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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.

The journal accepts quantitative, qualitative and experience-based full research papers, short communications or review studies. Applications and case studies introducing and describing impacts of new theoretical approaches in real conditions of practical case are also accepted.

All papers passed a double-blind peer review process.

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THE ROLE OF THE VIDEO INTERACTION GUIDANCE IN THE ENRICHMENT OF STUDENT TEACHERS' SOCIAL SKILLS

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Abstract

The school is a complicated social organism. The integration in it could be complicated for teacher novices, who have studied theoretically psychological and pedagogical aspects of learning, but have not many opportunities to develop their professional abilities in the real education.

The article deals with using of the video interaction guidance (VIG) in the education of the teachers to support their professional development – above all in the area of communication skills. The improvement of the communication significantly helps to create a positive, relaxed, but learning centred climate whereby increases the efficiency of the whole teaching process.

The investigation of using of the VIG in the preparation of student teachers is presented in the form of quantitative research and an illustrative case-study. Results of the research suggest that the positive video feedback provides a valuable opportunity for personal, professional and social development for both teachers and pupils across the range of contexts. The VIG improves the communication skills of student teachers, therefore enhances effective learning and teaching and minimises negative contact, e.g. misunderstanding, inattention or conflict. As a consequence, the using of the VIG had a positive impact on the self-esteem and mental hygiene of student teachers who have started fully enjoy the teaching, being energized by it.

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Video interaction guidance (VIG), social skills, communication skills, education of teachers

Introduction

Communication skills of a student teacher

Communication skills constitute highly important part of profession skills of teachers, enabling them to attach positive relationships with students and to create pleasant and effective atmosphere in the teaching process (Gursimsek et al., 2008, cited in Saka and Surmeli, 2010). Many studies of Czech and foreign authors warn that above all student teachers have insufficiently developed their abilities to manage the class (Locke and Ciechalski, 1995, Šimoník, 1995). According to Tok (2010), communication and behavioural management skills belong to the most substantial problems of the beginning teachers.

Facing up to this situation, the preparation of student teachers should be concentrated on the development of social skills. The integration of these activities directly to the teaching practice could help them to bridge over the gap between the theory and the real classwork. Video interaction guidance (VIG) enables to realize that with considerable efficiency.

Video interaction guidance

The VIG was developed in the Netherlands (e.g. Jansen & Wels, 1995, 1998, in Häggman-Laitila et al., 2003) as a short-time intensive method helping to improve interactions between parents and children, practiced by the organization named SPIN (Stichting Promotie Intensieve Thuisbehandeling – Institution of Supporting of Intensive Home Approach) as an alternative to institutionalization of problem children. It was being expanded into many other areas of a social contact – the VIG is used in a very wide range of contexts (education, health service, social work, management etc.).

The VIG is currently practiced in many different countries, including the Czech Republic, Finland, Germany, Hungary, Poland, Sweden, Switzerland, the United Kingdom and the United States (Fukkink and Tavecchio, 2010).

The method of the VIG has been inspired by a wide range of theoretical sources from several disciplines – some of the most important are human ethology (Trevarthen – theory of intersubjectivity, reciprocity, protoconversation; Papouschek and Papouschek – intuitive parenting), psychology (Bowlby – attachment theory, Vygotsky – zone of the proximal development, Bandura – social learning theory), research of communication (Jacobson - rituals of the contact, Watzlavik – common theories of verbal and nonverbal communication, videofeedback et al.), pedagogy (Tausch and Tausch, Rogers – humanistic pedagogy, Gordon – parental ability et al.) (Beaufortová, 2002).

Through the video-records, the method focuses on increasing of the successful interactions, including verbal, nonverbal and paraverbal aspects of the communication. A unique feature of the VIG is that trainees watch themselves from a distance and have time for self-reflection, with the possibility to stop, review or to slow down the recording (Fukkink and Tavecchio, 2010).

The impact of the video-feedback on the development of the communication skills has been expressed elaborately in the theory of positive self-modelling by Dowrick and his colleagues (1999, cited in Bidlová, 2005). On the basis of many researches, the theory emphasizes that the positive self-review enables the increase of the adaptive behaviour that has been contaminated by unwanted elements of behaviour, facilitates the transfer of some environment-specific behaviour into another environment, reduces the anxiety etc. (Bidlová, 2005). According to this theory, the VIG trainer selects and labels successful elements of interaction, intending to strengthen the communication skills of the client.

The records are analysed according to the Contact principles – categories of observable elements of behaviour that the VIG trainer and the client try to identify on the record (Biemans, 1990, in Beaufortová, 2002). The knowledge of these principles enables the client to increase his/her communication capability that means having more variants of communication. Wider communication repertoire then increases the probability of an effective communication in every situation (Šilhánová, 2008).

The VIG clients are taught these principles by video analysis under the guidance of the VIG trainer. The analysis takes place in supportive, productive climate. Clients are guided to identify successful communication principles and to think how to use these principles in other situations. This way of learning is demonstrably more efficient than to only point out and eliminate mistakes. “Based on the social learning theory of Bandura (1997), the VIG assumes that positive reinforcement of positive behaviour increases the self-efficacy of learners. “(Fukkink and Tavecchio, 2010, p. 2).

Principles of using the VIG at school

The goal of the VIG at schools is to help the teachers to develop their communication and self-reflection skills. That would enable them to attach relationships with students successfully, to manage the class and the education efficiently and to support their self-confidence in the role of the teacher.

The basic premise of using the VIG at school is that pedagogical climate in the classroom is created by the teacher. He/she uses his/her communicational and organizational abilities to influence behaviour and performance of the students. Consequently, he/she is greatly responsible for the quality of the interactions in the classroom. If he/she helps the students to work without stress, in relaxed climate, if he/she tries to stimulate them and expresses pleasure from their successes, the teacher creates “learning-centred climate” (Bidlová, 2005).

The VIG at school uses the records of ordinary situations from the education to improve the communication through finding, enriching and strengthening the communication skills of the teacher. The possibility to see him/herself from the distance, to review or slow down the record and to analyse the behaviour of the teacher and the students under the guidance of the VIG trainer gives the teacher a new frame of view on the problem situations and on possible solutions.

With the help of the VIG trainer, the teacher is appealed to be as active as possible in identifying the elements which make these moments effective, reflecting on their impact on the students and considering how could he/she increase using of this elements of communication. Watching these successful moments, teacher gain confidence in his/her communication sources and in his/her ability to identify own strengths and areas for development (Forsyth, 2008).

The objective of this article is to characterise the role of the VIG in the education of the student teachers, using the quantitative research and a case–study approach.

Material and Methods

Method of the VIG

The VIG process involves the negotiating the goals of the work, resulting from actual needs of the teacher. Then the videotrainer is filming the teacher, short (approximately 10 minutes) records are being created at agreed times during the lesson. The crucial parts of the record are being selected and analysed by the videotrainer (Forsyth, 2008). These parts are then being watched and discussed with the teacher with the intention of revealing and strengthening of his/her own communication sources, which seems to be more efficient than to point out and eliminate mistakes (Häggman-Laitila et al., 2003). This part of the VIG process leads into specification of partial goals for the next work of the teacher. This is supported by the next VIG intervention.

VIG implementation into undergraduate study of teaching – quantitative research

The pilot evaluation has been designed and organized by the first author of this article (the second one was a member of the realization team). The study focused on the possibility of the VIG implementation into undergraduate study of Teaching Psychology at secondary schools and colleges. 133 students of Teaching Psychology (103 females, 30 males) practising at 30 secondary schools and at 12 colleges of 10 regions of the Czech Republic for at least 3 months. The data were collected from October 2003 till June 2009.

The study had two crucial aims: the VIG implementation and evaluation. Three VIG trainers aimed at supporting and helping to develop the social skills of the students of Teaching Psychology by using the VIG during the role playing (microteaching) and students' practices at real schools. Initially, short segments of microteaching (10 minutes) were recording by the VIG trainer and then analysed and discussed with the trainer and other present students of Teaching Psychology. Consecutively, the students were being recorded three times during their practices at real schools. All the recordings were followed by individual analysing and discussing the material with the VIG trainer. At the end of the discussion, the students set the partial goals for their professional growth (by the first and second recordings, these goals became objects of the next VIG intervention).

The evaluation focused on measuring changes in the social skills of the student teachers over the VIG intervention period by video analysis. The data presented in this paper were gathered from the written notes of the VIG trainers and from the analysis of the written reflections of the student teachers.

The next form of evaluation of the recorded materials, which has still not been finished, is the structured observation with the help of the program V. I. P., designed for the analysis of the videorecords. Three educated observers analyse the records according to the designed categorisation system: analysis of the used teaching methods (lecturing, exercising, discussion, groupwork, using of psychological tests, games, roleplaying, brainstorming, presenting of some related video or a book), analysis of the emotional state of the teacher (calm, sad, concentrated, bored etc.), analysis of the attention (the teacher focused on some student, group of students, blackboard; students focused on the teacher, their notes, each other etc.).

Case-study

One of the participants of the research was selected to demonstrate the impact of the VIG on the student teachers in more detail. The student was a 23 year woman who had been already working as a teacher of social sciences at a grammar school.

Despite of her advanced teaching skills she faced up to the insufficient attention of students, who were allowed to use notebooks during lessons (an important part of the school orientation). She needed to find out some efficient ways how to activate the students more.

The VIG was used during the lessons of the general psychology in the class of approximately 15 students (15 and 16 year old). The approximately 10 minutes long records were created at agreed times and then analysed in compliance with the VIG approach by the second author of this article.

Results

VIG implementation into undergraduate study of teaching – quantitative research

Figure 1 shows the teaching methods that student teachers used during their microteaching and practice. They started used more student-centred and activating methods after the VIG intervention such as exercising, discussions, group work, the form of lecturing was changed also (the questioning increased). Few students also administer the psychological tests, play role with students, used a brainstorming, play a video or read a book.

All presented data were gathered from notes of the videotrainers and from self-reflections of the student teachers. Percentages represent the part of the students who used a teaching method during their microteaching and practices.

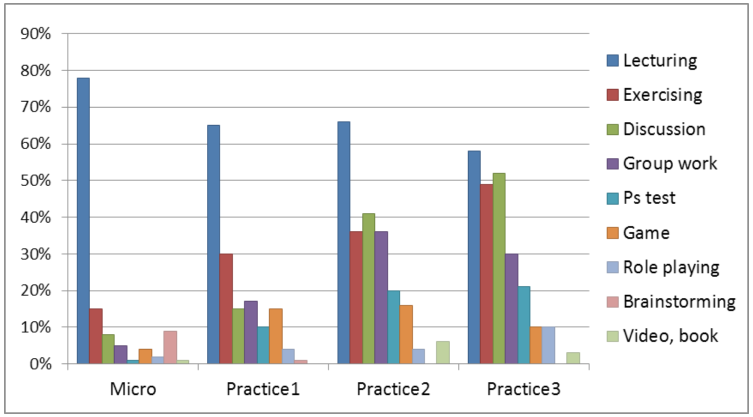

Fig. 1: Teaching methods

Figure 2 shows changes in social skills of the student teachers during their teaching practice. There are remarkable changes after first and second VIG feedback.

The decrease in activating and discussing between microteaching and the first practice might have been caused by the fact that the student teachers were less familiar with the students in the real classes than with their colleagues. After two feedbacks more students used stronger and clearer signals, they were more readable for students, their non verbal and verbal attuning improved also. They reduced guiding and corrections.

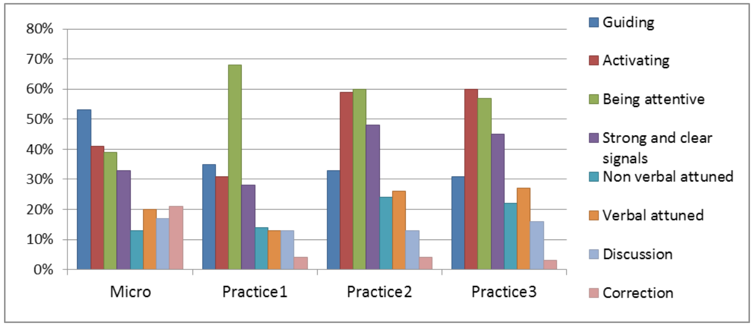

Fig. 2: Social skills

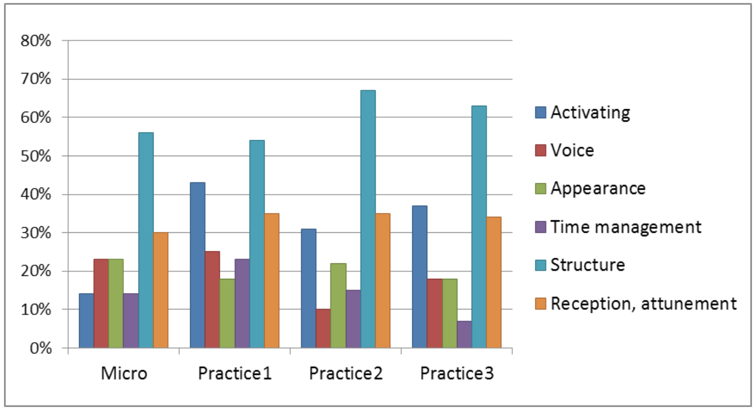

Fig. 3: Working goals of students

Figure 3 shows changes in working goals that student teachers set during the VIG intervention. The goal "to activate students more" remarkably raised after first real experience of teaching in a big class of students as well as the aim to be better attuned, to make better structure of the lecture and to have a better time-plan of activities. Many of them worked on their voice (modulation, intonation, articulation, loudness, fluency etc.) and on their appearance (dress, face expression, movement, gestures etc.).

Case-study

During the first recording, the teacher seemed to be free-hearted and tolerant, well-prepared, trying to involve all the students into the education. She tried to activate the students to infer examples, connections etc., but the notebooks created a barrier of the eye-contact and of the interactions generally.

In the following discussion, we were talking about the communication sources and strengths of the teacher. We were observing the connection between the eye-contact with the teacher and the activity of the students. A possibility to limit using of the notebooks was discussed, but the teacher would like to attract attention and activate students without limiting them. The partial goals till the next intervention were: more equable eye-contact with all students, direct activations.

On the next video, the teacher tried to activate the students more directly, even in the connection with the notebooks ("try to find this out" etc.), but she was working hard herself, not giving enough space to reactions of students. She had succeeded in activation of students by the concrete examples.

In the discussion, the teacher was astonished that she had given so small space for students' reactions. We were talking about different forms of teaching (if it is more efficient to lecture without a participation of students or to activate them and guide them through the education). We were discussing the possibility to limit using of notebooks occasionally, the teacher considered trying it, because she realized that she needed more of the eye-contact with students to attract their attention.

In the last recording, there was a huge change in the organization. The teacher and the students were sitting in a circle together, the teacher succeeded in activation of the students more times. The students were paying more attention to the teacher and to themselves as well.

The teacher was very absorbed by the changes that increased the students' activity and the efficiency of the education. She was pleasured that she had managed to attract the attention and realized how the changes reached thanks the VIG helped her to feel more comfortable with the education.

Discussion

The results of quantitative research indicate the potential of the VIG method as an efficient tool for the enrichment of future teachers' social skills. We realize that we affected only a small part of the complex relations between teacher and students. We did not monitor all the variables that enter into their interaction, but we chose those that may be crucial for the education of student teachers and can be monitored through the VIG method as well.

