

Journal on Efficiency and Responsibility in Education and Science



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Aims and Scope

The Journal on Efficiency and Responsibility in Education and Science aims to publish perspectives of authors dealing with issues of efficiency and/or responsibility in education and related scientific disciplines. The focus is on topics such as:

- theory and methodology of pedagogy and education;
- theory and methodology of science;
- human resources and human relations management;
- knowledge management and knowledge engineering;
- systems engineering and information engineering;
- quantitative methods.

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RESPONSIBILITY OF SCHOOL'S LEADERS IN TACKLING THE E-LEARNING BARRIERS IN TECHNICAL AND VOCATIONAL EDUCATION HIGHER INSTITUTIONS

Abstract

This conceptual reviewed paper looks critically at the trend of information and communication technology especially now that the implementation of e-learning is gaining more relevance in Nigerian tertiary institutions. It discusses the level of preparedness in terms of the required skills by Technical and Vocational Education (TVE) teachers, availability of infrastructures and other constraints in using the ICTs for effective teaching and learning. Beside, leadership strategies ranging from school administration, executive leaders and policy makers roles were also discussed as a vital component in line with the outlined barrier to TVE teacher preparedness to e-learning. Specifically, the study sought to answer four among the most critical questions that need to be addressed for effective implementation of e-learning in Nigerian tertiary institutions. The paper concluded by suggesting strategies based on the four questions stated in this study. Amongst are urgent step needs be taken by school and executive administrators and policy makers in the training of TVE teachers in the relevant ICTs areas through in-service training and seminars/workshops.

Key Words

Information and Communication Technology (ICTs), Technical and Vocational Education TVE Teachers and Leadership

Mohd Khata Jabor, Magaji Ibrahim Sale,
Ahmad Aliyu Deba, Aede Hatib Musta'mal, Abubakar Sadiq

¹Faculty of Education, Universiti Teknologi Malaysia,
Skudai Johor Bahru, Malaysia

²School of Technical Education, F.C.E (Technical) Gombe,
Gombe State, Nigeria

³Vocational & Technical Education Programme,
A.T.B.University, Bauchi, Bauchi State, Nigeria

ahmadaliyu@yahoo.com

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Introduction

Information communication Technology ICTs is increasingly becoming more widespread throughout tertiary institutions in many countries including Nigeria and other African nations. Advantages offered by ICTs have made Authors, for instance Yekini, Rufai, Adetoba, Akinwale, & Ojo, (2012) to recommend that the new reforms in higher education can best be supported through the utilization of the advantage offered as a result of the new advancement of ICTs. Many tertiary institutions in the developing countries like Nigeria, Mauritania, Ghana, Uganda and many more have understood great roles of this valuable technological paradigms and turning to use of it in the form of what it is referred to as e-learning as complement to teacher led tuition on campuses. The vital role of TVE in the production of skilled and competent personnel necessary for economic, social, industrial, and technological development cannot be achieved if an effective and efficient learning and teaching process is not maintained in the programme. In reality, according to Aina (2009) and Sukri & Shu'aibu, (2013) stated that the success of all plans concerning technology and industrial development depends to a large extent on the ability of TVE to raise and have dedicated ICTs and on the same vein on the ability of the programmes to raise competent TVE teachers. The teacher in any form is a strategic to the development of the education. In this regard, Samuel & Olusiji (2013) revealed that if the quality of the TVE teacher is not adequately enhanced through effective teacher preparation programmes to become intelligently richer, more challenging and extended beyond pre-service training into a system of continuous professional career development, the nation's dream self-reliable nation through scientific and technological development will be an illusion.

It has become very paramount for TVE teachers to be technologically literate enough to apply the modern ICT such as the computer, internet, and the internet technologies to make use of them in their instructional delivery in order to be able to critically face the challenges of the present global information world. This is one of the ways to produce TVE graduate that can compete with their counterpart in the global workforce. However, e-learning in its broadest sense according to Bappa-Aliyu, M. (2012) refers to instruction delivered via an electronic media including the internet, intranets, extranets, satellite broadcast, audio/video tape, interactive television, CD-ROM. In the view of Robinson & Robertson, (2010) e-learning means using ICT in teaching and learning. In another development the concept of e-learning according to Olele & Williams (2012) is broadly interpreted to embrace any teaching and learning activity that involves the use of ICT. Besides all, proponents of ICT in education for instance, Jegede (2011) has made it clear that one of the most cited reasons for using ICT in the classroom has been to better the current generation of students for a workplace where ICT particularly computers, the internet and related technologies are becoming more and more ubiquitous. The ability to use ICTs effectively and efficiently is thus seen as representing a competitive edge in an increasingly globalizing job market.

The potentialities of E-learning in Higher Education

Numerous researchers around the world are having common opinions about the importance of e-learning toward sustaining sound education in schools. For instance, it enhances access to quality education as it has potentials of reaching out to so many learners and offering education where quality is not compromised (Ukwungwu 2004), improves educational

delivery system as it aids teachers and students in the teaching and learning processes (Wuru, 2008), promotes self learning capabilities of ICT-enabled education and enhance mastery of subjects by University students as well as teachers, enables optimal utilization of existing ICT facilities (Olele & Williams 2012), reduces and even eliminate anti social activities in the school system (Tondeur, et al, 2008) and indeed encourage global competitiveness in the education system (Samuel, & Olusiji, 2013). The fact that relevant literatures revealed positive breakthrough of e-learning system, yet barriers to it integration in the educational system particularly TVE remain a matter of concern.

TVE teacher programme in tertiary institutions may therefore either assume a leadership role in the transformation of TVE or to be left behind in the swirl of rapid technological change. According to Agumuo (2005) for TVE teachers reap the full benefits of ICT for effective elearning in tertiary institutions, it is essential that pre-service and in-service TVE teachers have basic ICTs skills and competencies. The need for having these basic literacy components is deemed necessary because e-Learning is now an essential component of education.

Everything that higher education leaders do, such as creating effective learning environments, creating positive relations with the community, managing the staff, establishing a vision, setting goals, building support systems for staff and students, and monitoring effective instruction, must be in service of student learning (IEL, 2000). Knowing the great roles of technology today, educational leaders are challenged to find which leadership practices effectively influence teachers to improve their instructional techniques and to continue their professional development and growth, in addition to focusing their attention, and the attention of the entire school

community, on student learning through the use of ICT. "As studies show the crucial role that higher education leaders can play in improving teaching and learning, it is clear that these leaders today must also serve as leaders for student learning" (UNESCO 2002). The traditional hierarchical leadership styles, once The traditional hierarchical leadership styles, employed by principals and other school administrators are not sufficient for schools today. Rather, educational leaders are expected to be learning leaders (Reeves, 2006) who also have the capacity to nurture relationships and foster the ability to shape schools into learning communities. This library research paper is guided by four research questions deliberately formulated to answer e-learning readiness of TVE teachers in tertiary institutions as follows:

1. What is the status of e-learning in TVE tertiary institutions in Nigeria?
2. What are the ICT skills needed by TVE teachers to be able to use and apply ICTs in their teaching activities?
3. What are the constraints to the adoption of e-learning among TVE teachers in tertiary institutions?
4. What are the leadership strategies to be adopted for effective skills acquisition in ICTs by TVE teachers for effective implementation of e-learning?

Status of Information and Communication Technology Infrastructure

According to the UNESCO (2002) world report which stressed the need that a country's educational technology infrastructure must sits on top of the national telecommunication and information infrastructure and hence, before any ICT based

programme is implemented policy makers, educational planners and school administrators must carefully consider the following:

1. Are there appropriate rooms or building available to house the technology?
2. Another basic requirement is the availability of electricity and telephone is miles away
3. The third factor to be considered ubiquity of different types of ICT in the country in general and in the educational system (at all levels) in particular. for instance, a basic requirement for computer-based learning or on-line learning is access to computers in schools, communities as well as affordable internet services

Technology optimist expressed great expectations for the potentials of ICT in future attempt to address the most pressing challenges in Nigerian education. In the African tertiary institutions connectivity survey (ATICS) (2004), Nigeria was represented by 8 universities and the summary of the findings from the survey conducted prove abortive about adequacy of ICTs facilities. The summary extracts are as follows:

1. None of the Universities surveyed has access to International Fibre and are likely to rely on satellite connectivity in the near future
2. Broadband capacity for the institutions surveyed is well under what is now considered as household norms in the USA and Europe
3. Rate charged per kbps/month are exorbitant compared to the rates charged in USA and Europe. VSAT companies are the most experience
4. Donor initiatives and academic networks have the largest bandwidth, whereas the smallest average bandwidth was

recorded for institutions using private ISPs

5. The formation of consortia has been useful to enhancing bandwidth quality and reduced cost elsewhere in the world
6. There are considerable differences in levels of computer access between distributions
7. The number of users per computer combined with the bandwidth available per computer determines the utility of the internet for each user. In some institutions loading a single webpage takes several minutes and the used of web based mail, electronics journals and scientific databases will be virtually impossible

According to Moon (2005) in the 2003 e-learning readiness ranking, compiled by the Economist Intelligence Unit, Nigeria was ranked 60 out of 60. Moon concluded that it is probably safe to predict that Nigeria Public will be barred from general access to the modern ICTs for a long time because quite preferred factors indigenous to Sub-saharan Africa will continue to influence the development negatively. It is against this background that Ndukwe (2006) regretted the extensive lack of basic ICT skills among Nigeria teachers and students in tertiary institutions. Many ICT advocate have connect access to technology and competence in using it. For instance Moon (2005) opined that access to technology and competence in using it are mutually interdependent on each other. As such it is right to pronounce that competence in using modern ICTs cannot be developed without access to the same technology. On the other hand investment in technology will soon prove futile if competence in the use of the same technology is not developed.

BARRIER TO THE INTEGRATION OF ICT IN TVE

Modern technology offer many means of improving teaching and learning in the classroom. Dawes (2004) opined that new technologies have the potential to support education across the curriculum and provide opportunity for effective communication between teacher and students in ways that have not been possible before. ICT in education has the potential to be influential in bringing about changes in ways of teaching. However, these potential may not be easily realized as stated by Dawes without effective competency of the teacher. The issue of TVE teacher ICT competency in Nigeria remained a top topic of debate among TVE practitioners. For instance, Albirini (2009), Al-Alwani (2005) and many to mentioned stated that problem arise when teachers are expected to implement changes in what may well be adverse circumstances.

Due to importance of ICT in the society and education in particular identifying the possible obstacles to the integration of these technologies in the education specifically TVE would be an importance step in improving the quality of learning and teaching in the field of TVE. The act of integrating ICT into learning and teaching is a complex process and one that may encounter a number of difficulties. Difficulties affecting the integration of ICT in TVE according to Schoepp, (2005) are known as barrier. These barrier are been categories as 'intrinsic' and 'extrinsic' barriers. These two forms of barriers are view by researchers from different point views. Ertmer, (1999) referred to extrinsic barrier as first-order and cited time, support, resources and training. While according to this researcher intrinsic barrier as second-order and cited attitude, beliefs, practices and resistance. Other researchers such as Al-Alwani (2005) viewed extrinsic barrier as pertaining to organization rather than individuals and intrinsic barrier as pertaining

teachers, administrators and individuals. Likewise, Albirini (2009) has grouped barriers as teacher-level barriers and school-level barriers. For the purpose of this library work the barrier to e-learning integration in TVE will be view based on the opinion of Albirini as follows:

TEACHER-LEVEL BARRIERS

Teacher-level barrier to e-learning in many countries has remained a point of debate among researcher in the field TVE. Many researchers have shed light to this aspect of barrier as one of the contributory factor that militates against e-learning in developing countries. Teacher-level barrier have been outlined to include but not limited to:

1. **Lack of Teacher confidence:** several researchers for instance Beggs (2008) and Dewes (2001) among others indicate that one barrier than prevent teachers from using ICT in their teaching is lack of self-assurance. Teachers lack self confidence with the use ICT for fear of failure (Beggs (2008). According to him limitation in teacher's knowledge makes them feel anxious about using ICT in the classroom and thus not confident to use it in their classroom teaching.
2. **Lack of Teacher Competence:** another similar barrier that relate to teacher about the use of e-learning in school is lack of teacher competence in integrating ICT into their pedagogical practices. Albirini (2006), likewise Bingimlas (2009) observed that lack of technology competence serve as one of the main barrier to their acceptance and even the adoption of ICT in their instruction delivery. Research finding from a worldwide survey conducted by Pelgrum (2001) revealed that teachers' lack of knowledge and skills in the area of ICT is a serious obstacle to using ICT at all levels of Education.

3. Resistance to Change and Negative Attitude: research findings such as Albirini (2006) and Schoepp (2005) among others indicated that teacher's attitude and inherent resistance to change was significant barrier to e-learning in most developing countries including Nigeria and this has made many teachers not to adopt ICT into the classroom for their instructional activities. They also showed that teachers who resist to changes specifically to do with technology are not rejecting the need for change but lack the necessary education in accepting that changes and are given insufficient long-term opportunities to make sense of the new technologies for themselves.

SCHOOL-LEVEL-BARRIER TO E-LEARNING IN TVE

Despite teacher-level-barrier to e-learning in TVE some barrier are considered by other researchers as school-level-barrier to comprise the following:

Lack of time: research findings such as begs (2000), Al-Alwani 92005) and Albirini (2006) among other indicate that teachers who have competence and confidence in using ICT in the classroom still make little use of technologies because they do not have enough time. This includes the time the teachers have to plan technology lessons, explore the different internet sites or look at various aspect of educational software. Also they lack the time needed to prepare lessons, explore and practice using the technology, deal with technical problems and receive adequate training.

Lack of Effective Training: research findings such as Beggs (2000), Schoepp (2005) and Sicilia (2005) among other showed that there was not enough training opportunity for teachers on the use of ICT in a classroom environment. According to Albirini (2006) the issue of training has to do with several components to ensure effectiveness of the training in digital

literacy, lack of pedagogic and didactic training on how to use ICT in the classroom and lack of training concerning the use of technologies in technology specific areas were recognized as obstacles to using new technologies in the classroom.

Lack of Accessibility: the barrier relating to accessibility of new technologies for teachers are wide spread and differ from country to country (Empirica, 2006). In general these barriers include insufficient number of computers, insufficient peripherals, and insufficient number of copies of software and insufficient simultaneous internet access. Other includes lack of appropriate infrastructure and a lack of appropriate material resources. Similarly, Olele & Williams (2012) asserts that poor choices of hardware and software and lack of consideration of what is suitable for classroom teaching are problems facing many teachers. These limitations influence teachers' motivation to use ICT in the classroom.

Lack of Technical Support: without adequate technical support both in the classroom and whole school resources, teachers cannot be expected to overcome this barrier. These technical barriers include waiting for websites to open, failing to connect to the internet, printer not printing, malfunctioning computers and teachers having to work on old computers. In teaching TVE studies by Gomes (2005) revealed that integration of ICT in TVE teaching and learning needs a technician to constantly check the system or devices.

Strategic Leadership Roles for Effective Implementation of E-learning in TVE

Leadership can either hinder or support the implementation of technology in higher education, as decision makers develop policies, they must consider how the policies affect acquisition of and access to technologies for e-learning. Policies related to

use of technology should also support the use of technology rather than obstruct it. According to Chitana et al (2008) if the provision of e-learning is to become a key element in any educational institution, government in collaboration with professional bodies should provide a programme for staff development and regular retraining of teachers in the area of ICT skills identified in the study. Other strategies included the following:

1. Provision of E-learning infrastructure and a range of e-learning tools that are of high quality
2. Effective collaboration among departments and institution for the provision of information, training and support required by teachers and student in the use of e-learning tool and facilities
3. School administrators should identify Universities and other tertiary education curricular areas where e-learning could be employed to both effect and promote the use of elearning in these areas
4. Higher institutions leaders should establish mechanism to support academic staffs in using e-learning facilities and tools to beat effect in the development and delivery of instructions.

Conclusion

ICT is increasingly becoming more widespread throughout tertiary institutions in many countries across the world including developing countries like Nigeria. Access and competence to ICTs should go along with the access to the same technology. Developing a high competence level in the pedagogical uses of ICTs will continue to be a challenge in educational institutions. A well defined policy for the training of TVE teachers in these

new technologies area should be made and also appropriate facilities should be put in place to be supported with adequate funding and good maintenance culture.

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THE QUALITY OF MATHEMATICAL PROBLEMS – EVALUATION AND SELF-EVALUATION

Eva Patáková

Charles University in Prague

eva.patakova@email.cz

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Abstract

The research presented in the article consists of two parts. Firstly, opinions on mathematical problem quality are explored within four groups of participants (novices, specialists and experts in problem posing; high school students who never posed their own problems). Secondly, self-reflections written by the participants who have some experience in problem posing (novices, specialists and experts) are explored and compared with the general view of problem quality received in the first part of the research.

The more experienced problem posers have more requirements on problem quality (both as general requirements and within their own work on posing problems). There is a slight decrease in ability to notice important features of mathematical problem quality after the first experience in problem posing. Experts lay stress on mathematical features of the problem whilst novices and specialists more on problem – student interaction.

Key Words

Quality of mathematical problems, self-evaluative comments, problem posing, expert – specialist – novice comparison

Introduction

In this article, the term “mathematical problem” means a word problem that is more difficult and more elaborated than a common exercise. Stehlíková (2000) says that the exercise becomes a problem if the solver does not immediately see the solving strategy and he / she has to search for it.

The presented study is a part of research on the comparison of problem posing process by problem posers on various experience levels. Problem posing is one of the developing fields in mathematics education. In this work, problem posing by various groups of professionals is explored.

A model of problem posing process of “skilled problem posers”¹ and novices has been made by Pelczer and Gamboa (2009). It includes the phases of Setup, Transformation, Formulation, Evaluation and Final assessment. The novices usually use a linear problem posing model (e.g. Setup – Formulation – Evaluation). Not all five phases of problem posing process are usually present. Mostly, there are nearly no transformations. (If a novice finds out that his / her suggested problem is not good, he / she does not transform it but drops it completely and starts from the beginning.) On the contrary, the model of problem posing process by skilled problem posers is cyclic. A skilled problem poser moves through various stages, transforms and sometimes performs the Final assessment stage.

The wider research which is the source of presented study (e.g. Patáková, 2013b) deals with three categories of respondents:

1. **Novices:** Participants with nearly no experience in problem posing.

¹ These are called “Experts” in the article by Pelczer and Gamboa. The term is changed in this study because “experts” have a different meaning there.

2. **Specialists:** Participants – mostly lower and upper secondary school teachers – who pose problems but not more than their teaching profession requires.
3. **Experts:** Very skilled problem posers – e.g. authors of problems for mathematical competitions, textbook authors, ...

