) identified the option partially effective. It is necessary to focus on the feedback from trained employees in industrial practice and to try to increase the effectiveness of educational activities,

which at the same time influences the increase of performance and thus the profitability of the company. As stated, (Papulova and Papula, 2015: 516) ´education is a strong success factor´.
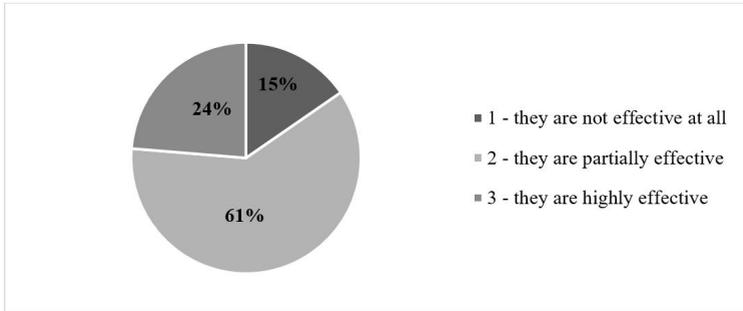

Figure 4: Assessing the effectiveness of the education (own elaboration, 2019)

The evaluation of the research hypotheses: To evaluate the individual correlations, the authors of the paper approached the nonparametric correlation test, Spearman's test (r_s) and parametric correlation test, Pearson's test (r).

Research hypotheses (RH):

RH1: There is a statistically significant relationship between the job factor *success* and *career growth* perceived by employees of industrial enterprises.The Spearman correlation test results show that there is a statistically significant relationship between the job factor *success* and job factor *career growth*. This variable correlates at $\alpha = 0.001$ with Spearman's correlation coefficient $r_s = 0.632$. The authors do not reject hypothesis 1 and can confirm that there is a strong relationship between monitored variables.

RH2: There is a statistically significant relationship between the factor *relationship with the superior* and *relationship with subordinates* perceived by employees of industrial enterprises.The Spearman correlation test results show that there is a statistically significant relationship between the job factor *relationship with the superior* and job factor *relationship with subordinates*. This variable correlates at $\alpha = 0.001$ with Spearman's correlation coefficient $r_s = 0.794$. The authors do not reject hypothesis 2 and can confirm that there is a strong relationship between monitored variables.

RH3: There is a statistically significant relationship between job factors *personal growth* and *the possibility of further education* perceived by employees of industrial enterprises.

The Pearson correlation test results show that there is a statically significant relationship between job factor *personal growth* and *the possibility of further education*. This variable correlates at $\alpha = 0.05$ with Pearson's correlation coefficient $r = 0.703$. The authors do not reject hypothesis 3 and can confirm that there is a strong relationship between monitored variablesResearches in the field of human resources management do not adequately analyse fluctuation issue (Szarkova, 2019). Important findings include the finding that up to 62% of respondents declared, that they did not plan to change their current job in the following 12 months. Another finding is that 84% of respondents have attended the educational activity in the last 24 months. Industrial enterprises in Slovakia consider further development of skills as very important (Papulova and Papula, 2015). As negative, it can be assessed, that the majority of respondents (61%) consider educational activities as partially effective and 15% of respondents consider educational activities as ineffective. The poor current situation of training effectiveness is a consequence of lack interest of management in industrial enterprises and failure of analysing the feedback of training activities by employees.

Conclusion

The main aim of the paper was to investigate and further characterise the job factors and their importance for different generation groups and in educational activities in the work process in industrial enterprises in the Slovak Republic. On the basis of the research and analyses it has been proved that there are four generation groups on the labour market (baby boomers, generation X, generation Y, generation Z).

It is suggesting the possibility of a closer analysis of educational activities by employees. The respondents have created from selected job factors the order of the most important, among them: interesting job and good salary. All findings from the field of job factors can be used to motivate employees of industrial enterprises. The main reason for this is the fact that ´human resources are managed in a sustainable way in order to increase market share and increase business competitiveness´ (Babelova et al., 2010, Stacho et al., 2017: 310). Partial analysis divided by generation groups provide important information that can be used in a business practice.

The significant relationships were found between the job factors within the set hypotheses. The benefit of this finding is important due to the systematic education and motivation of employees. If industrial enterprises cannot influence one factor, the fact that there is an internally consistent and strong relationship with the other factor can achieve the desired effect. The authors of the paper consider all findings to be significant from a business practice perspective. Finally, the research results will be published in the scientific reports and will be provided to all industrial enterprises involved in carried out research.