In the process of analysis and interpretation of the data few problems arose (mainly caused by the nature of field research design). Above all, only the short segments of every lesson had been recorded and then were analysed. These segments had been chosen mostly according to the needs or working goals of the student teachers so they sometimes do not fully represent their teaching style. Using of certain teaching methods could have been affected by influences such as the topic of the lesson or by the condition of the student teacher (e.g. nervous or uncertain teachers used to hide themselves behind the lecturing that seems them much safer then discussion, which is probably the reason for the decrease in activating between microteaching and the first practice in Fig. 2).

As we can see in the case study and partially in Fig. 3, the VIG influenced not only their communication skills but also their way of thinking about the education (e.g. if it is more important and efficient to transmit the information or to activate the students to think about the topic, to infer connections and conclusions etc.). We agree with Forsyth (2008), who suggests that the VIG is able to cause changes in the student teachers understanding and practice. One of interesting conclusions of her study, which was not examined in our research, is the fact that the student teachers after the VIG were able to generalise their skills to another context. This conclusion confirms the efficiency of the VIG method for the teachers.

Despite the research mentioned above provides enriching information for student teachers, it will be very helpful to support it by the findings from structured observation processed by the program V. I. P. This investigation is going to bring precious data from the microanalysis of attention, emotions and other important aspect of communication.

Conclusion

According to the described research, the VIG provides an important tool to analyse and develop effective teacher-students interactions and to prepare and positively motivate student teachers for their future profession. There is a substantial positive impact of the VIG on the self-reflection processes of the students. The method helps to reduce insecurity and nervousness of the student teachers in their practice as well.

The student teachers rated very high the possibility to see themselves on the records and analysed them together with positive and supporting VIG trainers and other students. They found helpful to see the records of other students as well.

In summation, the VIG has a positive effect on teacher-students' communication and perception: the student teachers used activating techniques more frequently, became more attentive, receptive and attuned to the initiatives of students. As a consequence, students were more involved into the education.

Acknowledgements

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WEIGHTING OF STUDENTS' PREFERENCES OF TEACHER'S COMPETENCIES

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Abstract

The aim of this article is to describe the proposed methodology of identification of the students' weights or preferences of teacher's managerial competencies at the Faculty of Economics, Czech University of Life Sciences in Prague (CULS). The goal of this article is not to evaluate the teacher's scientific ability but describe the evaluation of the teacher's managerial competencies weights from students' point of view.

For setting of weights there are many different methods that varied in the proportion of including the subjective and objective judgement. Commonly diffused method is the Analytic Hierarchy or Network Process by prof. Saaty (AHP or ANP). Because it is not possible to see or to evaluate teacher's competencies in complexity, we proposed the questionnaires for pairwise comparisons of various teacher's managerial characteristics and competencies. These answers are then analysed using the AHP method. The AHP is a method deriving global weights from partial weights received as result of pairwise comparisons.

Key Words

Teacher's managerial competencies, Analytic Hierarchy Process, competencies weights

Introduction

Teacher usually thinks that students are receiving and understanding information in the same way teacher does (Skarupská 2007). Mareš (1998) then asks, do we really need to change students' learning styles instead of personalizing the teachers? Because commonly more than 20 students are in the course, it is reasonable to personalize teacher to students, not the other way. Teacher then has to act as a professional, who has a wide scale of work tools and only he/she has to decide how to use them in different students groups (Skarupská, 2007).

But do the teachers know what students expect, which pedagogical methods they prefer, what they want not from scientific but from organizational point of view?

In this paper we focused not on the identification of the main teacher's managerial competencies and their analysis from educational process point of view. The aim of this article is to describe the methodology of how to identify the student's preferences or weights of teacher's managerial competencies at the Faculty of Economics, Czech University of Life Sciences in Prague (CULS). Used methodology is based on surveys of the students based on pairwise comparisons of selected teacher's managerial competencies and their analysis using the Analytic Hierarchy process.

Material and Methods

Because the students are not able to see or to evaluate managerial competencies of teachers in complexity, we excluded the technical competencies of teacher from observation. For the rest of managerial competencies of teachers were found the key characteristics from the student's point of view. The base for identification of teacher's managerial competencies had been the Casselmann typology of teacher's roles, which was disintegrated to lower levels (Casselmann, 1967). These levels came from managerial competencies (Koontz and Weihrich, 1993) and were described according to Philip Morris competencies model (Hroník, 2006). The competencies observed in the study are in Table 1 (Brozova et al, 2011).

Competencies groups	Competencies	Characteristics/Anti-characteristics
L21 Content and form of teaching	L311 Amount of information L312 Complexity of reading L313 Content of reading L314 Form of reading L315 Depth of reading L316 Way of reading	L411High/Low amount of information L412 High/Low complexity of reading L413 Oriented on the form of reading/Oriented on the content of reading L414 Oral/IT based presentation L415 Narrow specialization/Broad overview L416 Innovative/Classical education methods
L22 Organisation of lecture	L321 Focus on group or individual L322 Setting the rules L323 Solving problems L324 Evaluation process L325 Evaluation criteria L326 Plan of teaching L327 Flexibility L328 Monitoring	L421 Individual/Group focus L422 Consistent/Changeable decision making L423 First hand/Diplomatic manner L424 Quantitative/Qualitative evaluation methods L425 Consistent/Changeable criteria L426 Fixed/Framwork education plan L427 Impressible/Uninfluenced L428 Follow/Do not follow control or monitoring

L23 Personality of teacher	L331 Teacher's self-presentation L332 Communication skills L333 Focus on student L334 Support of student's independence L335 Ability to improvise L336 Teacher's outlook L337 Way of speaking	L431 Quiet/Energic way of speaking L432 Good/Poor communication skills L433 Students/Topic orientation L434 Directive/Democratic manner L435 React/Do not react to students L536 Casual/Informal look L437 Professional/Conversional language styl

Table 1: Competencies groups and their elements

In Table 1 the teacher's competencies are organised into three groups and it is possible to create the hierarchy of this competency system. And more, it is possible to suppose, that the students preferences differ according to the intensity of the competency characteristic.

The whole competency system is really complicated and comprehensive and preference information can have many different forms; therefore its transformation into numerical expression is necessary for mathematical models calculation. So students' weights of these teacher's competencies are estimated as preferences received using Saaty pairwise comparisons methods and subsequently synthesized using the AHP method. The AHP method using quantitative pairwise comparisons is the suitable tool for this analysis, because it enables above described evaluation by sequential comparisons of all possible pairs of items. The AHP is a method deriving global preferences from partial preferences that represent relative measurements of the hierarchical dependences of decision elements (Saaty, 1980, 1999). Fundamental characteristics of both methods are following.

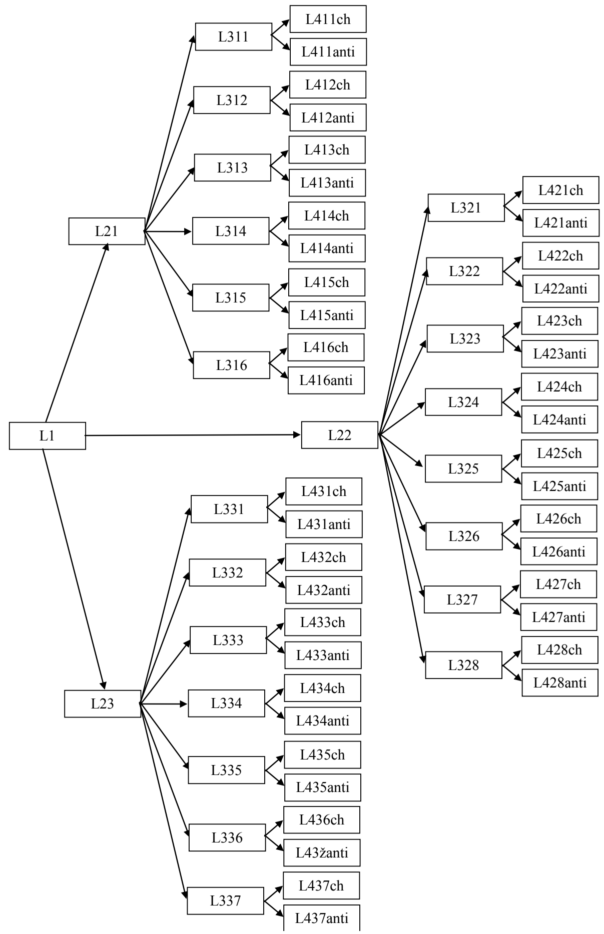


Figure 1: Hierarchy of teacher's competency system

Saaty's pairwise comparison method

Pairwise comparison is the process of comparing pairs of items to judge which of each pair is preferred, or has a greater amount of some quantitative property. One broadly used method is Saaty's pairwise comparison method (Saaty, 1980). It is based on the expert evaluation of this preference and then uses mathematical calculations (for instance the geometrical mean) to convert these judgements to priorities for each of the criteria.

Analytical Hierarchical Process (AHP)

The AHP (Saaty (1980, 1999) is based on mathematics and psychology. The procedure for using the AHP consists of the following steps:

1. Creation of the problem hierarchy containing the decision goal, the variants for reaching it, and the criteria for evaluating the variants.
2. Calculation of the priorities among the elements of the hierarchy by making a series of judgements based on pairwise comparison of the elements.
3. Checking the consistency of the judgements.
4. Synthesis of these judgements to yield a set of overall priorities for the hierarchy.
5. Selection of the best variant based on the highest overall priority.

The AHP model for setting of weights has four levels (Figure 1): the first one L1 with the goal – the preference setting, the second L2x with the group of competences, the third L3xx with the weighting of competencies or the competencies and the fourth L4xx with qualitative characteristics describing the competencies.

To receive the necessary data for this analysis, the student's survey was made. The students filled the questionnaire in MS Excel (Figure 2) and then the answers were synthesized by the AHP for every questionnaire. Because no student can be preferred more than other one which studies the same specialization, the average weights were calculated and analysed at the end.

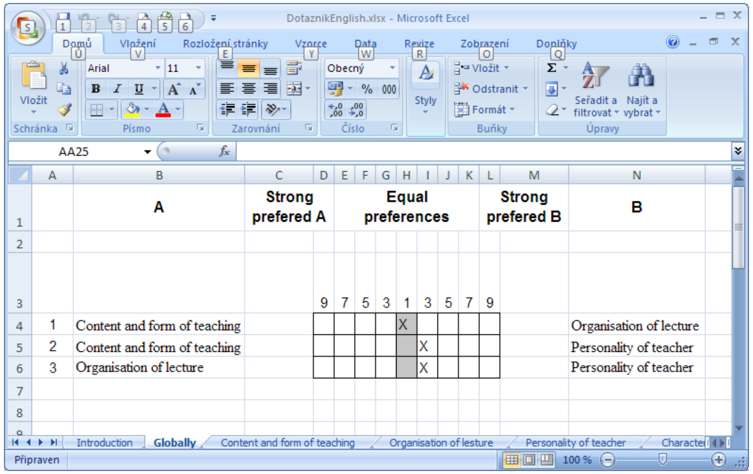


Figure 2: The part of questionnaire

These data then are worked up using MS Excel tools – functions and also macros. Saaty's matrices were recalculated automatically using sheets functions, consistency index was calculated using Goal seeking and results were completed using special macros made for this purpose. The next Figure 3 shows sheet organisation for Saaty's matrix calculation and consistency index checking for competencies and competency groups. When value of consistency index is very bad, corresponding answers are removed from the final elaboration. Weights of characteristics and anticharacteristics are calculated as shown in Figure 4.

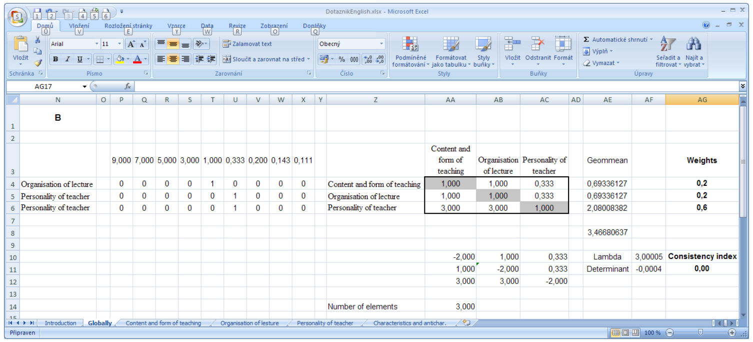


Figure 3: Saaty's matrix calculation and consistency index checking

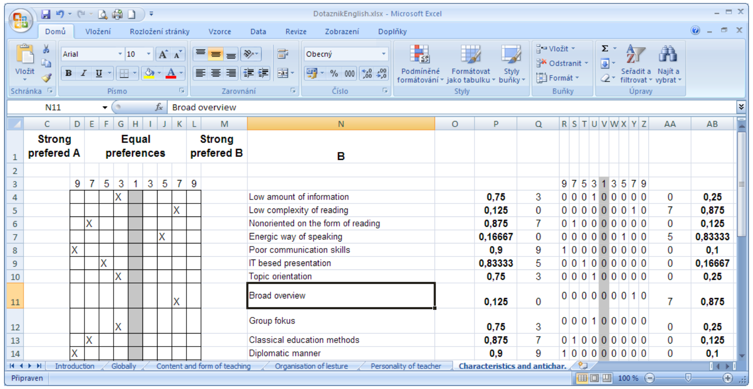


Figure 4: Weights calculation for characteristics and anticharacteristic

Results and Discussion

Suggested methodology was tested on small group of four students. This number of students is really small but also in this test we can show the first results and mainly, this test on a small group of students shows the reasonability of this approach (Brozova et al, 2011).

The analysis of the second level of hierarchy

Preferences of competency groups show, that for students organisation of lectures is not very important (Figure 5). It can be explained by student's ability to accept changes. The most important is the personality of teachers, students often choose the subjects not only according to their contents (the second preference) but also according to the teacher.

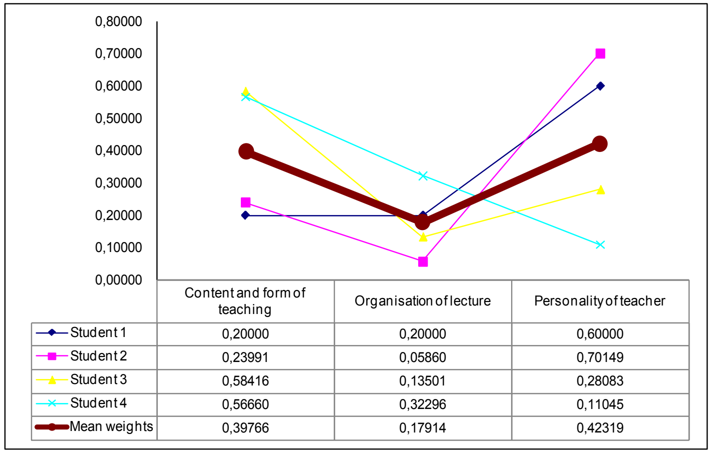
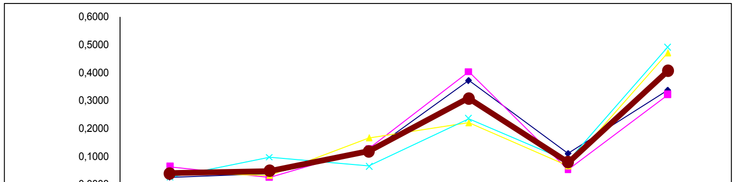


Figure 5: Preferences of groups of competencies

The analysis of the third level of hierarchy

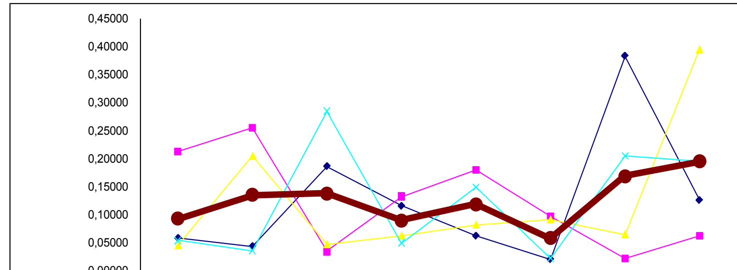
Surprisingly these results show, that for students the way and form of reading is much more important than the content of subject, its difficulty, complexity and so on (Figure 6).