The three groups were examined according to *idea types* used during their problem posing (Patáková, 2013b). Experts were found to perform most intentional ideas from the three groups. The intentional idea is such that the problem poser is fully aware of its consequences, it is completely goal orientated. Usually it means that some backward computation of conditions is necessary so that the problem completely fulfils the author’s goals. Specialists performed fewer intentional ideas than experts, participants from the novice’s category did not use this idea type at all.

Problem quality is a subjective concept that cannot be measured in an objective way. However, it is possible to look into the opinions on problem quality. For example, Tarhan et al. (2008) investigated opinions of 9th grade students while exploring problem-based learning in chemistry classes – within a questionnaire the students had to answer what quality a good problem should fulfil. Four dominant topics important for students as problem quality occurred: “The problem should be related to our prior knowledge. The problem should have some leading questions. The problem should be related to the daily life. Problem and questions should be clearly stated.” (Tarhan et al., 2008: 296)

The goal of the first part of the research is to explore the understanding of the quality of mathematical problems by four groups of participants – experts, specialists, novices, and secondary school students with no experience of problem

solving. (The first part of the research has already been described in Patáková, 2013a.) The second part of the research looks into the problem posing process of the first three groups; occurrence of application of problem quality criteria is explored. The research questions are namely:

1. What are the most important signs of “mathematical problem quality” for the participants?
2. What differences (described in a qualitative way) are there in “mathematical problem quality” opinions of the four groups (experts, specialists, novices, high school students)?
3. How are the opinions on “mathematical problem quality” applied during the problem posing process of the three groups (experts, specialists, novices)?

Material and Methods

Overall 106 participants took part in the study: 21 experts, 17 specialists and 23 novices; and in the follow-up study 45 high school students who never posed their own mathematical problems.

The novices – first year university students of mathematics education – and high school students took part in the research compulsorily; the participation of experts and specialists was voluntary.

In the *first part* of the research the participants were asked to write a short essay on their opinion on mathematical word problem quality.

The written essays were processed in Atlas.ti software and methods derived from the grounded theory were used for their interpretation. The first coding process was made without any abstraction (in vivo coding). There was no grouping of similar statements – the quotations were coded equally in case

they had the same meaning. 45 codes were obtained in this way (e.g. “ ‘Nice’ numbers in problem solution”, “Presence of propedeutics”, “Adequate difficulty”, ...). A first comparison was performed and codes related to each other were merged (these are called “sub-codes” in the following text). There were 16 sub-codes (e.g. “Benefit for the student”, “Adequacy”, “Inventiveness”, ...). After the second comparison and second code merging, 5 codes were obtained for the last analysis: “Problem assignment”, “Mathematical features”, “Motivational strength”, “Student”, “Comfort”:

1. **Problem assignment:** The code covers all assignment requirements. These are e.g. the assignment length, topic originality, intelligibility, unambiguous assignment, ...
2. **Mathematical features:** In most cases quotations coded as “Mathematical features” mean requirements on the process of problem solution. The participants want the problem to require non-standard solving methods, to be solvable by more than one method, ...
3. **Motivational strength:** The quotations coded as “Motivational strength” concern both the effect of the problem on a student and the features of the problem itself. It may concern the attraction of the problem, satisfaction felt by the student who solved the problem successfully, the surprising result, ... This code goes more into the mathematical attractiveness than into the attractiveness of the context.
4. **Student:** All quotations concerning a student, with the exception of motivational strength, are coded as “Student”. It means all requirements on problem difficulty, adequacy

of problem goals and problem purpose, effect on students, development of key competences of students², ...

5. **Comfort:** The code “Comfort” covers statements about practical use of a problem and its context. The problem should be applicable without any adaptations and using the problem should be comfortable. The main sub-code is “Correctness” which regards mistakes in problem assignment, in the author’s solution, in the non-mathematical context, ... The other sub-codes of Comfort concern e.g. the presence of an intermediate result, preferences of concrete topics, “nice” numbers, ...

A small follow-up study was carried out after the main study. When the data for the three groups of participants (experts, specialists, novices) had been processed, the same task – to write a short essay on their view of mathematical word problem quality – was given to 45 high school students. Their essays were processed by the code system gained during the main study phase.

The *second part* of the research was based on analysis of the written self-reflections of the whole problem posing process of the participants. The participants from the groups of experts, specialists and novices were asked to pose a difficult, interesting and original mathematical problem for approximately 15-year old students and to write a detailed self-reflection of their problem posing process. They were not told what exactly would be explored in the self-reflections. The topic of the problem was not given – Stoyanova and Ellerton (1996) call this “free problem posing situation”. (Here is impossible to repeat the follow-up

study with students not posing problems. If the task to pose a problem and write a self-reflection is given to them, they shift to the group of novices in problem posing.)

The opinions on the quality of mathematical problems are thus explored from a different point of view. Self-evaluative comments are searched for – i.e. notes in the self-reflections where the poser evaluates his / her steps and ideas in the problem posing process. So self-evaluative comments express some application of the general opinions on the quality of Mathematical problems – this application is made by the respondents within the context of the own problem posing process.

The example of self-evaluative comments:

*... So the question on the whole amount of divisors can be asked. ... I made a computation and found three solutions. ... **This is lovely but this too difficult for 15-year old students.** What to do about this? If the numbers are 7 and 9, ... ?*

The type and frequency of self-evaluative comments present in the reflections are observed. The comments were coded by 5 codes obtained during the first research phase. The three groups of respondents were compared again. Differences between general opinions on problem quality of the participants and their practical applications were described as well.

Results

Results of the first phase will be first presented in terms of the group of participants and next in terms of individual codes.

² The term “key competences of students” is one of the main terms used in recent Czech school reform (Kotásek et. al 2001) so it is no wonder that it appears in the essays frequently.

General view of the quality of problems by experts, specialists and novices

21 **experts** participated in the study. There are 88 coded quotations about opinions on quality of mathematical problems in their essays, which means 4.2 coded quotations per person, see Fig. 1.

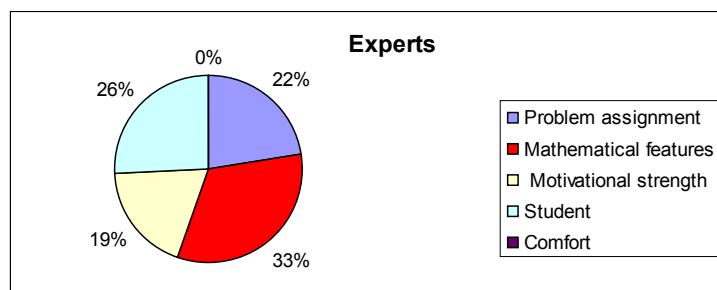


Fig. 1: Requirements on problem quality by experts³

The dominant topic for the experts is “Mathematical features of the problem”. Their problem quality requirements are both general and quite specific. Some examples:

The solution requires non-trivial ideas.

There is no possibility to avoid the supposed solution method by routine and not interesting testing of all possibilities.

The problem enables more than one solving method.

Solving of the problem requires deep understanding of the concepts used.

The story of the word problem does not bring factors enabling us to reject some intermediate results, which can be rejected in a clear

³ The graphs used in the article serve just to describe the research sample, they are not meant to express a general statement.

mathematical way as well. (E.g. ‘I reject the alternative that the width of the allotment is 7 meters because such an allotment would be impractically narrow.’)

The experts’ essays did not contain any quotations regarding “Comfort”. The question is why none of them mentioned correctness of the author’s solution. There are two possible explanations. The experts are likely to take it for granted or they do not perceive the author’s solution to belong to the characteristics of the problem.

17 **specialists** participated in the study. There are 62 coded quotations about opinions on quality of mathematical problems in their essays, which means 3.6 coded quotations per person, see Fig. 2.

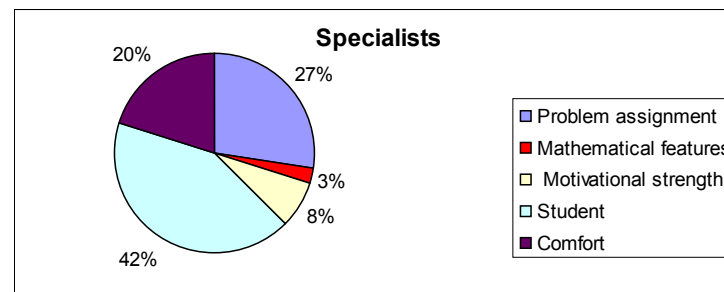


Fig. 2: Requirements on problem quality by specialists

As expected, the dominant feature of problem quality for specialists is “Student”. At least one quotation by a specialist is present in every sub-code forming the whole code “Student”. The quotations concern difficulty of the problem for students, adequacy of the problem for its purpose, adequacy of solving time, development of key competences, benefit of the problem for students. Some examples:

Not entirely easy solution.

The problem motivates a student to search for further knowledge; it cultivates his / her spoken and written language.

Adequacy for the students who should solve it.

To enrich the skills.

Links to further topics that will be taught in the class.

The problem may provide some added value for a student.

On the contrary, “Mathematical features” of the problem are mentioned only by two specialist participants – both of them want the problem to come up with something new.

23 **novices** participated in the research. There are 37 coded quotations about opinions on quality of mathematical problems in their essays, which means 1.6 coded quotations per person, see Fig. 3.

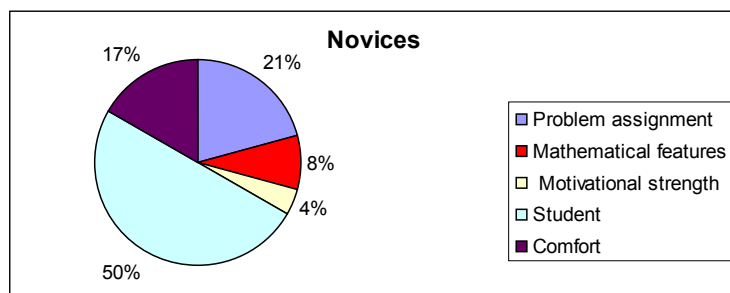


Fig. 3: Requirements on problem quality by novices

The amount of coded quotations per person is worth noticing. If compared with the other groups, this number is very low. The essays of novices were usually very short – mostly containing

only one or two coded quotations. The most frequent code is “Student” – 9 of the total 37 novices’ quotations were marked by “Not too easy” sub-code of the code Student. Some examples:

The problem is not too easy.

The problem forces the solver to think.

The problem requires some input knowledge.

The least mentioned code by the novices is “Motivational strength” – only two novice participants mentioned it.

Codes distribution in essays

The code “**Problem assignment**” contains quotations from all three groups of participants. However, quotations are distributed unevenly within sub-codes “Elegance” and “Intelligibility, Unambiguous assignment”. “Elegance” means clarity, brevity, accuracy of formulations, ... (e.g. *Clarity of problem assessment., The assessment isn’t complicated whilst the solution is easy.*) Most of the quotations coded as “Elegance” belong to experts (9 from 12). On contrary the sub-code “Intelligibility, Unambiguous assignment” was mostly related to quotations of specialists (14 from 21).

The majority of quotations coded as “**Mathematical features**” belong to experts (29 from 33). Sub-codes “Non-standard solving methods” and “Types of mathematical imperfections” consist of quotations written by experts only. There are some quotations by specialists and novices within sub-codes “Inventiveness” and “Problem solving process” but they also mostly belong to experts.

The topic “**Motivational strength**” is mentioned mostly by experts as well (17 from 23 quotations). Sub-codes “Attractiveness of problem assessment” and “Pleasure in solving” belong to experts only.

“**Student**” is a frequent topic for all three groups of participants. Some disproportions can be found within sub-codes “Not too easy” (9 quotations from 15 by novices), “Forces the student to think” (8 quotations from 12 by specialists), “Competences development” (6 quotations from 8 by specialists) and “Added value for the student” (7 quotations from 8 by experts).

As mentioned above, no quotation by experts regards “**Comfort**”. Some disproportion among specialists and novices can only be found within the sub-code “Correctness” (8 quotations from 9 by specialists).

Follow-up study with high school students

45 high school students (17–19-year old) participated in the study. There are 102 coded quotations about opinions on quality of mathematical problems in their essays, which means 2.3 coded quotations per person, see Fig. 4.

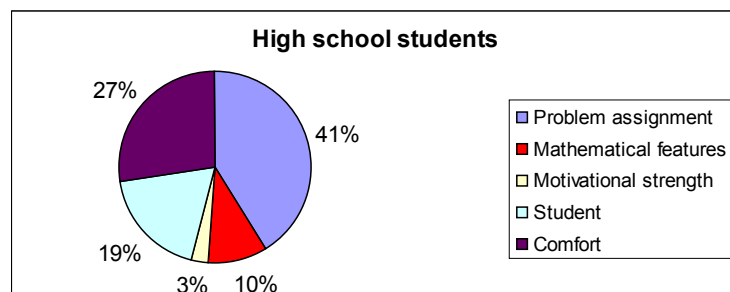


Fig. 4: Requirements on problem quality by high school students not posing problems

The dominant feature of problem quality for high school participants is “Problem assignment” which comes from a single sub-code “Intelligibility, Unambiguous assignment”.

This sub-code is the most frequent one in high school students’ essays (40 from 42 quotations coded as Problem assignment). This was mentioned by 34 from 45 high school participants. (6 of them made requirements on both parts of this sub-code – intelligibility and unambiguous assignment so they contributed twice to this sub-code.)

The second most frequented code was “Comfort” – the students very often required the problem to be pleasantly solvable for them. Whilst the other groups of respondents – in case they mentioned this aspect – want the problem to be original and non-routine, the students often want the opposite. Especially students with lower marks want the problem to be textbook-like, similar to the problem they know how to solve.

Requirements on specific topics which should / should not be included in the problem and requirements on daily-life situations are often present as well. Some examples coded as “Comfort”:

Daily-life situation, real context is more attractive for students.

Not off the topic discussed within the lessons.

It would be the best if there was a solution – both the solution method and the result for my control.

If it is clear what is to be computed.

The problems should ideally be posed by our teacher – such problems are optimal for the class and there are no problems with topics unknown to students.

Self-evaluative comments applied in the self-reflections

In the second part of the research self-evaluative comments were searched for in the self-reflections of the problem posing process. Thus we shift from the level of general requirements to the level of their applications. The respondents evaluated their

steps and intermediate results during problem posing and they used these evaluations to improve their problem. The graphs show the structure of self-evaluative comments in the self-reflections within the three groups of participants.

21 **experts** participated in the study. There are 118 coded self-evaluative comments in their self-reflections, which means 5.6 coded quotations per person, see Fig. 5.

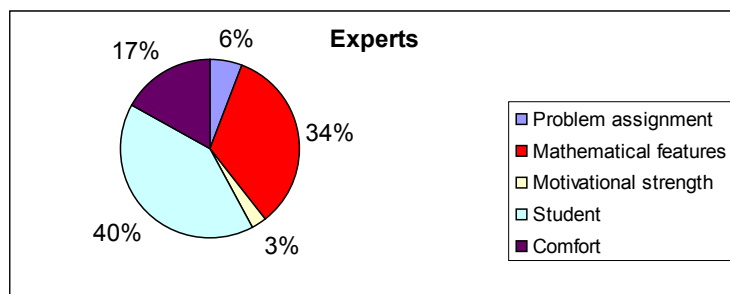


Fig. 5: Self-evaluative comments by experts

The majority of self-evaluative comments by experts regards the code "Student". The reason is that the evaluation of the difficulty of the problem and its suitability for the student appears frequently. There is a big ratio of quotations coded as "Mathematical features" again. Just as in general requirements, the experts lay stress on existence of different methods to solve the problem, non-routine solving methods etc. in their work. The quotations coded as "Comfort" occur as well – e.g. evaluation of the context of the problem. (I.e. the given numbers should not be in contradiction to reality ...) Some examples:

It is not good, the solution isn't elegant and there is no need to think much to find the idea to solve it. (Mathematical features)

The solution is fine – i.e. the numbers are not small enough to be easy to be guessed. (Mathematical features)

So... Why had the cars gone with the same speed before? Well, this is weird. I'll change it somehow later... (Comfort)

17 **specialists** participated in the study. There are 57 coded self-evaluative comments in their self-reflections, which means 3.4 coded quotations per person, see Fig. 6.

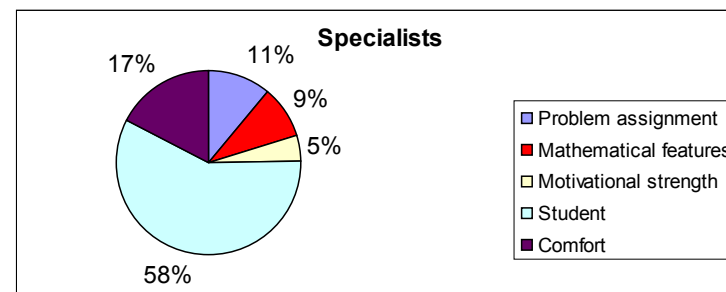


Fig. 6: Self-evaluative comments by specialists

The majority of self-evaluative comments of specialists regard the code "Student" where the dominant topics are the difficulty of the problem for students and the evaluation of the problem with respect to what the student should know (knowledge, abilities, competences). Some examples:

I must say I started to like my problem because of its complexity and simplicity at the same time. (Mathematical features)

It requires the geometrical insight, knowledge of the properties of geometrical shapes and mainly the ability to divide the problem into small tasks leading to the solution of the whole problem. (Student)

As for me it is not too difficult intellectually for children, rather it will demand concentration, patience and accuracy during the work and knowledge of what can be factored. (Student)

23 **novices** participated in the study. There are 34 coded self-evaluative comments in their self-reflections, which means 1.5 coded quotations per person, see Fig. 7.