Acknowledgements

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USE OF DIGITAL MEANS IN DIFFERENT SUBJECTS TEACHING

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Abstract

The paper presents some of the results of the research focused on identification of the ways the teachers use interactive educational activities and digital means in their teaching practice in dependence on the subjects they teach (i.e. which purposes teachers of different subjects follow if they apply these means into the education process). The main research question was whether it is the same for all teachers, independently on the character of the subject they teach, or whether it depends on the taught subject. Methodology of the research was based on a personal inquire and the collected data were evaluated using the statistical software (descriptive statistics and contingency analysis). As the results have showed, the purposes significantly differ in dependence on the character of the taught subjects. In the paper, in more detail results for teaching natural science subjects are discussed.

Keywords

Efficiency of teaching, implementation of digital didactic means, interactive activities, teacher training, teachers' didactic technological competences

Introduction

Issue of digital didactic means interventions in teaching process has been a subject of many researches and empirical investigations (e.g. Klement et al., 2017; McKnight et al., 2016; Montrieux et al., 2015; Martiník, 2016; Skutil, Maněnová and Čermáková, 2013; Sangrà, González-Sanmamed, 2010). As Anderson and Weert (2002) state, supporting learning and teaching processes by digital means can significantly improve quality of education by emphasizing such skills as critical thinking, decision-making and handling of dynamic situations, working in groups, or communicating effectively. On the other hand, effective integration of technology into the system of education is a part of a complex system, and is influenced by many factors as e.g. teachers' attitudes towards the technology, their skills to use these means in their teaching practice, nature of the subjects they teach, purposes they follow, personalities of their students.

Main goal of the presented research was to identify requirements and needs of the practicing (in-service) teachers' for upgrading their professional digital literacy skills (i.e. their didactic technological competences – Záhorec, Hašková, Munk, 2018). Additional to that, within the carried out research also the ways, in which the teachers use interactive educational activities and digital means in their teaching practice, were monitored. The paper presents results just of this part of the research.

Teacher's skills to use material and technical teaching means in teaching processes of the school subject s/he teaches are an integral part of a teacher's professional competence profile, abstractedly from the subject the teacher is teaching (Gadušová et al., 2017). A question is for which purposes teachers use technical teaching means – mainly the newest digital ones – in their subject teaching. We were interested in which part of the education process teachers apply digital

teaching tools, and with them connected interactive activities, to support teaching and learning processes. Is it the same for all subjects or are there some significant differences in dependence on the character of the taught subject? So the main research question for us was whether it is the same for all teachers, independently on the character of the subject they teach, or whether it depends on the taught subject.

MATERIALS AND METHODS

The main question of our research was, as it is above-mentioned, in which part of the education process teachers apply digital means to support teaching and learning processes. Under the term *teaching process* in the stated research question, we do not mean strictly only a traditional lesson and its agenda. We understand it in a broader sense, as a continual process of education going through several lessons.

Two research questions resulted from the stated main question:

Q1: *What are the purposes for which teachers use the digital means most often during their lessons?*

Q2: *Do the purposes for which teachers use the digital means during their lessons depend on the character of the taught subject?*

Additionally to the research question RQ2, a further question was stated:

Q3: *Do the purposes for which teachers use the digital means during their lessons depend on the sub-category of the teaching staff to which a teacher belongs?*

Research sample consisted of 173 teachers – participants of teacher continuous education carried out from December 2017 to October 2018. The participants were primary and secondary school teachers representing primary and secondary schools in three of eight regions of Slovakia (Nitra region, Trnava region and Bratislava region, the regions for participants from which the continuous education was done). A detailed description of the research sample is summarised in Table 1. As main characteristics to describe composition of the research sample were used the factors gender, lengths of the teacher´s teaching practice and category and sub-category of the teaching staff to which the concerned teacher belongs according to the legislation rules. Slovak legislation (Law No. 317/2009 on Teaching Staff and Specialists and its Amendments) distinguishes 7 categories of the teaching staff, which are teacher, vocational education teacher (supervisor), governess, teacher assistant, foreign lecturer, sport school/classroom trainer, accompanist. In relation to the regional schools (ISCED1 – ISCED3) the legislation categorizes teachers in three sub-categories, which are (a) *primary education teacher*, (b) *lower secondary education teacher* and (c) *upper secondary education teacher*. As Table 1 shows, a majority of the respondents (50.29%) were teachers with teaching practice from 5 to 20 years.

To collect necessary research data the method of personal inquire was used. In frame of the personal inquire, the respondents responded de facto to the main research question (to its modification):

> In which part of the lesson do you most often use interactive education activities (supported by digital means)?

choosing one from the five offered alternatives answers (the one that corresponded mostly to their teaching practice and experiences):

> a) to invoke greater motivation to learn,
> b) to explain and exemplify new subject matter,
> c) to fixate new subject matter,
> d) to apply acquired knowledge,
> e) to diagnose and grade pupils / students.

