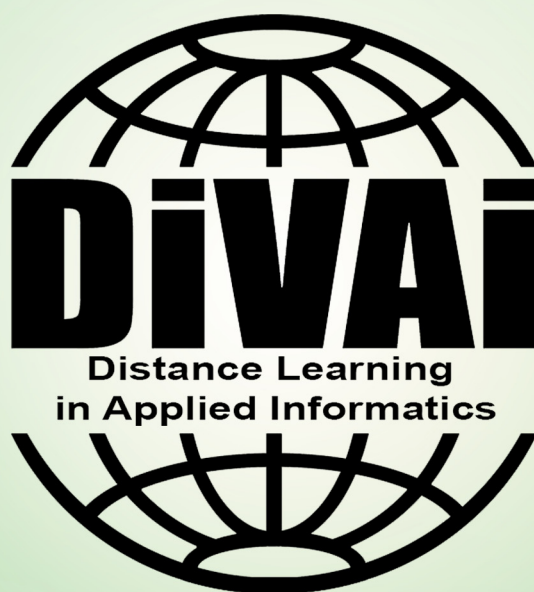Constantine the Philosopher University in Nitra
Faculty of Natural Sciences
Department of Informatics

DIVAI 2010 - DISTANCE LEARNING IN APPLIED INFORMATICS

Conference Proceedings

NITRA, MAY 4 - 6, 2010

Constantine the Philosopher University in Nitra

Faculty of Natural Sciences

Department of Informatics

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in Applied Informatics

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Preface

Dear readers,

the conference proceedings, you have obtained, represents a collection of scientific papers from the international conference DIVAI 2010 – Distance Learning in Applied Informatics. This conference is held under the patronage of prof. RNDr. Libor Vozár, CSc. Rector of the Constantine the Philosopher University in Nitra and prof. RNDr. Ľubomír Zelenický, CSc. Dean of the Faculty of Natural Sciences.

The conference proceedings contains not only the abstracts of the scientific papers presented at DIVAI 2010 - the international scientific conference, but also a CD with the full version of the presented papers.

The need for the conference was arisen by the growing tendency in terms of information interchange in the field of ICT application in education focusing predominantly on the concept of e-learning. Over time, the conference built up the reputation and gained on popularity among the e-learning supporters that traditionally meet in Nitra for the 8th time.

The program of the conference consists of presentations summarizing the latest inventions and development in the field of e-learning as well as its application at Slovak, Czech and other foreign universities.

DIVAI 2010, organized by the Department of Informatics, Faculty of Natural Sciences, Constantine the Philosopher University in Nitra, takes place exactly in that very moment the problem of ICT application (e-learning) and its support becomes crucial and widely discussed among international circles.

Therefore, we wish the Department of Informatics smooth running conference, success as well as power to expand in terms of further knowledge base building and successful ICT application. Moreover, we wish the Department the high quality working staff, lecturers, scientists as well as unceasing interest in the field from the part of students.

I believe in future development of the Department of Informatics. As a pioneer in the field of ICT application in education scientific research and various other fields, I am assured the department will keep updated about the problem. At this opportunity I would like to praise the work of guarantees, the team of organizers and sponsors, lecturers, and last but not least participants of DIVAI 2010 conference, for they all are to be considered vital contribution to the problem as well as smooth conference running and scientific proceeding.

prof. RNDr. Ľubomír Zelenický, CSc.
The Dean of the Faculty of Natural Sciences,
Constantine the Philosopher University in Nitra

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Track 3 - Life Long Learning

Summary

Boris Aberšek

To highlight the differences between conventional educational systems and simulation/game based systems, it is useful to consider simulations, the class of system most closely related to games. In such system, the ultimate goal is to create a virtual duplicate of reality for analysis, training, experimentation, or other purposes. Simulating reality is an approach that may or may not be useful in creating experience. This distinction yield several consequences. In simulation, behavior (of, say, objects, tools, engines and peoples) should be as realistic as possible. In simulations, the representation of environment tends to be uniform and consistent, allowing the users to act freely within that environment. For application seeking to teach users through realistic experience, game design techniques can make the experience much more memorable. In a testbed environment, the context and control afforded by games design techniques allow integration of technologies and evaluation of the overall experience, even with partial implementation. Perhaps it's time to take the lessons of game design seriously. I will start my paper with one simple question - could the ideas, methodology and development methods that make computer and video games so successful as a compelling users experience also be applied to developing relatively serious-mind applications? At the next few pages I will try to answer this question.

Vincentas Lamanauskas, Violeta Šlekienė, Loreta Ragulienė

The role of ICT in education in whole and particularly in science education is very important topic. It is worth emphasizing that in recent years, a general degree of integrating ICT in the process of teaching has increased in Lithuania as well as in other countries. It is accepted that ICT makes the process of teaching/learning more effective and beneficial whereas the education system starts functioning faster. The development of ICT and the process of globalization determine alteration in the education system as well as in the whole society. The implementation of new technologies in the educational process raises new possibilities for both teacher and learner, enhances education quality and makes the educational process more versatile. The research 'Student and Computer-Based Technologies' was conducted in January – March, 2010. Research sample consisted of 663 respondents who were 1st year university students (freshmen). To analyze research data, the measures of descriptive statistics (absolute and relative frequencies, popularity/usefulness/necessity indexes) have been applied. It has been stated, that respondents have practically unlimited opportunities to use mobile phone, computer, internet and e-data mini storage device - USB stick. Relatively new and rather expensive digital technologies are barely used. The most useful information communication technology for the first year students while studying is compute.

Jan Lojda

Intergenerational Portfolio Management (IPM) is a process for the development of an e-portfolio of knowledge, skills and competencies produced in partnerships between more experienced and less experienced workers, this often implies older and younger workers. IPM adds a new dimension and provides a unique setting to explore individual strengths and weaknesses, together with values, attitudes, and broad experiences that all play a part in how employees view and carry out their jobs. IPM enables to consider all the issues that the employees think are important in enjoying their job and doing it well. This could include the broader range of skills and experiences, the work itself and the systems and context of the workplace. During the IPM learning process, employees may discover that there are some tasks that they could do better or some tasks that could be changed to make them more effective at work or make the job more satisfying for

them.. The IPM e-portfolio will provide a good basis for discussion between an individual employee and his/her manager about plans for future training and development.

Petra Poulová

The effectiveness of the educational process is given by such factors as learner's intelligence, prior knowledge, level of motivation, stress, self-confidence, and learner's cognitive and learning style. The process of instruction supported by ICT is considered suitable and beneficial for learners of all styles. The reason is it offers a wide range of activities which can be aimed at any learning style and used by any teaching style instructor. The possibility of individualization of the educational process from the both students' and teachers' point of view is the greatest advantage.

Mikuláš Gangur

Virtual prediction market is an online simulation game running in the Faculty of Economics since autumn 2007 as a support education process in the selected course. Prediction market is a speculative market created for purpose of making predictions. Assets are created according to the final cash value that is tied to a particular event (e.g. Barack Obama will become U.S. president) or to estimate a score (e.g. the close value of PX index on Friday February 19th). The current market prices can be also interpreted as predictions of the probability of the event or the expected value of the score. In the paper this simulation game FreeMarket is presented as the part of courses Financial Mathematics and Capital Markets Analysis. The prediction market and quality of prediction estimates depend on the amount of the market participants and their trade activity. That's why it's necessary to motivate students to trade on such market. The paper introduces some methods to increase activity of students (market participants). First of all the results of market trades are supplement to final students' evaluation in these courses in the form of points that are added to total score of every student. In reality the FreeMarket credits (money), that student earns on the market, are transferred to points according to the declared rate. These points help students to increase their score for credit and final exam. The interconnection between simulation game and LMS Moodle is described together with description of transfer process. All these processes automatically and periodically update the students' score of assignment that is created in Moodle course for these purposes. Next in the paper the other tools to increase students' motivation are presented. As support of trade volume and market liquidity to increase the automatic process of stocks order regulations are introduced. This regulation is realized in two ways. In the first case the amount of stocks of already emitted events on the market is increased according to users market demand. In the second approach the list of events is prepared as external data file, the data are loaded to the system and then selected events are automatically placed to the market according to the demanded start date of every event. Next motivation factor for student activity showed is "FreeMarket inflation" that depends on the amount of free money in the system compared to the amount of orders and current stocks value. The way of inflation calculation is presented and its influence to the increased volume trades is explained. Finally other characteristics of FreeMarket are presented. The calculation of FreeMarket index and volume of trades are explained. Some of these characteristics became subject of students' interest in the form of proposed events. Thanks to this interest the premises were created for future automatic generation and sophisticated estimated opening prices not only for internal FreeMarket characteristics but also for external real financial market or economic indicators.

Tomáš Gregar, Tomáš Pitner, Miroslav Warchil, Jan Mudrák,
Ondřej Zezula, Jakub Talaš, Igor Zemský, Zdeněk Lévek

Machines knowing content of the documents, i.e. the idea of semantic web, could help with transmitting the knowledge. The lack of user-friendly tools for acquiring, storing and utilizing document semantics inflicts very rare usage of semantics among non-specialized users. Semantic-web research concerns with theoretical issues. We designed the project SELE (Semantic e-learning) to cope with some of these issues. This project allows user to create open source light-weight tools for gathering semantics from real usage, usable in further

research, and to use these tools (and also their development) in the learning. This paper describes a structure of the framework, their basic processes and developed tools and modules.

Petr Halamíček, Arnošt Motyčka

In the field of ICT management is the use of foreign computing sources a relatively new trend. This trend is more and more current and in future there will be a problem to escape from it. Today the administration of decentralized IT environment forces companies to employ new IT workers, because the current administrators are not able to handle the increasing number of a PC stations, applications, operating systems, databases, information systems, etc. We usually meet the situation when one employee has not only PC station, but also the notebook, PDA and others. On each of these devices there are different data and different applications installed on different operating systems. The most acceptable solution is to start gradual centralization by moving user operating systems and their applications to the powerful data centres, and then providing personalized operating system and applications to end users. The personalized OS "runs" on a powerful computing cluster and the user will be able to access it anytime and anywhere he wants. The purpose of this article is to inform about new management options using the new ICT possibilities of applying virtualization, to sketch a possible implementation in the classroom under administration of the Department of Informatics, and then to present virtualization tools Citrix XenServer and Citrix XenDesktop and the possibility of deployment. At the beginning it is necessary to consider the rate of deployment of virtualization technologies, whether to move the whole infrastructure or only some part into the datacentre. It should also be chosen the appropriate virtualization tool. The chosen solution passes through the phases of implementation and testing, which proves the propriety of the solution.

Milena Janáková

Students and other people interested in the area of operating and database systems have to their disposal specialized books, manuals, and web pages. The user's problem is orientation oneself in the themes and practical implementation of new methods and products. The purpose of education is to search useful methods and aspects for supporting optimal knowledge in multicultural and global societies based on multidimensional methodology. Effective aspects are visualisation and the use of interactive elements in presentations and simulations. Communication is important from the shared experiences point of view and special themed knowledge. E-learning requires the same. Optimal integration of interactive elements into communication with students is helped by simulation the real situation with Petri Nets. Adaptation the static offer of education materials by dynamic and interactive elements is not automatic. In the way of searching a well-balanced method is the inspirational access for contact mapping in a study by IBM called "Advocacy in the customer focused enterprise". Specific metrics are important for controlling the seriousness and prestige of given firms. E-learning also constitutes prestige of a given university, their educators, and others employees. The recommendation is that students must experience interest, topicality, plasticity, and efficiency. Students are also clients; clients of e-learning.

Jozef Kapusta, Michal Munk

The aim of adaptive hypermedia systems is present personalized information for the user which are relevant and the way, which is the most suitable for him. In the article we analyse usage of adaptive techniques Direct Guidance and Links Annotation for e-course personalization. The aim of the analysis is to find out, which technique is more effective in meaning of didactic efficiency. We aimed at the analysis of suitability of each adaptive technique depending on the type of educational material. In the experiment, we evaluated whether using of direct adaptive technique (e.g. technique of Direct Guidance, Hiding Links) is preferable in the lessons which are aimed at modification of the previous students` knowledge as in the lesson aimed at acquiring new knowledge.

Cyril Klimeš, Zoltán Balogh

Managing a learning process by means of an LMS (Learning Management System) requires solving complex decision processes which can be handled by using the System for support of decision-making (DSS). The DSSs are interactive computer systems which help decision-making subjects use data and models to solve unstructured problems. These systems are mostly based on risk analysis with usage of experience, judgement,

and intuition and they allow a very fast and flexible analysis with fair response, which enables the use of intuition and judgement of an experienced teacher. Such decisions are frequently led by undetermined information, which requires other decision models. We presume a learning process with a closed management cycle using the DSS. The DSS is then influenced by outside limiting conditions, among others time conditions, minimal qualitative conditions, etc, as the main and determining for proper securing of the educational process. The LMS is then roofed by the DSS, which suggests and chooses the most optimal alternative of the educational process. The DSS is joined by independent parameters which characterize both the current status of the educational process and restricting conditions and objectives of the top management. With respect to the fact that the combination of their occurrence has various probability incidence, we evaluate them by means of expert systems. Independent parameters and expert knowledge enter the so-called statistic evaluation of probability of the individual suggested alternatives. The output is a vector of the alternatives which is structured according to the probability magnitude of the individual alternatives. In addition, each alternative has defined particular indicators which describe the given alternative. The system of the indicators then enters the mathematical model which teaches the standard of the given alternative. One of the most used methods for modelling of such systems uses a functional relation to describe the development of the parameter in the monitored period. The functional relation, which stems from the behaviour of dependent and independent parameters, must then necessarily copy various and mostly significant deviances in the magnitude of the independent parameters. This trend is then automatically transmitted, for no reason, into the behaviour prognosis of the given parameter. The most usual cause of such a status is the effort to achieve the best approximation of the time series defining the behaviour of the given parameters. The aim of the paper is to propose a method eliminating the above-mentioned, mostly incidental, deviances in behaviour of unknown parameters and thus to create a model which would simulate the main trends in the parameter behaviour more authentically.