	Amount of information	Complexity of reading	Content of reading	Form of reading	Depth of reading	Way of reading
Student 1	0,0266	0,0401	0,1137	0,3719	0,1104	0,3372
Student 2	0,0646	0,0262	0,1289	0,4039	0,0538	0,3225
Student 3	0,0430	0,0315	0,1667	0,2208	0,0656	0,4725
Student 4	0,0248	0,0972	0,0647	0,2366	0,0846	0,4922
Mean weights	0,03976	0,04876	0,11849	0,30830	0,07859	0,40609

Figure 6: Preferences of competencies in content and form of teaching

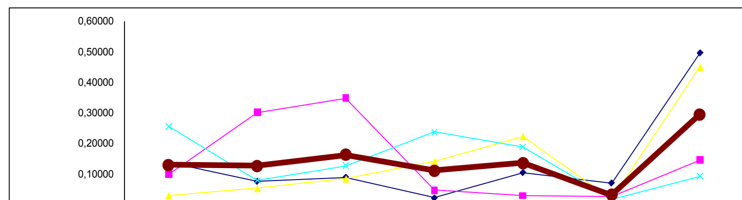
Organisation of lectures is not really important for student (Figure 7). In this group of competencies only the way of monitoring and flexibility can be mentioned, but their weights are not high.



	Focus on group or individual	Setting the rules	Solving problems	Evaluation process	Evaluation criteria	Plan of teaching	Flexibility	Monitoring
Student 1	0,05894	0,04431	0,18687	0,11600	0,06283	0,02112	0,38356	0,12637
Student 2	0,21344	0,25538	0,03534	0,13262	0,18030	0,09766	0,02266	0,06262
Student 3	0,04582	0,20595	0,04778	0,06305	0,08298	0,09215	0,06569	0,39658
Student 4	0,05471	0,03624	0,28487	0,04974	0,14937	0,02324	0,20524	0,19659
Mean weights	0,09323	0,13547	0,13872	0,09035	0,11887	0,05854	0,16929	0,19554

Figure 7: Preferences of competencies in organisation of lecture

In the last group of competencies the way of speaking has the highest preference (Figure 8). It seems that students are really excited and disturbed if the teacher has some inappropriate speech habits.



	Teacher's self-presentation	Communication skills	Focus on student	Support of student's independence	Ability to improvise	Teacher's outlook	Way of speaking
Student 1	0,13770	0,07703	0,09012	0,02247	0,10556	0,07161	0,49550
Student 2	0,09937	0,30176	0,34877	0,04751	0,02967	0,02661	0,14631
Student 3	0,03075	0,05361	0,08491	0,14111	0,22349	0,01602	0,45012
Student 4	0,25632	0,07943	0,12719	0,23828	0,18934	0,01653	0,09292
Mean weights	0,13103	0,12796	0,16275	0,11234	0,13701	0,03269	0,29621

Figure 8: Preferences of competencies in personality of teacher

The analysis of the synthesised information on the fourth level of hierarchy

Synthesised weights on the fourth level show the preferences of teacher's characteristic from the quantitative point of view (Figure 9,Table 2).

The innovative educational methods (not classical), oral based presentation (not IT based), and energic way of speaking (not quiet) are most preferred by students. The students want to enjoy their study. In the same time students preferred teachers which are democratic (not directive) and which react to their needs and problems.

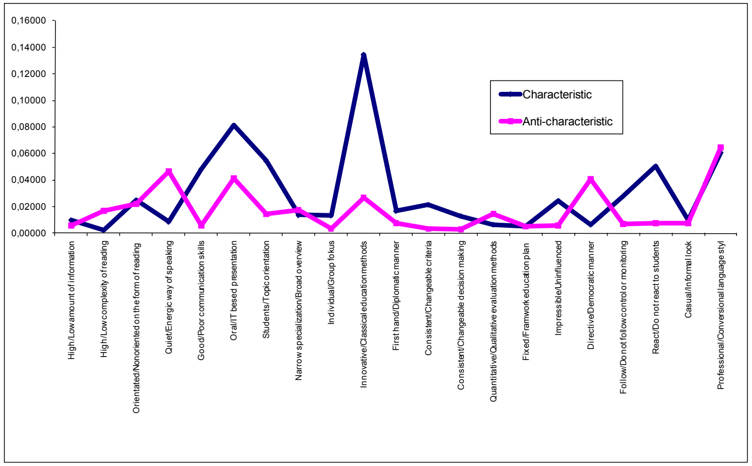


Figure 9: Graph of preferences of competencies in personality of teacher

Characteristics/Anticharacteristics	Weights of characteristics	Weights of anticharacteristics
High/Low amount of information	0,010045421	0,005763766
High/Low complexity of reading	0,002504769	0,016886991
Orientated/Nonoriented on the form of reading	0,025033042	0,022087979
Quiet/Energic way of speaking	0,008664485	0,046788218
Good/Poor communication skills	0,048396954	0,005753484
Oral/IT besed presentation	0,081222744	0,041377624
Students/Topic orientation	0,054524695	0,014348604
Narrow specialization/Broad overview	0,013673804	0,017580605
Individual/Group fokus	0,013395532	0,003305391
Innovative/Classical education methods	0,134573171	0,026914634
First hand/Diplomatic manner	0,016836214	0,007432203
Consistent/Changeable criteria	0,021640211	0,003209792
Consistent/Changeable decision making	0,013083621	0,003102302
Quantitative/Qualitative evaluation methods	0,006654517	0,014639937
Fixed/Framwork education plan	0,005505841	0,004981475
Impressible/Uninfluenced	0,024640205	0,005686201
Directive/Democratic manner	0,00663618	0,040906599
Follow/Do not follow control or monitoring	0,02809629	0,006932851
React/Do not react to students	0,050493447	0,007489459
Casual/Informal look	0,009655985	0,007638316
Professional/Conversional language styl	0,060588396	0,064766906

Table 2: Preferences of competencies in personality of teacher

Globally the way of reading, form of reading, and way of speaking, and democratic approach are more important characteristics of teacher, which influence the success and overall impact of reading and of subjects generally.

Conclusion

This article describes the new methodology for evaluation of students' weights or preferences of teacher's managerial competencies. The AHP model was worked up and the questionnaire for competencies evaluation was prepared. The test on a small group of students provides interesting results and their analysis was made. In conclusion it is possible to say, that

- The small test showed that this methodology is useful.
- Questionnaire for students takes not more than 10 minutes of their time, so students are willing to fill them.

- The form and content of results are adequate for the research of students' weights of teacher's managerial competencies.
- The small test results show, the innovative way of reading, classical form of reading, and energic way of speaking, and democratic behaviour of teacher are more important characteristics of teacher.

These results show the reasonability of proposed methods for weighting of student's preferences of teachers' managerial competencies. Of course, in this contribution we analysed only results of small study, but the results are realistic.

The next work will be focused on the analysis of results received from interviewing all students from study groups in the whole course.

Acknowledgements

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THE IMPACTS OF MULTIMEDIA LECTURES ON STUDENTS' PERFORMANCE IN TWO SPECIFIC SUBJECTS

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Abstract

The objective of the work is to suggest pedagogical, economical and user-oriented criteria to identify benefits of multimedia lectures on mathematical methods in economics. Based on our previous work, we describe them and suggest how to evaluate them including scales and measures, if possible. Then we concentrate on the pedagogical criteria and show their utilization for the efficiency evaluation of the multimedia lectures. For this purpose, we divided the students into two groups based on the frequency of utilizing the multimedia lectures for their study, and used the methods of statistical analysis. In particular, we applied two-sample F-test to know whether the variances of students' results are significantly different or not and an appropriate version of the t-test to know whether mean values of students' results are significantly different or not. The case study is based on the data acquired form the students' performance measurement in two specific subjects taught in the Czech University of Life Sciences Prague in 2010 and 2011.

Key Words

Multimedia lectures, performance, learning outcomes, mathematical methods in economics, operational research methods

Introduction

Many researchers have dealt with the analysis of educational effects and learning outcomes in order to define pedagogical efficiency in education. Guan (2009) investigated the effects of multimedia presentations on the efficiency of learning scientific information in the area of basic anatomy of human brains and their functions, the definition of cognitive psychology, and the structure of human memory. In particular, the author dealt with the impact of redundant information on learning outcomes. He found that information per se did not impair learning, which suggested that the redundancy effect could be rather caused by the interference in information processing. According to the results of his another experiment, there is a negative effect of auditory information on learning regardless of the length of the verbal information. No evidence supported the superiority of auditory instructional mode over the visual one.

For the creation of an efficient multimedia lecture, the issue of the lecture interactivity is quite important. Rasch and Schnotz (2009) made the comparison of two learning methods: studying a text with and without interactive elements (pictures) from the viewpoint of learning efficiency. In their specific issue, they found that learning from text only was more successful than learning from text and pictures. In addition, they found that the visualization format affected participants' interaction with pictures, but not the learning outcomes; however this effect was not influenced by interactivity. The results of above-mentioned research allow us to suppose that the element of the lecture interactivity is not crucial and it is not obligatory to include such elements into our lectures.

Windham (1988) developed the Model of Educational Production. He dealt with the definition of educational outputs and especially with the efficiency of the education from the economic point of view. In this case, he understands such efficiency as the maximization of total educational outputs subject to total costs expensed for all educational inputs. This approach is very similar to more general Data Envelope Analysis model known in the area of Operations Research (Charnes, Cooper and Rhodes, 1978).

Yunus and Salim (2008) mention that most works dealing with e-learning are focused on technical matters whereas less attention is given to the pedagogical aspect. Apart from that, unsatisfactory quality of e-learning hinders the learning effectiveness and resulting in no benefit or added value to its users. Thus, they examine the effectiveness of e-learning from the perspective of pedagogy and the criteria which contributes to the effectiveness. The presented scheme includes the following criteria influencing the effectiveness of e-learning from the perspective of pedagogy: individual, knowledge, learning, content and relationship between instructor and learner.

Průcha (1990) summarizes the most common opinions found in more pedagogical works dealing with the efficiency measurement in the educational process. On one hand, he says that the efficiency measurement in education is usually more complex, on the level of the whole educational process and its long-time effects. On the other hand, he does not exclude the possibility to evaluate individual parts of the educational process, such as specific lectures or teaching methods; unfortunately, specific criteria for such an evaluation are not specified there.

The objective of the paper is to suggest pedagogical, economical and user-oriented criteria for the efficiency evaluation of multimedia lectures on mathematical methods in economics. Based on our previous work (Houška, Beránková, 2010), we describe them and suggest ways for their evaluation including scales and measures, if possible. Then we concentrate on the pedagogical criteria and show how to use them for the efficiency evaluation of the multimedia lectures in two specific courses taught in the Czech University of Life Sciences Prague.

Materials and Methods

Criteria for the measurement of efficiency

Firstly, we have to see the efficiency measurement problem of the multimedia lectures wider, not only from the point of view of the pedagogical efficiency. For such a purpose, we can go out from a general concept for the construction of a criteria hierarchy (Saaty, 1980). It means that the criteria will be ordered into a hierarchy; the hierarchy will include three levels:

- level of the objective;
- level of the criteria groups;
- level of individual criteria under the criteria groups.

The objective level is represented by one formal object – efficiency of the multimedia lectures.

Groups of the criteria are suggested according to general objectives of the courses, because the multimedia lectures will be efficient if and only if they support the achievement of the courses learning outcomes. Moreover, such a support has to fulfill some economical criteria and last but not least, it has to be also user-friendly in order to students will be motivated to use it.

Inspired by Windham (1998) and Yunus and Salim (2008), we can distinguish three groups of evaluation criteria on the second hierarchical level:

Group 1 – pedagogical criteria (P) that are connected with the measuring of learning outputs and inputs on the level of selected courses.

Group 2 – economical criteria (E) that describe the economic efficiency of the multimedia lectures.

Group 3 – user-oriented criteria (U) that reflect a subjective satisfactory of the multimedia lectures users.

Then, criteria level (the third level of the hierarchy) could be as follows:

Pedagogical criteria

P1 – Learning outputs performed by the students in specific courses. We want to evaluate some progress of students, level of their knowledge, etc. This is an objective criterion; we will measure it by results of a didactic test.

P2 – Impact of the multimedia lectures on regular contact teaching (lectures, seminars). This is a subjective criterion; it is evaluated by the sample of teachers who participated on the teaching of Mathematical methods in economics. To obtain the teachers' opinions, we used a free interview method.

P3 – Number of tutorial within the semester. In the frame of the interview for P2, we asked the teachers for the amount of provided tutorials. This is an objective criterion measured by total time of provided tutorials in one semester or by the estimation of such tutorials respectively.

Economical criteria

E1 – Time for the multimedia lectures development. This cost criterion is expressed by total time necessary for the preparation of educational materials, recording the lectures and their editing.

Using the time units, we can compare the time requirements of both multimedia lectures and textbooks.

E2 – Cost for the distribution of the lectures among the students. It is expressed as the sum of staff costs and technical costs.

E3 – Maintenance costs. It calculates all kinds of costs spent within the utilization of the lectures.

User-oriented criteria

U1 – Total time of learning. This is partially objective criterion; it is measured by the estimation of learning time obtained from the questionnaire survey among the students.

U2 – Accessibility of educational materials. This criterion expresses the opportunity of providing the materials through standard shop, e-shop or learning management system.

U3 – Price of the educational material. This criterion is expressed by the amount of money necessary for obtaining the same amount of educational materials in different form.

U4 – General satisfaction of the users with multimedia lectures. This is a subjective criterion we asked the students by a questionnaire.

Complete hierarchy of criteria is shown in figure 1.