Factor	Factor category value	Absolute number	Relative number
Gender	male	15	8.67%
	female	158	91.33%
Length of teaching practice	up to 5 years (including)	46	26.59%
	from 5 up to 20 years (incl.)	87	50.29%
	more than 20 years	40	23.12%
Category of the teaching staff	teacher	156	90.17%
	governess	17	9.83%
Sub-category of the teaching staff	teacher of primary level of education (ISCED 1)	68	43.59%
	teacher of lower level of secondary education (ISCED 2)	69	44.23%
	teacher of upper level of secondary education (ISCED 3)	19	12.18%

Table 1: Description of the research sample (source: own research)

Some of the respondents stated one answer (responded to the stated question only once) – this was a case of the respondents who teach only one subject or two subjects, but both of the same character. The rest of the respondents – those who teach subjects of different character (e.g. math and foreign language) stated two answers – one for each of the two taught subjects. This means that the total number 133 stated in Table 2 represents a sub-group of 133 teachers, from the total number of the 173 respondents, who teach either one or two natural science subjects.

As to the character, the subjects were classified into five categories:

- natural science subjects,
- foreign languages,
- social science subjects,
- artwork and educational subjects,
- professional (vocational) subjects.

Collected data were processed by means of the statistical analysis in dependence on the factors presented in Table 1. Analysis of the respondents' responses on the factor category of the taught subject was based on contingency analysis, by means of which the measure of interdependence between two nominal variables is determined, i.e. it is used to analyse dependence of nominal variables, whether they are dependent of each other. Because of low expected frequencies, in frame of the non-parametric tests chi-quadrat test of independence, to test significance of contingency coefficients, was not used. The only assumption of chi-quadrat validity is, that the expected frequencies are bigger or max equal to 5 (1).

$$e_{ij} = \frac{r_i s_j}{n} \geq 5 \qquad (1)$$

In some cases, this assumption was corrupted. Because of that, null hypotheses, to test independence of the tested variables, were not stated, and so the contingency coefficients were calculated and the dependences were visualised.

Degree of the statistical dependence between the observed qualitative features were assessed on the basis of the contingency coefficient C and Cramer's contingency coefficient V (Cohen, In Rimančík, 2007).

Results

Because of the limited space, thereinafter there are presented and discussed in detail only results for teaching natural science subjects (Table 2). For the other groups of subjects we present only overviews of the main results (Table 3).

The contingency table (Table 2) presents recorded interaction frequencies of the responses in dependence on the respondents' segmentation factor sub-category of the teaching staff for the group of natural science subject teachers. At the same time, it shows also the main purposes for which the natural science teachers apply interactive activities and digital means in their teaching practise (the global results included in the table, i.e. results obtained for the whole group of the respondents, without their differentiation on the value of the factor sub-category of the teaching staff). The highest percentage occurrences (from the total number of 133 responses of all respondents) were recorded in case of the alternative responses b – to explain and exemplify new subject matter (50.38%) and a – to invoke greater motivation to learn (39.85%). The rest of the reasons to apply digital means into the natural science subjects teaching does not account any significance.

The presented results could be considered to be trivial or of low importance, expecting that the rest of the results (results regarding the purposes of the use of digital means in teaching the other groups of subjects, i.e. in teaching social science subjects, foreign languages, artwork and educational subjects, and professional/vocational subjects) have been more or less the same. In fact, the results for the particular groups of the subjects differ considerably (see Table 3). In case of teachers of natural science subjects the contingency analysis showed, that independently on the factor sub-category of the teaching staff there is no difference in purposes why they use interactive activities and digital means in their practice to support efficiency of the teaching and learning processes. Obtained value of the contingency coefficient (Contingency coefficient: 0.1881279; Cramer's V: 0.135445) proves that the measure of the dependence of responses of the particular sub-groups of the respondents on their affiliation to the relevant professional sub-category of the teaching staff is weak. The same (low measure of the dependence of the purpose for which the teachers use the digital means in teaching on the sub-category of the teaching staff they belong to) can be stated also for social science teachers (Contingency coefficient: 0.212146; Cramer's V: 0.1535039). For teachers teaching foreign languages, artwork and educational subjects and professional (vocational) subjects this measure is much higher, even moderate (Contingency coefficient: foreign languages 0.3729802, artwork and educational subjects 0.3075764, vocational subjects 0.5168308; Cramer's V: foreign languages 0.2842484, artwork and educational subjects 0.2285696, vocational subjects 0.4268892).