Managing Educational Process in LMS with Using Petri Nets _____ 107
Cyril Klimeš, Zoltán Balogh

The final function of the learning management system (LMS) is routing the communication depending on the student´s knowledge and abilities and according to that changing the quantity and ambitiousness of the material offered to the student. In the theory of management there can be seen the evident transition from combinative practices to sequenced rows and optimized processes (strategy of continuous assessment of the reflection of student's schooling and based on that adapting the further education is equal with the dual principle of identification and adaptable management). For the description and subsequent management in this way of learning Petri nets are advantageously utilised. Another approach to describe actual and real educational processes is utilising fuzzy modelling. If we want to describe the complicated reality we may decide between the relevance of the information that would be less accurate and accurateness of the information which would be less relevant. In the process of increasing the accuracy of description of educational process we get to a point where accuracy and relevance become mutually excepted characteristics. We may describe educational process in some sentences where we globally describe the parts of educational equipment and the educational process itself. Hereby we have learned how to teach human some knowledge but we will know nothing about linking of the steps of education, its components and/or people. If we want to know details we have to specify it in detail, provide the ability to absorb knowledge, quality of education, etc. with numbers. Therefore the number of information raises and because they are accurate we learn more but only about a small part of the educational process. As far as we want to describe all educational processes in detail it would lead up to a huge number of detailed information which nobody would be able to read. And if yes, to understand the essence which is described he would need natural language, i.e. he would return to inaccurate characteristics. On the contrary, he would badly lose in accurate details because human psychic has limited possibilities. Namely, it turns out that accuracy is just fancy or is on principle unavailable. All these facts are behind the considerations of founders of fuzzy logics. A strong device arises applying fuzzy logics into Petri nets for modelling educational process mainly for simple intelligibility and well-created mathematical apparatus, relatively simple design and for modularity of the solution (it is possible to add and remove the modules without the need to remake the whole system) and for robustness of design (in case the parameters of solving the task in a particular surroundings it is not necessary to modify the system).The article is solving the problem of implementation of fuzzy Petri nets into the concepts of LMS. 107

Tibor Kmeť

A neural network based optimal control synthesis is presented for solving optimal control problems with control and state constraints. The optimal control problem is transcribed into nonlinear programming problem which is implemented with adaptive critic neural network. The proposed simulation methods is illustrated by the optimal control problem of feeding adaptation of filter feeders of Daphnia. Results show that adaptive critic based systematic pproach holds promise for obtaining the optimal control with control and state constraints.

Mária Kmeťová

Information visualization is a new discipline using computer graphics technologies and based on piece of knowledge in statistics, informatics, geometry and psychology. Visualization offers technique for creating images, charts and animations for communicate some information. This is the merit of information visualization doing it extremely important for distant learning. Good and powerful visual representation of abstract data may help in communicating, analyzing data and confirming hypotheses and can substitute many pages of explanatory text. Examples from history give inspirations for building excellent visual representations, but wrong examples should be avoided in next creation of visualization.

Peter Kuna, Martin Magdin

In the contribution authors draw attention to e-learning courses evaluation from the standpoint of making and implementing new Statistics modul in the environment of LMS MOODLE system. In the present time, great emphasis is layed on gathering new information in a very short time, but also on a possibility of testing or certification of gained knowledge with its automatic interpretation and giving a feedback. For gathering new information are used various statistics methods. The authors decide to concern their attention on LMS MOODLE system, which belongs to one of the most used e-learning systems.

Roman Malo

E-learning systems are mostly one of the most important parts of university information systems. Within these systems a lot of functions are enabled for student's or teacher's activities during their educational interactions, nowadays often including any kind of adaptation. Using adaptation within e-learning systems is very important because this is the way how to: Increase eLearning efficiency – Information delivered by the preferred way are for students more understandable, one person likes for example text with pictures other elects audio records. Generally, that is why students don't need so much time in comparison with common learning. The support of individual teaching i.e. adaptation extents e-Learning advantages also in the area of individualization. There is no limitation to use eLearning course as a tool within face-to-face teaching for example for explanation of new problems, preparation for discussion and other activities. Respect students' needs – Traditional teaching often doesn't suit to all students because each of them must more or less conform to teacher's style. Learning styles adaptation enables enforcing students' needs. Reduction of "bad" influence of the teacher – What to do if teacher (or prepared course) are not optimal? Adaptation is also one of the solutions which can reduce this state. Described possibilities are the reason why adaptation should be considered at least as a possible future benefit. It is a domain that could bring more flexible and useful way of learning together with efficiency and easier motivation of students. The general questions are what and how to adapt and where are the limits for the whole implementation. It is clear that architecture of e-learning system has to cover up basic components common for adaptive systems. It means adaptive engine with rules of adaptation, user model, domain model and monitor of users' actions (behavior). The paper describes a proposal for implementing adaptation mechanisms for optimizing study and learning activities of students using various applications of e-learning systems. Basic classification and description of advantages and disadvantages of possible types of adaptation is also part of this paper. The e-learning system ELIS is considered as a concrete platform and the example of system with potential to extend its current functionality with adaptation.

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Miroslava Mesárošová

In the paper we discuss the possibilities of realization of the evaluation that is composed of several partial evaluations, especially if they were carried out by different evaluators. This type of evaluation can be used for example in evaluating the presentations, if we want also the audience (e.g. the other students) to join the evaluation process. Our intention is to introduce the possibilities that the learning management system, particularly LMS Moodle that we use to manage the education, offers to make the process of gathering data for evaluation, processing them and publishing the results to the students easier, more transparent for the students, more effective and less time-consuming for the teacher. We propose the usage of the Feedback activity in LSM Moodle as the tool for gathering the input data for evaluation from the students, the spreadsheet for processing the data and getting the final evaluation and the Grades module in LMS Moodle to publish the results to the students.

Multimedia Support in Artificial Intelligence and Robotics Courses _____ **149**

Ondřej Popelka, Michael Štencl

In this paper we present our approach and achievements in e-learning materials for artificial intelligence courses at FBE at Mendel University. There are three courses focused on the subject of artificial intelligence – Artificial Intelligence I and II and Neural networks in Applications and Handling Equipment. For these courses we have created an e-learning course consisting of an introductory text and many multimedia objects. The course itself is not directly correlated to any of the courses of full-time study. Rather they form a consistent introduction to artificial intelligence itself making them very suitable for lifelong learning. Specific subjects covered by the course are state space searching, heuristics, learning algorithms and neural networks. We have invested a great effort in making the content of the e-learning course attractive. Another part of our effort went into making the e-learning course interactive and generally fun to work with. To achieve this, the course contains several applications and interactive animations and some recordings of artificial intelligence in action. All of these objects are usable both in online and offline browsing mode. We have chosen a game of tic-tac-toe to demonstrate the creation of artificial intelligence computer player. Apart from this the course contains interactive animations created using Adobe Flash.

Business Architecture Modelling in Education _____ **155**

Ivana Rábová

All organizations are in commercial pressure that dictates that they must become more efficient in the way that they are able to exploit their data assets. One of the most challenging problems facing companies today is the ability to quickly and accurately answer the most basic of business questions. In fact, the larger and more distributed the organization, the more complex this problem appears to become. The model of business processes and model of other business concepts describes how the business intends to conduct itself. Many factors that crucially affect business operations are defined in business process description and business concepts specifications. Processes are often embedded in information systems without solid description or process model prepared to change registration. Students of informatics and managements domains at universities have to be good prepared for demands of external business environment. Requirements from praxis are inclement and they call for the knowledge of analytical procedures at level of information systems and at business level. That's why procedures and methods of business process modeling and enterprise architecture modeling are created and implemented in our education. The article deals with experience and pieces of knowledge from Information System Modelling, subject of education at UKF in Nitra. Business modelling creates an abstraction of complex business and establishes a common understanding that can be communicated to the business's stakeholders. Models help to identify new business opportunities (business improvement or innovation). We use in education UML as a very suitable language for modelling, because it has the ability to describe both the structural aspects of a business, the behavioral aspects of business and also the business rules that affect both structure and behavioral. We learn approach and extensions, the Eriksson Penker Business extensions to UML that extend UML with adapted model elements for business modelling. Method empower mapping of relationships between process diagrams and use case diagram and indicates which process will be support which functions of system in use case diagram. In Erriksson-Penker approach appears term of business architecture (enterprise architecture) as a complex composed of four different views (abstraction) of business each of which captures information about specific aspect of the business. In lectures we present (excepting business process diagrams) number of UML diagrams that show a specific part of business structure or a specific business situation. The diagrams contain and express the

objects, processes, rules, goals and visions defined in business situation. The article presents some interesting diagrams of business processes and their elements. Our approach to education could provide students and future business analysts with an essential approach to understanding, redesigning and communicating what really happens in business processes.

Peter Švec, Martin Drlík, Ján Skalka

Virtualization is a way to abstract applications and their underlying components away from the hardware supporting them and present a logical view of these resources. Virtual machine software and operating system virtualization technology can both help increase the utilization of physical resources by consolidating functions onto a smaller number of systems. There are some unspoken rules that affect implementation of new technologies. We are discussing these rules in this paper and analyzing their impact for implementation of virtualised environment at our university. As the e-learning solution, we are using LMS Moodle. That system has quite big requirements for hardware; not only the amount of memory installed but also the storage capacity. There are two approaches to virtual processing commonly used; the virtual machine software and partitioned operating systems. We are discussing what approach is the best for our e-learning solution and what virtualisation technology fits for us. We can choose from five virtualisation technologies; access virtualization that allows nearly any device to access any application without either having to know too much about the other; application virtualization allowing applications to run on many different operating systems and hardware platforms; processing virtualization that hides physical hardware configuration from system services, operating systems or applications; storage virtualization that hides where storage systems are and what type of device is actually supporting applications and data; network virtualization that presents a view of the network that differs from the physical view.

Milan Turčáni

The subject of our interest is educational process, which can be considered as dynamic process, changing in time, which can be examined from various viewpoints. We can focus on participants of this process, i.e. on students and lecturers, and observe their mutual relations and interactions. Educational process understood as a dynamic system is an insofar extensive sphere that it provides almost limitless opportunities of observation, modelling and simulation. In this contribution we shall focus mainly on the special part of educational processes – on teaching of subjects focusing on technical and system issues (Logical systems, Architecture of computers, Operating systems and Computer networks), which are specific with their focus on adopting the knowledge on principles and functionality of computer systems for the processing and transfer of information within the studies of informatics. _____ 167

Martin Vozár

All over the world, various teaching methods are used to get better results in education. Regarding the theme of this paper we decided to use Computer-Based Learning (CBL) in the teaching-learning process. Teaching the numerical and optimizing algorithms in the traditional form (e.i. lecture) is not very attractive and motivating for students. Therefore we decided to add visual demonstrations of the function of algorithms to the explanation of the educational content. In the lessons we use the dynamic visualizations that make the teaching-learning process more dynamic and effective. Furthermore, we can motivate the students better than before. The introduced paper deals with teaching optimizing algorithms with the usage of CBL. The optimizing algorithms form the curriculum of Numerical mathematics and optimization subject that is the obligatory subject for the students of Informatics in the fourth year of study of Teaching of academic subjects on the Faculty of Natural Sciences of Constantine the Philosopher University in Nitra. The content of the subject includes basic numerical and optimizing methods. For this subject we created the study materials and electronic didactic aids. The materials for the study of Numerical mathematics and optimization consist of more components forming a complete unit in the end. At the university education portal we created course using LMS Moodle. By this way we provide access to materials for all the time. Individual lectures in the course are thematically grouped. For each method there is an interactive presentation created by graphic editor based on vector graphics, e.g. Macromedia Flash MX. Using presentations, we stimulate students' imagination, as well as, by using visual material, we facilitate their learning and understanding of the algorithm. Next lessons include teaching text in pdf format, examples of practice and a forum. To confirm our

assumptions that teaching subject Numerical mathematics and optimization using the aids will be much easier and more effective we realized the research. The research was realized by questionnaire method, method of content analysis and quantitative methods of educational research. We asked students to fill up the questionnaire that was aimed at evaluation of the presentations and the application. We gained 31 evaluations that was the exact number of students undergoing the eighth term. In the paper, we mention only some of the twelve questions. On the basic of the research as well as practical experience, we can agree upon the conclusion that the described presentations and the application if sufficient aid facilitating the teaching and learning of Optimization subject. A teacher can use this material at the lectures, seminars, moreover; students can use them at home while preparing for school.

Metka Kordigel Aberšek

The development of literacy skills can provide important advantages for children with special needs. Exposes to early storytelling and learning the receptive role in literature - listening - situation provides the child with preknowledge and experiences, needed for later literacy acquisition. It cannot be assumed that if the child's language competence is not (yet) developed; he cannot learn to listen to a story and to understand it. On the contrary, ICT in literature education for children with special needs gives us the opportunity to use visual communication code to provide communication support for children with special needs, while supporting literary aesthetic experience and at the same time the process of emergent literacy. Historically educators have assumed that listening/reading to stories are skills that develop after children learn to talk. Because many children with special needs have significant delays in language development, there has been a reluctance to introduce storytelling activities to these children. However as Watson, Layton, Pierce, and Abraham (1994) point out, early exposure to literacy (also storytelling) activities are important for all children, regardless of their speech and language ability. The possibilities, given by the use of ICT, should have the consequence of rediscovering the importance of including storytelling activities in preschool curricula. This activity can support specific skills of listening, sound discrimination, and speech sound production in children who have hearing loss, communication delays, and learning disabilities. It is particularly important to realize that for some children who will never develop intelligible spoken language, use of pictures and print may be a critical alternative mode. In our paper we shall present the results of the case study, in which we used ICT as a means for literature education in a group of young adults. Our results show not only that ICT is an interesting tool, young people with special needs find nice and fancy, it does not only motivate but gives results of much higher quality regarding the understanding and interpretation of key structural elements of the literary text. Our investigation shows the connection of using visual support to the storytelling via ICT and listeners (viewers) understanding of literary persons and literary setting. Reception of the story supported with ICT shows results in understanding the moral of literary characters and the understanding of literary action, which was measured by the ability of predicting the story. On the behalf of the experiment we can conclude, many highly motivating and efficient ICT strategies can be used throughout the literature reception activities to encourage the literature understanding, language acquisition and emergent literature skills for young people with special needs.

Ján Beňačka

The paper gives some examples of using Excel as an effective modelling tool for teaching and learning functions and calculus at secondary school from the view of teaching the corresponding skills in informatics lessons. They are: graphing elementary functions, graphing polynomials and general functions, finding zero points and extremes of functions, and solving systems of linear equations. Developing interactive models of parametric systems for studying their behaviour at changing inputs is a known way of using spreadsheets. Making the models, students gather new knowledge and skills in the spirit of constructivism and discovering mathematics.

Martin Cápay

Assessment and classification is very sensitive phase of the learning process and it is necessary to ensure the greatest possible fairness and objectivity throughout the whole process of testing. Assessment of programming knowledge and skills is especially challenging task. Testing programming, whether the practical or the theoretical part, is likely subjective. To ensure the objectivity of the assessment, possibly reducing the degree of subjectivity, it was necessary to proceed to develop a unified system, at least in the case of testing knowledge of the theoretical part. However, there was not a database of questions and tasks that would require an active application of knowledge and programming skills for correct answer, and in which the correctness of responses could be evaluated automatically. The aim of the paper is present the developed and verified model of computer-aided knowledge testing with regard to the content of programming subjects. We analyzed the possibilities of systems suitable for testing and enabling simple archiving of results and their statistical processing and we finally chose LMS Moodle as the most accessible alternative for educational organizations. We developed and implemented model of computer-aided testing specified the 28 thematic areas and defined their goals and assumptions to master them. We built up a database of 237 questions and tasks appropriate for testing knowledge of the subjects of programming formulated for implementation into the selected computer system. Our model was verified during research, which took place during three years among the students of the Department of Informatics after the completion of programming test at the end of the semester. In the last phase we realized national research among the selected group of secondary and university teachers of Informatics. We verified the efficiency and effectiveness of the testing system based on the created model. We also defined the propriety of computer usage in the process of examination of students' knowledge. According to the results, the predominance of positive perception of electronic testing is clear, but there was also not confirmed that the students clearly prefer computer testing and evaluation to teacher's assessment. The biggest complaint from the students and partially from teachers was directed to display the remaining time, which make rise of the nervousness. The results of the research show that the elaboration of the content into the thematic areas of the model, and specification of their objectives are reasonable. Recommendation of further usage of electronic tests is unquestionable.