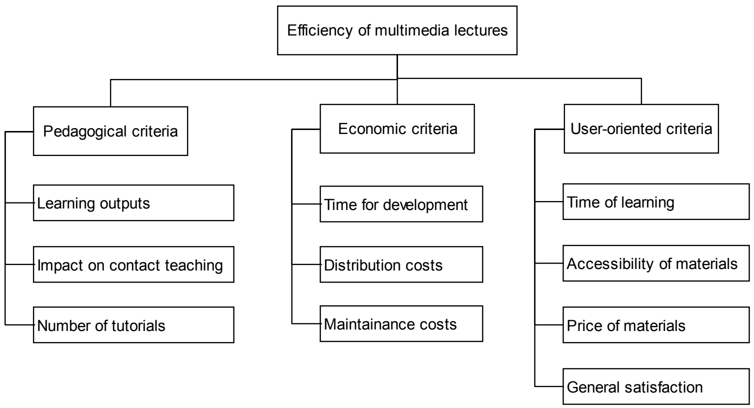

Figure 1: Complete hierarchy of the criteria for multimedia lectures efficiency measurement

Design of the study

The study focuses on the students of Mathematical Methods in Economics I. (MME I., study programmes Economics and Management, and Business and Administration) and Operations Research Methods (ORM, study programme Informatics). They study in a regular form with 2 hours of lectures and 2 hours of seminars per week. Total numbers of students involved into the evaluation of the first didactic test in individual years are in the following table:

Year	MME I.	ORM
2010	370	94
2011	553	91
Total	1364	364

Table 1: Total numbers of students

All data are taken from the learning management system Moodle. We divided the students into two groups:

Group A: The students, who did not intensively use video-lectures for their preparation. It means that they did not utilize the video-lectures at all or in occasion only – 5 times or less from the beginning of the semester to the date of their first evaluation test.

Group B: The students, who prepared with video-lectures intensively, i.e. more than 5 times during the same period.

Based on the above-mentioned segmentation, we formulate the following hypothesis:

Learning outcomes of the Group A were significantly worse than the outcomes of the Group B. We use single measure for the quantification of the learning outcomes; score of the students achieved in a didactic test, we use a cardinal scale from 0 to 50 points.

To reach the maximal objectivity of the study and comparability of received result, we set up the following conditions:

- We consider only the results reached in the regular date of the test. Some students absented in the regular date and tried to pass his/her test later; their results are excluded from the study.
- Moreover, we carefully balanced the hardness of individual variants of the didactic test. Based on results of the students from the previous years, we re-sorted test items among the variants of the tests. After this operation all average test scores did not differ about more than 5% from the total average of all test results.

To compare the learning outcomes between the two groups of students, we use two statistical tests (Freedman, Pisani and Purves, 2007):

- two-sample F-test to know whether the variances of students' results in two groups of students are significantly different or not;
- based on the F-test, an appropriate version of the t-test to know whether mean values of students' results in two groups of students are significantly different or not.

Normal distribution of data is the necessary condition for these tests to be applied correctly. Visually, we can assume the data are distributed normally, see figures 1 and 2.

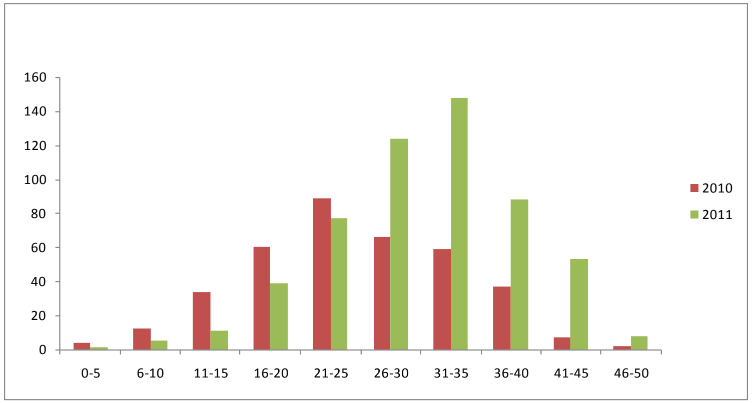

Figure 1: Histograms of students' results in individual years (subject: MME I.)

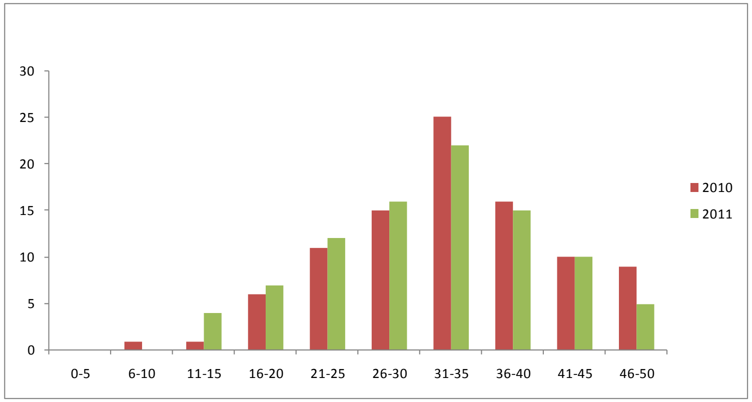

Figure 2: Histograms of students' results in individual years (subject: ORM)

Results

We concentrate to the group of the pedagogical criteria and demonstrate their application for the evaluation of two specific courses on mathematical methods in economics:

- Mathematical methods in economics I. (MME I.) for the students of the study programme Business and administration and
- Operations research methods (ORM) for the students of the study programme Informatics.

These courses are very suitable for the purpose of the case study, because we can simply compare two different instances of such courses: current courses with the support of the multimedia lectures and last courses without such a support. Moreover,

- number of students in these courses is high, results from some statistical surveys are statistically significant;
- within these two years, there are no significant changes in courses structure, contents, teachers, testing methods, etc., no new textbook was provided to the students;
- multimedia lectures cover both lectures and seminars and so the students can use them for both theoretical knowledge and practical skills improvement;
- multimedia lectures are available to the students since the beginning of the semester and information about the availability of such lectures is generally known among the students.

Firstly, we investigated the impact of the multimedia lectures on the pedagogical criteria. Table 2 summarizes basic information about the courses that are involved in the case study. All data were acquired from LMS Moodle.

Number of students	MME I.	ORM
School year 2009/2010	370	94
School year 2010/2011	553	91
Multimedia support	3 lectures, 3 examples	4 lectures, 6 examples
Course topics covered by the support (in % of coverage)	86%	90%

Table 2: Basic information about the courses

For the evaluation of the criterion P1, we used the results of the first didactic test and analyzed them by statistical methods. We divided the students into two groups subject to the utilization of the multimedia lectures. In the first group, there were the students who used the lectures extensively (no utilization or up to 5 times of utilizations); in the second one, there were the students who used the lectures more than 5 times. Data for the statistical analysis are in the following table (the maximum test score is 50 points).

Utilization intensity	Number of students		Average test score		Standard deviation	
	MME I.	ORM	MME I.	ORM	MME I.	ORM
2010						
No or up to 5 times	250	83	24.20	33.99	8	9.1
More than 6 times	120	11	27.07	37.27	9.29	10.26
All students	370	94	25.13	34.37	8.53	9.25
2011						
No or up to 5 times	384	81	30.30	32.01	7.98	10.00
More than 6 times	169	10	31.56	34.02	7.00	8.56
All students	553	91	30.68	32.25	7.42	8.87

Table 3: Average test score in relation to the intensity of multimedia lectures utilization

The above given data were tested on the equivalency of means. Separately in individual courses, the hypothesis that the mean value of the test score is higher for the students who used the multimedia lectures more intensively was tested. For such a purpose, the two-sample t-test was used. The appropriate version of the t-test depends on the equality of variances determined by the F-test. Its results are in the following table:

	MME I.		ORM	
	0-5 lectures	6+ lectures	0-5 lectures	6+ lectures
2010				
Mean value	24.20	27.07	33.99	37.27
Variance	63.96	86.34	82.84	105.22
Observations	250	120	83	11
Common variance	--- [1]	$\alpha = 0.05$	85.27 [2]	$\alpha = 0.05$
t-test value	-2.90		-1.11	
t-critical value	1.65		1.66	
2011				
Mean value	30.30	31.56	32.01	34.02
Variance	63.71	49.03	100.04	73.29
Observations	384	169	81	10
Common variance	59.23 [2]	$\alpha = 0.05$	--- [1]	$\alpha = 0.05$
t-test value	-1.78		-0.74	
t-critical value	1.65		1.78	

Table 4: Statistical analysis of learning outputs in individual courses

[1] two-sample t-test for different variances

[2] two-sample t-test for equal variances

As results from Table 3, there are no differences between the results in individual years. There is a significant difference of mean values for the students from the course MME I. On the contrary, the difference is not statistically significant for the students from the course ORM. To explain that, we have to return back to the comparison of both courses and describe their relevant differences:

1. The authors of the multimedia lectures are not involved in the teaching of the MME I.; on the other hand, they cover about 33% of the teaching of the ORM. It means that the multimedia lectures are an original study support for the MME I. students, but the students of the ORM are used to hear very similar way of explanation in their contact lectures like in the multimedia ones.
2. In contrast to the MME I. students, the ORM students could use any support during the testing (textbooks, notes from lectures, seminars, etc.), except communication with their neighbors or third persons. These factors explain an absolute value of differences (that is about 10 points) in average scores of both groups of students. On the other hand, if the student can use the support during the test, the role of his/her theoretical knowledge acquired from the multimedia lectures becomes marginal.

Discussion

We also describe shortly the multimedia lectures evaluation subject to other pedagogical criteria. For interest we summarize and present here information received from our several colleagues; we discussed with them whether and how they had noticed the existence of the multimedia lectures and their utilization by the students. Because of a subjective nature of these criteria, it is worth making the comparison of situations in teaching with and without multimedia support.

The teachers mostly evaluated the criterion P2 (the impact of the multimedia lectures on regular contact teaching) in a positive way. They told us that the multimedia lectures allow them to make their contact lessons more continuous. Before the multimedia support, they had to always stop the lecture, when at least one student had not understood the explanation and repeat it again. Now, it is possible to refer the student to the specific multimedia lecture and/or a clearly performed solution of an example.

The teachers' evaluations of the criterion P3 (a number of tutorial within the semester) are very similar. Amount of time spent by the tutorials before the support and now is approximately the same, but level of asked questions significantly increased. The teachers concluded that the students are really able to use the multimedia support to find answers to their problems and they asked their teachers for the tutorial in case of difficult problem only.

Based on the observations, we are going to design a new systematic research aimed at the pedagogical criteria P2 and P3 as well as the user-oriented criteria U1 – U4.

Conclusion

The evaluation of learning outputs is a complex process. The efficiency measurement of individual teaching methods is very difficult, because there are many factors, which influence such efficiency together; it is practically impossible to extract the impact of one specific factor and analyze it separately. We proved a statistical significance of the difference of learning outputs measured by a didactic test score in specific course with and without the support of the multimedia lectures. Despite this fact, we cannot conclude that the difference is fully caused by the existence and utilization of such lectures by the students. There is no way how to disprove the assumption about the strong dependency between a study effort of a student and her/his propensity to the utilization of all available study support including multimedia lectures.

On the other hand, we registered a significant improve of some subjectively evaluated efficiency criteria. The utilization of the multimedia lectures had a positive impact on contact teaching and the contents of tutorials provided to the students within the school year. Finally, we have to note very positive informal feedback from our students. Regardless of measurable efficiency, the best award for the multimedia lectures authors are the compliments from the students and their wishes and demand of more and more such lectures that make their studies easier.

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INTRODUCING SYSTEM DYNAMICS AT CULS PRAGUE

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Abstract

The system thinking is the important component of study at the Faculty of Economics and Management, Czech University of Life Sciences Prague (CULS Prague) but the system dynamics is not the part of education there. Current effort is to focus on implementation of system dynamics into existing courses of Mathematical Methods in Economics.

The objective of the paper is to design and test flexible seminars' structure of system dynamics at the Czech University of Life Sciences Prague during the lessons and seminars on the courses of Mathematical Methods in Economics. The results are necessary for successful introduction of system dynamics courses at CULS Prague. First part of the paper describes the role of system dynamics in education and the registered benefits from its implementation into education at different schools and universities. Second part contains the sources that constitute the basis for the seminars' structure design. The proposed structure is tested in third part through the questionnaire and the opinions of students.

Key Words

System dynamics, simulation, education, system thinking

Introduction

The system dynamics as well as its teaching methods have developed since 1950, when J.W. Forrester wrote his first system dynamic works (Forrester, 1989).Significance of the system dynamics teaching led to a special issue of the System Dynamics Review in 1993 (Gould-Kreutzer, 1993) and papers with educational content are regular part of System Dynamics Society conferences. From the beginning, Forrester proposed an integrating role of the system dynamics in the management education (Gould-Kreutzer, 1993) and according to the wide range of schools where the system dynamics is being taught it looks like this goal is going to be slowly achieved.

In the lessons of 35 years Forrester (1993) describes the benefit of the system dynamics in management. The education of system dynamic provides "enterprise designer" which Forrester compare to airplane designer. Then the ordinary managers can be compared to pilots. Even a very good pilot (manager) cannot fly a plane (manage an organisation) that is badly designed.

In the middle of 1980s Clauset (1985) made a survey focused on system dynamics courses. There were a few of system dynamics courses, most of them located in the United States, Canada and northern Europe. Majority of them was for graduate students.

Davidsen et. al. (1993) tested the benefits of teaching the system dynamics at the Nordic high schools (15 and 18 years old students). These tests did not focus on the knowledge of the system dynamics but on the impact of the system dynamics course on understanding of macroeconomics and questions from social and ecological sciences. Students who passed the system dynamics courses achieved 10% better results than those without such course; and the quality of their argumentation significantly increased.

Ossimitz (2000) summarized teaching of system dynamics at the high schools in Germany and Austria and tested the effectiveness of the courses. The teaching of system dynamics affected also the teachers thinking. Despite high impact of the teacher and the difficulties of measurement of the system thinking skills improved.

Sedehi et. al. (2008) compared approaches in the teaching of the system dynamics at various universities in Italy. Very different universities with different specialisation (from enterprise communication to statistics and engineering) needed to adjust the courses to their students' abilities. In spite of a difficult comparison it showed that all courses use business cases and introduction to the system thinking before the system dynamics methodology.

Wu and Onipede (2010) enhanced the system dynamics course at the Pennsylvania University by students' application presentation and experiments appropriate to the field of study. This led to the better evaluation of courses from the students and the significant increase of interest in the system dynamics.

Even younger students can study the system dynamics. The Creative Learning Exchange (2011) provides training of system dynamics and system thinking in K-12 education (K-12 means from kindergarten to 12th grade which means primary and secondary education in USA and Canada).

The system dynamics is relatively young in Czech environment; development of this field at universities could improve understanding the complex problems and thus it could improve the decision making in companies and public institutions (Mildeova and Vojtko, 2005). Such improvement is covetable especially in new EU countries (Mildeová and Němcová, 2009).

Even though the system thinking is an important component of study at the Faculty of Economics and Management, Czech University of Life Sciences Prague, the system dynamics itself is not a part of it. The current effort is to implement the system dynamics into existing courses of Mathematical Methods in Economics. The time donation in the different courses varies. The level of mathematical and system thinking skills depends usually on the study programme. The previously cited system dynamics courses' cases consisted of, at least, tens of hours; the basic (smallest) time donation at the CULS Prague is two lectures and two seminars (one lecture or seminar lasts 1.5 hour).

The objective of the paper is to suggest flexible seminars' structure of system dynamics at the CULS Prague. The flexibility consists of two characteristics. Firstly, the time flexibility that means the themes organisation of seminars adjusts to the time donation. Secondly, the theme flexibility that stands for the capability of the seminars' structure to reflect the knowledge base of students. Then the impact of the suggested seminars and lectures was tested. The students evaluated short introduction to the system dynamics that consist of two seminars and two lectures. The lectures were composed as the brief introduction into following topics:

- Simulations
- System dynamics theory
- System representation:
  - Diagramming
  - Numerical integration
  - Delays
  - Dimensional consistency
  - System archetypes

Students' answers will be used for further development of system dynamics courses at CULS Prague.