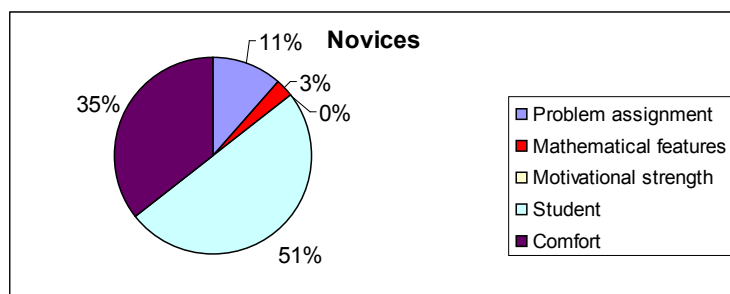


Fig. 6: Self-evaluative comments by novices

The dominant topic for the novices is “Student” where the main sub-topic is the evaluation of the problem difficulty again. Some examples:

But this is not enough to form a difficult problem. (Student)

But still I considered my problem to be too easy. (Student)

... 5 and 7 are better numbers – the computation will be more pleasant. (Comfort)

Discussion

The results – not surprisingly – show that the experts who participated in the study have the most complex set of general requirements on problem quality. Their essays were the longest and contained most coded quotations when compared with the other groups (4.2 coded quotations per person on average). Specialists have also quite a complex set of requirements on problem quality. The amount of their coded quotations is a bit lower (3.6 coded quotations per person). Their essays are shorter than the experts’ ones. Experts usually convey their statements in detail whilst specialists are often more concise. (Sometimes there are one-word quotations only – e.g. “Correctness”.) The least requirements on problem quality are observed by novices (1.6 coded quotations per person). This result comes from the fact that within creative work on problem posing it is necessary to think over problems (and their quality) in detail. As Zhouf (2010) states, an expert usually establishes his / her own requirements on problem quality and on this basis he / she decides about the future use of his / her posed problem. Specialists sometimes pose problems themselves and moreover they work with problems actively by selecting problems for students and working with them during the lessons. Novices usually meet the problems “only” as problem solvers which is a less active role in comparison with the other groups.

The same trend can be found within self-evaluative comments. Experts show the biggest amount of self-evaluative comments as well (5.6 coded quotations per person), lesser amount can be observed by specialists (3.4 coded quotations per person), the least amount was found in the self-reflections of novices (1.5 coded quotations per person). Again the participants show the trend that the more experienced problem poser uses more criteria on problem quality which can be found both in the

general essays and in self-evaluative comments of their own work. The last two mentioned results correspond with each other.

One fourth of novices' coded quotations in the general essays regard the opinion that the problem should not be too easy. The reason is probably that the participants wrote their essays immediately after they tried to pose their own problem. Here they found that if they try to formulate a problem which just crossed their mind, the problem is often trivial. Thus they consider posing a non-trivial problem to be "the art" and their statements about problem quality are the natural reaction on their own problems which they still remembered and which they rejected as poor-quality ones. This explanation is based on several interviews with the participants from the group of novices.

In the general essays of high school students not usually posing problems, the quotations about topics described by Tarhan et al. (2008, see Introduction) are quite frequent. If we consider the findings by Tarhan et al. within the codes introduced in this study, all of them would be coded as "Comfort" or "Problem assignment" (sub-code "Intelligibility, Unambiguous assignment") which corresponds with the findings of the presented study completely. Requirements namely on daily-life situations (coded as "Comfort" in this study) are frequent in another literature as well – e.g. Zhou (2012) states that students prefer real life engineering problems compared to hypothetical, academic problems.

An interesting result is that high school students not posing problems introduce more requirements on problem quality than novices in problem posing (high school students have 2.3 whilst novices only 1.6 coded quotations per person). A similar trend is showed in a different context in Vondrová and Žalská (2012).

They explored the ability of students to notice mathematics specific phenomena when observing mathematics teaching on video. Their interest lies in the amount of mathematics specific phenomena noticed and described by the students in their written reflections. Two groups of university students were explored: students before and after their compulsory pedagogical practice and mathematics education courses. Quite surprisingly a slight decrease in the "ability to notice" after completing pedagogical practice was found. The presented study shows the same phenomenon: the students who completed "their practice" – which means problem posing experience here – showed lower "ability to notice" important features of high-quality problems. The reason seems to be similar as Vondrová and Žalská state. One starts to be less critical when he / she finds what the activity – whether teaching practice or problem posing – really involves. Another reason could come from the differences between high school and university classes. (Participants not posing problems were from high schools, novices in problem posing were first-year university students.) The problems and exercises usually solved at the university are more difficult than high school ones but on the other hand they are rarely word problems.

Looking in self-evaluative comments within the self-reflections, all the three groups lay most stress on "Student". It is obvious that within their work problem posers frequently watch the difficulty of the posed problem. Though the ratio of "Mathematical features" quotations by experts remains high as well, the other groups do not accent it much. Within the code "Comfort" all the three groups watch the adequacy of the context and the "nice numbers" more than they did in general essays. This comes from the situation. They just describe the process of problem posing – it means also posing the context so they

are forced to work with it and it often inspires them to make a self-evaluative comment. The ratio of “Motivational strength” is lower within all the three groups than it was in general essays⁴. The reason is probably that the big part of attractiveness of the problem’s mathematical content lays in the good choice of the topic which can be influenced only a little later.

The above findings on problem quality requirements coming from both research phases correspond with the model of Pelzer and Gamboa (2009). In their model, problem posers are grouped as novices and “skilled problem posers”. Using the terminology of this study, novices remain the same and skilled problem posers correspond with specialists and experts together. Novices usually pose problems according to a linear model whilst skilled problem posers follow the cyclic one. The research presented in this study shows that skilled problem posers have a more complex set of requirements on problem quality. If they want to fulfil all of them, it is natural that they have to improve their problem, to enrich it and to adapt it many times – these are typical signs of the cyclic model of problem posing. To fulfil fewer criteria it is enough to elaborate an initial idea directly – without any corrections – just implying one or two criteria. If the initial idea does not prove to be suitable to fulfil these criteria, the poser drops it and looks for another initial idea. These are typical signs of a linear problem posing process described by Pelczer and Gamboa (2009).

The findings correspond with my previous study (Patáková, 2013b) as well. Experts were found to perform most intentional ideas. This is in agreement with the finding that experts have

the most complex set of requirements on problem quality. They know exactly how their problem should look – and intentional ideas help them to fulfil the goal.

Conclusions

The experts are the group who deals most with “Mathematical features” from the explored groups. (They have a lot of requirements on assessment elegance, problem solving process, attractiveness of the problem for students, new pieces of knowledge and new views of the mathematical topics for students, adequate problem difficulty, ...) They have most requirements on problem quality from the explored groups.

Specialists emphasise more the effect of a problem on a student and the practical use of a problem. (The problem should be correct, force students to think, develop important skills and competences.) They have quite a complex set of problem quality requirements as well.

Novices introduce quite a narrow set of requirements on problem quality related mostly with their first experience on posing non-trivial problems with a dominant need to pose a problem which is not too easy for its solver.

High school students not posing problems look at the thing from another point of view. Mostly they do not think about problem quality in general but about himself / herself working with the problem. (How the problem should look to be pleasant for them to solve it.) They have more general requirements on mathematical problem quality than novices in problem posing. The study will be deepened and connected to the findings from the wider research.

⁴ This is not processed statistically because the data from the two phases does not have exactly the same character.

Acknowledgements

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BE BORN AS SUCCESSFUL MATHEMATICS OR LANGUAGE LEARNER: MYTHS, TRUE OR FALSE?

Marek Sedlačík, Ivana Čechová, Lucie Doudová

Czech University of Life Sciences Prague
marek.sedlacik@unob.cz

Abstract

Applied mathematics and English language belong among consequential subjects within the Faculty of Economics and Management curriculum. The authors focused on these two subjects and apart from their description they deal with entrance exam analysis for bachelor degree at the Faculty of Economics and Management, which is a part of the University of Defence. In an endeavour to widen the understanding referring to factors predicting academic achievement in tertiary education, the authors compare the entrance test results and try to find out whether there is an independent relationship between success in the English language test and success in the Learning Potential Test. Exploratory statistics and methods of non-parametric statistics for testing of the hypothesis regarding this relationship is described in the last part of this article.

Key Words

Applied mathematics, bachelor study programmes, English language, entrance exams analysis, multiple intelligences academic achievement

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Introduction

Today we live in a complex social and political world. More than ever before, we want to plan our own lives, we are expected to contribute actively to society, and must learn to live positively with cultural, ethnic and linguistic diversity. Education, in its broadest sense, is the key to learning and understanding how to meet the 21st century challenges. The importance of education for Europe has been endorsed at the highest level in the last decades. "Europe can – and must show that it is possible both to achieve dynamic economic growth and to strengthen social cohesion. Emphasising that, people are Europe's main asset and should be the focal point of the Union's policies. Above all, education and training systems must adapt to the new realities of the 21st century and that lifelong learning is an essential policy for the development of citizenship, social cohesion and employment" (European Council Presidency Conclusions). Student success has become a primary focus of today's educational institutions and is an area of national concern.

Education and training has been crucial for successful career and life, for growth and jobs and they have been a key element for its follow-up with the 2020 perspective. In accordance with Education and Training 2010 work programme "creating a well-functioning knowledge triangle of education, research and innovation and helping all citizens to be better skilled are crucial for growth and jobs, as well as for equity and social inclusion". The European Framework for Key Competences for Lifelong Learning identifies and defines eight key competences necessary for personal fulfilment, active citizenship, social inclusion and employability in a knowledge society:

- communication in the mother tongue;
- communication in foreign languages;

- mathematical competence and basic competences in science and technology;
- digital competence;
- learning to learn;
- social and civic competences;
- sense of initiative and entrepreneurship;
- cultural awareness and expression (Education and Training 2010 work programme; Crick, R. D., 2008).

European Union in its endeavour to apply the above mentioned competences into the member states education policies as well as to improve education and training systems set the following strategic objectives:

- improving the quality and effectiveness of education and the measurement of progress through agreed instruments;
- facilitating the access of all to education and training systems;
- opening-up education and training systems to the wider world.

However, the successful mastery of academic content, once viewed entirely as the learners' responsibility, is now considered a shared responsibility between three major players: the student, the teacher, and the educational institution.

Faculty of Economics and Management teachers are fully aware of the European education policy and they strive for applying it in their teaching practice.

Mathematic and linguistic intelligences

However, the authors, teachers of applied mathematics and English language, quite often face the widespread prejudice: “people are either born good at mathematics or language”. Is it true or myth? Is it possible to be good at both subjects? And how to achieve it?

Generally said, people have multiple intelligences but most people excel in only few areas because it is what they develop, for example, most artists develop and practice their skills in the arts more, so they tend to neglect the mathematics and science. Mathematics and languages are controlled by different sides of the brain: aptitude in mathematics is controlled by the left brain, while aptitude in languages is controlled by the right and people are either more of the left-brainer than the right-brainer. Some people balance their aptitudes, but most people don't.

According to Howard Gardner, a psychologist and professor of neuroscience from Harvard University, human beings have eight different kinds of intelligence that reflect different ways of interacting with the world:

- Linguistic intelligence (word smart)
- Logical/Mathematical intelligence (number/reasoning smart)
- Spatial intelligence (picture smart)
- Musical Rhythmic intelligence (music smart)
- Bodily/Kinaesthetic intelligence (body smart)
- Intrapersonal intelligence (self-smart)
- Interpersonal intelligence (people smart)
- Naturalist intelligence (nature smart).

Gardner's theory has emerged from recent cognitive research and documents the extent to which students possess different kinds of minds and therefore learn, remember, perform, and understand in different ways (Gardner, 1990). According to this theory, “we are all able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, and the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves” (Gardner, 1990). This theory has been confirmed in the Lazear research as well (Lazear, 2003).

Where individuals differ is in the strength of these intelligences - the so-called profile of intelligences - and in the ways in which such intelligences are invoked and combined to carry out different tasks, solve diverse problems, and progress in various domains. “Each person has a unique combination, or profile. Although we each have all eight intelligences, no two individuals have them in the same exact configuration” (Gardner, 1990).

In his later work Gardner states: “Much work needs to be done on the question of how the intelligences can best be mobilized to achieve specific pedagogical goals” (Gardner, 2003). It is complicated to grasp multiple-intelligences theory and implement its implications effectively. However, those teachers who thoughtfully use this theory to support their wider educational goals find it a worthy partner in their subject improvement.

The objective of this paper is to assess and interpret relations and dependencies among variables characterizing mathematic and linguistic intelligences. In particular, the paper aims to compare relationship between success in the English language test and

in the Learning Potential Test and to find out what differences or similarities there are between English language and Applied mathematics marks.

To fulfil the above listed aims, instruments of descriptive statistics and methods of non-parametric statistics have been applied. All the calculations have been performed using the Application STAT1 (Neubauer, Sedlačík and Kříž, 2012) and the STATISTICA 11 software.

Materials and Methods

The University of Defence (UoD) ensures education both of Czech Army specialists and civil students within accredited bachelor, master and doctoral study programmes. All these programmes have two basic forms of study – full-time and combined, which are legalized by the Act no. 111/1998 Coll., on universities § 44., The UoD strives to accommodate the interests of military and civilian study candidates, who wish to complement their existing education in accordance with the rising demands on qualifications and respond to the change of professional orientation or the needs of requalification. By this, the UoD is reflecting European and worldwide life-long learning trends. Students of both forms have to fulfil the same requirements, although the students of the combined form have to join their study with a regular job and everyday duties.

Faculty of Economics and Management (FEM) provides university education in - Bachelor's degree programme, Follow-up Master's degree programme, and PhD degree programme. The bachelor's degree programme qualifies students to cope with the managerial processes on the knowledge platform specifically in branches such as management, economics, law, mathematics, statistics and informatics. In the next part

of the article the authors will concentrate on only Applied Mathematics and English language, core subjects of entrance exam at the Faculty of Economics and Management.

Applied Mathematics

As mentioned in the above paragraph, we will focus on teaching such FEM subjects which we can classify into the group of Applied Mathematics. Specifically, it refers to curricular subjects taught within the bachelor study programme, i.e. Mathematics, Statistics and Basics of Operational Research. We will also mention chosen follow-up subjects which are taught in the master study programme, possibly in the doctoral study programme. This part of education represents the essential tool which forms FEM graduates especially while clarifying and solving real phenomena and problems, modelling decision-making situations, decision-making under uncertainty, risk preventing and analysing for troops, citizens and property protection, solving the economics of national defence issues, etc.

The subject Mathematics is taught in the 1st and 2nd terms and assumes the knowledge of secondary schools Mathematics. The subject provides theoretical basis for a number of special and profile subjects which are taught at FEM. They are followed by subjects taught both by the Department of Econometrics itself, and by specialist departments. This subject includes following topics:

- Linear Algebra
- Elementary Functions
- Differential Calculus of Functions of One Variable
- Integral Calculus of Functions of One Variable
- Differential and Difference Equations
- Differential Calculus of Functions of More Variables

The subject Statistics is taught in the 3rd term and it follows the subject Mathematics. It contains the explanation of basic terms from probability, mathematical statistics, and the basic concepts of its theory and statistical methods of parameter estimation and hypothesis testing. The teaching is supported by the computer data processing, software STAT1 and R (Neubauer, 2012). The aim of the subject is to understand the stochastic way of thinking while evaluating data from the practice. The content of the subject is following:

- Probability
- Descriptive Statistics
- Random Variable
- Inductive Statistics

The following subject Basics of Operational Research is taught in the 4th term and it follows subjects Mathematics and Statistics. The subject deals with basic principles and methodology of the mathematical modelling of decision-making situations. Students learn how to solve standard tasks from linear programming, i.e. the operations planning task, nutrition problem, distributive problem, transport task, assignment problem. The subject includes following topics:

- System Theory
- Linear Programming
- Allocation Problems

In further study the above mentioned three subjects are followed by subjects like Logic Basics, Economic-Mathematics Methods, Statistics II, Risks Rating and their Modelling, Applied Mathematics and Statistics, etc.

It is necessary to remark that currently there is in progress the preparation for accreditation acquiring of the continuous master study programme which is in accordance with the requirements of the Army of the CR General Staff / the Ministry of Defence of the CR (GS/MO), educational field Security Branches of the National Qualifications Framework. It is obvious that in connection with the planned change the above described structure of subjects included in the area of Applied Mathematics will be significantly modified; the basic subjects of Applied Mathematics will be followed by subjects more oriented into the sphere of security, risk rating etc.

Educators quite often have to answer a question if students can be good both at mathematics and languages. The term 'good' is a relative concept. If a good learner could be defined, the opposite end of spectrum, a bad language learner, should also exist. However, how could a teacher or a test define the specific point where 'good' becomes 'bad'? The answer to this question would be highly subjective and would vary significantly depending on numerous factors such as class dynamics, objectives, the scale and duration of the study, etc. (Slimani, 2001). There have been a number of attempts to specify the qualities of the 'good learner', based on studies carried out by Rubin (1975), Naiman et al (1978). These studies found that "...good learners take advantage of potentially useful learning situations, and if necessary create them. They develop learning techniques and strategies appropriate to their individual needs."

A recent study conducted by researchers from Johns Hopkins University in Baltimore confirms that there are people who are born for good or just not good at math (Stanley, Keating & Fox, 1974). One's mathematical ability according to the results of the study is determined by innate factors. Congenital factor is referred to as i 'number sense' or sensitivity to the numbers

(Libertus, 2011). "We believe that 'number sense' is universal, whereas math ability has been thought to be highly dependent on culture and language, and takes many years to learn," Melissa Libertus, lead author of the study, said. Researchers discovered that number sense was innate by testing 200 children on several tasks measuring number sense, mathematical ability and verbal ability.

Learning a second language is usually difficult and often when we speak it we cannot disguise our origin or accent. Some students claim that they love to learn and improve, but they have just got "no talent" for languages. However, there is no evidence that there is a critical period for academic skills such as learning a foreign language. The reason is the remarkable plasticity of the brain throughout life. There are "sensitive periods" for certain aspects of language learning – "windows of opportunity" within which people can acquire certain ability most easily and efficiently. But there's no reason that adults can't learn a new language and acquire an almost native accent (Diaz et al, 2012).

However, each student is responsible for his/her own learning. Students' motivation, determination, and discipline makes the greatest difference in how effectively they learn, no matter how well developed their intellectual abilities are. The learning behaviour also makes the greatest difference in students' job, personal life, and as a responsible citizen of society long after university studies.

English language

The UoD as well as the Faculty of Economics and Management emphasize studying foreign languages because the Czech Army belongs to the NATO structures. Language training is a very important part of the curriculum. English is undoubtedly a priority as it is a mandatory subject for all students at the University. However, all students have to study two foreign languages. In addition to the obligatory English, they can choose German, French or Russian as the second language.

Language education at the Faculty of Economics and Management of the UoD respects the standard of NATO STANAG 6001 and is managed according to the Common European Framework of References, which sets individual competences, especially the communicative one. Communicative competence assumes knowledge of the socio-cultural environment of the particular country where the language is spoken as the target competence of language education. Knowledge of foreign languages helps reduce language barriers and is essential for increasing individuals' mobility both in their personal and professional lives.