Jacek Grudzień

After reform of the curriculum in Polish schools (the eight year primary school and four- or five-year high school was transformed into six-year primary school, three-year secondary and three-or four-year upper-secondary school) a problem of the declining level of knowledge emerged among high-school graduates. The main reasons of this are several phenomena, including: insufficient number of hours in the course of science education in vocational schools, shortening of the learning time for technical subjects to one year and rapidly evolving technology. The aim of the paper is to prevent this undesirable phenomenon among computer science technician graduates from the school where the author works. The article presents several approaches to the implementation of a combined curriculum of vocational subjects for this profession in order to overcome students' difficulties with the material mastery. The results of the teaching and knowledge recording of the scope of the subject Computer Technology Devices parts Computer Arithmetic and Digital Devices for groups benefiting from traditional teaching methods were compared with the results of groups using different methods of supporting e-learning. The groups were divided into several categories, concerning: standard teaching, teaching along with standard power-assisted materials placed on the web, standard teaching with assistance e-learning Claroline platform and standard teaching with assistance e-learning platform Moodle, which allows the introduction of elements of artificial intelligence to control the learning process of students. This last mentioned group used an unfinished skeleton of Moodle course, which is still in its experimental stage. The purpose of a thorough analysis of the material consolidation were tests carried out after six - seven months since the end-of-course date. The knowledge tests were including the ability to convert numbers between different numeric systems, coding decimal numbers, recognition of symbols of digital elements and understanding of the operation of simple digital circuits. The test results were treated statistically and presented in the form of graphs and histograms. On the basis of the test results, the

differences between students studying different methods were found. There were also found the dissimilarities in the efficiency of learning among high school learners and the learning competence of the students after the introduction of e-learning (based on the author's former paper). The paper presents a few conclusions: the creation of the e-learning course for pupils is much greater challenge for the author of the course than the creation of the course for students and not all learning platforms are able to fulfill properly its mission to assist the learning process. The introduction of several techniques based on the achievements of artificial intelligence (a simple expert system used in the module lesson of MOODLE) has radically improved high-school student performance. The implementation of the different teaching strategies to improve the students' results of the professional examinations was proposed in the recommendations. It proved the necessity of continuing working on the experimental platform based on the MOODLE in order to improve the learning process in the high-school.

Agnieszka Heba

The changing market conditions related to the processes of globalization cause changes in human resource management. An employee wishing to retain their place of work must be flexible and capable of rapid adaptation of new technologies, especially information technology. Standard professional preparation, especially in the areas of advanced technology no longer enough, which forces the use of new techniques and technologies of teaching, especially in the sciences directly related to information technology. The case of learning throughout life has been noticed and appreciated by European institutions. Defined eight key competences that are needed by every man for self-fulfillment and personal development, for active citizenship and full social inclusion and employment. These include, inter alia, mathematical competence. Very accurately described it, Mogens Nisse. The idea of mathematical competence is in Polish and Czech standards, examination requirements. The article presents the results of the first stage of his doctoral thesis undertaken at the Faculty of Education, University of Ostrava on the development of mathematical competence in students of secondary schools using e-learning. Essential factors inspiring the creation and implementation of the research were: to develop techniques for creating e-learning courses through, inter alia, a system MOODLE CLMS), the desire to create the possibility of the emergence of a new type of educational materials and the results of surveys conducted among students and teachers of the Silesian province. I stage of research related to the results of two surveys sent to 500 students and 500 mathematics teachers of secondary schools in Poland within the province of Silesia. Studied knowledge of respondents about the use of modern ICT in education and e-learning. Developed a questionnaire consisting of 21 questions, grouped by type of information to provide. Initial questions provide general information about respondents, age, gender, indication of the type of school in which they work and learn for students. In addition, questions were addressed to teachers, inter alia, the seniority and the type of school completed. Another of the questions concerned the use of modern ICT technology - communication in education, in particular concerning the evaluation of their computer skills. Surveyed were asked to indicate the programs that they use in class or preparing for it. The last group of questions concerned, knowledge by teachers and students of e-learning and operate the system in Moodle. After analysis of the results found that Polish teachers of mathematics and students have insufficient knowledge of the use of modern information and communication technologies in education and e-learning. On the basis of survey data as a result there were specified milestones for research and their implementation.

Gabriela Lovászová, Viera Palmárová, Júlia Tomanová

Collaborative learning occurs in situations when two or more people are engaged in learning activity that involves some kind of productive collaboration (e. g. working on group projects, joint problem solving, collaborative writing, debates/discussions, team competitions, role playing games). Every member of a learning group shares his/her knowledge, skills, experience, creative ideas, opinions, attitudes as well as motivation to fulfill the task successfully with his/her fellow learners. Individuals have to co-operate in pairs or groups to search for understanding and solutions. They often create a concrete artifact of their common learning (e. g. computer program, constructed model, presentation of project's results) in order to show it to others. This social interaction is considered to be one of the key concepts in modern constructivist and constructionist learning theories. In this paper, the classification of collaborative learning activities suitable for classroom environment is discussed. We focus on teacher coordinated, synchronous, problem solving and strategy planning class activities mediated by computers in network. We have been looking for such

collaborative learning context, in which the benefit of face to face communication combines effectively with advantages provided by digital technology enhancement (multimedia, interactivity, immediate feedback, attractive scenario). As a result of this effort, an original online educational game was designed and implemented. The game was developed using Imagine Logo. The built-in network support included in this programming environment solves the problem of establishing the client-server connection, controlling the online communication and transmitting data via network through specialized classes. The paper presents features of the above-mentioned educational game and deals with some implementation details as well. The game is an open system so it can be customized to fit the needs of its potential users better (educational goal and rules of the game, nature and difficulty of tasks to be managed by players, time limit, number of competing teams). In conclusion, we sum up the findings acquired while realizing suggested network-based collaborative learning activity with students. These findings relate mainly to methodical and organizational aspects of computer supported collaborative learning (CSCL) activities: (1) collaboration stimulates students' motivation to learn and enhances their activity significantly, (2) digital technology helps to meet the educational goals of an collaborative learning activity in a more attractive and effective manner, (3) the educational goal of a network-based collaborative learning activity is a crucial attribute of its design.

Searching Eastwards _____ 221

Alena Mašláňová

A teacher who creates his/her own teaching materials often gets inpired with other teachers. Teacher searches not only for ready made materials, but also for ideas that could be modified for his/her purposes. After some time teacher starts searching beyond the sources in his/her mother tongue, usually in English. Nevertheless, our contribution is aimed at Russian sources. Firstly, we have searched the sources of the Russian State Library. It offers searching not only among books and articles, but also dissertations, and interlibrary lending services. General Federal Educational Portals (Базовые федеральные образовательные порталы) with its several links can be considered as the main informational signpost.The first of its links is the Federal Portal „The Russian Education" (Федеральный портал "Российское образование"). There we can find a catalogue of educational Internet resources. We can search according to the level of education, subject, kind of resource, and user. Federal Centre of Informational-educational Resources (Федеральный центр информационно-образовательных ресурсов) is an interesting portal offering six types of educational resources. They are divided according to the level to the comprehensive, secondary comprehensive, lower professional education, and upper professional education. These domains are further divided according to the subjects. The materials (teaching units/objects) are described (copyright, software, time assessment, target user, size etc.) Russian national portal for secondary education (Российский общеобразовательный портал) offers Internet resources of teaching texts, lesson units, and information on local educational portals. Portal of Informational Support of Comprehensive State Exam (Портал информационной поддержки единого государственного экзамена) provides the sample tasks for this exam.We also mention several specialised portals, such as Federal Educational Portal "Economy. Sociology. Management.", Federal Law Portal "Legal Russia", Social Humanities and Political Education portal, ICT in Education with developed searching for Internet resources. Russian Portal of Open Education (Российский портал открытого образования) offers more than 200 subjects of education. The visitors can animate the course work in two demo Moodle courses. The portal All-Russian Pupils´ Olympic Games (Всероссийская олимпиада школьников) provides organisational information and chosen sample tasks from previous years. From the point of view of our subject, the most interesting is the portal Network of Creative Teachers (Сеть творческих учителей). It offers ready made teaching projects, methodology, guidance for using ICT educational support, forums and assessments. A Window of Approach to Educational Resources. Electronic Library (Единое окно доступа к образовательным ресурсам. Электронная библиотека.) offers on-line teaching and methodology texts. Web pages of individual schools are none the less interesting sources. Some of them offer teaching materials. Searching eastwards provides very edifying comparison of Russian and Czech Internet education background. It offers methodology support as well as display of possible future shape of Czech educational portals.

Application of Computerized Test Technologies for Quality of Knowledge Diagnostics _____ 227

Konstantine N. Nishchev

The article presents the experience in developing and application of a test system allowing to diagnose the assessment of learners' knowledge through its monitoring during the set period of study. Among the recent educational technologies the computerised technologies of knowledge assessment and quality of knowledge take an important place. Effective components of the above technologies are computerised test systems featuring a high level of processing promptness and technological effectiveness of assessment. The important

advantage of the computerised test systems lies in the opportunity to use them as an instrumental means of monitoring and diagnostics of the academic process. Under the author's guidance there has been developed a computerised test system allowing to diagnose the current state of the academic process through its monitoring results.. The system lets the user assess the current level of students' knowledge, present the testing results in a wide range of forms and statistical samples. Another important advantage of the system is the opportunity to automatically determine the components of testing materials content which were the most difficult to complete. Analysis of such information provides reasons to change the academic process in a certain discipline. A set of programmes functions in the OS Windows and is available for use as a networking option. The system provides the opportunity to create test assignments databases by a user without any programming skills; the opportunity to automatically compile test assignments using the test assignments databases in various disciplines; the opportunity to manage the procedure of testing from the working place of a lecturer; the opportunity to control each student's completing progress in a real time; the opportunity to automatically present the results of a testing in various aspects in respect to analytical goals. System has the function to diagnose the quality of academic process as it allows to summarise and analyse the results of testing received by students in the set sections of the study material (syllabus in whole, separate part of a syllabus, separate themes). Structurally the system consists of the following parts for preparation and editing of electronic test assignments; preparation of documentation accompanying testing; administration of testing and control of its procedure (working place of a lecturer); organization of a test procedure (working place of a test); statistical processing of test results. Test system was trialed when students knowledge assessment in general physics had been monitored. Results testify to the opportunity of its wider use including the systems of distant learning.

Remote Teaching as Information Search Skills' Education Means for Senior Pupils _____ 231

Palmira Pečiuliauskienė, Marija Barkauskaitė, Angelė Borodinienė

In the informational – creative society a person has to study nearly all his life, to absorb the knowledge created somewhere else in the world, to use it, to create new knowledge and to pass it to others. These processes are determined by the development of technologies and the variety of sources. The two kinds of long-existed information sources (printed and verbal) were supplied by a new kind of information sources – electronic information sources: electronic course books, databases, teaching material on electronic media, and others. When the variety of information and its sources is increasing, other information management skills are necessary – to select the necessary knowledge, to systemize, to analyze and to spread it. In the second half of the XX century it was enough to find one or several printed sources of necessary information in order to solve a problem, and nowadays – to select one suitable source from a number of printed and electronic sources. To do this, new skills are necessary – information skills. They start forming in a comprehensive school. The structure of information skills is complicated. They are made of information search, understanding adaptation, and spread skills. This article only analyzes the skills of information search. Considering the new possibilities of teaching, the article discusses a scientific problem of how from an educological point of view senior pupils information search skills' are being influenced by remote teaching as well as physics tasks of different integrality level. The conducted quantitative research shows that traditional and new technologies are combined in educational practice of secondary schools. The article analyzes information search skills of senior pupils (final classes XI – XII). The first stage of information search is the planning of information search. The survey allowed distinguishing the following steps of information search planning: the content analysis of the assigned task, the prediction of possible information sources (electronic or printed). The second stage of information search is work with information sources. The article analyzes how senior pupils plan information search, what information sources they use, how often open code distant teaching program Moodle is used. What is more, the article analyzes whether and how the first and the second stages of information search are influenced by the content of the assigned task. In the research according to the content type the assigned tasks are grouped as follows: nonintegrated content, internal integrated content, and inter-subject content.

Technological and Educational Factors Determining Information Search Skills of Senior Pupils _____ 233

Palmira Pečiuliauskienė, Marija Barkauskaitė, Angelė Borodinienė

The article deals with educational and technological factors, which determine senior pupils' (XI – XII formers') information search skills. The conducted quantitative research shows that when respondents (senior pupils) search for educational information, they use internet-electronic information search systems most often. When planning information search, students should raise questions, which stimulate the meaningfulness of studying. Fast information search tempo on the Internet sources limits pupils' reflexive planning skills, does

not stimulate deeper insights into the task content or alternative search of information sources. Educational processes influence the formation of information search skills. The format of the assigned tasks content determines the planning of information search. Interdisciplinary tasks encourage pupils to plan information search, to see into the task content better, and to reflect the studying. Non-integrated tasks limit the planning of information search. They stimulate mechanic, fast search of information in the internet-electronic information search system.

Sławomir Postek, Maria Ledzińska

In this article we attempt to present a review of the chain of thought and research studies which led from traditional, institutionalized education, through distance education and e-learning to the newest ideas of b-learning and complementary learning. Each stage presented its creators with certain difficulties, highlighted by research projects of which selected samples we discuss. In the case of complementary learning, the most recent development in distance education, aside from discussing the research results, we present the reader with an outlook on the problems not yet resolved, and awaiting scientific attention.

Mateja Pšunder, Mateja Ploj Virtič

This paper presents a historical development of distance learning and a comparison with e-learning. The advantages and disadvantages of e-learning and distance learning are discussed. Since the preparation of e-material is a demanding and time-consuming task, the article also includes a discussion about preparing study material and the characteristics of good e-materials. Quality preparation of e-materials requires qualified teachers who master, beside the manufacture of e-materials, also the use of ICT. These skills have been added to the list of teacher competencies in the last decade. We call them digital skills. The paper presents the Moodle Educational Portal, which is one of the most popular open source learning systems in the field of education. Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). In the conclusion, the vision of integrating e-learning into the study process at the higher education is described. This vertical connection of the entire education within the same field of expertise is very important for all three levels of users.