Material and Methods

The System dynamics deals with behaviour of complex systems over time. It focuses on a system description and understanding aiming at the policy analysis and design. Computer simulation supports the understanding of complex dynamic systems. The system dynamics core lies in feedback thinking with stress on delayed effects, stock and flow structure and nonlinear behaviour. The endogenous point of view is crucial for the system dynamics approach. See e.g. Meadows (2008), Sterman (2000) or System Dynamics Society (2011) for exhaustive definitions. The proposed organisation of the system dynamics seminars at the CULS Prague is based on the integration of the good experience of the other authors.

The theme arrangement arises from the principles of a system zoo (Bossel, 2007a, 2007b) and system archetypes (Senge, 2009). Whereas archetypes represent typical structures that conduct some characteristic performance, the animals from the system zoo consist of fundamental modelling structures with aim at the diagramming practice (stock and flow diagrams) and quantitative point of view. Even though the system archetypes are too simple for practical models (Lyneis, 1999) they still have great pedagogical value.

Concerning organisation of seminars' themes we mainly focus on the second and third step from the system dynamics process (fig. 1) by Forrester (1994) that create the hard operational research part of the process. The fourth step is also integrated especially for the longer courses.

System archetypes are assumed to be explained during lectures, the special theme of system archetypes in seminars consists of mathematical modelling of chosen archetype and archetypes identification in study cases.

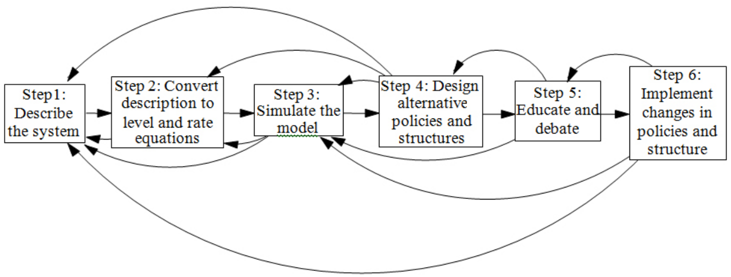

Fig. 1: System dynamics process, from Forrester (1994)

The system dynamics computer simulation is based on continuous behaviour, which leads to system of differential equations – this contains lot of differences to other topics from the Mathematical Methods in Economics courses. Fundamental tool that works as a bridge between mental models and mathematical expression of the complex dynamic system is diagramming – causal loop diagrams and stock and flow diagrams (Coyle, 1996, Sterman, 2000).

Coyle (1996) provides teaching time table that helps with time estimations of not already tested teaching examples and models. Similarly to Wu and Onipede (2010) or Sedehi et. al. (2008) Coyle stresses the differentiation of the courses on the basis of students' specialisation. Such differentiation is grounded on the cases variation and also on the emphasis topics corresponding to student abilities and knowledge.

Nearly from the beginning of the system dynamics the one classical tool is used: The Beer Distribution Game. This non-computer simulation is widely used for explaining the basics of the system dynamics and system thinking (Senge, 2009, Sterman, 2000). A small simplified model of distribution problem helps to introduce system thinking, system dynamics, counterintuitive behaviour of systems, the effect of delays, etc.

Pruyt (2009, 2010) successfully uses "hot" actual case for teaching support. Actual real-world problems like Soft drugs case or Mexican flu model are used to increase students' interest. It is clear that such models are difficult to prepare but this disadvantage can be reduced by hot cases sharing (Pruyt, 2010).

Vensim PLE (Personal Learning Edition) Plus was chosen as a software used for the seminars because of student friendly policy of Ventana Systems (2011). The version Vensim PLE for non-commercial use is downloadable for free that allows efficient home preparation of students. The cases must correspond to the fewer number of Vensim PLE functions in comparison with higher versions of the Vensim.

Questionnaire survey

We used a questionnaire to evaluate impact of first two levels ot the proposed seminars structure. Questionnaire contained binary comparison of themes in the specific course students with the possibilities to explain their views. The questionnaire is divided to seven parts and its anonymous, questions are following:

Man/Woman

a) Binary comparison of topics – tick the topic that you find *interesting*.

1) System dynamics (SD) x Nonlinear programming (NP)
2) System dynamics (SD) x Inventory theory (IT)
3) System dynamics (SD) x Input/output table (I/O)

4) System dynamics (SD) x Queuing theory (QT)
5) Input/output table (I/O) x Nonlinear programming (NP)
6) Input/output table (I/O) x Queuing theory (QT)
7) Input/output table (I/O) x Inventory theory (IT)
8) Queuing theory (QT)xInventory theory (IT)
9) Queuing theory (QT) x Nonlinear programming (NP)
10) Inventory theory (IT) x Nonlinear programming (NP)

b) Would you find the System Dynamics as a practically discipline??

c) Describe three cases of problems which can be solving through the System dynamics.

d) Which part (topics) of lectures and practice you find more interesting?

e) Which one (or more) of the discussed topics would you suggest to spend more time?

f) Would you be more interested in learning the system dynamics??

g) Which part(s) from the lectures and exercise(s) of system dynamics will come the least interesting??

This questionnaire was used for the students of system engineering in the second year of their study as two lessons in the subject of Mathematical methods of Economics. These students are highly qualified in the mathematical methods. The classes are small and count between 15 to 20 students, and most of them are interesting in this kind of topic.

Results

The purpose of seminar´s structure

The organisation of seminars' themes is proposed in the graph form that shows links between the particular topics (fig. 2). Each node represents the theme accomplished. The arcs represent the recommended or estimated time for the theme.

Using spiral teaching approach like e.g. Road Maps at Creative Learning Exchange (2011) the explained problems are repeated and extended in subsequent problems. If the problem appears first time it must be explained and the corresponding theory from lectures must be briefly repeated. It is why the cases time can vary. Note that, the seminars' structure is not the project management graph and it is not necessary to use all the arcs to finish the theme but only just one.

Currently, times are rough estimations based on other authors' papers and will be improved with growing experience. Some topics lengths are not only estimations but also recommended time. The seminars are divided into 5 levels based on increasing complexity and difficulty, first of them focuses on the basic skills in systems dynamics and students must go thru these basic levels.

The level V can be reached in fifth seminar. Going shorter way (avoiding some themes) to level V must result in easier and/or longer hot or student case. It is obvious that levels do not represent the difficulty in absolute terms but only relative difficult to lower levels.

The backward arrows from level IV to Level III do not mean that the cycle is allowed, they present just the logical consequence of topics. Arrows to level V denote it is possible to start students' or hot cases after finishing any of the level IV themes. Students' case means the hot case connected to chosen diploma thesis or project for another subject of actual semester.

The chronological succession of themes is pretty clear but the beginning of the course needn't to be the beer distribution game. Focusing on the courses with very small time donation the critical issues are in level I, which is assumed to take one seminar. Two or more seminars donation can start with beer distribution game and continue with level I or start with level I and continue with part of level II.

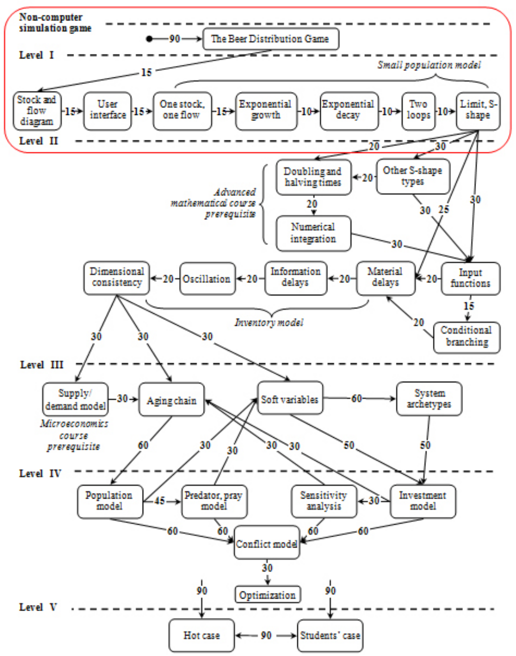

Fig. 2: The introduction seminar in graph of the seminars' structure (Krejčí et al., 2011)

Firstly, the theme flexibility is represented by parts connected to another courses. Such connection can make both courses more comprehensible and interesting for students. Also levels 3 – 5 contain very different topics thus the seminars can be tailored to the students' group demands.

To bring the organisation of seminars' themes to life we use the environment of LMS Moodle (fig. 3). Among other functions this learning system allows highlighting and hiding of some course parts what corresponds to the changing structure of the seminars. Moreover, in the case of the course structure with two lectures to one seminar, the themes are assumed to serve for the home preparation. The use of LMS Moodle can also help with this problem

Fig. 3: SD course in LMS Moodle

The necessary theory including the simulations and system dynamics theory was introduced during the Lessons. The theoretical part precedes the main part of the practical applications where the students have to go through the two practical seminars, with subject of:

- Beer distribution game,
- Vensim – Level I.

The marked part of the system dynamics has been taught as the last part of the study. The he whole seminar structure of the whole course is in following table, the system dynamics was a part of Mathematical Methods.

	Topic	Practical seminars
1	Structural analysis	Matching task
2	Mathematical programming	The counts in structural analysis
3	Gradient methods	Free extremes solving problem Solving of nonlinear tasks in EXCEL
4	Lagrange multipliers Quadratic programming Wolfe´s algorithm	The short-and long-step method Zoutendijk´s algorithm
5	Stochastic processes Markov chain	Wolfe´s algorithm
6	Test	Nonlinear programming
7	Queuing theory	Markov chain
8	Inventory models - deterministic	Queuing theory
10	simulation models	Inventory models - deterministic
11	Basics of System Dynamics	The Beer Distribution Game
12	System Dynamics - Vensim	Vensim

After these topics, the students filled the questionnaire, the questionnaire was completed by 15 students of System engineering the five of them doesn´t visited the whole seminar so they have been removed. After that there were 10 regular questionnaires with 4 females and 6 males.

First part of results was **binary comparisons of topics,** sorted by weights, which are calculated through the method called Fuller´s triangle (see: Anderson et al., 1991). The weights help us to order the main topics of all lessons in the subject of Mathematical methods in Economics according to the attractiveness:

All students	
System dynamics	**0,19** (3)
I/O	0,16 (5)
Queuing theory	0,22 (2)
Inventory theory	**0,26 (1)**
Nonlinear programming	0,17 (4)

Tab. 1: The order of topic for all students

If we divide the results by gender, the order is totally changed, see in table:

	males	females
System dynamics	**0,283** (1)	**0,05** (5)
I/O	0,133 (4)	0,2 (3)
Queuing theory	0,250 (2)	0,175 (4)
Inventory theory	0,217 (3)	*0,325* (1)
Nonlinear programming	0,117 (5)	0,25 (2)

Tab. 2: The order of topic for males and females

The males' students prefer the systems dynamics as most interesting topic but females perceive the system dynamics as less topics.

From the second part of survey students answered the **open questions**; the results can be summarizing in these conclusions:

- All students find system dynamics as practical discipline
  - Six of them were able to write examples of problems relevant to system dynamics
- The most interesting
  - Vensim
  - Beer distribution game
- Which theme should be granted more time
  - Vensim
- The less interesting
  - Theory (lectures)
  - Numerical integration.

Discussion

Results from the questionnaire indicate the direction of further development. The result of such short introduction should be the students' avarenes of system dynamics. They will not be system dynamists, but they should know the system dynamics is useful and practical discipline, they should understand the basic system dynamics principles and they should be able to identify the problem that s relevant to system dynamics. That is why we consider result six answers on question c as insufficient and as indicator for further improvement.

Similarly to Wu and Onipede (2010) we should stress the application presentation and experiments appropriate to the field of study. This should improve the students' orientation in them and their evaluation of course as well. .

This is also connected to hot cases. As Pruyt (2009, 2010) stressed these models are difficult to prepare and it is impossible to solve such problems in two seminars courses. But implementation of such cases into lectures, their presentation and explanation of the impact of such model should improve the students' knowledge of field of system dynamics study and also increase the attractiveness of that theme.

The proposed seminars structure can be compared to Coyle's system dynamics course time table. Even though the time table focus on one week seminar, its author suggests its modification for two weeks or whole semester. Lenght of the Coyle's seminar is about 30 hours that correspond to one semester course with one lecture and one seminar per week. It also contains optimisation and practical examples. Coyle's course does not include beer distribution game. The beer distribution game should be included only in case of long course at CULS Prague. This change will lead to increase of time donation to practical seminars with simulation soft ware.

Conclusion

The time schedules for single themes must be methodically improved to adjust the whole usefulness of the proposal. At present, the longest configuration gives the length of nearly 11 seminars. The proposal does not contain the tests. Addition of two tests and time reserve for differences in the time lengths of the topics gives full semester subject. Nevertheless, the longest configuration loses both time and theme flexibility. Thus, such configuration requires completed micro economic course and advanced mathematical course as well. But even the full semester course can introduce only the most basic principles of the system dynamics.

Whole flexible course structure is based on a good experience of referenced authors. The practice show more possible connections between the themes. Also some new themes can appear as valuable to be implemented into the course.

For the successful implementation of the system dynamics courses the seminars' the organisation and study models are not sufficient. Many supporting materials will be prepared. We have already assisted making the system dynamics video lecture, which is the part of successful multimedia lectures project running at the CULS Prague (Houška and Houšková Beránková, 2010).

In the paper we purposed the whole seminars´ structure, which is divided to the levels. These levels are possibility which will put some system dynamics topics in the course. The seminars´ structure is way how to start with systems dynamics as a part of teaching subjects.

We are at the beginning of long process. The long term goal is full semester system dynamics course. According to literature implementation of system dynamics courses at CULS Prague can be considered as way how to improve students' system thinking and understanding of complex problems. Successful implementation of the courses should result in improvement in other subjects at university like e.g. economics or sociology but it should also improve the decision making in practice. Such results are hard to measure (especially the impact on practice) but highly desirable.

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BUSINESS ENGLISH COURSES ONLINE SUPPORT

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Abstract

The paper deals with the project called Online Study Support for the Subject of Business English within the Fund of Higher Education Development of the Czech Republic. It will be created in the form of a twelve-module course in the Moodle Learning Management System (LMS) on the B1 level of the Common European Framework of References for Languages. Moodle is an open source Virtual Learning Environment which is free, developed by a worldwide community and is used for study purposes. It allows the teachers to create online courses and the students to enrol in them. The course is focused on the development of business and economic terminology, on reading comprehension, listening comprehension and the work with up-to-date authentic audio-visual materials. The course comprises the topics such as business and its basic terms, business letters, business organizations, macroeconomics and microeconomics, personnel management, marketing, email, accounting and finance etc.

Single units have the following structure: lead in, key words and definitions, specialist material, various activities such as filling in the gaps, multiple choice, matching, word formation, word order etc. These electronic activities are created in the most famous authoring tool in our field called Hot Potatoes, they can be stored on a central server and accessed from anywhere through the Internet. Online support will be intended for students of all faculties and fields of study at the Czech University of Life Sciences (CULS) in Prague, including incoming Erasmus students and academic staff as well as the students of other universities.