Consequently, the basic teaching approach is the communicative method which comprises the whole spectrum of activating methods, the aim of which is to improve students' motivation and creativity. The two-way process of language education assumes two participants and consists of two communicative processes. The speaker (writer) produces his/her speech and transfers information. The listener (reader) receives the information and reacts to it. In other words, every student of foreign languages needs a whole range of skills and abilities,

e. g. writing letters and emails, reading books, listening to the radio, speaking on the phone, which supposes four basic language skills:

- Listening comprehension
- Speaking
- Reading comprehension
- Writing

Bachelor degree students study General English in the first semester and then they follow by special topics, divided to the following modules

Military modules, with topics such as:

- Military Ranks; Daily Routines and Responsibilities; Uniform and Equipment; Branches of the Army; Combat Vehicles; Terrain;
- Armed Forces; Military Service; Army of the Czech Republic; Land Forces; Air Force; Current Deployments; Peace Support Operations; Women in the Military;
- International Organizations; European Union; NATO; United Nations; Humanitarian Assistance; Problems of Today; Security Risks and Threats;

Economic module:

- Introduction to the Economic System; Production; Business Cycle; Types of Business Organizations; Marketing the Product; Starting a Business; International Trade; Transport and Communication; People and Work;

The last semester of bachelor's degree is focused on STANAG topics, such as:

- Environment; Crime, Gun Possession; Discrimination, Xenophobia, Racism; Addictions, Bad Habits; Terrorism;

Students' language competence is examined not only at the compulsory tertiary exam which focuses on English for General Academic Purposes, and partly on English for Specific Academic Purposes, but also at standardized NATO language exam STANAG 6001. The students are expected to pass SLP 2 in English, which corresponds to B1 level according to the Common European Reference Framework.

The usage of information technologies is one of the possibilities how to teach more effectively and attractively. Teachers of the Language Training Centre have used in their work different electronic tools (LMS MOODLE, LMS Barborka, web-based conferencing, emails CD, etc.) as well as findings from the latest research to make teaching and learning languages more efficient.

Entrance exams at the Faculty of Economics and Management

Applicants for the military full-time study programme take in their entrance exam these following tests:

- Learning Potential Test - written test
- English language - written test
- Physical fitness – practical test

Applicants for the military part-time study programme and civilian (both full time and part time) take Learning Potential Test only.

The Learning Potential Test (LPT) is divided into three parts; each part always contains ten questions.

The first part deals with numeric thoughts and logic, the second part focuses on spatial imagination and abstract thinking, and the last part concentrates on basic mathematical skills. Learning Potential Test result is assessed between 0 to 60 points; a pass mark for this test is 30.

The English language test (ELT) examines reading comprehension, vocabulary and grammar. The minimal entrance level should be at least A2 according to the Common European Framework of Reference for Languages, or SLP 1 (Standardized Language Profile) according to NATO STANAG 6001. The English language test is assessed between 0 to 50 points; a pass mark for this test is 25.

With regard to this contribution the authors will not describe practical fitness test in detail. Detailed information regarding the entrance exam is available at the University of Defence web site.

Hypotheses and Methods of their Verification

In order to identify relations and dependencies among determinants, values of which have been gathered in relation to international armaments cooperation, the following hypotheses have been formulated. These hypotheses are focused on the key cost considerations of international armaments cooperation:

- Are there any differences between English Language Test (ELT) and Learning Potential Test (LPT) tests at military students?
- Are there any differences between ELT and LPT tests at civilian students?
- Do the ELT marks and LPT marks correlate?
- Is there any relationship between ELT and LPT?

The hypotheses have been verified using data resulting from the entrance exams at the Faculty of Economics and Management. To compare the findings on the whole, explorative analyses methods were used (Neubauer, Sedláčik and Kříž, 2012). Next analyses was dealing with a group of the military full time study programme applicants and the normality was both tested assessed to measure the association of variables that has been characterized by Pearson's correlation coefficient (Andel, 2003). Finally, the Pearson test of independence in the contingency table (Rauchová and Houška 2013) and a Fisher's exacts test have been used and *p-value* were calculated. For detailed description of the above mentioned statistical methods used to test hypothesis within this paper see Agresti (2002), Johnson and Wichern, (2007).

Results and Discussion

Exploratory statistics was the first step of our research. The authors used data gathered from 2011, which means academic year 2011/2012. To illustrate a basic reference to frequency distribution, a histogram from pass marks received in both the LPT and the ELT were created (Figure 1).

Altogether, 796 applicants were analysed; out of this number 345 were military full time study programme applicants, 54 were military part time study programme applicants (for these applicants the English language test was not required), and 397 were applicants for the civilian study programme.

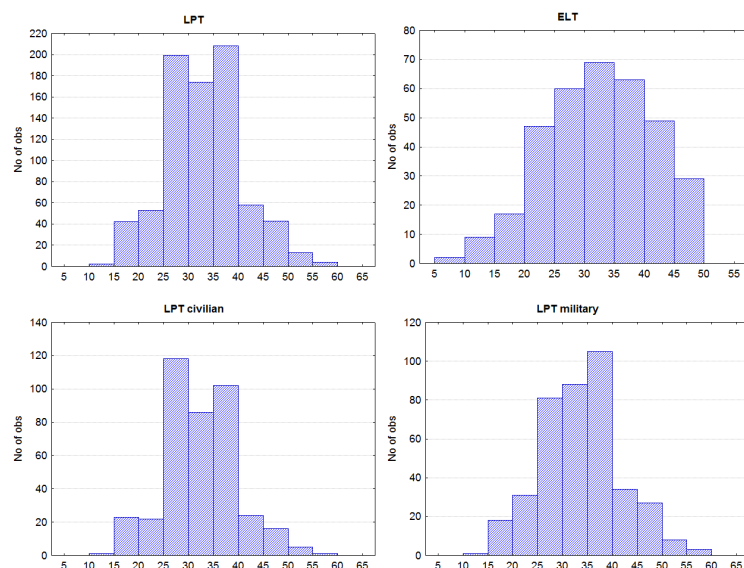


Figure 1: Histograms of the LPT and the ELT

In the ELT 18.26 % of applicants failed and 81.74 % of applicants passed. In the LPT 27.11 % failed and 72.89 % passed.

	LPT	ELT
Valid N	796	345
Mean	33.51	32.94
Median	34	33
Mode	32	39
Minimum	12	10
Maximum	56	50
Lower Quartile	28	26
Upper Quartile	38	39
Std.Dev.	7.59	8.85

Table 1: Descriptive characteristics

If we look at the data characteristics in detail, it is obvious that basic indicators of position (mean, median, mode See Table 1) all exceed the “passing grade” assigned to both tests, the LPT and in particular the ELT. It is possible to compare these results with those in the figure below (Figure 2), which demonstrates that in the LPT the military applicants were more successful in comparison with civilian students; 75 % of military applicants exceed a score of 30 points. A similar result was found in the ELT as well.

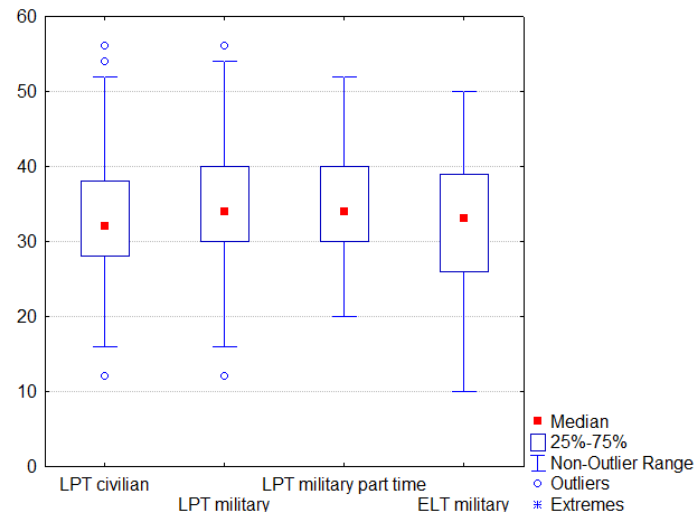


Figure 2: Box Plot of particular groups of applicants in the LPT and the ELT

Figure 2 shows that in a group of civilian and military applicants of the full time study programmes outliers occur.

In the next part, the hypothesis regarding an independent relationship between success in the English language test and success in the LPT was tested. It is essential to add that this research was only possible for those students who took both tests – the LPT and the ELT – which were a group of applicants for the military full time study programme. The overall results are stated in the below-mentioned Figure 3.

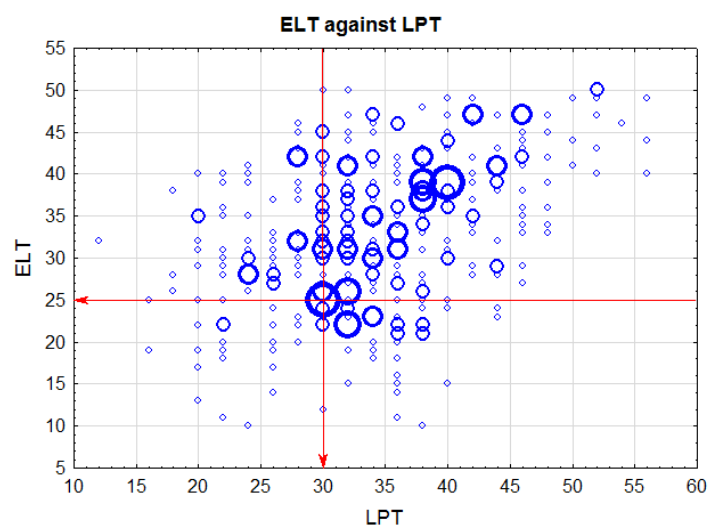


Figure 3: Scatterplot of ELT against LPT

Two-dimensional classification of attained marks frequency in both ELT and LPT is demonstrated by bubbles. Both tests pass marks are drawn colourfully. In these sectors it is possible to perceive that minimum level in both tests was attained by 64 % of students (see table 2).

In accordance with hypotheses, the normality of above given data was tested by standard statistical methods (see Johnson and Wichern, 2007; Neubauer, Sedlačák and Kříž, 2012). At the 5 % level of significance it is possible to state that attained marks in both tests come from normal, two-dimensional distribution.

To describe the results of the survey and to verify relations among individual categories of applicants, besides using their basic characteristics the Pearson's correlation coefficient R has been calculated and tested (Andel, 2003) in order to examine relation between the individual categories of variables. The variable ELT significantly at the 5 % level of significance and positively linearly correlates with variable LPT, $R = 0.41$, p -value < 0.05 .

To verify relationship between success in the ELT and success in the LPT it is possible to use (Johnson and Wichern, 2007; Andel, 2003) the Pearson χ^2 test of independence in the contingency chart (see Table 2) and a Fisher's exacts test. The calculations are completed at the level of significance of 5 %.

		ELT		Total
		Failed	Passed	
LPT	Failed	21	60	81
	Passed	42	222	264
Total		63	282	345

Table 2: 2x2 chart of the independence test

For the above mentioned outcomes, the following p -values were calculated: for the Pearson χ^2 test $p=0.04123$ and for Fisher's test $p=0.04874$. Both p -values are less than a chosen level of significance of 5 %; therefore we can reject at the level

of significance of 5 % the hypothesis regarding an independent relationship between success in the ELT and success in the LPT. Table 2 shows that a group of applicants successful in both the LPT and the ELT predominate noticeably.

Conclusion

The above mentioned results prove the link between the Learning Potential Test and the English language test. If an applicant is good at English, he or she is good at the Learning Potential Test too. It is obvious that being good at mathematics does not necessarily mean being bad at languages.

The explanation can be very simple. Some people can have a greater aptitude for complex, or not-so-complex, mathematical operations than others; on the other hand some people can pick up languages so easily that we say they have a special gift, a so-called "ear for languages".

There is still a question of who has natural ability and who doesn't may get to the heart of the divide. If a student approaches a subject thinking that he or she is not very good at it, he or she may not work as hard to master it. The authors think that approaching mathematics or a foreign language with the sense that it is hard may affect students' ability to learn it. Teachers say that with enough hard work, motivation and practice, those who may not think they are good at mathematics or foreign language may end up being good students.

The further authors' endeavour is to observe the students study results during their studies and to find out how successful they are in the core subjects. Besides Applied Mathematics and English language the authors have already gathered the students' marks from Economics, Management, Law and some military subjects.

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ALTERNATIVE APPROACHES TO EFFICIENCY EVALUATION OF HIGHER EDUCATION INSTITUTIONS

Andrea Furková

University of Economics in Bratislava
furkova@ueba.sk

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Abstract

Evaluation of efficiency and ranking of higher education institutions is very popular and important topic of public policy. The assessment of the quality of higher education institutions can stimulate positive changes in higher education. In this study we focus on assessment and ranking of Slovak economic faculties. We try to apply two different quantitative approaches for evaluation Slovak economic faculties - Stochastic Frontier Analysis (SFA) as an econometric approach and PROMETHEE II as multicriteria decision making method. Via SFA we examine faculties' success from scientific point of view, i.e. their success in area of publications and citations. Next part of analysis deals with assessing of Slovak economic sciences faculties from overall point of view through the multicriteria decision making method. In the analysis we employ panel data covering 11 economic faculties observed over the period of 5 years. Our main aim is to point out other quantitative approaches to efficiency estimation of higher education institutions.

Key Words

Efficiency measurement, higher education institutions, multicriteria decision making methods, stochastic frontier analysis

Introduction

Nowadays, many assessments and rankings of higher education institutions (HEI) and their faculties are published by wide range of agencies and organizations. Due to the higher education globalization, the focus has shifted to worldwide rankings and assessments. Evaluation of HEI seems to become a very popular and important supporting decision tool. University leaders believe that good rankings help to maintain and build institutional position and reputation, students and postgraduates exploit rankings to make a university choice, last but not least the rankings influence stakeholders' decisions about accreditation, sponsorship or employee recruitment. Ranking is also important from national and international partnerships and collaborations point of view. Leaders often verify a potential partner's rank prior to entering into discussion about research and academic partnerships. HEI assessments and rankings provided by wide range of agencies and organizations are based on different ranking systems; different indicators or metrics are used to measure higher education activities. In Slovak Republic, there are two agencies dealing with assessment and ranking of HEI: Accreditation Commission and ARRA (Academic Ranking and Rating Agency). ARRA is an independent Slovak civil association established in 2004 by former student leaders and personalities from the academic field with the objectives of assessing the quality of Slovak higher education institutions and to stimulate positive changes in Slovak higher education (Furková, 2013).

In this study we also decided to focus on assessment and ranking of HEI, namely we chose economic sciences (group EKONOM - Slovak economic faculties) following ARRA classification of higher education institutions and their faculties. According

to ARRA, the faculties are classified into eleven field-specific groups in order to compare only faculties that have the same orientation and similar working conditions (ARRA, 2013). The selection of criteria and classification of faculties in characteristic groups is based on the results of the development in the area of the assessment of higher education institutions in Slovakia as well as on international trends. The criteria (indicators) are divided into two main groups; education and research. The criteria are defined in ARRA (2013).

Faculties gain a certain number of points for each group of indicators. The faculty with the highest value of the indicator in a group gets 100 points and other faculties in the group get points calculated as a linear proportion of the value of their indicator to the value of the highest indicator. Assigning summary point scores to faculties, the scores being expressed as an average of points for all indicators, i.e., the ranking of faculties in individual groups is based on average point score for all groups of indicators (ARRA, 2013). Annually, based on this methodology ARRA prepares and publishes report assessing Slovak higher education institutions from overall point of view (Furková, 2013).

In our analysis we try to exploit two different quantitative approaches for evaluation Slovak economic faculties - Stochastic Frontier Analysis (SFA) as an econometric approach and PROMETHEE II as multicriteria decision making method. Via SFA we examine faculties' success from scientific point of view, i.e. their success in area of publications and citations (Publications and Citations (criteria VV1 – VV3a). Used SFA methodology is based on econometric theory where pre-specified functional form is estimated and inefficiency is modelled as an additional stochastic term (Kumbhakar et al., 2000). Applying SFA for measuring technical efficiency of economic faculties within the

time period of 5 years we try to evaluate a quality of scientific research activities. The analysis is based on production function principle context; evaluated faculties are treated as producers of output (publications and citations) given some inputs. In our analysis various versions of stochastic frontier production function panel data models are applied. We estimated levels of technical efficiency for each economic faculty and the differences in estimated scores, parameters and ranking of faculties are compared across different panel data models. Next part of analysis deals with assessing of Slovak economic faculties from overall point of view through the multicriteria decision making method. From set of multicriteria decision making methods we chose PROMETHEE II method. This method requires defining a set of criteria and set of alternatives. As criteria were opted ARRA criteria and Slovak economic faculties - group EKONOM represented alternatives. PROMETHEE II method provides us final ranking of faculties and the comparison with ARRA ranking is also presented. Main aim of our analysis is to point out alternative approaches to efficiency estimation of HEI.

Materials and Methods

In this part of paper we briefly present proposed methodologies for assessments and rankings of higher education institutions. Firstly, we will discuss SFA methodology (according to Furková, 2013) and the second part will introduce PROMETHEE II method (according to Furková et al., 2012).

Stochastic Frontier Analysis

Stochastic frontier analysis has become a popular tool for production analysis. Stochastic frontier models date back to studies of Aigner, Lovell and Schmidt (1977) and Meeusen and van den Broeck (1977), who independently proposed a

stochastic frontier production function model with a two-part composed error term. In the production context (this approach could be also used in cost context), where its use is most common, this error is composed of a standard random error term, representing measurement random factors, and a one-sided random variable representing technical inefficiency, i.e. the distance of the observation from the production frontier. This technical efficiency reflects the ability of a unit (firm, country or school) to obtain maximal output from a given set of inputs. If the unit is 100 % efficient, it lays on the production frontier itself and this measure is bounded between zero and one.

The general form of the stochastic frontier production function model for panel data can be formulated as follows:

$$Y_{it} = f(X_{it}, \beta) \exp(v_{it} - u_i) \quad (1)$$

where Y_{it} denotes the production at the t -th observation ($t = 1, 2, \dots, T$) and T is number of time periods) for the i -th unit ($i = 1, 2, \dots, N$) and N is number of units), X_{it} is the corresponding matrix of inputs and other explanatory variables, β is a vector of unknown parameters to be estimated, v_{it} is symmetric random variable reflecting effect of statistical noise, u_i is time invariant technical inefficiency term. Compound error term is then formulated as $\varepsilon_{it} = v_{it} - u_i$. This random effect model can be estimated using Maximum Likelihood Estimation (MLE) method, Generalized Least Square Method or Method of Moments. Using Maximum Likelihood Estimation method requires making distribution assumptions for stochastic terms. Usually we assume that v_{it} are random variables to be normally distributed ($v_{it} \sim iid N(0, \sigma_v^2)$) and u_i are non-negative time-invariant random variables to be half normal distributed ($u_i \sim iid N^+(0, \sigma_u^2)$) or truncated normal distribution ($u_i \sim iid N^+(m, \sigma_u^2)$) can be also considered. The next step is

to obtain estimates of the technical efficiency of each unit. The problem is to extract the information that ε_{it} contains on u_i (we have estimates of $\varepsilon_{it} = v_{it} - u_{it}$, which obviously contain information on u_i). A solution of this problem is obtained from the conditional distribution of u_i given by ε_{it} . This procedure is known as JLMS decomposition (for more details see Jondrow et al., 1982). An alternative minimum squared error predictor estimator can be also used for separation the inefficiency effect from the statistical noise (for more details see Kumbhakar et al., 2000 or Furková, 2009). Once the point estimates of u_i are obtained, estimates of the technical efficiency of each unit can be obtained by substituting them into equation (2). If the production frontier is specified as stochastic, the appropriate measure of individual technical efficiency becomes:

$$TE_i = \frac{Y_{it}}{f(X_{it}, \beta) \exp\{v_{it}\}} = \exp\{-u_i\} \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (2)$$

which defines technical efficiency as the ratio of observed outputs quantities to the maximum outputs quantities attainable in an environment characterized by $\exp\{v_{it}\}$.