Martin Bílek, Ilona Semrádová, Ivana Šimonová

The paper deals with research activities run at the University of Hradec Kralove, Faculty of Education and Faculty of Informatics and Management, Czech Republic, which relate to information and communication technologies implemented in the process of instruction in various subjects. Particularly the role of a virtual learning environment (VLE) is mentioned and discussed, and information about core current projects is provided. The project work is understood to be a tool of VLE reflection, which is considered both from generally accepted points of view, and new approaches are also introduced.

Mária Burianová, Martin Magdin

The following contribution deals with the continual education of Primary school teachers, particularly by the content of educational programme with an e-learning support created at the Department of Informatics at UKF in Nitra. The continual education Act as a part of whole-life education is effective from 1.november 2009. It solves a task of systematic process of acquiring knowledges, capabilities, skills on standard function of pedagogical and specialized activity or supplement of professional competences of pedagogical and specialized employees. These competences are necessary for completion qualified conditions of pedagogical and specialized employee. The educational continual programmes are based on acquiring the definite number of credits and also on support of carrier growth of teachers in contrast with previous educational activities in postgraduate education with achieving of certificate after graduation, which did not solve other carrier growth neither teachers compensation packages. After taking effect of continual education Act, many educational institutions started to create and offer programmes of various kinds. The selection and

accreditation of each educational programme depend on new-coined accredited commission of Ministry of education of Slovakia. The hypothesis about subject fields of UKF which will be supported by positive judgement of educational content and following accreditation is noticeable. The programmes of informatic character will have more difficult position, because many public either private institution had been offering various courses and activities which were focused on acquiring computer skills by achieving of standard necessary for certificate ECDL. By the time this interest had declined. The Department of Informatics as a consequence of previously mentioned problem, decided to develop continual educational program which would increase basic computer knowledges of teachers. The concentration was focused mainly on those products which will support innovating teaching methods by using project teaching in daily practice of primary school teachers. The training activity Press enter accredited by the accredited commission by the end of the previous year. It is based on combined form of education with the e-learning support. It contains topics relating to the knowledges of orientation in virtual space and sphere of hardware and personal security and its extending. The attention is paid to children's safety using an internet space for various activities. The security knowledge or copyrights abusing have also connection with virtual space. One of the topics is also the creation of own web pages by normal way or with the help of models, patterns of various commercial or non-commercial institutions. Attractive and good quality presentation on own web site is not going without any knowledges from graphic sphere. The knowledges from multimedia are also closely connected with it. The knowledges of systems LMS sphere for teaching operation are the right orientation in scholarship market. 265

Information and communication technologies (ICT) have become a very important part of our everyday lives. Thus the ICT skills have become an essential need for everyone who wants to benefit from innovation of today's world. On the face of it, we can say that ICT play an important role especially in education. ICT can help to transformation of learning environment – it enable new ways of teaching and learning, it helps to constitute a shift from a teacher-centred pedagogy to a student's active learning and has changed much more aspects of traditional pedagogy. E-learning encompasses all forms of Technology-Enhanced Learning or Web-based learning including computer based learning, computer based training and computer-supported collaborative learning. E-learning is usually suited to distance learning but can also be used in conjunction with face-to-face teaching (blended learning). In higher education we can see the increasing tendency to work in virtual learning environment or multiuser virtual environment in which all study processes are handled through a consistent user interface. Various forms of e-learning provide benefits especially in the case of life long learning students. It is convenience and flexibility to learners first of all which means that learners are not bound to a specific time or place to physically attend classes. The Department of ICT education of the Centre for Lifelong Education (Faculty of Education, Palacky University in Olomouc) provides for last 4 years the life long courses for teachers focused on the use of ICT in education of different subjects (English language, Czech language etc.). Our courses are focused on development of basic ICT skills and its creative use in classroom. To help our learners develop ICT skills also in the area of e-learning activities, the courses have been realized as a blended learning which means the part of face-to-face teaching and study in the Learning Management System Unifor. On the base of our experiences from the courses since 2006 we can note that the majority of teachers usually come with basic ICT skills (which mean the work with MS Office software, work in Internet network (mail, chat, internet sources searching) or work with an education software). They are less skilled in the area of work with interactive whiteboard or using Web 2.0 tools (mostly it is a passive work with "wiki" tools or multimedia storages as YouTube etc.). The majority of the learners are not able to work with ICT in a creative way which means that they have created their first online blog or the first published webpage in our seminars. Therefore we find it beneficial to teach our learners how to work with ICT actively to be able to use the virtual environment in their own communication with their pupils (by creating online education objects or online school magazine etc.). E-learning in LMS also enables our teachers to develop their ICT skills by the use it within the educational process and help them to better understand the digital educational object structure.

Distance learning, owing to such advantages as flexibility, ease of access, modular character, quality, cost-effectiveness, state-of-the-art technology, large audiences, social balance, global reach, the new role of the teacher, positive effect on the learner, has become a leading mode of tuition and instructional technology practically at all levels of the education system. It is difficult to imagine today any contemporary university or department without a website. Moreover, it is getting more and more common for universities and individual

departments to operate distance learning platforms which implement various teaching, scientific and educational goals. This article examines various aspects of experience in the use of the distance learning platform of the Faculty of Ethnology and Sciences of Education (FESE) in Cieszyn (University of Silesia in Katowice) in teacher training and lifelong learning. Furthermore, the author discusses examples of good practice in comprehensive, systematic and effective use of the faculty distance learning platform, based on CLMS MOODLE system in order to: 1) provide pedagogical support for teaching programme courses, run in the full-time and part-time mode (hybrid learning), 2) assist teaching staff as well as graduate and post-graduate students in carrying out scientific research and pedagogical experiments, 3) train future and active teachers, post-graduate students, counsellors, teacher trainers, therapists, and others teachers in distance learning – to use e-learning in their own work and to act as tutors, 4) provide access to educational materials for students and other users; 5) foster international cooperation, in particular, through international projects.

E-Learning Supported Lifelong Learning: Leonardo Da Vinci Projects Innoskills and Faster _____ 285
Jiří Vacek, Dana Egerová

The paper briefly summarizes information on two projects of the Leonardo da Vinci programme – transfer of innovation, in which the UWB participates as the project partner. The project InnoSkills focuses on the growth of competencies of the SME staff in innovation management. The training is supported by the learning platform http://www.innoskills.net. Its main elements are: Innovation Guide, consisting of consisting of 12 chapters focused on different issues of the innovation management; the guide is implemented as online e-learning modules supported by multimedia elements. Innovation Rooms offering access to selected web based tools enabling collaboration and knowledge sharing. Resource Library containing additional material, web links, documents and articles linked to the chapters of the Innovation Guide. Guide to informal and cooperative learning. The main target groups are SME managers, consultants, students and researchers. Project partners are Treviso Tecnologia (Italy, coordinator), LiNK MV and Pro-competence (Germany), E-Learning concepts Rietsch KEG (Austria), Parkurbis (Portugal) and Firenze Tecnologia (Italy) The project FASTER focuses on ambitious, rapidly growing, knowledge-intensive entrepreneurs and companies (gazelles). At the UWB, the main target groups are nascent entrepreneurs – master and Ph.D. students. Other possible users are starting companies looking for best practices, examples, possibilities of financing, business planning, etc. It is based on the ISTUD Entrepreneurship Programme adapted to partner countries on the basis of the regional analysis of entrepreneurial milieu and training needs in partner countries. The training materials and other tools will be available at the project website http://www.fasterentrepreneurs.eu/. FASTER project fosters the cooperation among key actors involved in entrepreneurship promotion such as organizations providing learning opportunities, incubators, Technology Transfer Offices and early stage investors. The cooperation among the above mentioned actors is crucial for the success and effectiveness of the training programme, because it will give the opportunity to the would-be entrepreneur to build a network able to support him in the starting phase. Project partners are The West Pomeranian Business School (Poland – coordinator), ISTUD Foundation and RTD Talos (Italy), INNOSTART (Hungary) and META Group (Cyprus). The full paper includes more detailed information on the objectives and outputs of both projects, references to additional information and examples of the use of project platforms.

Distance Learning at Comprehensive School of Lithuania: the Need Analysis _____ 293
Rytis Vilkonis, Irina Barabanova

The vision of distance education in Lithuania is to secure affordable life-long learning based on the use of modern ICT for every citizen of Lithuania by expanding a distance teaching/learning network. (Development of Lithuanian Distance Learning Network.- Strategy, 2005). Distance Education (DE) in Lithuania is expanding quite rapidly. However until now it is more prevalent in universities. This is explained by a better technical base of universities (Matulionis, 2007). In 2009, a research on the need for distance learning services within the non-formal adult education framework showed that the distance learning opportunity would have the circle of its users in the given field of education as well (Vilkonis, Turskienė, 2009). A course of distance learning has also been prepared at one comprehensive school in Vilnius (Ozo school). It is used by children of emigrants who wish to continue their education in Lithuania. For example, in the academic year 2006-2007 there were 220 distance learning students from Lithuania, Norway, Ireland, England, Spain, Belgium, Georgia, the United States and Germany. The need for distance learning within a comprehensive education system has not been investigated in Lithuania so far although certain features and theoretical background suggests the existence of such a need. The research issue was expressed in the following questions: What is the current need for distance education services at a comprehensive school of Lithuania? What groups of students are interested in such an opportunity? Hence, the research was aimed at finding out the need for distance

learning at a comprehensive school of Lithuania as well as target groups of students. The research was based on qualitative research methodology. The underlying technique employed in the research was a Delphi method expert survey. The research took place in October-December 2009. 12 experts participated in the research. Employees from the education system and other institutions were selected as experts due to the nature of their professional activities, available information and sufficient competence on answering questions related to the needs of the students and the school. The findings showed that the need for distance learning was stimulated by students and the school needs. In conclusion, the following groups of distance students can be distinguished: children undergoing treatment for a long time (at home, in hospitals, health centres), students living abroad, prisoners, athletes spending a large proportion of the school year at sports camps, gifted students, students with special needs or special learning needs, students unable to attend school or to train together with other students for various reasons (including pregnant schoolgirls), students repeating the course, immigrants, working adult students and extra students in preparation for the final examinations. Schools lacking one or another specialist are also interested in the distance learning opportunity. It is a matter of great relevance in rural areas and remote regions. Distant teaching could be referred to certain modules for several schools simultaneously.

Keynote Lectures

Human versus Computer Intelligence in E-learning Process

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Keywords: ict, education, intelligent tutors, e-laboratories, artificial intelligence

Abstract: To highlight the differences between conventional educational systems and simulation/game based systems, it is useful to consider simulations, the class of system most closely related to games. In such system, the ultimate goal is to create a virtual duplicate of reality for analysis, training, experimentation, or other purposes. Simulating reality is an approach that may or may not be useful in creating experience. This distinction yield several consequences. In simulation, behavior (of, say, objects, tools, engines and peoples) should be as realistic as possible. In simulations, the representation of environment tends to be uniform and consistent, allowing the users to act freely within that environment. For application seeking to teach users through realistic experience, game design techniques can make the experience much more memorable. In a testbed environment, the context and control afforded by games design techniques allow integration of technologies and evaluation of the overall experience, even with partial implementation. Perhaps it's time to take the lessons of game design seriously. I will start my paper with one simple question - could the ideas, methodology and development methods that make computer and video games so successful as a compelling users experience also be applied to developing relatively serious-mind applications? At the next few pages I will try to answer this question.

Introduction

A wave of innovation is being stimulated by the Information Technology (IT) revolution that promises to revitalise our schools (Aberšek, 1996, 2005). Outcome-based teaching methods, electronic learning at a distance and collaborative group work are becoming popular phrases in today's progressive educational milieu. These changes are proving so effective that they signal the need for a major reconceptualization of the learning process. The goal of school system must focus on instilling that vital desire of "learning to learn" in today's students. To accomplish this, teachers must involve the student as an active, self-directed learner. Powerful new forms of IT are providing to create an information-rich learning environment in which students and teachers can explore and not only learn or teach. More than thirty studies have shown that this new approach improves learning over 50 percent compared to the traditional approach. Also from our research it is obviously that with computer tutoring system we have improved learning and get better knowledge (approx. from 20 to 40%, depend on type and generation of tutoring system) with our students.

How to solve the educational problems of young generations with technical and nature science knowledge? In this article I will hand out the concrete activities that will indicate solutions above for mentioned problems. Important is that we use methods which enable students to actively participate in educational process while acquiring skills necessary to function in tomorrow's world, especially tomorrow technological society. As I mentioned previous I will restrict my attention in this paper only on one of four pillars (according to figure 2) of educational system, namely only on the **educational environment**.

Tutoring Educational Systems

There is no denying the appeal of computer especially if it's connected with video games. Their magnetic effect on children's (and students too) attention is all too familiar to parents and teacher,

particularly when the alternatives are homework and household chores (Massey and Brown, 2005). Questions are:

1. *What is it about computer and games that make them so appealing?*
2. *What lessons might be learned from their construction that could be applied to other applications?*

Before we answer to these questions we must first answer to:
- how does human intellect work and/or how does human percept individual information,
- how are computers and video games build and at the end
- how must be advance learning environment build up?

In the main part of this paper I will try to explore these questions, offering several examples of how computer games ideas influence the architecture of systems not developed directly for entertainment (Aberšek, 2009).

For conventional software, design is usually driven by a **specification** of **set of requirements.** In game design, the driving force is the user's experience. Game designer try to **imagine** what players will experience as they work their way through the game, trying to deliver the most exciting and compelling experience possible (Langely, 2006).

Two key aspects of player's experience are the goals they pursue and the environment in which they pursue them. Game designer often seek to keep players engaged by creating three levels of goals:
- short-term, lasting perhaps seconds,
- medium-term, lasting minutes and
- long-term, lasting the length of the game.

A good story is not simply a sequence of things that happened but a carefully constructed tapestry in which events are juxtaposed and emotions peak and ebb. A good game is also highly interactive, deliberately generating tension between the degree of control the story imposes and the player's freedom of interaction. Two extremes are:

1. With no story and complete freedom of interaction players do what they want, but their experience can be boring.
2. On the other hand, if the story provides too much control, the experiences become more like watching a movie than playing a game. The secret of the solution is in balancing these two extremes. And this is also most important when we creating learning "game" environment. We must always live enough time and space for exploring!

The main goal of a game is entertainment*. But could be also learning pleasure? Could the same ideas be applied to application with more serious-minding goals?* (Jones and Beyron, 2007) We have identified two general classes of application that could benefit from a game-based design approach, namely:

1. The first we call **experience-based systems**. In game design, the main focus is the user's experience.
2. The second class involves using a game-based approach to **construct a testbed for emerging technologies**. A game world makes it possible to test emerging technologies in a comparatively rich environment before they are ready for the full-scale complexities of the real world. The game world can also provide an environment in which a number of technologies are integrated together while revealing interdependencies and emerging research issues.
3.