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Introduction

Information and Communication(s) Technologies (ICTs) have appeared as a transformative element in language teaching and learning, and have become an integral part of a number of courses of English for specific purposes (ESP) in the last few years. However, technology in language teaching is not considered to be new. Since the 1960s and 1970s tape recorders, videos and language laboratories have been used in classrooms and are still used. In the 1980s, Computer assisted language learning (CALL) emerged (the use of computer technology is referred to as Computer Aided Instruction - (CAI), using computer-assisted materials and it became popular and common in language teaching. Learners reacted to the stimulus given by the computer (behaviorism) and carried out different tasks such as gapfilling, matching and multiple-choice activities with feedback on their performance provided by the computer.

In the 1990s, Technology enhanced language learning (TELL) appeared as a response to the opportunities offered by the Internet and web-based tools (Dudeney, Hockly, 2007). The terms of the Internet, Net, Web are often used interchangeably, though Chinnery (2005) distinguishes between the Internet and the Web. "The Internet is a network of networks connecting computers all over the world, allowing them to share information using a variety of languages or protocols. The Web is a section of the Internet that uses a special format called HyperTextTransfer Protocol to transfer information.". Use of ICT technologies was supported by the Council of Europe in 1989-1996, in the project focused on modern languages teaching "Language Learning for European Citizenship". One of the conclusions stressed that ICT development in recent decades was the strongest factor in the globalisationof modern life. (Hanzlíková, 2001)

The project is being created in the form of a twelve-module course in the Moodle Learning Management System (LMS) on the B1 level of the Common European Framework of Reference for Languages. A current trend in university teaching is the lowering of the number of contact lessons and a higher emphasis is put on e-learning method of studies. The project is designed in accordance with a long-term intention and key priorities of the CULS development that include the development of indirect teaching forms and methods, electronic teaching aids creation, enhancing the quality and effectiveness of studies and self-studies within the LMS Moodle. It is an open source Virtual Learning Environment which is free, developed by a worldwide community and is used for study purposes. It allows the teachers to create online courses and the students to enrol in them. As Dudeney and Hockly (2007) mention, teachers can combine various resources – pages and links to websites – with interactive activities such as quizzes, questionnaires, forums and chat rooms to create the course. Some electronic activities are created in the most famous authoring tool in our field called Hot Potatoes. An authoring tool is an installable program allowing teachers to create own materials in electronic format and then it can be distributed to students via web pages.

Hot Potatoes is Windows or Mac program that creates a variety of activities (multiple choice, short answer, jumbled sentence, crossword, matching, gap-fill) and teachers can freely download it for educational purposes. It also allows including audio files in MP3 format and exercises can be stored on a central server. It means that they can be accessed from anywhere through the Internet. (Dudeney, Hockly, 2007) The results of the project will be freely available in LMS Moodle on the university web pages for a period of at least two years after the year of commencing the solution of the project.

The main objective of the project is creating the complex online support for the Business English course intended for students of all fields of studies at the Czech University of Life Sciences in Prague, particularly for the students of the Faculty of Economics and Management and for the Students of the Technical Faculty majoring in Trade and Business field of study. It is designed for at least intermediate students who mastered general grammatical principles and basic vocabulary in their previous studies. Online study material will support an interactive form of the teaching by means of multimedia application on the condition of the increasing of specialist demands for studies and of course the quality of studies. It concerns the usage of information and communication technologies for more effective access to education for a bigger number of learners at the qualitatively higher level.

One of the basic prerequisites of this type of studies is the quality of study materials. They will substitute, if the need be, immediate contact of teachers with full time students as well as with distance students.

Material and Methods

At present, Business English is taught in the form of contact teaching (once in a week for 90 minutes) combined with the use of a textbook and additional audio-visual materials. The time that is available for the lessons does not enable to use the potential of authentic materials and current events in the field of studies. This can be effectively offset by the online study support which will also strengthen the motivation of the students and support them as autonomous learners. Moreover, the students of distance studies, which have a substantial support within university studies, have very limited opportunities to consult with the teacher owing to their jobs, time and distance limitations. This project and computer technology will enable them to control solved assignments and a feedback.

The way of solution follows from the following schedule:

1st phase: The gathering of material and its analysis from the methodological point of view as far as single phases of lessons of Business English are concerned and with regards to usingknowledge in business and management spheres, in negotiations with foreign partners, in the sphere of research etc. The complete gathering of material includes specialist topics that are encompassed into online study support.

2nd phase: The processing and the arrangement of specialist texts with exercises, listening, videos, picture materials and independent tasks so that they would correspond with the requirements stipulated for self-studies within e-learning teaching.

3rd phase: Teaching material will be evaluated together with foreign colleagues from partner University of Plymouth and Slovak agricultural university in Nitra and then will be placed on web pages of the Czech University of Life Sciences in Prague within LMS Moodle.

Results

The course is focused on the development of business and economic terminology, on reading comprehension, listening comprehension and the work with up-to-date authentic audio-visual materials. Online study support for Business English is in the form of a 12-module course in the learning management system (LMS) Moodle with the following topics:

- Business and its basic terms
- Business letter: layout, content, style
- Business Organizations

- Company profile
- Macroeconomics, microeconomics
- Enquiries, replies, orders
- Personnel management
- Curriculum vitae, letter of application, job contract
- Marketing
- Email
- Accounting and finance
- Invoicing, quotation, payment

Module structure

Single thematic units are of the following structure with respect to the principles of e-learning

teaching:

a)Lead-in

b)Key words and definitions

c)Specialist material – reading/audio-visual

d)Various activities

e)Resources

The course will be focused primarily on:

a) development of specialist vocabulary

b) reading comprehension

c) listening comprehension

d) work with authentic and up-to-date audio-visual language materials (web pages and presentation of firms, products, services, business chambers, specialist journals).

The content of the course

The content of the course will be the following:

a) **authentic materials concerning the topic** (a follow-up to the contact lesson and the work with a textbook)

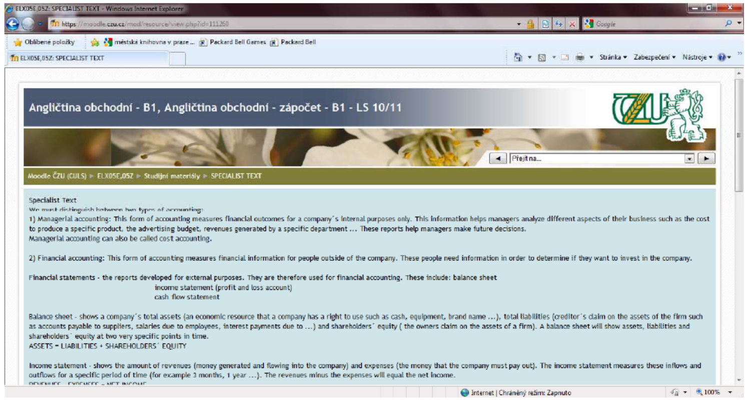

Figure 1: A page from the Moodle Business English course showing a specialist test intended for reading comprehension practice

b) **autocorrective exercises** such as filling in the gaps, multiple choice, true/false, word formation, matching, synonyms/ antonyms etc.

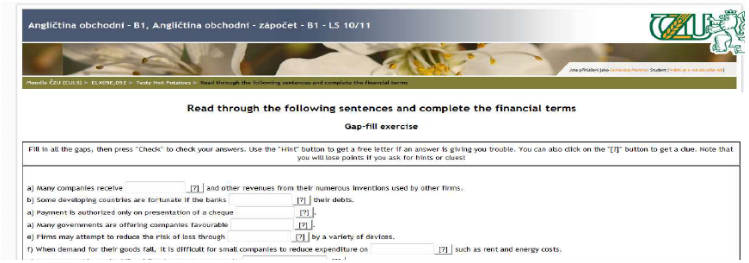

Fig. 2: A page from the Moodle Business English course showing a fill-in gap exercise intended for students' vocabulary practice

c) in some modules on-line handing in of **written assignments** (translations, letters)

d) **other additional activities**

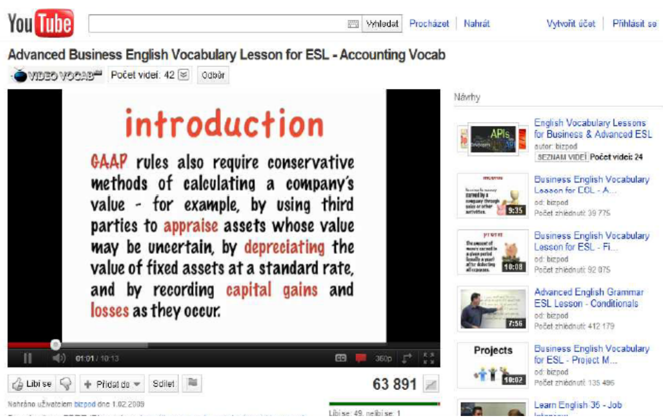

Fig. 3: A page from the Moodle Business English course showing a link with a listening comprehension exercise on the Internet

e) test (it can be for training purposes with limited or unlimited number of possibilities or it can be a credit test with just one try and a time limit)

Fig. 4: A page from the Moodle Business English course showing a multiple choice test which can be used either for revision of the topic or as an assessment device

Discussion

The authors of the project are not economists, they are language teachers. Just the same, the course does not focus on the issues of business and economics as such but on the English language used in business. It should provide the students with a useful guide or a tool how to communicate about business in English. Therefore, the development of the four above mentioned skills will be of major importance. The development of grammatical knowledge was not in the first plan of the course, as the students are already supposed to have a sufficient command of English grammar appropriate for B1 level within the Common European Framework of Reference for Languages.

The development of vocabulary that can be applied in business and economics is of primary importance. By learning and practising specialist vocabulary the students more or less receive a guide, or a key to performing other activities like speaking, reading, writing and last but not least, listening. As this is of course an on-line course which serves as a teaching/learning support, the development of a speaking skill will be left to a regular class where a face-to-face student/teacher interaction is possible. On the contrary, the on-line support should emphasise the development and practice of those skills that are "neglected" in face-to-face teaching/learning in favour of developing speaking skills. And vice versa, the use of the online course should give conversation in class more room and thus by engaging the class in conversation it enhances their speaking skill.

Lexical versus grammatical and phonological competence

Learning the language of science is a major part of science education. Every science lesson is in fact a language lesson. Science education often involves dealing with familiar words and giving them new meaning in new contexts. And equally, many of the words from our daily lives have been derived from science (Wellington, Osborne, 2001). Every single word is unique in its etymology, meaning and behaviour, including its collocations (Stubbs, 1986). Furthermore, any individual speaker's vocabulary is unique. It is the network of personal connections which seemingly do not concern the linguistic competence at all. In this respect, grammatical and phonological competence is essentially different from lexical competence. As Stubbs (1986) further claims, unlike the two former competences, the lexical competence never really achieves its completeness, not even for a native speaker.

Our vocabulary, be it native or foreign, may keep growing throughout our whole life. New meanings may be acquired for old words; new relations between words can be formed. Correspondingly, when we think of language, we almost inevitably think of words – vocabulary. And when we speak about language development, we tend to speak about the enlargement of our vocabulary. The notion of extending our vocabulary derives from our intuition that some words are simpler, more basic or more important than others (Perera, 1980). As Stubbs (1986) claims, in some form the idea of basic vocabulary must underline all vocabulary teaching. It certainly underlines vocabulary lists of various kinds including teaching English as a foreign language or English for specific purposes (ESP).

The stock of words of a language creates its vocabulary or lexicon. The lexicon of a language encapsulates the perceptions and experiences of a language community and thus its culture. It is structured in very complex ways (Quirk, Stein, 1993). The extent and depth of command of the particular words that we use vary according to our age, education and social and professional surroundings. There is a difference between the so-called active and passive vocabulary. The active vocabulary includes words that a person actually uses, whereas the passive vocabulary includes the words the person understands or would understand, however, does not use them actively in speech. In reality, the command of words which we think we actually „have" either actively or passively are mixed. There are words in our lexicon that we know very well and words that we have no idea what they mean and there will be many layers in between. The process of learning new senses of words is never complete.

Quirk and Stein (1993, p. 141,142) distinguish three types of vocabulary in which we operate. All the necessities of our every-day life are covered in the core vocabulary which is actually much bigger than the other two types. The second type is what might be referred to as the private vocabulary which is shared only with family and close friends and which came into being only through personal experience of the members of the group. Last but not least, there is the specialized vocabulary shared with groups that pursue specials interests. Especially in our adult life, as Quirk and Stein (1993, p.144) further argue, we are too busy to give much thought to our command of the core vocabulary. On the contrary, we are far more preoccupied with learning the specialized vocabularies that we need for our profession. That is why the study of the lexicon has a crucial role in the teaching and learning both mother tongue and foreign languages.

An important part of the speaker's language competence is the ability to recognize that some words are ordinary while others are rare, exotic, specialist, technical and so on. The introduction to The Oxford English Dictionary (1989) presents the following concept of vocabulary. The vocabulary of English is not a fixed a quantity with definite limits. It is rather a nebulous mass with its clear and unmistakeable nucleus which spreads to all sides (OED, 1989) Thus in the middle we find common vocabulary which is enriched by colloquial, literary vocabulary and slang. Distancing from the core common vocabulary, we will find foreign, dialectal, technical and scientific vocabulary.

Vocabulary enlargement and reading comprehension

In recent years, it has been argued whether to teach specialist vocabulary or not. The study of vocabulary has been given a minor focus in classrooms. This was partially due to the use of modern communicative approaches to foreign language teaching (Bramki, Williams, 2003). For instance, Robinson (1980) says that textbooks do not need to concentrate on specialist vocabulary as the students will absorb it from the main course studies. However, the issue is not whether to teach specialist vocabulary or not, but what strategies to apply to its teaching and learning. In their article, Bramki and Williams (2003) argue that when teaching vocabulary we must consider the difference between development and recognition.

Vocabulary development refers to the teacher who deliberately and systematically expands the students' vocabulary by introducing word lists, dictionary exercises, functional grouping and the like. It is probably this deliberate, systematic expansion of specialist vocabulary that is regarded as being outside of the province of the teacher. In contrast, vocabulary recognition relates to the strategies that an efficient student/reader employs while reading a text. This way the reader works out the meaning of unfamiliar words that he encounters with in the text. However, it is up to the teacher to help the student/reader to acquire effective strategies which will enable the student/reader to understand the unfamiliar words or contexts. Those **strategies** are common to both specialist and non-specialist vocabulary. According to Bramki and Williams (2003), these strategies include guessing from context, cognate recognition and back-tracking a nominal compound in order to find functional inter-relationships of its constituents.

Vocabulary recognition is in fact lexical familiarization. In their article, Bramki and Williams (2003) present examples of different categories of lexical familiarization. **Exemplification** provides the reader with an instance or instances of what the newly introduced term refers to. For instance d*urable consumer goods* will be exemplified by the list of the following: books, furniture, TV sets, and domestic electric appliances. **Explanation** will provide the reader with a sequence of words equivalent or opposed in meaning to the newly-introduced term. For instance, saving will be explained as the act of foregoing consumption. They further mention **definition** and **stipulation** which is a kind of definition indicating that the term being defined has its particular meaning only in a given situation and that it will not have the same meaning in different situations. Most dictionary or thesaurus entries may be regarded as definitions or stipulations. Finally, synonymy provides the reader with a more familiar lexical item with almost the same meaning. Thus laissez-faire will be referred to as market economy for better understanding the unfamiliar term.