If we allow efficiency changes in time, inefficiency component will consist of two parts, namely cross-section component (u_i) and time component (β_t):

$$u_{it} = u_i + \beta_t \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (3)$$

and time invariant production efficiency model given by equation (1), we can reformulate as follows:

$$Y_{it} = f(X_{it}, \beta) \exp(v_{it} - u_{it}) \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (4)$$

where u_{it} is now time variant technical inefficiency term of compounded error term $\varepsilon_{it} = v_{it} - u_{it}$, remaining variables are defined in model (1) as well.

There are proposed various approaches to estimate time varying production frontier model given by equations (3) and (4) (for more details see Kumbhakar et al., 2000). Battese and Coelli (see Coelli et al., 2005) presented a model where they modelled the inefficiency component in (4) according to following exponential time function:

$$u_{it} = \exp\{-\eta(t-T)\}u_i \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (5)$$

where η is unknown parameter to be estimated. The function value is determined by value of parameter η and number of observations. This model can be estimated by using MLE method. The likelihood function of this model is a generalization of the likelihood function for the conventional model (for more details see e.g. Kumbhakar et al., 2000). Estimates of the technical efficiency of each unit at time t can be obtained by substituting estimates of u_{it} into following equation:

$$TE_{it} = \exp\{-u_{it}\} \quad i = 1, \dots, N \quad t = 1, \dots, T \quad (6)$$

Multi-attribute decision making methods

Multicriteria decision making problems can be divided into main groups according to definition of the feasible set of the alternatives. The first is the case when we have a finite number of criteria but the number of the feasible alternatives (the alternatives are determined by the system of requirements constraints) is infinite. These problems belong to the field of multiple criteria optimization. On the other hand the problems of the type when the number of the criterions and alternatives is finite, and the alternatives are given explicitly are called

multi-attribute decision making problems (MDMP). The theory of MDMP is established very well and the possibilities of real applications (evaluation of investment alternatives, evaluation of credibility of bank clients, rating of companies, consumer goods evaluation and many others) are very large. We know relatively many different methods e.g. PROMETHEE, ELECTRE, WSA, TOPSIS (see e.g. Jablonský and Dlouhý, 2004). The multi-attribute decision making problem is usually defined by criterion matrix as follows:

$$\begin{matrix} & Y_1 & Y_2 & \dots & Y_k \\ \begin{matrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{matrix} & \begin{bmatrix} y_{11} & y_{12} & \dots & y_{1k} \\ y_{21} & y_{22} & \dots & y_{2k} \\ \vdots & \vdots & \ddots & \vdots \\ y_{n1} & y_{n2} & \dots & y_{nk} \end{bmatrix} \end{matrix} \quad (7)$$

where X_1, X_2, \dots, X_n is the set of n alternatives,

Y_1, Y_2, \dots, Y_k is the set of k criteria,

y_{ij} is the criterion value of the alternative X_i ,
 $i=1,2,\dots,n, j=1,2,\dots,k$.

In the matrix each column belongs to a criterion and each row describes the performance of an alternative, i.e. each element of the matrix y_{ij} is a single numerical value representing the performance of alternative i on criterion j . The essential part of the multi-attribute decision making problem is setting the type of the criteria (minimization or maximization) and assigning the criteria weights. The weight w_i reflects the relative importance of criteria and is assumed to be positive. The weights of the criteria are usually determined on subjective basis. They represent the opinion of a single decision maker

or synthesize the opinions of a group of experts using a group decision technique, as well. The main goal of the multi-attribute decision making techniques can be complete or partial ranking of the alternatives.

The multi-attribute decision making methods are based either on the Multi-attribute Utility Theory (MAUT) or Outranking Methods. The family of MAUT methods consists of aggregating the different criteria into a function, which has to be maximized. The MAUT methods are based on the utility functions. The utility functions can be applied to transform the raw performance values of the alternatives against diverse criteria to a common, dimensionless scale. In the practice, the intervals $[0, 1]$ are used for this purpose and more preferred performance obtains a higher utility value of the utility function. From this group of methods can be mentioned e.g. WSA – Weighted Sum Approach or SMART – Simple Multi-Attribute Rating Technique.

The concept of outranking methods is based on pairwise outranking assessments and having determined for each pair of alternatives whether one alternative outranks another, these pairwise outranking assessments can be combined into a partial or complete ranking. The most popular families of the outranking method are the ELECTRE, the PROMETHEE methods or TOPIS method. Selected MDMP method – PROMETHEE II used in our analysis will be briefly outlined in next part.

The implementation of the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluation) method requires the knowledge of criterion matrix (7), weights of the criteria and preference functions of criteria with their parameters for measuring the strength of the preference of the pairs of alternatives with respect to the given criterion. PROMETHEE method can provide partial ranking of alternatives (PROMETHEE I) or complete alternatives ranking (PROMETHEE II). The

procedure of the method can be summarized as follows. The first, the alternatives are compared in pairs for each criterion. The preference for the alternative is expressed by a number from the interval [0,1] (0 for no preference or indifference and 1 for strict preference). The preference function F_i relating the difference in performance to preference is selected by the decision maker (for more details see e.g. Jablonský and Dlouhý, 2004). Next a multicriteria preference index is formed for each pair of alternative as a weighted average of the corresponding preferences for each criterion. The index $\pi(X_i, X_j)$ expresses the preference of alternative X_i over alternative X_j considering all criteria and can be defined as:

$$\pi(X_i, X_j) = \frac{\sum_{i=1}^k w_i F_i(X_i, X_j)}{\sum_{i=1}^k w_i} \quad (8)$$

In order to rank the alternatives, the following precedence flows are defined:

Positive outranking flow:

$$\phi^+(X_i) = \frac{1}{n-1} \sum_{j=1}^k \pi(X_i, X_j) \quad (9)$$

Negative outranking flow:

$$\phi^-(X_i) = \frac{1}{n-1} \sum_{j=1}^k \pi(X_j, X_i) \quad (10)$$

The positive outranking flow expresses how much each alternative is outranking all the others. The higher positive outranking flow, the better the alternative and it represents the power of this alternative. The negative outranking flow

expresses how much each alternative is outranked by all the others. The smaller negative flow, the better the alternative and it represents the weakness of this alternative.

The PROMETHEE II method provides complete ranking of the alternatives according the net outranking flow which is defined as follows:

$$\phi(X_i) = \phi^+(X_i) - \phi^-(X_i) \quad (11)$$

All alternatives are now comparable, the alternative with the highest $\phi(X_i)$ can be considered as the best one. The PROMETHEE I method offers partial ranking based on the comparison of the positive and negative outranking flows (for more details see e.g. Jablonský and Dlouhý, 2004).

Results

The first part of analysis was based on an econometric approach – SFA (according to Furková, 2013). Models of SFA defined by equations (1) and (4), (5) were applied in order to evaluate the scientific research activities of economic faculties through estimated levels of efficiency. Our balanced panel data set of

11¹ Slovak economic faculties observed over a period from 2008 to 2012 includes 55 observations in total. All data are based on information from statistics of ARRA (for more details see ARRA, 2013). The output and input selection is a crucial step in our analysis and as our goal in the first part of analysis is the evaluation of the scientific research activities, we chose as output variable aggregated ARRA indicator *Publications and Citations* (VV1 – VV3a) - Y1. As inputs which would significantly influence scientific research activities were chosen aggregated ARRA indicators *Students and Teachers* (SV1 – SV4) - X1, *PhD Studies* (VV4a – VV6) - X2 and *Grants* (VV7 – VV10) - X3 ((for more details see ARRA, 2013). Next important step of the analysis is to choose appropriate form of the production function. We decided to use more flexible translogarithmic function instead of more traditional Cobb – Douglas production function.

The first part of SFA analysis was based on the assumption of time invariant technical efficiency. We applied SFA panel data models with time invariant technical efficiency assumption (Model1 and Model2) and the analysis was based on the estimation of the model given by equation (12):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln X1_{it} + \beta_2 \ln X2_{it} + \beta_3 \ln X3_{it} + \\ + (1/2) \left[\beta_{11} (\ln X1_{it})^2 + \beta_{12} (\ln X1_{it})(\ln X2_{it}) + \beta_{13} (\ln X1_{it})(\ln X3_{it}) + \right. \\ \left. + \beta_{22} (\ln X2_{it})^2 + \beta_{23} (\ln X2_{it})(\ln X3_{it}) + \beta_{33} (\ln X3_{it})^2 \right] + v_{it} - u_{it} \quad (12)$$

$$i = 1, \dots, N \quad t = 1, \dots, T$$

In order to estimate the model with time varying technical efficiency (Model3 and Model4) we formulated model given by equation (13):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln X1_{it} + \beta_2 \ln X2_{it} + \beta_3 \ln X3_{it} + \\ + (1/2) \left[\beta_{11} (\ln X1_{it})^2 + \beta_{12} (\ln X1_{it})(\ln X2_{it}) + \beta_{13} (\ln X1_{it})(\ln X3_{it}) + \right. \\ \left. + \beta_{22} (\ln X2_{it})^2 + \beta_{23} (\ln X2_{it})(\ln X3_{it}) + \beta_{33} (\ln X3_{it})^2 \right] + v_{it} - u_{it} \quad (13)$$

$$i = 1, \dots, N \quad t = 1, \dots, T$$

where u_{it} is defined by equation (5).

In all models v_{it} is reflecting effect of statistical noise and u_i or u_{it} are random variables reflecting time invariant or time varying technical inefficiency respectively. Remaining variables have been defined before. The parameters of the models defined by equation (12) and (13) have been jointly estimated by the MLE method using FRONTIER 4.1 (Coelli, T.J., 1996). The MLE method requires making the distributional assumptions for stochastic terms. We made following distributional assumptions:

Model1: $v_{it} \sim iid N(0, \sigma_v^2)$, $u_i \sim iid N^+(0, \sigma_u^2)$,

Model2: $v_{it} \sim iid N(0, \sigma_v^2)$, $u_i \sim iid N^+(\mu, \sigma_u^2)$,

Model3: $v_{it} \sim iid N(0, \sigma_v^2)$, $u_{it} \sim iid N^+(0, \sigma_u^2)$,

Model4: $v_{it} \sim iid N(0, \sigma_v^2)$, $u_{it} \sim iid N^+(\mu, \sigma_u^2)$.

In all models for separation the inefficiency effect from the statistical noise was used Battese and Coelli point estimator (see Coelli et al., 2005). The individual technical efficiency estimates were obtained by substituting the inefficiency effects into the

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Faculty of Management, Comenius University in Bratislava; Faculty of Business Economy, University of Economics in Bratislava; Faculty of Economic Informatics, University of Economics in Bratislava; Faculty of Economics, Technical University of Košice; Faculty of Management, University of Prešov; Faculty of Business, University of Economics in Bratislava; Faculty of National Economy, University of Economics in Bratislava; Faculty of Economics, Matej Bel University in Banská Bystrica; Faculty of Economics and Management, Slovak University of Agriculture in Nitra; Faculty of Business Management, University of Economics in Bratislava; Faculty of Operation and Economics of Transport and Communications, University of Žilina.

equations (2) and (6). The final estimates of the parameters of all frontier models are listed in Table 1. The gamma parameter² value e.g. in Model1 is 0,7782 which suggests that 77,82 % of the disturbance term is due to inefficiency and its statistical signification (Model1 and Model2) implies that the technical inefficiency term is a significant addition to the model. Model1 and Model2 are both based on the assumption of time invariant technical efficiency but the models were estimated under different distributional assumptions for inefficiency term, in the first one was used the half normal distribution assumption (Model1) while in the second model was used truncated normal distributional assumption (Model2). Therefore additional estimated parameter μ is listed for Model2 in Table1. Parameter μ is found to be not significant; therefore half normal specification is preferred for the distribution of u . In addition this conclusion was also confirmed by results of performed LR test. If the model is estimated by the method of ML method, hypothesis concerning individual coefficients can be tested using LR test. Our null hypothesis was set as $H_0: \mu = \eta = 0$, which implies time invariant half normal inefficiency effects and this hypothesis was confirmed. Maximized values of the log-likelihood function of all models are listed in last row of Table 1. The value of log-likelihood expresses the likelihood of observing the sample observations as a function of the unknown parameters (for more details see e.g. Coelli et al., 2005). Applied time variant efficiency models provide individual efficiency

² Estimation of stochastic frontier production function model by MLE method requires parameterization of the log-likelihood function. Frontier 4.1 utilises γ parameterization ($\gamma = \sigma_u^2 / \sigma^2$), ($\sigma^2 = \sigma_u^2 + \sigma_v^2$). Values of the parameter must lie between 0 and 1, if $\gamma = 0$ then all deviations from the frontier are due to noise, while $\gamma = 1$ means all deviation are due to technical inefficiency (for more details see Coelli, 1996 or Coelli et al., 2005).

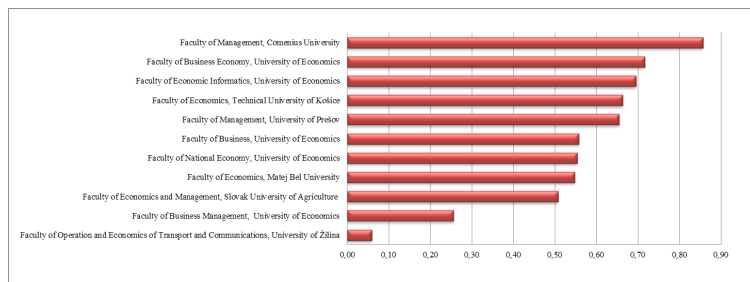
measures for the faculties in each year but it is not possible to present these extensive results due to insufficient space. Due to this fact we present only results of Model1 (see Figure 1). The scores can move between 0 and 1, where the highest value implies a perfectly efficient faculty.

	Model1		Model2		Model3		Model4	
	Estimate	Stand. error	Estimate	Stand. error	Estimate	Stand. error	Estimate	Stand. error
β_0	-7.19*	2.6901	-6.98*	2.0040	-0.38	0.9994	-0.38	0.9994
β_1	-9375.51*	0.9157	-9375.52*	0.9115	-9375.76*	0.9889	-9375.76*	0.9889
β_2	-8796.73*	0.9405	-8796.73*	0.9404	-8796.70*	0.9894	-8796.70*	0.9894
β_3	2332.61*	0.9419	2332.60*	0.9414	2332.46*	0.9954	2332.46*	0.9954
β_{11}	4414.37*	0.5205	4414.35*	0.4868	4413.83*	0.9490	4413.83*	0.9490
β_{12}	1175.64*	0.6921	1175.64*	0.6913	1175.71*	0.9514	1175.71*	0.9514
β_{13}	501.24*	0.7004	501.21*	0.6974	500.92*	0.9789	500.92*	0.9789
β_{22}	3635.74*	0.8082	3635.75*	0.8078	3635.81*	0.9679	3635.81*	0.9679
β_{23}	-1960.36*	0.8130	-1960.39*	0.8113	-1960.62*	0.9860	-1960.62*	0.9860
β_{33}	-0.03	0.1146	-0.01	0.0963	0.20	0.9572	0.20	0.9572
Variance Parameters								
σ^2	1.5265*	0.6734	3.6245	2.3187	4.4602*	0.9999	4.4602*	0.9999
γ	0.7782*	0.1045	0.9073*	0.0710	0.9051	0.9668	0.9051	0.9668
μ			-3.6269	2.5760			0.0017	0.9999
η					0.1267	0.7282	0.1267	0.7284
Log-likelihood	-58.4553		-57.5006		-60.1876		-60.1903	

Source: own calculations (Frontier 4.1)

* significant at $\alpha = 0.05$

Table 1: Parameters of the Production Functions



Source: own calculations

Figure 1: Efficiency scores and ranking of faculties according to SFA

The second part of our analysis is aimed to exploitation of another quantitative approach for assessment of Slovak economic faculties via multi-attribute decision making methods namely PROMETHEE II method. Contrary to the first presented approach where the analysis was oriented to faculties' success from scientific point of view, i.e. their success in area of publications and citations, this part examines Slovak economic faculties from overall point of view. As criterions, ARRA criterions were opted again and in addition to SFA approach we added criterion Applications for Study (SV6-8). As alternatives were chosen Slovak economic faculties - group EKONOM and observed period was again from 2008 to 2012. We supposed the same importance of all criterions and all calculations originated from SANNA (System for Analysis of Alternative) (Jablonský and Dlouhý, 2004). PROMETHEE II method is based on the principle of evaluating alternatives based on preference relation. Selected preference functions of criterions with their parameters for measuring the strength of preference of the pairs of alternatives with respect to the given criterion are given in Table 2. Six different types of preference

function are proposed in the original PROMETHEE definition. In our analysis we chose type 3 (V-shape criterion) and type 4 (Level criterion) of preference functions for our criterions. This decision was due to the fact that the type 3 allows to specify preference threshold and moreover type 4 enable us to define also indifference threshold (for more details see Jablonský and Dlouhý, 2004). Based on these information and according to formula (8) multicriteria preference indices were calculated (see Table 3 – calculations for year 2012). Following the net flow values (see Table 3) calculated according to formulas (9), (10) and (11) we obtained complete ranking of the faculties (see Table 4).