From Smart to Intelligent Self Learning Tutoring System – a Hasty Glance in the Future

Learning, knowledge and intelligence are closely related. Although there is no universally accepted definition of intelligence, it can be roughly defined as follows:

Intelligence is an ability to adapt to the environment and to solve problems.

Nowadays, most of the researchers agree that there is no intelligence without learning, so learning-adaptation takes place in almost all living beings, the most obvious in humans. Learning by a living system is called *natural learning*; if, however, the learner is a machine – a computer, it is called *machine learning*. The purpose of developing machine learning methods is, besides better understanding of natural learning and intelligence, to enable the algorithmic problem solving that requires specific knowledge. In order to solve problems we obviously need knowledge and the ability to use it. Often such knowledge is unknown or is used by a limited number of human experts. Under certain preconditions, by using machine learning algorithms we can efficiently generate such a knowledge which can be used to solve new problems.

Even the whole natural evolution can be regarded as learning: with genetic crossover, mutation and natural selection it creates better and better systems, capable to adapt to different environments. The principle of evolution can also be used in machine learning to guide the search in the hypothesis space through so called *genetic algorithms*.

Artificial Intelligence

A long term goal of machine learning research, which currently seems unreachable, is to create an artificial system that could through learning achieve or even surpass the human intelligence. A wider research area with the same ultimate goal is called artificial intelligence. Artificial intelligence (AI) research deals with the development of systems that act more or less intelligently and are able to solve relatively hard problems. These methods are often based on imitation of human problem solving. AI areas, besides machine learning, are knowledge representation, natural language understanding, automatic reasoning and theorem proving, logic programming, qualitative modelling, expert systems, game playing, heuristic problem solving, artificial senses, robotics and cognitive modelling.

In all AI areas machine learning algorithms play an essential role. Practically everywhere one has to include learning. By using learning techniques, the systems can learn and improve in perception, language understanding, reasoning and theorem proving, heuristic problem solving, and game playing. The area of logic programming is also highly related to inductive logic programming that aims to develop logic programs from examples of the target relation. Also in qualitative modelling the machine learning algorithms are used to generate descriptions of complex models from examples of the target system behaviour. For the development of an expert system one can use machine learning to generate the knowledge base from training examples of solved problems. Intelligent robots inevitably have to improve their procedures for problem solving through learning. Finally, cognitive modelling is practically impossible without taking into account learning algorithms.

Natural Learning

Humans learn throughout whole life. We learn practically every day, which means that our knowledge is changing, broadening and improving all the time. Besides humans, also animals learn. The ability to learn depends on the evaluative stage of species. Investigation and interpretation of natural learning is the domain of the psychology of learning and the educational psychology. The former investigates and analyses the principles and abilities of learning. On the other hand, the latter investigates the methods of human learning and education and aims at improving the results of educational process. Educational psychology considers attention, tiredness and motivation to be of

crucial importance for a successful educational process and carefully takes into account the relation between teacher and students, and suggests various motivation and rewarding strategies. All those are of great importance for human learning, however, much less important for the (contemporary) machine learning.

Learning, Intelligence, Consciousness

As we already stated, intelligence is defined as the ability to adapt to the environment and to solve problems. Learning alone, however, is not enough. In order to be able to learn, a system has to have some capacities, such as sufficient memory capacity, ability to reason (processor), ability to perceive (input and output) etc. These abilities do not suffice if they are not appropriately integrated or if they lack an appropriate learning algorithm. Besides, for efficient learning one needs also some initial knowledge – background knowledge, which is inherited in living systems. By learning the abilities of the system increase, therefore intelligence also increases (Dennett, 2005).

The Amount of Intelligence

The systems cannot be strictly ordered with respect to the amount of intelligence because we have to consider various types of intelligence (abilities): numerical, textual, semantically, pictorial, spatial, motor, memorial, perceptive, inductive, deductive etc. Lately, even emotional intelligence became widely recognized. Some authors describe more than one hundred types of human intelligence. A system (a human or a machine) can be better in some types of intelligence and worse in others and vice versa. When speaking about artificial intelligence we do not expect from an intelligent system to be extremely capable in only one narrow aspect of intelligence, such as for example the speed and the amount of memory, the speed of computation or the speed of searching the space or (almost optimal) game playing – nowadays computers in each of these aspects already have very advanced capabilities. We expect from an intelligent system to be (at least to some extent) intelligent in all areas which are characteristic of human problem solving. It seems that we need an integration of all different types of intelligence into a single sensible whole (a kind of supervisory system) so that during problem solving it is possible to switch appropriately between different types of intelligence. Anyway, most of the speculations about artificial intelligence do not take into account yet another level: consciousness (which seems to be a good candidate for the supervisory system).

Limits of Symbolic Computability

Theory of computability reveals that only a tiny (one could say a negligible) part of all problems, which can be formally described, can be algorithmically solved.

Nowadays the science uses the following formal symbolic languages for describing (modelling) reality:

- mathematical logic,
- programming languages,
- recursive functions, and
- formal grammars.

All these formalisms have equivalent expressive power and they all have equivalent limitations: they can partially describe the phenomena in the discrete world (discrete functions), and practically a negligible part of the continuous world (continuous functions). Therefore, if the world is indeed continuous, then most probably it is undescribable by any of formalisms which we are able to use with our (rational) mind. This would implicate that any knowledge that can be reached by science, described in books or by teachers, cannot be ultimate, as it is always only an approximation of the reality.

In all years from the very beginning of electronic computers we cannot notice any crucial progress towards the ultimate goal of creating an intelligent machine by using machine learning algorithms. Anyway, we can mention some important steps:

- Lenat's Automatic Mathematician - an interesting system for discovering new concepts in mathematics,
- great successes of computers in complex games, such as checkers, backgammon, and chess,
- artificial neural networks for modelling the cognitive processes in the brain,
- ACT-R, cognitive model of brain and brain function (Anderson, 2007)

But the principal limitations for programming languages and other formalisms, described above, that stem from the computability theory, hold also for any ML algorithm, no matter how advanced and complex it is. Very strict limitations are posed by the theory of learnability. The latter is derived from the computability theory – the machine learner is necessarily an algorithm. As it may be expected, all the limitations for computability hold also for learnability.

Possibility of Artificial Intelligence

Practically all research of artificial intelligence methods tries to develop systems that behave intelligently and are able to solve relatively hard problems. The developed methods are often based on imitating the human problem solving. The human mind is what emerges from the actions of number of largely independent cognitive modules integrated by central control system (Anderson, 2007). Figure 7 showed some approach for the organization of these information processing modules. To achieve the rapid processing required for functionality of the mind, different information-processing functions are computed as much as possible by different independent modules associated with different brain regions. However, the need for coordination requires a communication among these modules.

As a long-term goal we are interested whether computer intelligence (capability) can indeed achieve or even exceed the human intelligence. Important aspects for understanding the abilities of artificial intelligence are the impact of learning on intelligence, the speed of problem solving, the principal limitations of algorithms, and the imitation of intelligent behaviour.
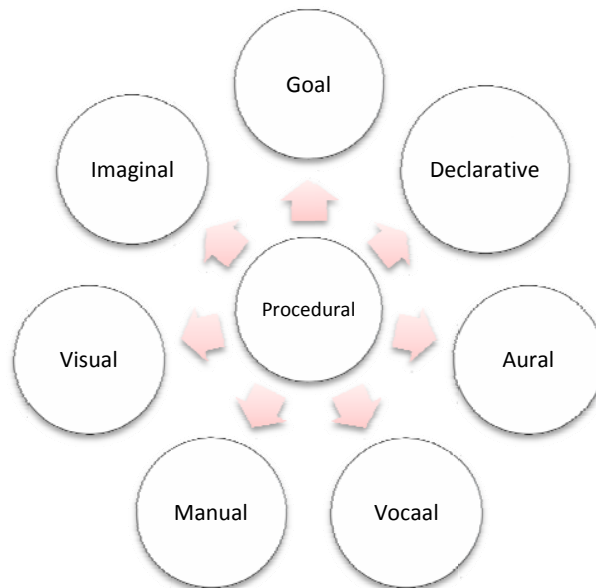
Figure 1: Modular architecture of human mind (Anderson, 2007)

Impact of learning on intelligence: By learning the capability of the system increases, therefore also its intelligence increases. Human intelligence is dynamic and is changing throughout the whole life, mostly increasing. However, when determining the amount of intelligence one has to take into account numerous different types of intelligences.

Faster is more intelligent: Adaptation to the environment and problem solving are better (more efficient) if they are faster. Therefore, intelligence is highly related to speed and time. All tests of intelligence are timed as are also all examinations. Therefore, we can conclude, in that sense, that faster computers are more intelligent than slower ones that parallel processing is more intelligent than serial one, etc.

Limitations of intelligence: If humans were equivalent (degradable) to a computer algorithm then all the limitations posed by the computability theory would hold also for humans - this would have strong impact on the abilities of human intelligence. If, however, we assume that humans are stronger "machines" than (digital) computers (for example continuous and not discrete machines) then the human activity is undescribable. The consequence of this assumption is that it is impossible to algorithmically derive an artificial intelligent system which would completely reproduce the human behaviour.

Imitating intelligent behaviour: Nowadays the technology of movies, multimedia, computers, robots, and virtual reality is very convincing and suggests that it is possible to imitate just everything and induce the sensation of reality.

Therefore, if we omit the consciousness, a machine can in principle be intelligent enough (for example by huge amount of memory, containing the solutions to all possible situations) to induce the sensation of artificial intelligence. If we add also extraordinary processing abilities (super parallelism with super-fast processors), algorithms for efficient search of huge spaces and machine learning algorithms that would enable online improvements of algorithms and heuristics, then such a machine could rightly be named "intelligent" - it could outperform the humans in many if not in all "practical" tasks. Of course, such a machine still lacks consciousness.

(Im)possibility of Artificial Consciousness

In principle, we are able to determine (detect or objectively measure) any system that has certain learning capabilities and that has a certain level of intelligence. Opposed to learning and intelligence, consciousness is much different. It is necessarily related to subjective experience and any objective observer has no means to verify it. Although nontrivial, it is objectively possible to determine the ability to learn, the amount of acquired knowledge, the ability to (intelligently) adapt to the environment and solve problems. Various tests of intelligence are able to measure only specific types of intelligence and the results are typically only partially reliable. On the other hand, in principle it is not possible to verify the consciousness of the system. Whether a (biological or artificial) system is conscious or not is known only to the system itself – in the case that it is conscious. An observer from outside has no way to verify it. You can speak about consciousness only if you yourself are conscious and if you assume that systems, similar to you, are also conscious. Any conscious system can be imitated with an unconscious system to arbitrary (but always incomplete) resemblance; therefore any objective observer can be fooled.

In the following we speculate about some interesting viewpoints. A system can be more or less intelligent but without consciousness (such as robot or in an extreme case a human zombie) or a system can be conscious but much less intelligent (such as less intelligent people, animals etc.). Consciousness seems to be fundamentally related to the following notions: *life, intelligence, and free will*.

Consciousness = life? Humans are conscious, dogs and cats are conscious (typical claims of pat owners), and even amoeba may be conscious to some extent. Nowadays science is still not able to explain the origin of life. By materialistic assumption life appeared by chance (which is highly improbable) or it is a result of the complexity and self organization of the matter. Another theory states that life came out of the space (amino acids on the meteors), but then we have to ask, where and how were those amino acids created. By vitalistic assumption, on the other hand, the life was created by a higher force - a universal consciousness.

Does more intelligence enable higher level of consciousness? Although consciousness is not objectively verifiable nor measurable we can speculate that with greater capabilities, i.e. greater intelligence, the higher level of consciousness can be achieved - we can assume that less developed species are less intelligent than more developed ones. Of course, you can have obvious

counterexamples: have a super intelligent system (for example a highly intelligent man) and remove consciousness (such as brain washing or simple blindness with his or her own ego), you can obtain a highly intelligent system (for example a fanatic or an extremely avaricious man for money or power) that is not conscious of his or her actions. If we paraphrase: a child (in the sense of lack of consciousness) is playing with a nuclear bomb. The consequences can be catastrophic.

Does consciousness implicate free will? If a system only reacts to outside stimuli then its responses are determined and unconscious. A conscious system can by itself, without any outside cause or stimulus, decide for an action (and not reaction) which means that it has free will. Various researchers and philosophers still argue whether free will exists at all, however, it seems sensible to assume that if consciousness exists then exists also free will.

Conclusion

Information technology, through networking, knowledge-based systems and artificial intelligence, interactive multimedia, and other technologies, play and will in future play even more an increasingly important role in the way that education is taught and delivered to the student.

For this reason we present in this paper some ideas of such learning-training environment for education. Like the researchers in other countries we tend to develop a user-friendly general system particularly for solving problems based on experience-based tutoring systems primary for executing better lessons and for students self learning.

Like all powerful tools, the experience-based design approaches must be applied carefully. Without a carefully designed experience and extensive testing, these systems could easily result in unwanted outcomes (such as negative training or increased phobia anxiety). Despite the promise of the early efforts, the best approaches to designing these experiences are still topics of research and debate.

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First Year Students` Experiences with Technology: The Case of Lithuania

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Abstract: The role of ICT in education in whole and particularly in science education is very important topic. It is worth emphasizing that in recent years, a general degree of integrating ICT in the process of teaching has increased in Lithuania as well as in other countries. It is accepted that ICT makes the process of teaching/learning more effective and beneficial whereas the education system starts functioning faster. The development of ICT and the process of globalization determine alteration in the education system as well as in the whole society. The implementation of new technologies in the educational process raises new possibilities for both teacher and learner, enhances education quality and makes the educational process more versatile. The research 'Student and Computer-Based Technologies' was conducted in January – March, 2010. Research sample consisted of 663 respondents who were 1st year university students (freshmen). To analyze research data, the measures of descriptive statistics (absolute and relative frequencies, popularity/usefulness/necessity indexes) have been applied. It has been stated, that respondents have practically unlimited opportunities to use mobile phone, computer, internet and e-data mini storage device - USB stick. Relatively new and rather expensive digital technologies are barely used. The most useful information communication technology for the first year students while studying is compute.

Introduction

Rapid growth of information communication technologies and their penetration into education process is inevitable. New innovative technologies are constantly being created. We can mention one of the newest technologies – Augmented Reality teaching/learning platform – having been created while implementing international science innovation project „ARiSE"(Augmented Reality in School Environments). 21st century requires from the teacher deeper understanding of the pupil's general ability and culture competence education. It is necessary to seek that the pupil could be able operatively react to rapid society changes, to be flexible, active, trying to improve and form an attitude that he will have to learn for the rest of his life. On the other hand, the amount of information is continuously growing. The need rises to use the newest ICT effectively. Using ICT gives many possibilities to make education process more picturesque, more interesting and more diverse. The same attitudes are valid in the university study process as well. It would seem that pupils nowadays are able to use information communication technologies rather well. However, we can notice that quite often a lot of difficulties arise both to students and teachers trying to effectively use ICT in the study process. Using ICT is very important for scientists and teachers because currently without using them or using insufficiently will not guarantee suitable standard of the studies. It is also obvious, that practically all ICT can be useful in the studies. The question is how to find optimal balance between the newest and classical technologies.