The percentages of the relative frequencies of the particular responses presented in Table 3 refer to the total frequencies of the particular responses recorded for teaching the relevant subject category (see the explanation stated bellow Table 1). These were in case of natural science subjects 133, in case of social science subjects 108, in case of foreign languages 107, in case of artwork and educational subjects 100 and 18 for professional (vocational) subjects.

Teaching natural science subjects	Sub-category of the teaching staff			Row – Totals
	primary education teachers	lower secondary education teacher	upper secondary education teacher	
a – *to invoke greater motivation to learn*	32	18	3	53
column %	39.02%	41.86%	37.50%	
row %	60.38%	33.96%	5.66%	
Total %	24.06%	13.53%	2.26%	39.85%
b – *to explain and exemplify new subject matter*	43	19	5	67
column %	52.44%	44.19%	62.50%	
row %	64.18%	28.36%	7.46%	
Total %	32.33%	14.29%	3.76%	50.38%
c – *to fixate new subject matter*	3	3	0	6
column %	3.66%	6.98%	0.00%	
row %	50.00%	50.00%	0.00%	
Total %	2.26%	2.26%	0.00%	4.51%
d – *to apply acquired knowledge*	2	3	0	5
column %	2.44%	6.98%	0.00%	
row %	40.00%	60.00%	0.00%	
Total %	1.50%	2.26%	0.00%	3.76%
e – *to diagnose and grade pupils / students*	2	0	0	2
column %	2.44%	0.00%	0.00%	
row %	100.00%	0.00%	0.00%	
Total %	1.50%	0.00%	0.00%	1.50%
Total	82	43	8	133
Total %	61.65%	32.33%	6.02%	100.00%

Table 2: Contingency table of the frequencies of the particular responses recorded at the stated question according to the factor sub-category of the teaching staff (source: own research)

Teachers of	Relative frequencies of the particular responses				
	natural sciences	social sciences	foreign lang.	artwork, educ. s.	profess., vocat. s.
a – *to invoke greater motivation to learn*	39.85	30.56	44.86	60.00	33.33
b – *to explain and exemplify new subject matter*	50.38	43.56	28.97	17.00	16.67
c – *to fixate new subject matter*	4.51	15.74	15.89	15.00	38.89
d – *to apply acquired knowledge*	3.76	9.26	9.35	6.00	11.11
e – *to diagnose and grade pupils / students*	1.50	0.93	0.93	2.00	0.00

Table 3: Relative frequencies of the particular responses stated by different subject teachers (source: own research)

DISCUSSION

Alike the results of our research, conclusions of a number of other research studies confirm that the use of digital means in teaching has a significant motivational impact on pupils (Bártek, Nocar, Wossala, 2016; Clarke, Svanaes, 2014; Klement, 2014; Olofsson, Lindberg, Fransson, Hauge 2011; Harris, 2010). A research done by Brotánková (2016) showed, that most of the basic school teachers (lower level of secondary schools – ISCED 2) in the Czech Republic use digital means in their teaching practice most frequently to present illustrative materials and film sequences and to present exercise assignments. Currently Hladný (2018) carried out an empirical investigation

to find out for what purposes secondary school teachers in the Czech Republic (upper level of secondary schools – ISCED 3) use the digital means. The results showed that teachers use digital technologies mainly for purposes of new subject matter presentation (explanation) and completing the explanation of the new topics by different demonstrations. To a lesser extent the teachers use these means to test and asses how students' have acquired the new knowledge.

As to the natural science subject teaching we assess the obtained results as very positive mainly because of two reasons. The first is that natural science subjects are very demanding in relation to abstract thinking and abstract imagination. Therefore, it is very desirable to bring the presented subject matter nearer to learners based on the use of the newest technologies to support their understanding of the presented topics. The second one is may be even much more important. It regards the fact which has been proved in many researches, and it is that natural science subjects belong to the unpopular ones (Akarsu, 2017; Odcházelová, 2014; Lamanauskas, 2013; Yazachew, 2013). In this context, we appreciate that natural science teachers have an outstanding tendency to look for new possibilities to influence pupils and students' interest in natural science, to cultivate their curiosity about the world around them and to form their motivation in natural science study.

Conclusion

The obtained results has proved a dependence of the purposes for which teachers use the digital means during their lessons on the character of the taught subjects (there are differences among the main significant purposes to use the digital means in teaching the respective groups of the subjects to increase efficiency of their teaching). On the other hand, the dependence of the purposes for which the teachers use the digital means in their teaching practice on the sub-category of the teaching staff to which a teacher belong has not been proved. These results should be taken into consideration at creation curricula of teacher trainees' didactic-technological preparation as well as at creation curricula of professional development courses focused on upgrading in-service teachers' didactic-technological competences.

Acknowledgements

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