Preference function:	3-linear	3-linear	4-level	4-level	3-linear
	Applications for Study (SV6-SV8)	Students and Teachers (SV1-SV4)	Publications and Citations (VV1-VV3a)	PhD Studies (VV4-VV6)	Grants (VV7-VV10)
q-indif			5	6	
p-pref	10	5	8	10	4

Source: own settings

Table 2: Parameters of the Preference Functions

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	F(+)	F
A1	0,000	0,500	0,600	0,600	0,600	0,880	0,800	0,760	0,800	0,660	0,760	0,696	0,520
A2	0,240	0,000	0,440	0,800	0,600	1,000	0,800	0,840	0,800	0,700	0,840	0,706	0,544
A3	0,200	0,400	0,000	0,600	0,600	0,800	0,800	0,760	0,600	0,860	0,960	0,658	0,506
A4	0,080	0,000	0,040	0,000	0,200	0,470	0,400	0,500	0,200	0,550	0,400	0,284	-0,108
A5	0,240	0,120	0,040	0,400	0,000	0,600	0,600	0,560	0,400	0,400	0,760	0,412	0,040
A6	0,000	0,000	0,000	0,000	0,200	0,000	0,400	0,050	0,140	0,300	0,200	0,129	-0,458
A7	0,200	0,200	0,200	0,350	0,400	0,400	0,000	0,400	0,200	0,500	0,300	0,315	-0,220
A8	0,200	0,000	0,000	0,160	0,200	0,240	0,400	0,000	0,180	0,200	0,200	0,178	-0,344
A9	0,200	0,200	0,200	0,450	0,320	0,600	0,600	0,700	0,000	0,500	0,600	0,437	0,054
A10	0,200	0,200	0,000	0,200	0,400	0,440	0,300	0,450	0,280	0,000	0,500	0,297	-0,205
A11	0,200	0,000	0,000	0,360	0,200	0,440	0,250	0,200	0,230	0,350	0,000	0,223	-0,329
F(-)	0,176	0,162	0,152	0,392	0,372	0,587	0,535	0,522	0,383	0,502	0,552		

Source: own calculations (SANNA), (A1) – (A11)³

Table 3: Multicriteria preference indices and outranking flows – year 2012

Discussion

In our analysis we have exploited two different quantitative approaches for evaluation Slovak economic faculties (group ECONOM) - SFA as an econometric approach and PROMETHEE II as multicriteria decision making method. As a result of applications of SFA models are efficiency scores of observed

³ Faculty of Economics, Technical University of Košice (A1), Faculty of Economics and Management, Slovak University of Agriculture in Nitra (A2), Faculty of National Economy, University of Economics in Bratislava (A3), Faculty of Business, University of Economics in Bratislava (A4), Faculty of Operation and Economics of Transport and Communications, University of Žilina (A5), Faculty of Business Economy, University of Economics in Bratislava (A6), Faculty of Management, Comenius University in Bratislava (A7), Faculty of Economic Informatics, University of Economics in Bratislava (A8), Faculty of Economics, Matej Bel University in Banská Bystrica (A9), Faculty of Business Management, University of Economics in Bratislava (A10), Faculty of Management, University of Prešov (A11).

units (faculties) and according to these scores units could be ranked. On the other hand multi-attribute decision making methods do not provide efficiency scores but direct ranking of units is obtained.

Firstly, inefficiency effects were estimated by using four models of SFA. As for Model1 and Model2 we can see (Table1) that almost all the parameters are statistically significant at conventional levels and the parameters are mildly different from one model to another. Most of estimated parameters have expected positive signs besides surprisingly negative signs of parameter β_1 (corresponding with *Students and Teachers*), β_2 (corresponding with *PhD Studies*) and β_{33} (corresponding with quadratic term *Grants*). Our results suggest that these indicators have negative effects on the scientific activities – *Publications and citations*. This conclusion may not be so straightforward, i.e. it should be interesting to observe interaction between explanatory variables. Positive signs of parameters corresponding with these interaction terms confirm that e.g. variable *Students and Teachers* exerts a positive impact on *Publications and citations* only in presence of *Grants* and *PhD Studies*, i.e. variable *Students and Teachers* by itself does not induce efficiency gains. According to results of performed LR test we decided to prefer Model1 to remaining models. In our data set it is not necessary to apply time varying efficiency model (Model3 and Model4) and half normal distribution assumption for inefficiency term is preferred. Moreover, non-signification of η (an extra parameter in time variant models) also confirmed our decision for Model1 (Furková, 2013).

Faculty	University	Ranking ARRA and (PROMETHEE II)				
		2008	2009	2010	2011	2012
Faculty of Economics	Technical University of Košice	1 (3)	1 (1)	2 (2)	1 (2)	1 (2)
Faculty of Economics and Management	Slovak University of Agriculture	2 (1)	2 (2)	1 (1)	2 (1)	2 (1)
Faculty of National Economy	University of Economics	4 (2)	3 (3)	3 (3)	3 (3)	3 (3)
Faculty of Business	University of Economics	5 (5)	4 (5)	6 (5)	8 (7)	5 (6)
Faculty of Operation and Economics of Transport and Communications	University of Žilina	3 (4)	5 (4)	5 (4)	5 (4)	6 (5)
Faculty of Business Economy	University of Economics	7 (6)	6 (6)	8 (10)	9 (10)	10 (11)
Faculty of Management	Comenius University	6 (9)	7 (7)	7 (8)	6 (6)	8 (8)
Faculty of Economic Informatics	University of Economics	9 (8)	8 (8)	9 (9)	7 (8)	7 (10)
Faculty of Economics	Matej Bel University	10 (10)	9 (9)	4 (6)	4 (9)	4 (4)
Faculty of Business Management	University of Economics	8 (7)	10 (10)	10 (7)	10 (5)	9 (7)
Faculty of Management	University of Prešov	11 (11)	11 (11)	11 (11)	11 (11)	11 (9)

Source: own calculations of PROMETHEE II ranking and ARRA assessments

Table 4: Assessment of ARRA and PROMETHEE II ranking over a period from 2008 to 2012

Figure 1 provides efficiency estimates and ordering of economic faculties according to Model1. The highest score of efficiency in scientific activities (see Figure1) achieved Faculty

of Management, Comenius University (0.8570) and the worst according to our model was set Faculty of Operation and Economics of Transport and Communications, University of Žilina (efficiency score only 0.0591).

From multi-attribute decision making methods we use PROMETHEE II method and final rankings (in the brackets) are listed in Table 4. However, it would not be convenient to compare these rankings with our SFA results by reason of different aims of analysis. Whereas, SFA analysis was focused on success of faculties only in scientific activities, PROMETHEE takes into account more aspects.

However, assessment of ARRA over a period from 2008 to 2012 (also listed in Tab 4) is comparable with our results of PROMETHEE II ranking. Both assessments have provided very similar results, e.g. as the best economic faculties were alternately set Faculty of Economics, Technical University of Košice and Faculty of Economics and Management, Slovak University of Agriculture. Accordingly, as the worst faculty was nearly always set Faculty of Management, University of Prešov.

Conclusion

We presented SFA methodology and PROMETHEE II method as a contribution to the discussion about quantitative measurement of evaluation of HEI. In the first part of the paper we briefly discussed process of assessment and ranking of HEI in Slovak Republic. Following ARRA indicators of assessment we have exploited chosen quantitative approaches to evaluation of units. These methodologies were also presented in the second part. However, there are other multi-attribute decision making methods which could be used depending on the aim of the analysis, obtained data, etc. Moreover, the analysis might be enriched by using further quantitative parametric (e.g. DFA –

Distribution Free Approach) or nonparametric (e.g. DEA – Data Envelopment Analysis or FDH - Free Disposal Hull) methods for efficiency measurement. Another interesting area for further research on this topic would be an international assessment of HEI.

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EMPLOYEE LEARNING AND DEVELOPMENT IN ORGANISATIONS

Lucie Vnoučková

The University of Economics and Management
lucie.vnouckova@vsem.cz

Abstract

The primary goal of all organisations is efficiency of human resources. Therefore activities as HR controlling, performance management but also cutting costs are the main theme. Current organisations need to monitor human resources to keep their competitiveness. Thus paper describes the key factor of organisational efficiency - employee education, talent management and the necessity to retain skilled employees. The aim of the paper is to reveal the current approach in organisations to education and learning based on primary survey of employees. The data were collected using quantitative primary survey in Czech organisations across sectors. The questionnaire was compiled based on the theoretical background. The paper has been processed based on the analysis of secondary sources, outcome synthesis and the evaluation of results of a questionnaire survey. The data were analysed using descriptive statistic, correlation analysis and factor analysis. The SPSS programme was used for the analyses. The outcomes were categorized and the analyses revealed the main factors affecting organisational approach to employee learning and development. The results identify three possible approaches in organisations to employee learning and development. The first type of organisations educates employees by their own rules, second type does not support education of employees in any way, it is only an interest of employees themselves and thirdly knowledgeable employees were identified as those employees do as much

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as possible to learn and grow and they choose job position in order to develop constantly. The results can be taken into account in further analysis and in organisation of adult education.

Key Words

Development, efficiency, employee, learning, organisation, talent

Introduction

To keep and develop quality knowledgeable employees is the main goal of all organisations. The only thing that really matters in order to increase the level of organisations and economy is human resources and their management and development. Therefore organisations should focus on education and learning of each individual. It is also necessary to educate and develop employees in order to their work and social values and behaviour – each employee is individuality with different perception and personality. Organisations should focus on specifics of their employees in order to set effective goals of education, learning and training of employees. Employees who are educated and developed are usually highly interested in organisational goals, strategy; they are communicative, cooperative and proactive, respectful, customer-friendly, willing and able to constantly learn. As Mazouch and Fischer (2011) stated, measurement of education level in organisations is necessary to prognosis of future development. Therefore, paper focuses on employee education and approaches to employee education and learning both by Czech organisations and also by employees themselves. The aim of the paper is to reveal the current approach in Czech organisations to education and learning based on primary survey of employees.

Vostrá, Jindrová and Dömeová (2011) and Zeman (2009) state that it is necessary to care for employees in the way of education and development, otherwise there is a possibility that organisation will lose those employees. The necessity to keep educated, trained and skilled employees is also registered by European Union. Vostrá, Jindrová and Dömeová (2011) mentioned key indicators of Lisbon Strategy, which focus mainly on sustainability of employees and employment. It is the priority of the whole Europe, which is focused on people

and knowledge. The main priority of knowledge society till the year 2020 is namely productivity, education and employment and their impact on development of Europe. Mráček (2009) highlights that current economic crisis brought lowering of new products and services, new patents and also lowering of expenditure on research, development and education. But lowering of expenditure on research, development and education cause lowering of new products, services, and patents. If an organisation cut expenditure on education and learning, the productivity, innovation and thus ability to attract customer will be also lower. This phenomenon supports the need of education, learning and care for knowledgeable and skilled employees. Additionally, Mráček (2009) notes that if organisations lower their expenses on education and learning, they make a strategic mistake, because the best employees are no longer motivated to work in organisation. This results into weakening of the whole organisation which is not ready for recovery of economy and thus it is real threat to competitiveness.

Q1: Is education and learning supported by Czech organisations?

Although the main motivation principles were defined many times by many authors, we may still describe them as considerable simplified, as Chwaszcz (2011) mentioned. The author stated that reality brings much more variables which cause deviation from theory and also that employee is not always rational. Ramlall (2004) in his study identified factors leading to work satisfaction. Firstly it was basic needs according to Maslow (1943) secondly equality, thirdly filled expectation and finally concept of job position. Studies resulted into low correlation between dissatisfaction with remuneration; on the contrary, organisations were suggested to focus on increasing of qualification and competencies of employees and obviousness meaning of their work. Therefore it is necessary to change

the way of cooperation between employees and managers. Managers should focus on new competencies and behaviour according to use of employee as a person, not just work unit (Königová and Fejfar, 2011). Competencies and competence models represent a possibility to unify needs of organisation with abilities of employees and their education and growth. According to Peters (2011) and Vronský (2012) emphasis should be placed on managers who would be able to work with employees in certain way.

Q2: Are employees motivated to education and learning by Czech organisations?

Peters (2011) highlights soft factors in organisations. He states that intangible trivia determines the final employee satisfaction, their possible grow and willingness to learn and grow. Covey (2011) and Peters (2011) also states that it is necessary for future development of employees and organisation to use sustainable values which will lead to sustainable development. Namely: cooperation, ethics, integrity (relationships) and quality and values for the next generation. Authors argue that the main decisions which proved to be right and persisting (and authors have shown many examples proving such statement) are often not according to economic, financial and other analysis (which, according to Peters (2011) caused current crisis), but based on abilities of employees, their character, relationships and common values (cooperation, sacrifice, listening and orientation on goals, results, needs and customer as person and citizen).

Q3: Can education and learning be considered as long term concept in Czech organisations?

Stated questions will be evaluated based on primary outputs in the end of results of the paper.

Materials and Methods

The data for the evaluation of current education and learning in Czech organisations has been collected in primary quantitative survey by means of questionnaire investigation. Questionnaire was completed by 110 employees across sectors. The method used for the collection of data was an electronic questionnaire that automatically recorded and pre-categorised respondents' answers (CAWI method). The selection of a representative sample of employee population across sectors was carried out by a random selection of e-mail addresses, which incorporates the advantages of multilevel random selection (Disman, 2008). In total, 1 122 e-mails including questionnaire were sent to Czech organisations in January and February 2013. The sample was selected solely for the purposes of the survey. Answers of respondents were categorised according to identification questions that formed the first part of the questionnaire. In the survey, the measurement was based on closed questions with one or several possible answer(s) that had been selected based on the study of literature, documents and other related surveys carried out by the following authors: Colvin (2010), Maxwell (2012), Horváthová (2011), Knight (2011) and Vronský (2012). The methods used in the study were inspired by Meyer and Allen, (1991), Gosling, Rentfrow and Swann (2003), John, Naumann and Soto (2008), Anderson (2009), Michela (2007), Jablonský (2011) and Xin et al. (2011). Also, a semantic differential was applied that permitted the identification of nuances in respondents' attitudes through the questionnaire. Respondents' reactions to target statements and their attitudes to the given matter were restricted by offering a set of several statements (Hayes, 1998). The extremes of the seven-point scale represented bipolar concepts of the evaluation dimension. Using a scale of 1 to 7, respondents expressed their inclination towards one of

the pre-set extreme statements or, provided it was not possible to favour either of the sides, selected a median, neutral value (the median value was characterised by number 4). The scale permitted not only the specification of respondents' attitudes, but also their intensity. The respondents were mainly (51 %) from small organisations (till 50 employees), 24 % were from medium sized organisations and 26 % from large organisations (over 250 employees). Age of the respondents was mainly until 30 years (47%), between 30 and 40 years were 27% and over 40 years were 26% of respondents. The analysis was carried out using the Microsoft Excel 2007, and SPSS programmes. The conclusiveness of the outputs and relationships obtained were supported by the tools of descriptive statistics, for testing of results the analysis of correlation and factor analysis were used to review the outcomes.

Results

Bellow in this chapter, main results will be interpreted. Firstly, the overall situation in Czech organisations will be presented. Secondly, deeper analyses (correlation, association and factor analysis) will give us insight view into organisational practices in education and learning.

Education and learning in Czech organisations

The surveyed employees are willing to be educated and they would like to use such opportunity. 95.5% of respondents want to grow in their current job position. That is a good sign for organisations, because the motivation of employees is overall high and thus it is easier to work on education and training of such employees. As theory states, the internal motivation is the key to effective education of adults (Knight, 2011; Colvin, 2010). Current employees perceive modern trend of necessity

of flexibility and therefore they want to use any possibility to grow (Vostrá, Jindrová and Dömeová, 2011). Employees also know that job position is usually not for a life time and they want to explore their skills and knowledge to be successful in their profession whether in current position or the next one (Linhartová, 2012a).

But employees stated that they were motivated for education and learning by long-term intangible rewards only in 37%. On the contrary, 44% of employees have no support from organisation. Almost the same results were found by focusing on tangible rewards (money and benefits). 33% of organisations support education and learning in mentioned way, on the other hand 56.5% of organisations do not reward education at all. Colvin (2010) stated, that tangible rewards (such as salary, money and benefits) are contra productive to motivation to learn, therefore this result will be discussed further in deeper analyses (two-dimensional – correlation analysis and multidimensional – factor analysis).

Quite positive results we get regarding to a specific knowledge educated in organisations. Almost 66% of employees stated that their education and learning in organisation is focused on a specific skills related to their work. Surveyed employees also evaluate their job positions as a place where they can grow and they have chosen this position because of this possibility (in 89%). Mostly, the position was chosen in the area of future interest (82%) and surveyed employees show their own initiative in order to learn and grow (95.5%), which supports the motivation to self-development, learning and study. This concept proves the result that 70% of employees study and work on their development also at home (but still there are 21% of employees demotivated, who do not want to do anything else than necessary and they are not willing to offer their free time).

Education and learning is a part of job in 66.5% of organisations according to results of the questioning; and in 73% employees have set a specific goal (together with their manager or supervisor) to achieve in learning and growth process. Organisational learning and education also seems to be a long-term process. 63% of evaluated employees see their education and learning as long-term process. Short-term goals and only single-purposed training or courses are used in 23% of organisations.

Overall, results revealed that most of the employees are willing to be part of education and learning process and they know about its necessity. Positive results were found that employees are mainly self-motivated and they are trying to find new ways to grow.

Associations between organisational practices related to learning and development

Previous chapter explained the overall situation in surveyed organisations. Therefore association analysis was used to found statistically significant relationships and similarities in usage of searched practices connected to learning and development of employees in organisations. For the association analysis Pearson's coefficient and Spearman's rho was used. Both analyses have shown similar results. Regarding the fact that there were 12 variables entering the analysis, the names of variables are coded (explanation of codes is in the Tab. 3) and the results are reduced in the Tab. 1 bellow. Marked are statistically significant correlations/associations. Double star means significance level of 0.01 and one star means significance level of 0.05.

	A	B	C	D	E	F	G	H	I	J	K	L
A Pearson	1.00	.43**	.19	.13	.38**	.10	.15	-.10	-.00	-.11	.20*	.16
A Spearman	1.00	.45**	.22*	.21*	.49**	.14	.14	-.18	-.04	-.17	.26**	.21*
B Pearson		1.00	.37**	.31**	.27**	.15	.14	.12	.24*	-.19*	.08	.19
B Spearman		1.00	.31**	.23*	.29**	.26**	.19*	.08	.21*	-.14	.14	.27**
C Pearson			1.00	.66**	.27**	.27**	.43**	.41**	.49**	.00	.41**	.06
C Spearman			1.00	.58**	.26**	.23*	.36**	.43**	.49**	-.03	.36**	.07
D Pearson				1.00	.22*	.27**	.64**	.32**	.46**	-.01	.43**	.11
D Spearman				1.00	.23**	.25**	.545**	.28**	.40**	-.06	.43**	.14
E Pearson					1.00	.36**	.14	.09	.30**	-.10	.26**	.45**
E Spearman					1.00	.35**	.20*	.03	.24*	-.18	.34**	.38**
F Pearson						1.00	.38**	.20*	.27**	-.05	.21*	.36**
F Spearman						1.00	.33**	.13	.22*	-.03	.18	.43**
G Pearson							1.00	.35**	.44**	.06	.45**	.18
G Spearman							1.00	.34**	.39**	.01	.41**	.17
H Pearson								1.00	.77**	.06	.25**	.08
H Spearman								1.00	.78**	.11	.21*	.02
I Pearson									1.00	.03	.33**	.16
I Spearman									1.00	.06	.29**	.09
J Pearson										1.00	-.01	-.07
J Spearman										1.00	-.08	-.12
K Pearson											1.00	.20*
K Spearman											1.00	.23*

Tab. 1 Association analysis of surveyed variables

The Tab. 1 shows that some of the selected variables are interconnected. Both analyses (Pearson's and Spearman's) gave similar results.