Listening comprehension

Learning the language depends on listening which provides the aural input that functions as the basis for language acquisition and thus enables the learners to interact in spoken communication. There are several listening strategies, or techniques, that contribute to the listening comprehension and remembering of listening input. The strategies can be classified into two groups depending on how the listener/learner processes this input. The two groups include „top-down“ strategies and „bottom-up“ strategies (The National Capital Language Resource Center, 2004).

The **top-down strategies** are listener based. This means that the listener makes use of background knowledge of the topic, the situation or context, the type of text and last but not least, the language. Among the top-down strategies are included listening for main idea, predicting, drawing inferences and summarizing. With the help of the background knowledge the listener can interpret what is heard and even anticipate what will come next using the above-mentioned techniques.

In contrast to the top-down strategies there are the so-called **bottom-up strategies** which are entirely text-based. This means that the listener relies on the language of the message, i.e. the combination of sounds, words, grammar which all together create meaning. They include listening for specific details and recognizing words and word-order patterns. Both kinds of the listening strategies can be successfully combined. In class it is up to the teacher to monitor which strategies or their combination was effective and whether the students achieved their listening comprehension goals using these strategies.

Before starting any listening comprehension, the teacher should decide which strategy or their mixture would serve best in a particular situation. This means activating the students‘ background knowledge of the topic in order to predict or anticipate content. Then attending to the parts of listening which are relevant for the identified purpose and ignoring the rest. This selectivity enables the students to focus on specific items that they are listening for and reduces the amount of information they have to hold in their short-term memory in order to recognize those specific items.

The combination of selected strategies should include both top-down and bottom-up strategies to increase the students‘ listening confidence. Last but not least, the monitoring of the listening comprehension should not be neglected as it helps them detect inconsistencies and failures and direct them to the use of alternate strategies.

As regards our course in the LMS Moodle, development of productive skills such as speaking and writing in a specialist level is limited. Writing is realized by email when students translate specialist text from Czech to English or write (rewrite) business letters, send them to the teacher who corrects them and send them back so that the students receive the feedback. Speaking is not realized within Moodle LMS, it is left to the face-to-face teaching. In Moodle there is included the development of receptive language skills such as listening comprehension and reading comprehension. There are listening activities with the follow-up activities for widening and strengthening terminology. All introductory specialist articles are focused on reading comprehension. Here the content and language integrated learning is used as there is the demand for the students to have the basic knowledge of topics that relate to the main field of studies at the FEM and specialist departments. Apart from the articles, all exercises are based on reading with proper comprehension.

Conclusion

Online support will serve for students of all faculties and fields of studies at the Czech University of Life Sciences (CULS) in Prague, including incoming Erasmus students and academic staff as well as the students of other universities. It will be the advantage for the students to have this material, which can be used for improving the communication with foreign partners, extending the terminology for specialist literature studies, whenever available on the Internet. New online study support will be focused on business and economic vocabulary and will be available to all students in time that will be the most proper for their studies. They can return to it, practice it and enhance it whenever they need. Language teaching will correspond to a modern way of teaching based on using new didactic procedures and technologies in the lessons.

Acknowledgements

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PUZZLES – A CREATIVE WAY OF DEVELOPMENT OF LOGICAL THINKING

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Abstract

Logical thinking of students should be enhanced at all levels of their studies. There are many possibilities how to achieve it. In the paper one possible way within the subjects "Discrete Mathematics" and "Discrete Methods and Optimization" dealing with graph theory and combinatorial optimization will be presented. These mathematical disciplines are powerful tools for teachers allowing them to develop logical thinking of students, increase their imagination and make them familiar with solutions to various problems. Thanks the knowledge gained within the subjects students should be able to describe various practical situations with the aid of graphs, solve the given problem expressed by the graph, and translate the solution back into the initial situation.

Student engagement is crucial for successful education. Practical tasks and puzzles attract students to know more about the explained subject matter and to apply gained knowledge. There are an endless number of enjoyable tasks, puzzles and logic problems in books like "Mathematics is Fun", in riddles magazines and on the Internet. In the paper, as an inspiration, four puzzles developing logical thinking appropriate to be solved using graph theory and combinatorial optimization will be introduced. On these puzzles of different level of difficulty the students' ability to find out the appropriate graph-representation of the given task and solve it will be discussed as well.

The author of the paper has been prepared with her students various multimedia applications dealing with objects appropriate to subject matter for more than 15 years. In the paper we also discuss a benefit of multimedia applications used as a support of subjects "Discrete Mathematics" and "Discrete Methods and Optimization".

Key Words

Logical thinking, enjoyable teaching and learning, puzzles, Graph theory, Combinatorial optimization, multimedia application

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Introduction

One of the pleasant ways to bring discussed topics closer to students and to practice them, is their illustrations and practical applications on real examples. Given terms or problems will be recollected well by students if they are presented in an interesting, sometimes „sprightly“ example of life. To demonstrate the use of the discussed issues it is often worth including the appropriate puzzles (logical tasks) into teaching methods. Not just because logical tasks can provide students with an initial idea, and the motivation to apply the theoretical knowledge, but it can also greatly contribute to the development of students' logical thinking, their imagination, and, especially in the case of graph theory and combinatorial algorithms, enhance their ability to transfer the problem into a graph and solve it.

The least significant role in making learning more fun and easier to understand, is the use of multimedia applications, which can be used both by the teacher as a supplement to the problem interpretation and by students as an efficient assistance in their individual preparation.

In the paper we initially introduce the four principles that we apply in our teaching. Then we show, in four puzzles of different level of difficulty, how it is also possible to develop the logical thinking of students and to increase their imagination within the subjects dealing with graph theory and combinatorial optimization and how to engage students in the lessons. At the end we emphasize the role of suitable multimedia applications dealing with objects appropriate to course subject matter that support students' self preparation and teachers' explanations of a topic.

Effective education developing logical thinking and imagination

Logical thinking is an important foundation skill. Karl Albrecht (Albrecht, 1984) says *that the basis of all logical thinking is sequential thought. This process involves taking the important ideas, facts, and conclusions involved in a problem and arranging them in a chain-like progression that takes on a meaning in and of itself. To think logically is to think in steps*.

Let us add that *sequential thought can be enhanced through the development of algorithmic thinking and that algorithmic thinking can be deeply enhanced in the subjects dealing with combinatorial optimization*.

The main aim of the subjects "Discrete Mathematics" (DIMA) and "Discrete Methods and Optimization" (DMO) taught at the Faculty of Informatics and Management is to develop students' imagination and deepen their capacity for logical and algorithmic thinking. Let us introduce the subjects more detailed.

DIMA is a compulsory subject taught in the fourth term. Students gain a basic level of competence in graph theory and combinatorial optimization. In the DIMA lectures and lessons non-directed graphs have been discussed and to the theoretical background of each explained concept and problem enough time has been devoted. Concerning graph algorithms, we try to make students familiar with certain algorithms in contexts to be able to get deeper insight into each problem and entirely understand it. We always try to examine the given topic as thoroughly as possible and find a "bridge" to another topic. Well-prepared students should be able to describe various practical situations with the aid of graphs, solve the given problem expressed by the graph, and translate the solution back into the initial situation. Various logical puzzles serve as a very suitable tool for checking this ability (see thereinafter).

DMO is a compulsory subject taught in the seventh term. Its aim is not only to develop students' knowledge gained in the subject "Discrete Mathematics" and to focus on directed graphs, but also to enhance students' skills in self study of a given new part from the area of graph theory and combinatorial optimization and their ability to explain it to the others.

In the first half of the term lectures and lessons are organized in the similar way as lectures and lessons of the DIMA subject. However, the second half of the term is focused on enhancing students' skills in self-study. According to e.g. (Nowak, Gowin, 1984) or (Pascual, 2010) or (Huba, Pestún and Huba, 2011) who recommend creating environment encouraging students to take risk in classroom discussions, we let students some time for studying new matter and preparing presentations. They work in teams preparing also a presentation containing appropriate theory illustrated on examples. Defence and discussion with other students take place in remaining lectures and lessons.

An indivisible part of the DMO exam is a presentation on an optional topic from the area of the subjects DIMA or DMO describing a practical task. This part of the examination runs as a colloquium and each student shows his/her work to the colleagues taking part on the exam.

Our approach to the development of logical thinking of students within the above mentioned subjects can be characterized by the following basic principles that we apply in our teaching (Milková, 2009).

- When starting explanation of new subject matter, a particular problem with a real life example or puzzle is introduced and suitable graph-representation of a problem is discussed.
- If possible, each concept and problem is examined from more than one point of view and various approaches to the given problem solution are discussed.
- Visualization of the particular issue as well as it is possible is done.
- The explained topic it thoroughly practiced and students' examples describing the topic are discussed.

Material and Methods

Practical examples and *puzzles* serve as a motivation to the explained subject matter; they are good tool enabling students to get an idea about its use. But they are also very good tool for finding out if students are able *to describe a given task with the aid of graphs, i.e. find a graph-representation of the task, solve it and translate the solution back into the initial situation*. Particularly when solving puzzles it isn't always easy to find immediately the needed graph-representation.

We have been looking for problems in various sources (in real life, in books like "Mathematics is Fun", in riddles magazines, on the Internet) that can be efficiently solved with the help of graphs and introduce them into lectures devoted to the appropriate topic.

History

The history serves also as a good source of practical examples and puzzles. In the area of graph theory there is the very valuable book "Graph Theory 1736 – 1936" (Biggs, Lloyd and Wilson, 1976). The most important problems since 1736 till 1936 are introduced there (the problem called Seven bridges of

Kőnigsberg formulated and solved by Leonhard Euler in 1736 is considered as the beginning of graph theory). In this book the connection of graph theory and puzzles is described well: *The origins of graph theory are humble, even frivolous. Whereas many branches of mathematics were motivated by fundamental problems of calculation, motion, and measurement, the problems which led to the development of graph theory were often little more than puzzles, designed to test ingenuity. But despite the apparent triviality of such puzzles, they captured the interest of mathematicians, with the result that graph theory has become a subject rich in theoretical results of surprising variety and depth.*

Logical tasks

The book written by Stanislav Vejmola (Vejmola, 1986) was the first impulse for our decision to include puzzles into the curriculum of the subjects DIMA and DMO. The book is organized in an interesting way. It is divided into three parts. The first part contains several problem assignments, in the second part the necessary graph theory background is introduced and, finally, in the third part solutions of the tasks given in the first part are shown.

In this paragraph let us introduce four puzzles of different difficulties, chosen from the Czech semi-monthly magazine *Hádanka a Křížovka* (*Riddle and Crossword puzzle* in English).

Logical tasks

Two detectives investigated the same group of people and used graph-representation of the relation between each pair of people who know each other. The first detective represented the people by letters, the other detective by numbers (see Fig. 1 and Fig. 2). Our task is to find out connection between their graph-representations.

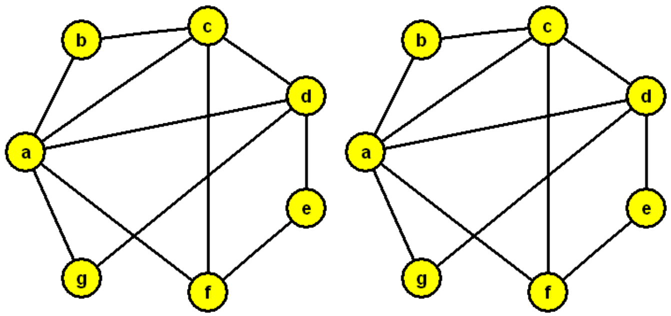

Fig. 1 The first detective graph-representation

Fig. 2 The second detective graph-representation

This puzzle is obvious example suitable for motivation to the concept isomorphism and to solve it means to find the isomorphism between the two graphs given on Fig. 1 and Fig. 2.

Remark: Isomorphism is an important basic graph theory concept explained in any textbook dealing with graph theory. Its definition and use is described in an interesting way in (Matoušek and Nešetřil, 1998) for example.

Pins

There are 13 pins connected by strings in the way given on Fig. 3. Someone changed their positions as it is shown on Fig. 4. The task is to find the initial position of pins (the initial order of pins).

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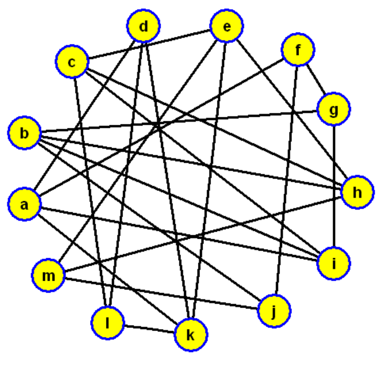


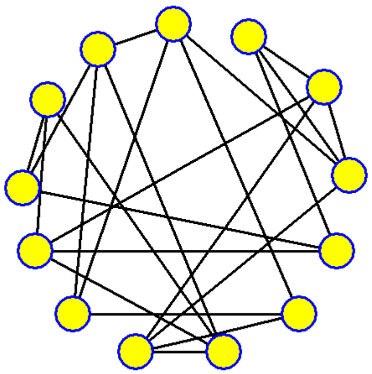


Fig. 3 Original position of pins given in the puzzle Pins

Fig. 4 Changed position of the pins

This puzzle is also an example suitable to the concept isomorphism. However, the two given graphs are more complicated and to find the isomorphism between them demands significantly more of students' attention. It is much easier and enjoyable to solve this puzzle using the GrAlg program (see thereinafter).

Towns

Try to place the names of towns Atlanta, Berlin, Caracas, Dallas, Lima, London, Metz, Nairobi, New York, Paris, Quito, Riga, Rome, Oslo, Tokyo into the frames of the given map (Fig. 5) so that no town shares any letter in its name with any towns in adjacent frames (neither horizontal nor vertical).

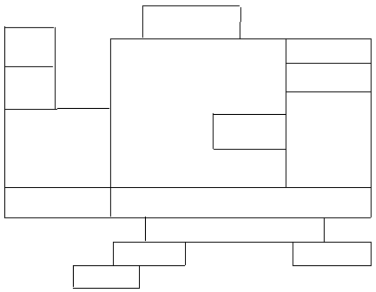


Fig. 5 Map of the puzzle Towns

To solve this puzzles using graph theory it is necessary to make graph-representation of both the map and also the relation between two towns that do not contain a same letter in their names at first (see Fig. 6 and Fig. 7), and then find the isomorphism between the graph representing the map and a subgraph of the graph representing the relation (Milková, 2009).