Researches carried out in various countries show that students' preparation level of using ICT is different. The research conducted in Australia shows that many first year students are highly tech-savvy (Kennedy, Judd, Churchward, Gray, Kerri-Lee Krause, 2008). However, the researchers state that when one moves beyond entrenched technologies and tools, the patterns of Access and use of a range of other technologies show considerable variation. The research carried out in Denmark, in which first year medical students participated, showed that significantly more males than females had access to a computer at home, and males had a more positive attitude towards the use of computers in their medical studies (Dørup, 2004).Similar results were received in Great Britain. The researchers stated that

students are receptive to new types of ICT in principle, although their level of familiarity and comfort with each application of technology varies (JISC research report, 2008). The researches are being carried out seeking to analyze the usage and effectiveness of very specific ICT in the study process. For example, it has been stated, that integration of educational technology such as wireless keypads are considered important elements in undergraduate health care students learning approaches. Williams, B., & Boyle, M. (2008) stated that students enjoy learning when using wireless keypads and that they offer an alternative and innovative pedagogical tool in providing better appreciation and understanding of other health care disciplines. Knowing the students' abilities in using ICT is important. As to researchers, by knowing the level of technological experience that students have when they arrive, university can utilize the most appropriate strategies, methods, and resources to help students (Arora, 2005; Frankowicz, 2008; Turčani, Kapusta, 2008; Lamanauskas, 2009). It is obvious that students need strong technology skills to succeed in the world of work. The main questions are still open:

- How does technology enhance student achievement?
- How to assess student progress in using ICT? or how to find the most appropriate   ways of assessing existing skills?
- How to effectively incorporate modern ICT into study process?

Hence, the object of research is the first year students` experiences with technology. The aim of the research is to analyze the first year students' experiences in using modern ICT.

Research Methodology

General Characteristics of Research

The research Student and Computer-Based Technologies was conducted in January – March, 2010. Before that a pilot research entitled Student and Computer-Based Technologies was conducted in October – November, 2009 (Lamanauskas, Šlekienė, Ragulienė, 2009).

The Applied Instrument

To collect the required data, an anonymous questionnaire including four main blocks was prepared. Questionnaire arranged by Australian researchers was used as a research instrument (Kennedy, Judd, Churchward, Gray, Kerri-Lee Krause, 2008). Questionnaire comprises four main blocks: demographic information (5 items), access to hardware and the Internet (13 items), use of abilities and skills with technology based tools (Computer: 11 items; Web: 18 items; Mobile phones: 8 items) and preferences for the use of technology based tools in University studies (19 items). Mentioned instrument was partially modified taking into account the study specifics of Lithuanian universities.

Research Sample

663 university studies' first year students participated in the research. From them – 469 Siauliai University, 82 – Vilnius pedagogical institute, 112 – Kaunas medical university students. According to sex 421 female (63.5%) took part in the research and 242 (36.5%) male. From them 295 (44.5%) respondents, city school graduates, 368 (55.5%) regional school graduates.

Table 1: Respondents' Characteristics (N/%).

According to sex	Female	Male	Total
	421/63,5	242/36,5	663/100
According to school graduation place	City school	Regional school	Total
	295/44,5	368/55,5	663/100
According to university	Siauliai university	Vilnius pedagogical university	Kaunas medical university
	469/70,7	82/12,4	112/16,9

Sampling was structured applying the stochastic method of group selection i.e., a consecutive 'bunch' system. Research sample is considered to be sufficiently reliable because of several reasons: sample contains students from three Lithuanian universities; all first year students graduated from secondary comprehensive schools in different places of Lithuania, therefore it is likely that they have varied experience in the field of using ICT.

Statistical data analysis

To analyze research data, the measures of descriptive statistics (absolute and relative frequencies, popularity/usefulness/necessity indexes) have been applied. Independent Samples Test – t-test for Equality of Means has been applied for comparing possible differences between features. The SSPS statistics batch is used as an instrument for data processing.

Results of Research

Respondents were asked what possibilities they have of using mobile phone, computer, camera, USB sticks, other technologies and the Internet (Table 2).

Table 2: Students about possibilities of using computer technologies (N/%, PI – Possibility index, 0 ≤ PI ≤ 1).

Your possibilities of using information computer technologies and internet		Unlimited	Limited	Have no access	PI
1.	Mobile phone	584/88.1	56/8.4	23/3.5	0.92
2.	Desktop computer	458/69.1	157/23.7	48/7.2	0.81
3.	'Laptop' computer	410/61.8	101/15.2	152/22.9	0.69
4.	'Palmtop' computer	38/5.7	62/9.4	563/84.9	0.10
5.	Digital camera	414/62.4	144/21.7	105/15.8	0.73
6.	Digital video camera	182/27.5	152/22.9	329/49.6	0.39
7.	Memory stick	571/86.1	52/7.8	40/6.0	0.90
8.	MP3 player	434/65.5	94/14.2	135/20.4	0.73
9.	iPod touch	64/9.7	74/11.2	525/79.2	0.15
10.	GPS navigator	74/11.2	128/19.3	461/69.5	0.21
11.	Portable library (eBook Reader)	22/3.3	72/10.9	569/85.8	0.09
12.	Games console	87/13.1	106/16.0	470/70.9	0.21
13. Internet	Broadband	376/56/7	63/9.5	224/33.8	0.61
	Dialup	234/35.3	120/18.1	309/46.6	0.44
	Wireless	260/39.2	94/14.2	309/46.6	0.46

94.6% of respondents have unlimited possibilities of using computer. In the questionnaire, three kinds of computers are distinguished: desktop computer, laptop computer and palmtop computer. The biggest possibility is of using desktop computer (possibility index PI = 0.81, standard deviation SD = 0.31), palmtop computer is used the least (PI = 0.10, SD = 0.26). This is one of the newest computer technologies, which is not very widely spread among our youth yet.

A statistically significant difference has been noticed between students having graduated from city and regional schools. Regional school students have bigger possibilities of using laptop computer (PI = 0.76), than city students (PI = 0.61). The null hypothesis about equal averages is rejected considering the level of significance which is $p < 0.001$; df = 661; t = - 4.64. We may assume that when acquiring a new computer, regional school students give preference to laptop computer.

Students, having unlimited possibilities of using computer, also widely use the most popular e- data mini storage device- USB stick (PI = 0.90, SD = 0.26). It seems to be an inseparable means of linking individual computers.

88.1% of respondents have unlimited possibilities of using a mobile phone. Possibility index of using a mobile phone is PI = 0.92, SD = 0.22 and only 3.5% do not have access to mobile phone. Digital camera is rather widely used as well (PI = 0.73, SD = 0.38). Digital video camera is already not so popular among students (PI = 0.39, SD = 0.42). Less than one third of respondents have unlimited possibilities of using digital video camera (182/27.5 %) and almost half of them have no access (329/49.6 %). GPS navigator (PI = 0.21, SD = 0, 34) and games console (PI = 0.21, SD = 0.36) have little popularity. iPod touch is little used (PI = 0.15, SD = 0.32) and eBook Reader is used very little (GI = 0.09, SD = 0.23). These are relatively new, rather expensive digital technologies that are not directly related with the studies. We could ascribe them to luxury or goods of specific interest. Statistics showed that respondents having e.g., iPod touch usually also have a GPS navigator (correlation coefficient r = 0.402), e-Book Reader (r = 0.447), digital video camera (r = 0.415), palm computer (r = 0.484). This is probably predetermined by family financial possibilities.

A statistically significant deviation was obtained which shows that students from the city (PI = 0.78) use MP3 players more than regional centre students do (PI = 0.68; p < 0.001; df = 661; t = - 3.01). Analysis in terms of sex showed that males (PI = 0.28) more than females (PI = 0.17) use games console (p < 0.001; df = 661; t = - 3.63) and GPS navigator: males - PI = 0.26, females - PI = 0, 18 (p < 0.005; df = 661; t = - 2.76).

92.3% of respondents have unlimited access to the internet. The biggest possibilities are of using broadband (cable) internet connection (PI = 0.61, SD = 0.46), and the least – dial-up connection (PI = 0.44, SD = 0.45), though dial-up connection is significantly more popular in regions than in cities. Statistically significant difference was established on possibilities of using dial-up (modem) internet between students having graduated from city and regional centre schools: regional - PI = 0.51, city - PI = 0.35 (p < 0.005; df = 661; t = - 2.76).

Questionnaire was made to find out how often and for what aims students are using computer (Table 3).

Table 3: Students about aims of using computer (N/%, UI – using index, 0 ≤ UI ≤ 1).

How often do you use computer for these aims	Every day	Once a week	Once a month	Less than once a month	Do not use it	UI
1.Use a computer for writing documents (e.g. using *Word*)	143/21.6	294/44.3	128/19.3	91/13.7	7/1.1	0.68
2.Use a computer for data processing (tables, graphics and so on.)	50/7.5	281/42.4	188/28.4	122/18.4	22/3.3	0.58
3. Use a computer for working with digital pictures/photos	130/19.6	232/35.0	157/23.7	108/16.3	36/5.4	0.62
4.Use a computer for creating web pages (e.g. using *Dreamweaver, Frontpage*)	21/3.2	25/5.3	27/4.1	59/8.9	521/78.6	0.11
5. Use a computer for creating multimedia presentations	28/4.2	149/22.5	292/44.0	173/26.1	21/3.2	0.50
6. Use a computer for creating editing audio and video (e.g. *iMovie*)	33/5.0	103/15.5	127/19.2	156/23.5	244/36.8	0.32
7. Use a computer for general study, without accessing the web	200/30.2	177/26.7	130/19.6	84/12.7	72/10.9	0.63
8. Use a computer to play digital music files (e.g. *iTunes*) without accessing the Internet	491/74.1	67/10.1	43/6.5	33/5.0	29/4.4	0.86
9. Use a computer to play games, without accessing the Internet /	133/20.1	136/20.5	78/11.8	94/14.2	222/33.5	0.45

web						
10. Use a games console to play games	56/8.4	59/8.9	55/8.3	46/6.9	447/67.4	0.21
11. Use a handheld computer (e.g. a PDA) as a personal organiser	50/7.5	64/9.7	52/7.8	57/8.6	440/66.4	0.21

Students state that most frequently, almost daily they use computer for Listening to music without accessing the Internet (UI = 0.86, SD = 0.27), nearly once a week – for Preparing/writing documents (UI = 0.68, SD = 0.25), for General study, without accessing the web (UI = 0.63, SD = 0.33), for Working with digital pictures/photos (UI = 0.62, SD = 0.28). We can see that computer became a daily necessity for students. It is intensively used to both studies and leisure time.

Very rarely computer is used for creation of web pages (UI = 0.11, SD = 0.25). Only 3.2% of students create web pages every day and 78.6% - do not create at all.

Statistically significant difference was not obtained between students having graduated from city and regional schools on possibilities of using computer. However, a statistically significant deviation was established in terms of sex. Male students more frequently use computer for Playing games using a games console: male - UI = 0.29, female - UI = 0.16 (p < 0.001; df = 661; t = - 4.74); for Playing games, without accessing the Internet: male - UI = 0.58, female - UI = 0.37 (p < 0.001; df = 661; t = - 6.69); for Creating and editing audio and video material: male - UI = 0.41, female - UI = 0.27 (p < 0.001; df = 661; t = - 5.59); for Creating web pages: male - UI = 0.19, female - UI = 0.07 (p < 0.001; df = 661; t = - 6.02). We can assert that boys are using more complicated computer functions than girls. Besides, considerable correlation link was obtained between respondents having a digital video camera and using computer for creating and editing audio and video material (r = 0.411). Thus, students, filming important events for themselves, usually are able to use special computer programmes, i.e., they create and edit films themselves.

Table 4 shows for what aims students are using a mobile phone.

Table 4: Students about aims of using a mobile phone (N/%, UI – using index, 0 ≤ UI ≤ 1).

How often do you use a mobile phone for these aims	Every day	Once a week	Once a month	Less than once a month	Do not use it	UI
1. Use a mobile phone to call people	531/80.1	86/13.0	16/2.4	27/4.1	3/0.5	0.92
2. Use a mobile phone to text/ SMS people	618/93.2	30/4.5	8/1.2	4/0.6	3/0.5	0.97
3. Use a mobile phone to take digital photos or movies	69/10.4	221/33.3	162/24.4	118/17.8	93/14.0	0.52
4. Use a mobile phone to send pictures or movies to other people	52/7.8	131/19.8	119/17.9	115/17.3	246/37.1	0.36
5. Use a mobile phone as a personal organiser (e.g. diary, address book)	77/11.6	115/17.4	83/12.5	78/11.8	310/46.8	0.34
6. Use a mobile phone to listen music, radio	213/32.1	143/21.6	84/12.7	90/13.6	133/20.1	0.58
7. Use a mobile phone to access information/ services on the web	99/14.9	94/14.2	65/9.8	108/16.3	297/44.8	0.35
8. Use a mobile phone to send or receive email	69/10.4	35/5.3	37/5.6	50/7.5	472/71/2	0.19

Students use basic functions of a mobile phone almost every day: sending SMS or MMS messages (UI = 0.97, SD = 0.11) and calling people (UI = 0.92, SD= 0.19). Besides, more than once a month the phone is

used to listen to music, radio (UI = 0.58, SD = 0.38), to take photos or movies (UI = 0.52, SD = 0.30), and the least it is used to send or receive email (UI = 0.19, SD = 0.34). Statistically significant deviation on possibilities of using a mobile phone was noticed only in terms of sex. Male students more often than female students are using special mobile phone functions: to Take photos or movies - UI = 0.58, UI = 0.49 (p < 0.001; df = 661; t = - 3.88); to Surf the net: male - UI = 0.44, UI = 0.29 (p < 0.001; df = 661; t = - 5.06); to Receive and send email: male - UI = 0.25, UI = 0.15 (p < 0.001; df = 661; t = - 3.68); to Listen to music, radio: male - UI = 0.63, UI = 0.55 (p < 0.01; df = 661; t = - 2.61).

Respondents were asked for what aims and how often they use the Internet (Table5).

Table5. Students about the aims of using the Internet (N/%, UI – using index, 0 ≤ UI ≤ 1).