With the willingness of the employees to grow (A) correlates the selection of the job in order to learn constantly (B), that employee is motivated by his/her own initiative (E) and employee is practicing also at home. This indicates really knowledgeable and talented employee. We may say that this correlation indicates

the best possible approach to learning and development. It is an internally motivated and self-driven attitude. To keep this kind of employee in an organisation is a crucial factor of efficiency.

With the selection of job position in order to learn (B) is associated the statement that learning and development is supported by the organisation (C), it is focused on specific skills (D), employee is internally motivated (E), he/she works in his/her area of interest (F) by Spearman's coefficient, also that learning is supported by intangible benefits and Spearman's coefficient also indicated that it is a long term attitude. Here it is possible to see a combination between internal motivation of an employee and support of an organisation. It is a good coincidence. Employee is willing to learn and to be developed and chooses his/her job position in order to fill this goal. As we may see, organisation supports long term development and focuses on long term support to increase employee's motivation by intangible benefits.

The statement that learning is supported by organisation (C) is associated with focus on specific skills (D), employee's internal initiative (E), work in the area of own interest (F), development is a part of the job (G), learning is rewarded (H) and supported (I) and employee is practicing at home (K). It is possible to describe this approach as cooperation between employee and organisation. Both parts are willing to develop employee's knowledge and skills. But the disadvantage of this approach is that it has not a specific goal and it is mainly only a single-purpose learning (not a long-term process).

The variable stating that learning and development are focused on specific skills correlates almost with all other variables except that the learning and development has a specific goal (J), it is a long term process (L) and surprisingly only weak association was found by only Spearman's coefficient with

internal willingness of employee to grow (A). This indicates that only the organisation is willing to develop their employees, but sometimes the way of forcing them will not be the best. Anyway, the lack of self-motivated and talented employees can be observed here.

The statement that development is an employee's internal initiative and he/she is motivated to constantly learn and self-development (E) correlates again almost with all other statements apart from the variables that learning is a part of job (only weak and not so significant correlation - G), than we may say that learning is not rewarded (H) and it has not a specific goal (J). The mentioned association revealed talented, knowledgeable employee who is not supported by organisation. It is a question, for how long this situation will continue. The employee knows about the necessity to learn and self-development, but the current conditions are not supportive. It is possible to expect this employee to change his/her job position in short period of time. The shift to a better job position is expected (Linhartová, 2012a).

The statement characterising employee, who works in his/her area of interest (F), also correlates with most of other statements. But surprisingly there is no connection between willingness to grow (A), partly with choosing the job position in order to learn (B), learning is not usually rewarded (H), it has not a specific goal (J) and employee does not want to sacrifice his/her free time to practice at home (K). Here we may see just a job position which was chosen in the area of interest, this type of employees like what they do, but they are not willing to be educated and developed. If they are, it is only an organisational goal.

Learning and development as a part of job (G) is associated again with most of organisational practices which are focused on employee's development. This type of employees again

are neither interested in self-development (A), nor chosen job position to learn, they do not have a set goal to learn (J) and it is not a planned process (L). As the previous type, these kinds of employees only follow the organisational rules, but they are not against it.

In the similar way it is possible to evaluate the statement that learning is rewarded (by money – H). This statement correlates with support from an organisation (C), focus on specific skills (D), part of job (G), support by intangible benefits (I) and the need to practice at home (K). Here it is possible to find really supportive and knowledge-oriented organisation, but the employees are not internally motivated and interested.

On the other hand, completely different attitude we may find when looking at the correlations connected to the support by intangible benefits (I). Employees are in this case motivated (E), choose job because of the possibility to learn in an organisation which set specific goals to develop them (B, C, D, G and H), employee likes what he/she does (F) and has no problem to practice at home (K). These results strongly support the assumption by Colvin (2010) that intangible rewards supports learning and development but tangible rewards (money) result in the opposite attitude. Here we may see it works in that way.

Completely independent is the statement that learning has a specific goal (J). Basically no correlations can be found here. Thus it is possible to say that goals do not primarily affect organisational learning.

On the contrary, when an employee is willing to practice at home (K), it is a good sign. He/she is interested in development (A), they usually work in an organisation which supports learning and development (C, D, G), it is also supported (H, I) and employee is internally motivated (E). Again, here it is possible to recognize talented and knowledgeable employee.

To evaluate the time schedule of learning and development (L) we may also support the premise of Colvin (2010) that only those, who are real talents know the rule that it is up to them to work on their development the whole their life (long-term) and in their free time (K), be self-motivated (E) and work in the area of their interest (F).

Summary, we may say that the most of the statements are inter-correlated. But as it was explained above, the correlations have a specific meaning and it reveals different approaches to employee learning and development. It is possible to find self-motivated employees and also supportive organisations which try to develop their employees and cooperation of both sides. However sometimes the organisation invests much more than it is possible to gain back from the employees' development. Still, the good result is that it is possible to find talents and knowledgeable employees in the population. Also, the assumption that intangible rewards support and develop learning and development and tangible rewards (money) works in the opposite direction – demotivation was found in the results of the analysis.

Factor analysis of approach to education and learning

Based on the results, which have shown a requisite level of correlation/association coefficient between analysed variables and revealed different attitudes to employee and organisational learning and development, a deeper analysis was used. In order to lower the amount of resulted outputs, the factor analysis was chosen. Varimax rotation method was used for analysis. The same characteristics were used for analysis, as were described above in previous chapter. As shown in Tab. 2, factor analysis revealed 3 statistically significant factors. To separate final amount of output factors a Kaiser-Guttman rule was employed.

Such factors were used for further analysis, whose variance was higher than 1.0. This value was chosen rationally because explanatory factor must have at least equal value as original standardised attribute. Such attributes (statements) were chosen as significant to create resulted factor, whose value was 0.3 and higher (Anderson, 2009).

	Total variance	% of Variance	Cumulative %
Factor 1	3,926	32,714	32,714
Factor 2	1,771	14,759	47,474
Factor 3	1,215	10,121	57,595

Tab. 2: Variance explained by factors

All factors together explain 58% of employee behaviour and attitude to education and learning. Tab. 3 show results of analysis by the Varimax method; Tab. 3 gradually show all factors and its attributes.

Factor analysis revealed three approaches to organisational learning and education in Czech organisations. First factor, which characterize one third of respondents can be described as learning and education which is a part of organisational culture. Employees stated, that learning and education is supported by organisation, it is focused on specific skills and knowledge, learning is rewarded (by tangible and also intangible) rewards, there is a specific goal of education and learning and also that education and learning is a part of their job. Therefore we may say that this kind of education and learning has a strong core in organisational culture and employees have to follow the organisational rule in order to fill the specific conditions focused on continuous learning. It is possible to notice, that those kind of employees are not always motivated by themselves or they did not choose the job because of the possibility to learn and grow, they are not willing to practice at home or do anything else than

necessary inside an organisation. Thus it is possible to conclude that it is primary the organisation which is concentrated on learning and education.

Code	Explanation of code – variable	Factor 1	Factor 2	Factor 3
A	Employee wants to learn and grow	0.051	0.160	0.771
B	Employee chosen job as a possibility to learn	0.287	0.049	0.715
C	Learning & edu. is supported by org.	0.773	-0.007	0.286
D	Learning & edu. is focused on spec. Skills	0.789	0.014	0.233
E	Employee is motivated by own initiative	0.166	0.691	0.361
F	Employee works in his/her area of interest	0.298	0.663	-0.005
G	Learning & education is part of work/job	0.717	0.173	0.026
H	Learning & edu. is rewarded (money, benefits)	0.732	0.102	-0.292
I	Learning & edu. is supported (intangible rew.)	0.790	0.218	-0.125
J	Learning & education has specific goal	0.552	0.219	0.120
K	Employee is practicing at home	0.017	0.834	0.090
L	Time horizon of learning (short vs long time)	0.094	-0.069	-0.475
	% of variance	33%	15%	10%
	Name of the factor	Organisation culture	Employees life style	Knowledge-able empl.

Tab. 3: Resultant factors by method Varimax

The second factor revealed describes completely different type of employee approach to education and learning. In this case, education and learning is not supported or organised by organisation, but it is internal motivation of employee which drives learning. Education is perceived as interesting and fulfilling, because employee works in the area of his/her

interest and therefore it is no problem to continue in learning and practicing at home. It seems that this kind of employees is strongly interested in the area of their work. Also, the analysis revealed that those employees are not strongly interested in learning and education itself, neither they chosen their job position in order to learn, nor focused on long term or continuous learning. But we may see an influence of support by intangible rewards and set of specific goals in learning. Therefore we may conclude that this group is interested in what they are doing and the want to do their best – as their life style.

The third factor is the extreme of employees who are really interested in education, learning and growth. Such group is probably key employees, knowledgeable employees or talents. They are focused on their career, choose their job because of possibility to learn and grow, they are motivated by internal initiative and they work on their education in long period – constantly. To keep such employees in organisation is a crucial factor of future development of organisations. But there is a risk of losing them, because those employees know their value and they can easily migrate (Linhartová, 2012b). This is validated also by choosing their job because of the possibility to learn. It is also possible to see that the third group of employees is not influenced by any kind of rewards or organisational goals; they work on their own learning and growth because they want to.

Evaluation of research questions

Based on the outputs of the survey and analyses we may conclude that the overall level of education and learning in Czech organisations (Q1) is satisfactory. Two third of employees are educated at work and one third of them are constantly and specifically supported by organisations. Employees are motivated (Q2) by organisations only in one third of the cases.

Most of the organisations do not support employee motivation at all. Luckily, most of the employees are motivated internally. And finally (Q3), education and learning is mainly (in 63% of cases) long-term process. But this result is related only to employee willingness to learn and grow. Thus it does not mean that 63% of Czech organisations are constantly focusing on life-long learning and career planning. As previous results states, it is 33% of them. The rest is approach of employees. On the other hand, 23% of organisations use only short-term goals and single-purposed training or courses.

Discussion

As it was mentioned in theoretical background of the paper, Colvin (2010) and other authors stated, that tangible rewards are destroying internal motivation to learn. The Tab. 1 and Tab. 3 support the presumption. According to the results of the survey, employees were not motivated, when education and learning was an organisational “rule” and it was rewarded (factor 1 in Tab. 3). On the other hand, employees grouped by factor 2 and factor 3 (Tab. 3) were acting in the opposite way. Their education, learning and growth was not rewarded or remunerated in any way, but still, they were motivated to continue and they were willing to practice in their free time (factor 2 of Tab. 3) or to work on their growth in long period; to choose specific job positions in order to learn and grow and they were really focused on their development and growth (factor 3 of Tab. 3).

Conclusion

Education and learning in organisations was surveyed among employees. As education level in organisations is necessary to prognosis of future development, the main approaches to education and learning was searched.

Association analysis revealed different approaches to employee learning and development. It is possible to find self-motivated (talented) employees and also supportive (learning) organisations which try to develop their employees. Additionally, cooperation of both sides was also found. However sometimes the organisation invest much more than it is possible to gain back from the employees' development. In that case all depends on the recruitment of quality employees who will use the chance offered by organisation. Still, the good result is that it is possible to find talents and knowledgeable employees in the population. Additionally, the assumption that intangible rewards supports and develops learning and development and tangible rewards (money) works in the opposite direction – demotivation was confirmed.

According to the results of the factor analysis, three possible approaches to education and learning were found. The three approaches characterize 58% of surveyed employees. Firstly learning organisations were revealed. Thus employees are educated because of already existing practices and goals inside the organisation. 33% of employees are continuously educated because of organisations, no matter whether they wish to learn and grow or not. Secondly, a group of employees who chooses to be educated in the area of their interest was found. They work on their own development separately from the organisation. The organisation does not support them in any way. And the third approach can be described as knowledgeable employees. They do everything they can to learn and grow. It is their career and their long term goal. They choose job positions in order to learn constantly.

We may say that the results indicate overall good quality of learning and development in organisations. Basically two thirds of employees are constantly developed. Not just that

they mentioned they would like to, but they really are and it is either part of their job or they work on their own education and growth by choosing specific job positions, practicing on their own or work on their career in long period of time.

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STRESS, SELF-EFFICACY AND WELL-BEING OF THE UNIVERSITY STUDENTS

Hana Chýlová, Ludmila Natovová

Czech University of Life Sciences Prague
chylova@pef.czu.cz

Abstract

This research is a follow-up to a previous study on the preferred stress coping strategies of students that ascertained rather unsettling result of surprisingly high number of negative strategies. This paper aims to investigate the levels of perceived self-efficacy and satisfaction with life (subjective well-being) in connection to stress coping strategies in a sample of university students.

The data were collected on a sample of 387 respondents with the use of three standardized questionnaires: General Self-Efficacy Scale, The Satisfaction With Life Scale and The Stress Coping Style Questionnaire. The significance of the difference between the means of our sample and other relevant samples was tested via t-test. Correlation coefficient was computed for self-efficacy, well-being, positive coping strategies and negative coping strategies.

The key findings of the study are that students in our sample perceive their general self-efficacy to be significantly heightened, while they are less satisfied with their lives than the normal population. Furthermore, we found significant correlations between self-efficacy and stress coping strategies, which induce, that the concept of self-efficacy is a strong and useful concept that deserves to be included into psychological seminars and contact lessons in education of our students.

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Introduction

Stress related to the numerous demands placed on university students during their studies has often led to high perceived distress, discomfort and overall dissatisfaction. These phenomena, with a particular focus on stress coping strategies and their connection with the health behaviour issues of the university student population, were discussed in Chýlová, Natovová and Kolman (2012), Natovová and Chýlová (2012), Chamoutová and Chýlová (2008). The outcomes of these sombre setting are usually also connected with poor academic performance (Cicognani, 2011, Kausar, 2010, Nickerson, Diener and Schwarz, 2011). The positive side, the belief in one's resources and capacity to cope with stressful events, the use of positive stress coping strategies and increase in overall satisfaction with life (well-being) should be in a focus of educators and researchers as well.

Even though this paper is a follow up of the previous research study of the composite authors, it seems to be important to clarify the basic terminology, which is going to be used throughout the following text. Carver (2011, p. 222) defines coping as *"efforts to deal with a threatening or harmful situation, either to remove the threat or to diminish the ways in which it can have an adverse impact on the person."* Well-known definition of coping from Lazarus and Folkman (1984) describes coping as cognitive and behavioural responses that people use in order to manage their stress. Kebza (2005) mentions the commonly used classification of coping strategies – problem-focused coping, emotion-focused coping and avoidance-oriented coping.

From our previous research work, we have learnt that some of the coping strategies used by our students significantly differ from strategies used by general Czech population (Chýlová and Natovová, 2012). There can be found certain gender differences

in coping, as well as differences between part-time and full-time students (Natovová and Chýlová, 2012). In our settings, this kind of studies tried to take into account the age of respondents with respect to stress coping strategies. Lukavský, Šolcová and Preiss (2011) focused their research on a proactive stress coping at a group of seniors, Baumgartner and Karařfová (2012) studied coping at young adults and adolescents in a connection with the concept of so called "emerging adulthood".

The authors of this study are reporting the outcomes of research on the general self-efficacy, and perceived well-being of the students' population, which is a follow-up to a previous study on the preferred stress coping strategies of students, that ascertained rather unsettling result of surprisingly high number of negative strategies and a low number of positive constructive strategies used (Chýlová, Natovová and Kolman, 2012).

Stress coping models (Lazarus and Folkman, 1984) emphasize the role of individual's resources in influencing his or her appraisal of stressful events and coping strategies, self-efficacy being an important individual resource. Major health behaviour theoretical and research constructs include the concept of self-efficacy as a proximal and direct predictor of intention and behaviour (Schwarzer and Luszczynska, 2008).

Albert Bandura (1997, Bandura and Locke, 2003), as the creator of the concept of self-efficacy, defines perceived self-efficacy as the belief about whether one can produce certain actions, whether one is able to succeed in a particular situation. Bandura described these beliefs as determinants of how people think, feel and, moreover, he claims that it is a uniformly good predictor of the same behaviours. That might be powerful reason why self-efficacy has become one of the most studied

topics among psychologists and educators - it can have an impact on everything from psychological states to motivation and behaviour.

General self-efficacy is the belief in one's competence to cope with a broad range of stressful or challenging demands, whereas specific self-efficacy is constrained to a particular task at hand (Luszczynska, Scholz and Schwarzer, 2005).

"A fundamental goal of education is to equip students with self-regulatory capabilities that enable them to educate themselves" (Bandura, 1997, p. 174). A strong sense of efficacy fosters a high level of motivation, academic accomplishments and development of intrinsic interest in academic subject matter (Bandura, 1997). In other words - the stronger the students' belief in self-efficacy the stronger is their cognitive growth. As stated by Bandura and Locke (2003), perceived self-efficacy is apprehended as an important contributor to academic accomplishments, achievement enhancement and many aspects of well-being. The relations between general self-efficacy, stress appraisal, well-being and achievement in a broad range of stressful or challenging encounters were explored by Luszczynska, Gutierrez-Dona and Schwarzer (2005) across several countries. Social cognitive theory (Bandura and Locke, 2003) expects that self-efficacy positively influences the performance in any kind of task. However, Neal (2003) suggests that the relation does not have to be necessarily straightforward; on account of his preliminary studies on ambiguous performance feedback, where negative effect of self-efficacy on within-person performance level was found. According to Slezáčková (2012), the outcomes of a number of studies highlight the important protective role of self-efficacy against stress, as well as its role regarding a close connection to the quality of life, effective coping with stress, and other desirable variables. Self-efficacy

also shows its importance in stress-coping training. Griffin and Clark (2011) mention the diminishing function of high self-efficacy on the negative effects of workload. Schwarzer (1997) recommends using the general self-efficacy scale in screening people at risk for coping deficiencies.