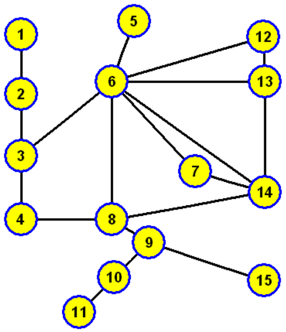


Fig. 6 graph-representation of the map given in the puzzle Towns

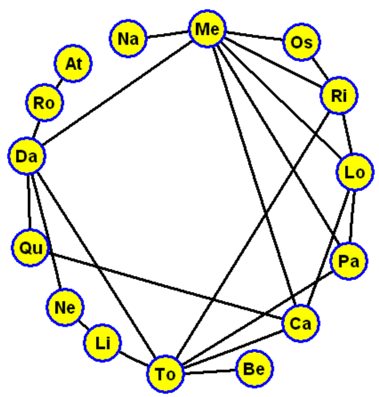
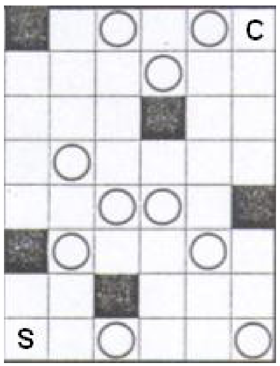


Fig. 7 graph-representation of the relation given in the puzzle Towns



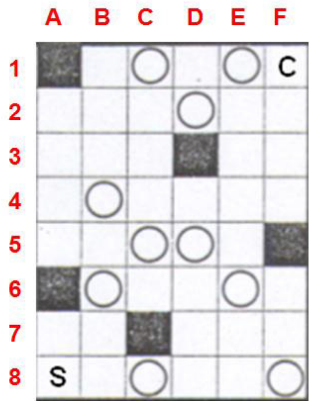


Fig. 8 Picture to the puzzle TWO and THRE

Fig. 9 Fig. 8 completed by numbers and letters

TWO and THREE

Let us consider the picture given in Fig. 8. There are three types of cells (fields); white, black and circular. The task is to find a way to move from point S to point C using the smallest number of steps possible while keeping the following rules:

- One step means to go on two (by the speed 2) or three (by the speed 3) cells.
- Go either horizontally or vertically.
- On S your speed is 2. As soon as you enter a circle, change the speed to 3 and as soon as you enter another circle, change the speed to 2 etc.
- Do not enter or go through black cells.

(Note: You can enter the same cells more times.)

Graph-representation of the picture on the Fig. 8 can be done in mind in the following way: Let us complete the picture on Fig. 8 by numbers and letters (see Fig. 9) and imagine that each cell is represented either by the vertex Pc^2, or by the vertex Pc^3, where $P \in \{A, B, C, D, E, F\}$ and $c \in \{1, 2, \ldots, 8\}$. The upper index determines the used speed.

In this way a directed graph G is obtained. Its vertices are Pc^i, $P \in \{A, B, C, D, E, F\}$, $c \in \{1, 2, \ldots, 8\}$, $i \in \{2, 3\}$, and there is the directed edge from the vertex Xy^z to the vertex Uv^w in the graph G if and only if there exists a step from the vertex Xy^z to the vertex Uv^w defined by the above rules (i. e. there are for example edges $(A8^2, C8^3)$, $(A8^3, D8^3)$, $(C8^2, A8^2)$, $(C8^2, E8^2)$, $(C8^3, F8^2)$, $(F8^2, D8^2)$, $(F8^2, F6^2)$).

To solve the puzzle TWO and THREE means to use Breadth-First Search algorithm to find the shortest path from the vertex

A8^2 (the cell **S**) to the vertex F1^i (the cell **C**, which can be achieved either as the vertex F1^2 or as the vertex F1^3).

Remark: The Breadth-First Search algorithm as well as several other well-known algorithms finding the shortest path in an undirected or directed graph can be found in many books dealing with graph theory and combinatorial algorithms. An outline of them is given, for example, in the book Introduction to algorithms (Cormen, Leiserson, Rivest and Stein, 2009).

Multimedia applications created on a script given by the teacher with regard to students needs

Multimedia applications play an important role among the electronic study materials assigned to the appropriate subject. Along with large software products dealing with a wide spectrum of objects developed by a team of professionals there are various smaller presentations and programs dealing with objects appropriate to course subject matter created on a script given by the teacher with regard to students needs. The author of the paper has been interested in creation of such study material for many years. With her students she prepares large programs and presentations for more than one year, usually within their thesis. Students create smaller ones during the term.

We really agree with the text written in the paper (Williams, 2005), where Williams says *that students need images and visualization in addition to words. Science learning is about creating images in mind and teaching should support such image formation.*

With the help of multimedia applications students can revise the topic when it is needed; they can use them as a useful complement of the printed study text. Some programs and presentations offer complete revision of the large subject matter, another serve as detailed visualization of the given topic explained within the lecture. Short animations can serve teacher as an understandable motivation to the given topic.

In the DIMA and DMO subjects there is no problem in illustrating the needed concepts using graphs. However, it is very important to prepare suitable illustrative graphs and use colours to emphasize characteristics of the explained concepts and graph-algorithms.

Let us briefly introduce multimedia applications created for the discussed subjects and emphasize their main benefit for students' self-study and keeping the basic principles introduced in the section Effective education developing logical thinking and imagination.

Program GrAlg

The essential program developed for the DIMA and DMO subjects is the program GrAlg (Graph Algorithms) created in the Delphi environment by our student within his thesis (Šitina, 2010).

The main purpose of the application is the easy creation and modification of graphs and the possibility to emphasize with colours basic graph-concepts and graph algorithms on graphs created within the program.

The program enables the creation of a new graph, editing it, saving graph in the program, in its matrix representation and also saving graph in bmp format. It also makes it possible *to display some graph properties of the given graph represented by figure*, to add colour to vertices and edges, and to change positions of vertices and edges by "drop and draw a vertex (an edge respectively)".

The biggest advantage of the GrAlg program is the possibility to run programs *visualizing all of the subjects explained algorithms* on nondirected graphs in a way from which the whole process and used data structures can clearly be seen (see Fig. 10).

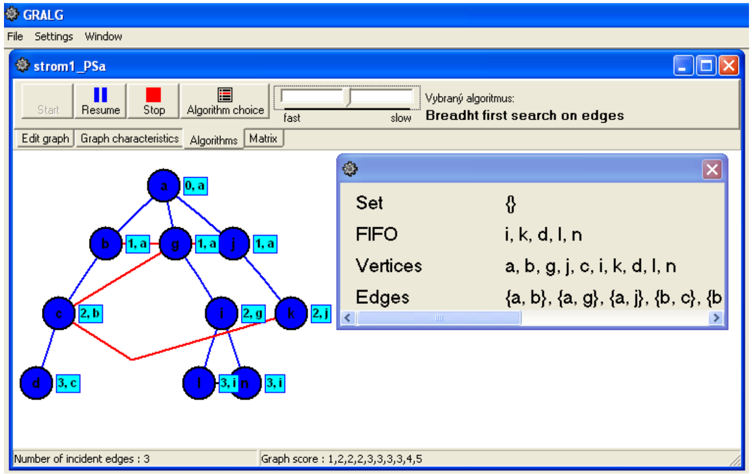


Fig. 10 Program GrAlg – visualization of the Breadth-First Search algorithm

The program allows the user to open more than one window so that two (or more) *objects or algorithms can be compared at once* (see Fig. 11).

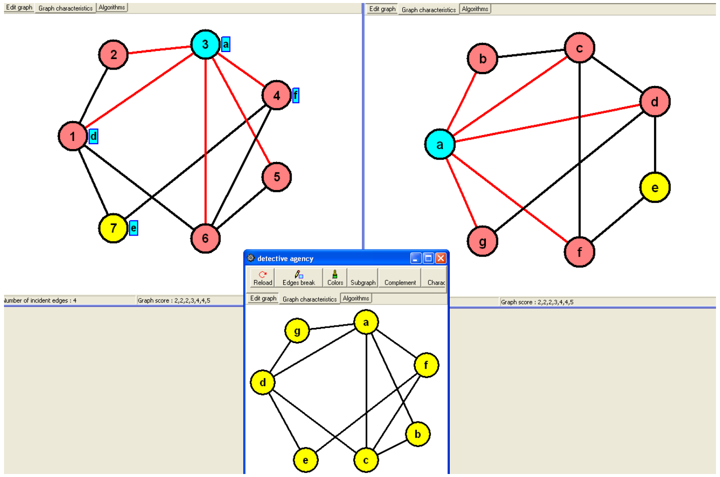


Fig. 11 Program GrAlg - three opened window to solve a puzzle Detective office

Using the GrAlg program students *can revise subject-matter* and more deeply understand it. They can use not only graphs prepared by the teacher but also graphs created by themselves and *explore the properties of these graphs and run in the program offered algorithms on these graphs*. The possibility to open more than one window enables them *to follow mutual relations among used concepts and algorithms*. The possibility to save each created graph in bmp format allows them easy insertion of needed graphs into their presentations (see the description of the DMO subject).

The GrAlg program is not only a substantial help to students in their self-study but it also helps teachers explain all needed concepts and the process of particular algorithms on lectures and seminars. More preciously, the program enables the teacher to complete his/her explanation within lectures in such a way that the topic is more comprehensible; the possibility to use colours allows the teacher to *emphasize needed objects and relations*; the option to open more than one window enables to *explain the problem from more points of view* and *show mutual relations among used concepts and algorithms*. Moreover, the possibility to save each created graph in bmp format allows teachers easy insertion of needed graphs into the study material and thus saves their time when preparing text material and presentations.

Results and Discussion

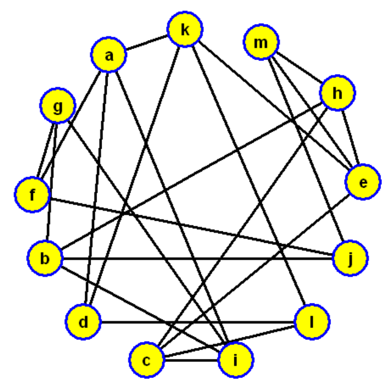
The theory of graphs and combinatorial optimization are wonderful, practical disciplines developing and deepening students' capacity for logical thinking. Using puzzles enable us to e*nhance logical thinking of students in an enjoyable creative way*.

Puzzles introduced as a motivation to the explained subject matter on lectures devoted to the appropriate topic aren't usually solved on the lecture. Students can (it isn't obligatory) solve them at home. However, there is often discussion on seminars about possible solutions.

The first two introduced puzzles don't demand graphical interpretation of the given task because it is set directly on graphs.

The map used in the third puzzle and also the demanded relation between two towns have obvious graph-representation for everyone experienced in graph theory. However to find out these graph-representations it makes students mostly difficulty because the puzzle *Towns* is placed to the DIMA subject at one of the first lessons. It serves as the very useful first step into the development of students' ability to „see" graph-representation of a task.

All tasks are easier to solve with help of the above mentioned program GrAlg. As we have mentioned the program enable to create graph and move its vertices and edges. Thus using the program there is no problem to change the view of the graph given on Fig. 3 to get graph on Fig. 4 (see Fig. 12) and to change the view of the graph given on Fig. 7 to get another picture (see Fig. 13), from which the solution is quite obvious.



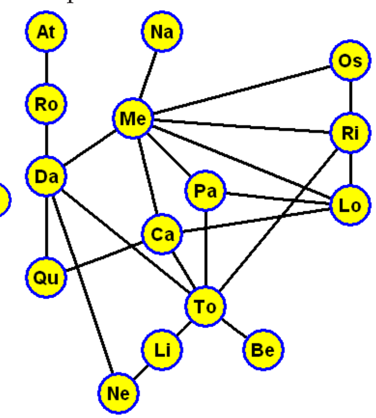


Fig. 12 another picture of the Fig. 3

Fig. 13 another picture of the Fig. 7

The fourth puzzle enhances students' imagination. Solving it students practice Breadth-First Search algorithm (see Fig. 10) and from an appropriate part of the Breadth-First Search Tree (Fig. 14) determine the shortest path.

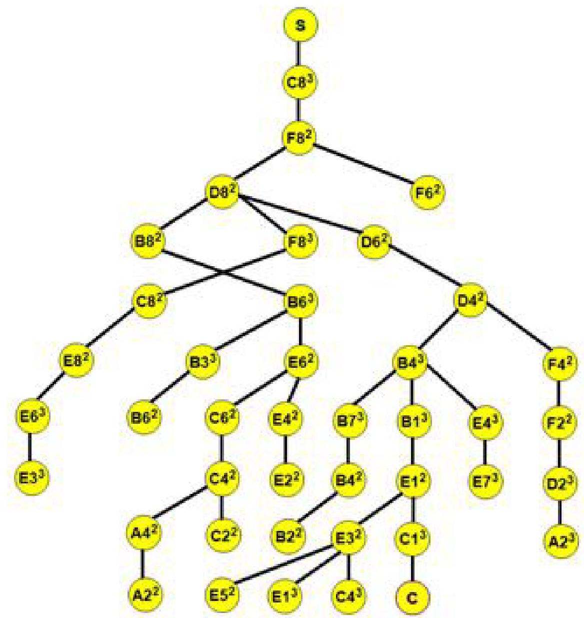


Fig. 14 Breadth-First Search Tree appropriate to the puzzle TWO and THREE

Moreover, the puzzle TWO and THREE evokes students to go on and find not only the one shortest path but also all the shortest paths between S and C. This topic is discussed with students within DMO subject. At students' disposal there is the paper (Milková, 2010a), where the description of the algorithm finding all the shortest paths between the two given vertices is described in detail. Description of the algorithm in English is done in the article (Milková, 2010b).

where the description of the algorithm finding all the shortest paths between the two given vertices is described in detail. Description of the algorithm in English is done in the article (Milková, 2010b).

We have already mentioned that we consider presentations and programs dealing with objects appropriate to course subject matter as a very useful complement of lectures and substantial help to students in their self-study. The main reason why we have devoted the time and energy to the creation of the program GrAlg although there are various programs visualising algorithms on graphs is that our program GrAlg is created exactly on a script given by the teacher (author of the paper) with regard to student's needs. For comparison let us mention e.g. very nice small open source Windisc, a collection of subprograms that deal with several discrete-math topics (see http://math.exeter.edu/rparris/windisc.html). The program *enables easy creation of graphs*, however *it does not visualise the whole process* but only the result of the selected algorithm. Another program, the program Algovision (author of the paper had an opportunity to revise a part of the program), was created by Luděk Kučera in Java environment (see kam.mff.cuni.cz/~ludek/Algovision/Algovision.html). The program serves as a support of his lectures given for students studying at the Mathematical-Physical Faculty, Charles University. The program contains several applets visualizing algorithms explained by professor Kučera on his lectures. Although the program is very useful, it is not user-friendly, applets are quite complicated, and therefore students need and have large manual with detailed description for users in their disposal. Moreover, *the program does not enable creation of own graphs*.

To have an own program created on a script given by the teacher with regard to students needs is really very beneficial. In near future we are going to prepare a text-book completed by CD containing the program GrAlg and appropriate graphs.

Conclusion

In the paper one possible way how to develop logical thinking of students and increase their imagination within the subjects dealing with graph theory and combinatorial optimization is presented.

On four puzzles of different level of difficulty were discussed the students' ability to find out the appropriate graph-representation of the given task and solve it.

Student engagement is crucial for successful education. Students learn more when they are intensively involved in their education, are asked to think about they are learning and apply it in different settings. Practical tasks and puzzles can help in this direction (see also e.g. (Hubálovský, 2010), (Hubálovský and Musílek, 2010), (Pražák, 2010), (Skiena, 1998)) as well as suitable multimedia applications.

Visualization of the particular issue as well as it is possible improves understanding of explained subject matter, enable the students to acquire, complete, test and deepen their knowledge and increase their imagination. Students admire quality multimedia applications prepared by their colleagues who, on the other hand, are proud that their works serve as a useful study material.

Acknowledgments

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