How often do you use the Internet for these aims	Every day	Once a week	Once a month	Less than once a month	Do not use	UI
1. Use the web to access a school or university portal	173/26.1	294/44.3	95/14.3	89/13.4	12/1.8	0.70
2. Use the web to look up reference information for study purposes (e.g. online dictionaries)	353/53.2	194/29.3	49/7.4	54/8.1	13/2.0	0.81
3. Use the web to browse for general information (e.g. news, holidaying, event timetables)	515/77.7	101/15.2	18/2.7	26/3.9	3/0.5	0.91
4. Use the Internet/web or a LAN to play networked games	171/25.8	134/20.2	87/13.1	98/14.8	173/26.1	0.51
5. Use the web to listen to sound recordings (e.g. via streaming audio or *iTunes*)	445/67.1	106/16.0	42/6.3	42/6.3	28/4.2	0.84
6. Use the web for other pastimes (i.e. for leisure activities, movies)	226/34.1	194/29.3	107/16.1	92/13.9	44/6.6	0.68
7. Use the web to buy or sell things (e.g. *eBay, Amazon*, air tickets.)	40/6.0	70/10.6	97/14.6	123/18.6	333/50.2	0.26
8. Use the web for other services (e.g. banking, paying bills)	43/6.5	151/22.8	181/27.3	92/13.9	196/29.6	0.41
9. Use the web to send or receive email (e.g. *Hotmail, Yahoo, Outlook*)	457/68.9	116/17.5	23/3.5	51/7.7	16/2.4	0.86
10. Use the web for instant messaging/ chat (e.g. *MSN, Yahoo, ICQ*)	555/83.7	58/8.7	10/1.5	26/3.9	14/2.1	0.92
11. Use the web to build and maintain a website	16/2.4	32/4.8	36/5.4	56/8.4	523/78.9	0.11
12. Use the web to download MP3 files (e.g. music, videos, podcasts)	317/47.8	183/27.6	64/9.7	77/11.6	22/3.3	0.76
13. Use the web to download software	136/20.5	176/26.5	176/26.5	103/15.5	72/10.9	0.58
14. Use the web to share	145/21.9	183/12.6	170/25.6	98/14.8	67/10.1	0.59

photographs or other digital material (e.g. using *Blinklist, Flickr*)						
15. Use the web to make phone calls (e.g. VoIP using *Skype*)	145/21.9	110/16.6	88/13.3	86/13.0	234/35.3	0.44
16. Use the web for web conferencing (e.g. using a webcam)	69/10.4	100/15.1	91/13.7	117/17.6	286/43.1	0.33
17. Use the web to read RSS feeds (e.g. news feeds)	76/11.5	102/15.4	60/9.0	82/12.4	343/51.7	0.31
18. Use social networking software on the web (e.g. *MySpace, Trendster*)	183/27.6	111/16.7	104/15.7	105/15.8	160/24.1	0.52

Most frequently students use the Internet for communication (UI = 0.92, SD = 0.21), to browse for general information (UI = 0.91, SD = 0.19), for e-mail services (UI = 0.86, SD = 0.26), to listen to music (UI = 0.84, SD = 0.28), for studies (UI = 0.81, SD = 0.26). The most seldom computer is used for creation of websites (UI = 0.11, SD = 0.24), for buying/selling (UI = 0.26, SD = 0.32). 27.6% of respondents every day take part in social websites (UI = 0.52, SD = 0.39), and 24.1% do not use these websites at all. A similar situation is with the games on the internet (UI = 0.51, SD = 0.39): 25, 8% use the internet for games every day and 26.1% do not play on the internet at all.

A statistically significant difference was obtained between students having graduated from city and regional schools considering participation in social websites: city - UI = 0.575, regional - UI = 0.48 (p < 0.005; df = 661; t = 2.79). Statistical analysis showed that social websites are more popular in cities than in regions. Quite a few significant differences were noticed in the analysis concerning sex. Boys use the internet significantly more frequently than girls for these purposes: to Send various files (music, video, e-cards): males - UI = 0.82, females- UI = 0.73 (p < 0.001; df = 661; t = - 3.95), to Download necessary software: males - UI = 0.74, females - UI = 0.48 (p < 0.001; df = 661; t = - 10.72), to Watch films: males - UI = 0.77, females - UI = 0.62 (p < 0.001; df = 661; t = - 5.87), to Play games: males - UI = 0.66, females - UI = 0.43 (p < 0.001; df = 661; t = - 7.51), to Participate in conference calls/video conferencing: males- UI = 0.40, females - UI = 0.29 (p < 0.001; df = 661; t = - 3.89), to Buy/sell: males - UI = 0.38, females - UI = 0.19 (p < 0.001; df = 661; t = - 7.41), to Create websites: males - UI = 0.18, females - UI = 0.06 (p < 0.001; df = 661; t = - 6.25). We can see that both boys and girls use the internet mostly for communication, for search of information and for e-mail services. However, boys use the internet much more variably than girls do.

The aim was to find out if information communication technologies are necessary studying at university (Table 6).

Table 6: Students about the necessity of communication technologies for studies (N/%, NI – necessity index, 0 ≤ NI ≤ 1).

Do you need these information communication technologies while studying	Yes	Neither yes nor no	No	NI
1. A computer for general study	631/95.1	27/4.1	5/0.8	0.97
2. A computer to create documents (e.g. using *Word, Excel,* PDFs)	597/90.0	58/8.7	8/1.3	0.94
3. A computer to create web pages (e.g. using *Dreamweaver, Frontpage*)	100/15.1	152/22.9	411/62.0	0.27
4. A computer to create multimedia presentations (e.g. *PowerPoint, Director*)	537/81.0	107/16.1	19/2.9	0.89

5.	A handheld computer (e.g. a PDA) as a personal organiser (e.g. diary, address book)	51/7.7	123/18.6	489/73.7	0.17
6.	The web to access a learning portal (e.g. a 'Course' or 'Learning Management System')	481/72.5	126/19.1	56/8.4	0.82
7.	The web to look up or search for information (e.g. online dictionaries, *Google*)	612/92.3	36/5.4	612/92.3	0.95
8.	The web for other services (e.g. enrolment, sign up for tutes, paying fees)	315/47.5	175/26.4	173/26.1	0.61
9.	The web for instant messaging/ chat (e.g. *MSN, Yahoo, ICQ*)	545/82.2	78/11.8	40/6.0	0.88
10.	The web to build and maintain a website	78/11.8	128/19.3	457/68.9	0.21
11.	Social networking software on the web (e.g. *MySpace, Trendster*)	252/38.0	239/36.0	172/26.0	0.56
12.	The web to download MP3 files (e.g. podcasts, *iTunes*)	567/85.5	66/10.0	30/4.5	0.91
13.	The web to download software	474/71.5	129/19.5	60/9.0	0.81
14.	The web for web conferencing (e.g. using a webcam)	181/27.3	239/36.0	243/36.7	0.45
15.	The web to read RSS feeds (e.g. news feeds)	161/24.3	186/28.0	316/47.7	0.38
16.	A mobile phone to send or receive text messages/ SMSs	517/78.0	72/10.9	74/11.2	0.83
17.	A mobile phone to send or receive email	173/26.1	138/20.8	352/53.1	0.37
18.	A mobile phone as a personal organiser	141/21.2	188/28.4	334/50.4	0.35
19.	A mobile phone to access web based information or services	149/22.5	181/27.3	333/50.2	0.36

The most needful information communication technology for the first year students is computer. Most of all it is necessary for general studies (NI = 0.97, SD = 0.13), to create documents (RI = 0.94, SD = 0.18), to make presentations (NI = 0.89, SD = 0.24). While studying the internet is the most needful for information search (NI = 0.95, SD = 0.18), to download various files (NI = 0.91, SD = 0.25), to talk/communicate (NI = 0.88, SD = 0.26), to download necessary software (NI = 0.81, SD = 0.32). According to respondents, palmtop computer is little necessary for studies to organise personal schedule (NI = 0.17, SD = 0.31) and mobile phone for organising personal schedule (NI = 0.35, SD = 0.40). Few respondents require computer to create websites (NI = 0.27, SD = 0.37), and the internet to create websites (RI = 0.21, SD = 0.35). Such results were expected because the great majority of respondents are studying social sciences.

Statistically significant difference was not noticed concerning the necessity of communication technologies for studies between students having graduated from city and regional schools. Analysis considering sex showed that information communication technologies in some aspects are more necessary for boys: Internet for downloading necessary software; male - NI = 0.87, female - NI = 0.78 (p < 0.001; df = 661; t = - 3.39), Mobile phone for searching the net: male - NI = 0.45, female - NI = 0.31 (p < 0.001; df = 661; t = - 4.37), Computer for creation of websites: male - NI = 0.38, female - NI = 0.20 (p < 0.001; df = 661; t = - 5.96), Internet for creation of websites: male - NI = 0.31, female - NI = 0.16 (p < 0.001; df = 661; t = - 5.76).

Conclusion

Having generalized the results of the research Student and information communication technologies, we can assert that:

- Respondents have practically unlimited possibilities to use a mobile phone,   computer, internet and e- data mini storage device - USB stick.

- Relatively new and very expensive digital technologies, such as iPod touch, eBook Reader, palmtop computer, GPS navigator and other are still little used.
- Respondents, having, for example, iPod touch, most frequently have GPS navigator, eBook Reader, digital video camera, palmtop computer. This might be predetermined by family financial possibilities.
- Computer became everyday necessity for students. It is intensively used both for studies and for leisure time. Boys use more complicated computer functions than girls.
- Almost every day students are using basic mobile phone functions (SMS texting and calling people). Special mobile phone functions (listen to music, radio, take photos or record videos, receive and send e-mail) boys use more often than girls do.
- Respondents usually use the internet for communication, information search and for e-mail services. Boys use the internet much more variably than girls do.
- The most needful information communication technology while studying for the first year students is computer. It is the most needful for general study needs, to create documents, to make presentations and so on.

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E-Portfolio as the Adaptive E-Learning Tool

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Abstract: Intergenerational Portfolio Management (IPM) is a process for the development of an e-portfolio of knowledge, skills and competencies produced in partnerships between more experienced and less experienced workers, this often implies older and younger workers. IPM adds a new dimension and provides a unique setting to explore individual strengths and weaknesses, together with values, attitudes, and broad experiences that all play a part in how employees view and carry out their jobs. IPM enables to consider all the issues that the employees think are important in enjoying their job and doing it well. This could include the broader range of skills and experiences, the work itself and the systems and context of the workplace. During the IPM learning process, employees may discover that there are some tasks that they could do better or some tasks that could be changed to make them more effective at work or make the job more satisfying for them.. The IPM e-portfolio will provide a good basis for discussion between an individual employee and his/her manager about plans for future training and development.

Introduction

Intergenerational Portfolio Management

Intergenerational Portfolio Management (IPM) is a process for the development of a portfolio of knowledge, skills and competencies produced in partnerships between more experienced and less experienced workers, this often implies older and younger workers. The focus of this European funded Leonardo da Vinci pilot project is nurses and health care assistants working in Health Services in Austria, Czech Republic, Greece, the UK and the Netherlands.

A New Dimension

Most health professionals in Europe have a competency framework which sets out the key professional knowledge, skills and understanding which enables health care workers to fulfill the requirements of their job. There are also appraisal systems when an individual's performance, future training and development needs are discussed with their manager. IPM recognizes there is more to doing a job well than professional competence and recognizes the importance of personal skills and qualities.

IPM adds a new dimension and provides a unique setting to explore individual strengths and weaknesses, together with values, attitudes, and broad experiences that all play a part in how nurses view and carry out their jobs. It offers nurses, in a safe environment, the opportunity to discuss issues with a colleague, who will have different values and experiences of life

IPM enables them to consider all the issues that they think are important in enjoying their job and doing it well. This could include the broader range of skills and experiences, the work itself and the systems and context of the workplace.

As a result of these discussions and learning, nurses will construct a personal portfolio that sets out what is important to them. It is not simply a factual history of training and work experience. The portfolio

will enable the nurse to portray his or her self as a 'whole' person and will contain all the information that they think is important in allowing them to enjoy and do their job well.

During the IPM learning process, nurses may discover that there are some tasks that they could do better or some tasks that could be changed to make them more effective at work or make the job more satisfying for them.. The IPM portfolio will provide a good basis for discussion between an individual nurse and his/her manager about plans for future training and development

Effects and Effectiveness

The pilots showed that there were important aspects for decision makers to consider before initiating the IPM process: the benefits for the organization and the costs in terms of staff time. However, responses to these questions depend on the context. In some settings where evaluation and mutual feedback is not common, IPM functioned primarily as a tool to initiate communication. In other situations where competence development is a more common practice, IPM really contributed to human resource management (HRM) development strategy.

This means that IPM is a flexible process and can be used in different situations and contexts. Therefore it is important to initially identify clear objectives for each situation thereby adding value to existing processes and creating realistic expectations.

In terms of effectiveness, IPM can initiate communication among nurses and between nurses and their managers – simultaneously it stimulates an organization debate about performance appraisal, human resource management (HRM) and competence development. Working on portfolios is a very practical activity which stimulates discussions about knowledge, skills and attitudes – and also about self image and the ways in which people view on another. Do we really want to share who and what we are? Or are we afraid of criticism or other consequences? Here we encountered a difficulty with nurses not wanting to share their portfolios in organizations and were concerned about confidentiality. For IPM to be most successful it is important to have a developmental HRM policy. The value of e-portfolios still needs to be further explored. Although it is more and more common that the computer plays also an important role in nursing as profession, this does not mean that nurses self evidentially have good computer skills and feel able to work with ICT-tools. Sharing private data via internet is still perceived as a threat,

A preliminary conclusion might be that IPM is helpful in many respects for the organization, but it needs more additional support to enjoy the benefits of sharing e-portfolios within an online competence management system. The effects might be the strongest when IPM is seen as part of process of cultural change in the organization towards a more open and sharing community. For such a process it is important to involve not only the nurses but also other hospital or care home staff such as doctors, technical staff and porters..

What Are the Potential Costs

Depending on the situation the costs can be low, because IPM can form part of the total staff development activity of HRM. The most important success factor for IPM is the availability of time. A well structured process of implementation and support is crucial and takes time. The minimum needed is three to four preparation and exchange meetings (2 – 3 hours) in a half year and each nurse needs 2- 3 hours monthly for duo-interviews and creating and updating the portfolio. Further management time is needed to establish the duos and creating the right matches The more clearly one defines what one expects from the duos and IPM the easier it is to be effective.

What Are the Benefits for the Organization

The benefits for the organization can be identified on different levels starting with the nurse and care assistants themselves – but also for the nurse coordinators, the line managers, heads of department

and the HR coordinators. Finally there are also benefits for the organization in general and for patients' care.

Benefits for Nurses and Health Care Assistants

- increased job satisfaction,
- greater skill sharing in the work environment,
- recognition and valuing of individual skills,
- learning to listen carefully to others,
- feeling more in contact with one another,
- strengthening team working,
- gaining feedback from other's experience,
- identifying individual strengths and weaknesses,
- creating a more harmonious working environment,
- creating opportunities to identify training needs,
- supporting career planning adapted to longer working lives.