As it was already mentioned, Bandura (1997, Bandura and Locke, 2003) sees self-efficacy as a causal contributor to human well-being and accomplishments. Also Kebza (2005) considers self-efficacy to be one of the main components of well-being. However, well-being is frequently viewed as an important intervening variable in itself. For example, the research study of Cicognani (2011), who also reported an increase in the number of coping strategies used by adolescents, specifically an increase in tension reducing strategies (alcohol abuse, drugs, etc.), was therefore concentrated on finding the relationship between coping strategies and supportive factors such as self-efficacy or well-being among adolescents.

Well-being can be considered as a global term designating the subjective mental and health ease. By accentuating the subjective experience, the term might be understood as mainly psychological, nevertheless, it is connected with other sciences as well, namely medicine, philosophy, pedagogy, economics, political sciences etc. (Paulík, 2010). Well-being is frequently assessed as a part of the concept of so called "quality of life", which is usually expressed as a combination of mutually interconnected factors: well-being, subjective assessment of one's health condition and life satisfaction. Even though some authors consider well-being to be a key factor and recommend to standardly monitor it in various contexts (Kebza 2005; Hodačová et al., 2011).

The last three decades witnessed a dramatic increase in research on the construct of subjective well-being (Pavot and Diener,

2008) Current approaches to subjective evaluation of quality of life are heterogeneous and thus researchers try to provide a unified starting point – complex model or the attempt to organize existing measurements (Džuka, 2012). Subjective quality of life can be identified through subjective indicators of life quality and ease - Diener and Suh (1997) considered the concept of well-being to be the emerging construct. Martin Seligman (2011) in his newest reconsideration of a happiness theory states that well-being has several contributing elements – positive emotions, engagement, meaning, positive relationships, and accomplishment.

Diener and Diener (1996) refer to subjective well-being as to a person's evaluation of his or her life. In their article "Most People Are Happy" (1996), they hypothesise that people might be motivated to attain positive states and to avoid or reduce unpleasant states and therefore may be likely to use positive coping strategies and, as a result, be mainly happy. Diener et al. (1985) claim that it is possible to isolate various components of subjective well-being: affective, emotional aspects (positive and negative affects) and cognitive, judgemental aspects – life satisfaction. Judgment of life satisfaction is dependent upon a subjective comparison of one's circumstances with what one considers to be the appropriate standard. In his recent studies Diener (Nickerson, Diener and Schwarz, 2011 or Diener et al., 2002) paid attention to the relation between positive affect and college success, respectively job outcomes.

The paper aims to investigate the levels of perceived self-efficacy and satisfaction with life (subjective well-being) in connection to stress coping strategies in a sample of university students from Czech University of Life Sciences in Prague. As mentioned previously, a higher level of perceived self-efficacy leads to a higher use of constructive ways of coping with

stressful situations, which is the main concern of the authors. The other assumed outcome of a higher level of self-efficacy, overall well-being and satisfaction with life, is also explored.

The present study is of the descriptive (exploratory) research design, aiming at an exploration of the subject matter using three standardized questionnaires: Stress Coping Styles Questionnaire – SVF 78 (Janke and Erdmann, 2003), General Self-efficacy Scale - GSES (Schwarzer and Jerusalem, 1995) and Satisfaction With Life Scale – SWLS (Diener et al. 1985). The results for our participants will be statistically compared to the results for the standardized groups in order to estimate the level of the explored characteristics. GSES questionnaire was standardized on a sample of Germans (in its country of origin), currently are available also data from students of economy and entrepreneurs from Czech Republic, which will represent other relevant group for comparison. For a group of respondents, who completed questionnaires on stress coping styles as well as on general self-efficacy, a statistical correlation of the results will be run in order to ascertain the plausibility of the hypothesis of their mutual relationship.

Materials and Methods

Participants

The data were collected during the academic years 2011/2012 and 2012/2013 from a sample of 387 students of the Czech University of Life Sciences in Prague. Participants came from various programmes of study (including both full-time and part-time students), different years of study (ranging from the 1st year of bachelor's studies to the 1st year of master's

studies), and two different faculties – the Faculty of Economics and Management and the Faculty of Agrobiological Sciences and Food and Industry.

Groups of respondents	N (N valid)	Women (N)	Women (%)	Men (N)	Men (%)	Mean age
GSES group	280 (276)	186	66,43	94	33,57	24,83
SWLS group	238 (238)	161	67,65	77	32,35	21,87
SWLS + GSES group	80 (77)	52	65	28	35	32,14
All participating respondents	438	296	67,5	142	32,49	21,86

Table 1: Descriptive statistics of the group of respondents.

In our previous research work, which was already mentioned (Chýlová and Natovová, 2012), we described the use of coping strategies at students of Czech University of Life Sciences. We compared our sample to standardized Czech population sample and found out, that our students significantly differ in the use of positive and also in the use of negative coping strategies, however, not in a positive way. Students use significantly less the most constructive and, in long-term perspective, most approved group of strategies (third group of positive strategies, which includes control of reactions, control of emotions and positive self-instructions). This research work continued with comparing the groups of part-time and full-time students and also with comparing age differentiated groups (age≤23, age≥24). We found similar differences in the use of coping strategies in different age groups and also in different study-mode groups,

especially regarding the use of the positive triad: situation control, reaction control and positive self-instruction (Natovová and Chýlová, 2013).

Method

In order to attain the data necessary for the intended analysis, three paper-and-pencil standardized psychological questionnaires were distributed to the participants (General Self-Efficacy Scale, The Satisfaction With Life Scale and The Stress Coping Style Questionnaire).

The **General Self-Efficacy Scale (GSES)** was created by Schwarzer and Jerusalem (1995) to predict coping with daily hassles as well as adaptation after experiencing various kinds of stressful life events. The scale includes 10 items measuring global feelings of self-efficacy. Responses are given on a 4-point scale (0 – not at all true; 3 – completely true). Responses to all 10 items are summed up to yield the final composite score. Typical items are *"Thanks to my resourcefulness, I know how to handle unforeseen situations,"* and *"When I am confronted with a problem, I can usually find several solutions."* Cronbach's alphas range from 0,76 to 0,90. The mean score on GSES is 28,63, with a standard deviation of 6,18 (Scholz et al, 2002). There is consistent evidence for associations between perceived self-efficacy and the variables under study confirming the validity of the psychometric scale. General self-efficacy appears to be a universal construct that yields meaningful relations with other psychological constructs (Luszczynska, Scholz and Schwarzer, 2005). A Czech adaptation of the scale, created by Krivohlavý (Krivohlavý, Schwarzer and Jerusalem, 1993), was used for the purpose of this study.

The Satisfaction With Life Scale (SWLS) is a scale designed by Diener et al. (1985) to measure global life satisfaction. Of the various components of subjective well-being, the SWLS is narrowly focused on assessing global life satisfaction and does not involve any related constructs. The SWLS consists of 5-item scales, where participants indicate how much they agree or disagree with each of the items using a 7-point scale that ranges from 7 (strongly agree) to 1 (strongly disagree). Typical items are *"The conditions of my life are excellent"*, *"In most ways my life is close to my ideal"* (Diener et al., 1985). Pavot and Diener (2008) refer to the favourable psychometric properties of SWLS, including its high internal consistency and high test-retest reliability (0,82), Cronbach's alpha 0,87. The mean score on the SWLS is 23,5, with a standard deviation of 6,43 (Pavot and Diener, 1993).

The Stress Coping Style Questionnaire (SVF 78) questionnaire was created by Janke and Erdmann (2003) and was introduced in detail in our previous studies (Natovová et al., 2012, Chýlová and Natovová, 2012). In summary, it is a questionnaire where subjects decide for each item how likely the reaction presented corresponds to his or her way of reacting, when he/she is *"... disturbed, irritated or upset by something or someone..."* (Janke and Erdmann, 2003). The SVF 78 has 13 subscales and contains 78 items. Positive coping strategies are measured on scales 1 – 7 and divided into three subgroups of positive strategies, while scales 10 – 13 measure negative coping strategies. In this research, we also focus on the analysis of self-efficacy and stress vulnerability variables in relation to the three groups of positive strategies mentioned above. Positive Strategies 1 include the subscales minimization and denial of guilt, Positive Strategies 2 contain the subscales distraction and substitute gratification, and the group of positive coping strategies is completed by the subscales situation control, reaction control and positive

self-instruction (Positive Strategies 3). SVF 78 is a reliable and valid psychodiagnostic tool adapted also for the use in Czech-speaking environment (Janke and Erdmann, 2003).

Statistical analysis

As for a statistical analysis of the data, besides descriptive statistics of the sample (Mean, Standard Deviation and Standard Error Mean), we will test the significance of the difference between the means of our samples and the means of other relevant samples (students of the University of Economics in Prague – VSE students, Czech entrepreneurs, and a standardized sample of the GSES group; a standardized sample of the SWLS group) via one sample t-test. To answer the other research question, whether a correlation exists between the variables: self-efficacy (GSES), well-being (SWLS), positive coping strategies (SVF – Positive strategies), negative coping strategies (SVF – Negative strategies), as well as between the groups of positive coping strategies (Positive strategies 1, Positive strategies 2, Positive strategies 3), Spearman correlation coefficient will be computed. The data processing will be done with the use of the SPSS 19 programme (Norušis, 2011).

Results

The results of the descriptive statistical analysis show that the mean value of Self-efficacy (GSES) in our sample is 28,45. The mean value of Well-being (SWLS) is 22,7. Other details on descriptive characteristics of these two scales (within each respective group of 238 and 227 respondents, whose questionnaires were valid; 4 questionnaires on GSES were incorrectly filled in and therefore not used for further analysis) are displayed in Table 2, below:

	N (valid)	Mean	Std. Deviation	Std. Error Mean
Satisfaction with Life Scale	238	22,70	6,04	0,39
General Self-efficacy Scale	276	29,66	3,80	0,23

Table 2: Results – descriptive statistics values of the Satisfaction with Life Scale (SWLS) and General Self-efficacy Scale (GSES) groups

The General Self-efficacy Scale (GSES) results were compared to the results of students of University of Economics in Prague on the same scale (Lukeš et al., 2004) in order to ascertain the possible concordance or disparity of the self-perception of the two groups of students, that could be considered comparable (and often are compared in other opportunities). The mean value of perceived general self-efficacy of our students emerged to be significantly higher. In comparison of our participants to the group of entrepreneurs from the Czech Republic, we have found a significant negative difference between the means. Of the same sense and significance is also the difference between the mean of our students and the mean of the general German population. As for the values of Well-being, the results of our sample were significantly lower than those of the compared population. The detailed results are shown in Table 3.

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
General Self-efficacy Scale	Test Value (VSE students) = 27, 36					
	10,05	275	0,00**	2,30	1,85	2,75
	Test Value (entrepreneurs) = 31, 02					
	-5,95	275	0,00**	-1,36	-1,81	-0,91
	Test Value (Germans) = 29, 28					
	1,66	275	0,10	0,38	-0,07	0,83
Satisfaction with Life Scale	Test Value = 23, ,5					
	-2,04	237	0,04*	-0,80	-1,57	-0,03

* $\alpha \leq 0.05$; ** $\alpha \leq 0.01$

Table 3: Results – one sample t-tests of the Satisfaction with Life Scale (SWLS) and General Self-efficacy Scale (GSES) groups

Another key concern of our research was whether there exist the correlations between self-efficacy, well-being and groups of coping strategies. We used non-parametric Spearman correlation coefficient due to his robustness, our smaller sample size and ordinal character of the data. The values of correlation coefficients are shown at Table 4, below.

General Self-efficacy Scale		General Self-efficacy Scale	Positive strategies	Negative strategies	Positive strategies 1	Positive strategies 2	Positive strategies 3	Satisfaction with Life Scale
	q	1	0,56	-0,71	0,48	0,03	0,53	0,17
	Sig.	-	0,00**	0,00**	0,00**	0,84	0,00**	0,14
	N	50	48	48	48	48	48	77

* $\alpha \leq 0.05$; ** $\alpha \leq 0.01$; q = value of Spearman's correlation coefficient; Sig. is 2-tailed

Table 4: Values of Spearman's correlation coefficient for Satisfaction with Life Scale (SWLS), General Self-efficacy Scale (GSES) and Coping strategies

Table 4 clearly displays that self-efficacy significantly positively correlates with positive coping strategies in general ($q = 0,56$), as well as with Positive Strategies 1 ($q = 0,48$) and 3 ($q = 0,53$). By contrast, in case of self-efficacy we have found statistically significant negative correlation with negative coping strategies ($q = -0,71$). As Table 4 shows, we found no statistically significant correlation between self-efficacy and well-being (GSES and SWLS). This finding is not in line with theoretical findings above and needs further investigation. However, we can assume that people who have confidence in their ability to manage everyday problems and concerns in an effective and efficient way are also more likely to use positive coping strategies (including the last three most effective coping strategies labelled as Positive Strategies 3). At the same time, higher perceived self-efficacy may predict lower use of negative coping strategies. Bandura

(1997) generally presumes that people who have confidence in their ability to efficiently achieve their goals are also healthier, more successful and more effective. These people are also likely to experience a lower level of stress, similarly to the conclusions of Lazarus (1999, p. 102) "*...when coping is ineffective, the level of stress is high; however, when coping is effective, the level of stress is apt to be low*".

Discussion

The above-described results bring several pieces of knowledge about a sample of students from CULS that are not exactly in accord with the expectations formed on the basis of literature overview. Firstly the GSES values seem to indicate the fact that CULS students perceive their general self-efficacy to be higher than it might have been expected according to the findings made on a similar population of students of University of Economics in Prague (Lukeš et al., 2004). At the same time, CULS students are less satisfied with their life, judging their overall well-being to be lower than could be expected among a similar population, according to the results of Diener et al. (1985). It is therefore apparent that our findings are also not in concordance with Diener and Diener (1996), who concluded their study on satisfaction with life with the affirmation that naturally occurring processes give most people the ability to remain happy, that people are generally satisfied with their life – their work, marriage, leisure.

The authors of this research study primarily aimed at broadening of the area of stress studied on university students towards other related intervening variables, namely self-efficacy and well-being. Even though we are well aware that other variables might be considered in the future research as well – for example the fatigue and the burn-out syndrome. Burn-out syndrome

is usually connected with negative emotions in relation to a profession, with demotivation, the loss of interest, however, some newer studies show also its interconnectedness with physiological markers (the stress hormones level) and thus with the level of cardiovascular and cerebrovascular diseases (Kebza, Šolcová, 2010). Similarly, Tanaka (2009) studied coping strategies adopted by university students in relationship to fatigue, and he found that fatigue and perceived level of stress and coping styles are closely correlated.

Should we ask about the reason for studying stress, coping, self-efficacy and well-being at university students, Tanaka (2009, p. 91) provides some answers *"however, further efforts to develop educational training programmes that reduce stress and help guide individuals to develop efficient stress coping styles would contribute to a lower incidence of severe fatigue, a higher rate of recovery from severe fatigue, and even more favourable academic outcomes among (medical) students"*.

Refocusing our attention to the positive side of the issue, to the academic success, we note that there exist many studies of the relation between subjective well-being and life satisfaction and various indicators of college success (Nickerson, Diener and Schwarz, 2011). Frisch et al. (2005) conducted a longitudinal study on a quality of life of students and commented upon the results, that they extend the predictive validity of life satisfaction to a new domain of academic retention. Neal and Yeo (2003) previously contributed to the debate regarding the direction of the relationship between self-efficacy and performance. Presently Yeo and Neal (2013) represent new critical way of reconsideration of Bandura's original theory; in their brand new article they explain the importance of designing and analysing studies involving self-efficacy at the within-person level of analysis and in this sense they explain the contradictory co-

existence of positive and negative dynamic self-efficacy effects across the between- and within-person levels of analysis, which might be of consideration for a future study.

Regardless the statistical significance of the number of the outcomes, we must be aware of the limitations of this study before trying to broaden its implications. First of them is a limited sample size. Our results describe students from Czech University of Life Sciences, not the entire Czech student population, and this fact needs to be taken into account, as this population seems to display certain unusual characteristics.

Conclusion

The most important point of the study is, as the results of statistical analysis show, that students in our sample differ in a number of ways from standardized samples and from a similar student population. CULS students have a significantly higher meaning of their general self-efficacy than other similar student population, while being less satisfied with their lives than the comparable student population. We found significant correlations between self-efficacy and stress coping strategies, which induce, that the concept of self-efficacy is a useful idea that deserves to be included into psychological seminars and contact lessons in education of our students.

Do the findings mentioned above imply that our students are generally dissatisfied while having heightened perception of their own capacities?

To answer any questions concerning differences in the general self-efficacy level and the nature of the dissatisfaction of our students would require further investigation. We found no correlation between self-efficacy and well-being. The proposed way of analysing self-efficacy on within-person level of analysis

might be taken into account. The means of intervention should be set accordingly, as an understanding of the underlying mechanism of these processes can aid in their designing.

It is a task for teachers and educators to support the enhancement of positive and constructive ways of dealing with major as well as minor life events among students. The desired outcome of interventions is to support positive relations between general self-efficacy and supposed aspects connected with stress-coping strategies, and the use of their relations for the prevention of negative stress impacts and the further boost of the positive personal growth of students, as well as their overall well-being, satisfaction, and academic achievement.

Furthermore, we have identified relations between the level of perceived self-efficacy and most groups of coping strategies (positive, negative, as well as the first and third subgroups of positive coping strategies as distinguished by Janke and Erdmann, 2003). Self-efficacy therefore appears to be a meaningful concept that can be well used in education and counselling related to coping with stress. Our future research work in this area should be outlined here. We are planning to focus on various spheres of work and private life and the perception of such specific self-efficacy (e.g. self-efficacy in relation to study, self-efficacy in relation to sports activities, self-efficacy in partnership, etc., as mentioned by Bandura, 1997, for example). For the purpose of education and psychological counselling at CULS, possibilities of training activities aimed at enhancing perceived self-efficacy in students of the Faculty of Economics and Management of the Czech University of Life Sciences should also be considered.

Finally, we would like to answer the question whether it is important at all to think about the issues of coping with stress, self-efficacy and behaviours that can lead to higher

vulnerability to stress in the academic environment. An answer to this question has been clearly formulated by Kausar (2010, p. 31) who notes that findings about relationship between academic workload, perceived stress and coping "*have important implications for students in higher (in our case university) education and highlight the importance of counselling in the higher education institutions (universities) which in turn may help improve their academic performance.*"

We agree with the above noted quotation and although we are aware of some shortcomings, particularly in terms of the research sample size and selection, we believe that our results add to the growing body of evidence suggesting that the influence of self-efficacy and stress coping strategies on well-being and life satisfaction of students is more than just a coincidence and can be inspiring and beneficial both for educational and counselling work with students.

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