Benefits for Managers, Senior Nurses and HR Coordinators

- promotes of exchange and sharing of information
- identifies training needs for nurses and care assistants
- generates ideas for ongoing service improvement through a participatory process
- improves team working, communication and sharing of skills thus developing a more cohesive workforce
- encourages communication between partners which continues in the workplace
- promotes a good working environment
- promotes sharing of experience and know-how
- motives the staff to work better and to feel useful and valued.
- creates a better understanding of the special skills and qualities of the members of the staff
- increases communication with the staff
- raises awareness of informal evaluation techniques
- develops a motivated, high performing workforce
- implements strategies in workforce planning and retention of nurses
- implements strategies for supporting nurses in adapting to longer working lives
- introduces a system to support the development of the workforce complementary to the formal appraisal system

Benefits to the hospitals and care homes

- promotes cooperation between the staff members
- creates a better image of the management team,
- provides a method to overcome "burnout" of staff.
- staff felt "flattered" and valued by participating in the project
- enables improved knowledge of skills and abilities of staff identifies the training needs of nurses and health care assistants.
- improves the working environment and thus has a direct impact on patient care.

IPM as Process of Cultural Change Options and Perspectives

Why starting with IPM?

Originally we have introduced IPM as a human resource instrument to encourage older nurses and retain them in the hospital setting, using and capitalizing on their rich experience. As a result of piloting we have learned that there are other ways to introduce IPM and to emphasize the general benefits of nurses and health care assistants working together.

We describe IPM as a process for the development of a portfolio of knowledge, skills and competencies produced in the partnership between more experienced and less experienced, often older and younger workers. The first question should be what do you think would be the benefits of IPM for your organization. The answers might be different, but they can help you to identify how and what IPM really can contribute to your organizational aims and objectives. Maybe you would like to create more equal balance in age and experience in your organization. Or you want to avoid 'burnout' of more experienced nurses. Maybe you first of all want to improve communication between workers of different ages and backgrounds. Or you may want to improve your human resource management systems. Or you may want to initiate the process of performance appraisal by working with portfolios. Or you may want to implement the use of e-portfolios. These are all good reasons to use IPM as an instrument in your organization.. However in all cases introduction and implementation of IPM could be part of a process of cultural change in your organization.

Policy and practice

We also experienced that there is sometimes a gap between organizational policy and day to day practice. In European, policies of employers in health services, often are require a patient centered approach, with high quality of care, provided by an age – positive approach to human resource management.

Currently there are constraints and challenges for health systems including: funding, privatization, quality of management; poor salaries (especially those lower in the hierarchy), poor communication, and top heavy management systems.

In this context IPM relates to both policy and practice levels. IPM could be the ideal tool in daily practice and at a policy level. IPM can be tailor made to address the problems and challenges in institutions.

What is your approach?

Broadly, there are two main challenges to work towards:

- Perfection approach: where we do the best we can from an HRM perspective and therefore consider how IPM can provide added value
- Improvement approach: where we aim at improvement and are a developmental organization and want to know what IPM can offer support for this.

Perfection approach

If your organization adopts the perfection approach how can IPM be effectively integrated into current instruments and measures. If the organization already works with portfolios, the format of the e-portfolio should be made similar to that already in use. If the organization uses a competence model, the elements of this model should be used in the e-portfolio. If the organization already has a mentorship program this should be harmonized with the partnership pairs of IPM. Secondly we need to check if IPM is in conflicts with other processes or experiences, in your organization. For example, previous negative

experiences with mentorship may inhibit the effective implementation of IPM. Consideration would need to be given to solving these problems in advance. Through careful analysis of the start situation, a tailor made IPM process can be designed and developed to improve your organization and make it more effective. Different implementation models for the IPM process can be developed depending on the priorities of the organization:

- If age is a criterion, - then intergenerational pairs can be established
- If the focus is more on communication – then pairs should focus more on sharing experiences and   exploring strengths and weaknesses.
- If broader equality issues, like ethnic, cultural backgrounds, and gender, are important, - then a pairing process that brings these individuals together can be applied
- If the emphasis is on competence development model, portfolio design and creating e-portfolios – then the IPM can be used to test the existing competence model and developing the e-portfolio
- If emphasis is on personal development plans and identifying learning needs – then the IPM process will be based on outcomes of the paired work which focuses on skills and competences and further training which is identified.
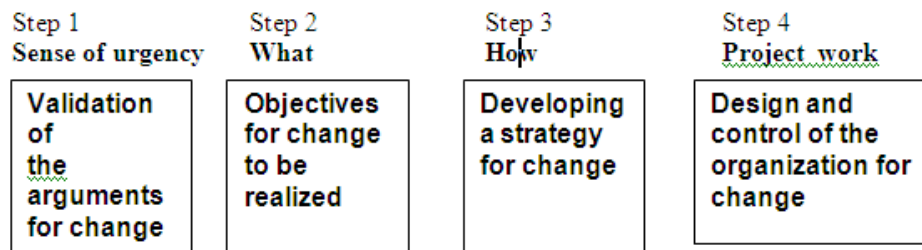
Improvement approach

If your organization identifies itself more as the improvement approach it is necessary to identify what your organization wants to change   IPM can play a crucial role in this organizational change. IPM can be used in several situations:

- improvement of communication
- improvement of corporate image
- improvement of HRM processes
- implementation of portfolio development
- implementation of competence model
- implementation of e-learning environment
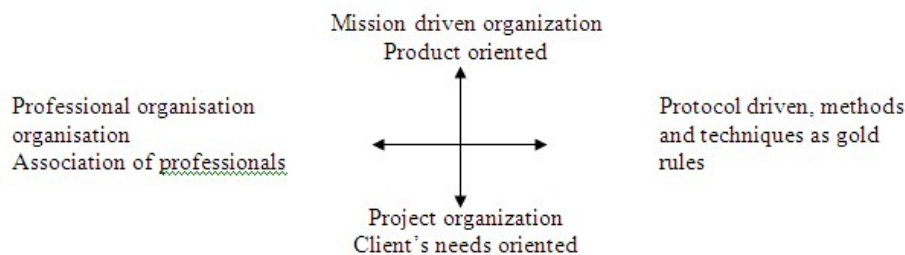- implementation of personal development plans

However, to improve your organization it is recommended to establish a change development plan and strategy. Then identify how IPM can be part of this strategy. IPM will be effective within the wider strategy which you have developed to realize changes in the organization, it is not in itself the instrument for change.

Change management

Organizational change has both content and process dimensions. It is one approach, for instance, to introduce IPM in a functionally organized health service. It is quite another to introduce IPM in a health insurer which is organized along product lines and market segments. It is quite different to introduce a system into an educational establishment that relies on a matrix structure. The 'languages' spoken and the approaches differ. The values differ. The cultures differ. Also, at a detailed level, the problems differ. However, the overall processes of change and change management remain pretty much the same, and it is this fundamental similarity of the change processes across organizations, industries, and structures that makes change management a task, a process, and an area of professional practice. A generic approach of change management is:

Step 1 **Sense of urgency**	Step 2 **What**	Step 3 **How**	Step 4 **Project work**
Validation of the arguments for change	**Objectives for change to be realized**	**Developing a strategy for change**	**Design and control of the organization for change**

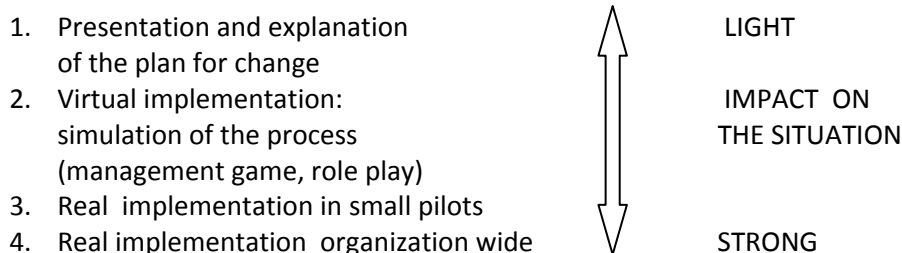Each of these steps is critical. However, in the pilots some of these steps have not been fully developed.. If you want to use IPM for a process of change in your organization we recommend consideration of: What do you want to change? How do you want to approach it? Before starting the process of change, consider carefully what kind of organization do we want to be:

Mission driven organization
Product oriented

Professional organisation
organisation
Association of professionals

Protocol driven, methods
and techniques as gold
rules

Project organization
Client's needs oriented

Protocol or mission driven organizations, like the Czech and the Dutch pilot hospitals, are the most difficult. The effect of IPM depends on the way it can and is embedded in daily practices in your organization. Client centered and result oriented organizations, like in UK and Austria, seem to be more successful here. Also for organizations which are already involved in transformation processes, like the Greek nursing homes, it can be easier to make IPM part of the transformation. When the process of change has been identified, it can be helpful to consider the how to go from A (start situation) to B (final situation):

	B Final Situation	
	Clear!	Not clear (?)
Clear (!)	! > ! The analytical organization	! > ? The exploring organization
Not clear (?)	? > ! Mission driven organization	? > ? Chaotic organization

difficult categories better to avoid!

A Start Situation
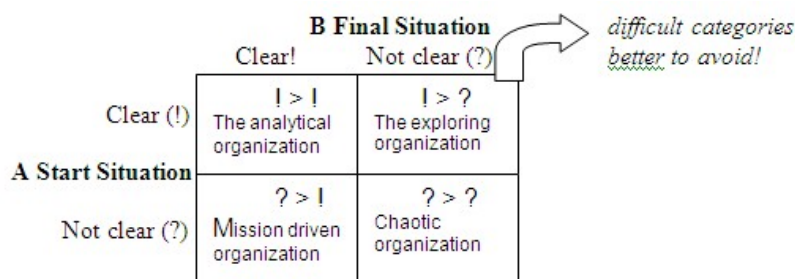
The realization of the plan for change –input which change the situation need to be implemented based on the desired impact on the organization. For a greater impact it is necessary to link the introduction of IPM to the whole organizational aims including a positive HRM approach and the process of transfer of knowledge within the organization:

1. Presentation and explanation of the plan for change
2. Virtual implementation: simulation of the process (management game, role play)
3. Real implementation in small pilots
4. Real implementation organization wide

LIGHT

IMPACT ON
THE SITUATION

STRONG

Consider the main factors that can create solutions for resistance for successful change:

- The senior staff should be committed and engaged
- The senior staff should make choices (and not too late) for possible alternative forms of implementation
- There needs to be commitment and clarity about the current and requested image of the organization
- The organization needs enough time for the process of change, there should be time for consolidation
- The power of the change agents needs to correspond with the level of responsibility
- Power games, political behavior, competition and territorial operating should be avoided: things should be done as agreed.
- People needs to be motivated to learn, for personal and professional development: conservatism, maintain what they currently posses, hang on to existing routines should be tackled and avoided
- There should be a need for a collective ambition – a need for shared values
- Anything else: ……….

Who knows his enemy, knows how to combat him…..

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Individual Learning Styles and E-Learning

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Keywords: elearning, ict, lci, learning combination inventory, learning management system, learning pattern, learning style, lms, teaching style, virtual learning environment

Abstract: The effectiveness of the educational process is given by such factors as learner's intelligence, prior knowledge, level of motivation, stress, self-confidence, and learner's cognitive and learning style. The process of instruction supported by ICT is considered suitable and beneficial for learners of all styles. The reason is it offers a wide range of activities which can be aimed at any learning style and used by any teaching style instructor. The possibility of individualization of the educational process from the both students´ and teachers´ point of view is the greatest advantage.

Introduction

Large experience gained in the process of ICT implementation in education received lately has started new discussions on the theory of learning and teaching styles. They play an important role in the process of instruction, especially if it is managed by a Learning Management System. (Šimonová, 2008)

A wide range of tools is available to authors of eLearning courses which can accommodate all learning styles, and students choose those activities which suit them best.

Although interactive multimedia tools offer numerous advantages, there exist several conflicting ideas concerning practical application of learning styles. (Mareš, 1998) The effectiveness of the educational process is given by many factors, e.g. learner's intelligence, level of knowledge, motivation, self-confidence, and learner's cognitive and learning style. Teacher's teaching style and the matches/mismatches with students´ learning styles influence the efficiency of the educational process to a large extent. Some authors (Felder and Silverman, 1998) say (instead others) that mismatching can cause further educational problems. It favours certain students and discriminates others, especially if the mismatches are extreme. On the other hand, if the same teaching style is used repeatedly, students become bored. (Gregorc, 1979)

The process of instruction supported by ICT may become suitable and beneficial for learners of various styles. The reason is it offers a wide range of tools and activities which can be tailored to any learning style and used by any teaching style instructor. The possibility to individualize the educational process from the both students´ and teachers´ point of view belongs to valuable advantages of eLearning. (Šimonová et al., 2009)

A Flexible Model of the ICT Supported Educational Process Reflecting Individual Learning Styles

New possibilities offered by modern technologies produce new questions. Numerous educators face the problem whether the educational process which is supported or managed by ICT and tailored to the preferred student´s learning style is more efficient than if the learning style in not taken into account.

Answer to this question is been discovered within the project "A flexible model of the ICT supported educational process reflecting individual learning styles". The project is currently solved by a joint team of researchers from the Faculty of Informatics and Management and Faculty of Education, University of Hradec Králové.

The main objective of the project is to find out whether using ICT-supported methods of instruction which reflect individual learning styles results in significantly higher level of students´ knowledge in

comparison to the traditional, majority (i.e. non-individualized) way of instruction. The main evaluative criteria are the quality, meaningfulness, effectiveness and limits of ICT/LMS implementation in the instructional process considering individual learning styles, and present proposals to its optimal contribution and extent. (Poulová, 2009)

Learning Combination Inventory

The project proceeds from the assumption that it is important for a student to be aware of his/her learning style, know what his/her strengths and weaknesses are and be provided a variety of instructional methods to choose the most suitable ones.

There exists a wide range of tools to define individual learning styles, both national and international. The research team has decided to use the "Learning Combination Inventory" (LCI) by Christine A. Johnston. Johnston created her model on the principle of "unlocking the will to learn". It emphasizes not the product of learning, but the process of learning, and focuses on how to unlock and what unlocks the learner's motivation and ability to learn, i.e. she tends to discover ways to achieving learner´s optimum intellectual development. (Johnston, 2006) Johnston's professional life has spanned three decades of teaching and researching focused on nurturing of real schools, real students and real educators, paying attention to effective communication and a clear understanding of the student-centred learning process.

LCI is a statistically valid and reliable instrument that measures the degree to which a person uses four interactive patterns of learning and operation. Johnston distinguishes four basic patterns:

- Sequential Processor;
- Precise Processor;
- Technical Processor;
- Confluent Processor.

Each of them participates in the individual´s process of learning to some extent, while some of them are preferred, others rejected.

Unlike other similar tools the LCI is easily and clearly evaluated. It consists of 28 closed questions supported by three open ones, which serve for verifying the determined patterns.

These were the most cogent arguments in the decision-making process which tool suits best to the project purposes.

Hence the main objective of project "A flexible model of the ICT supported educational process reflecting individual learning styles" is to adapt LCI to the conditions of Czech university education and run an experiment to find out whether using methods of instruction reflecting individual learning styles result in improving students´ knowledge significantly.

The Questionnaire Monitoring Preferred Formats of Study Materials

The project started with a pre-activity which aimed at detecting whether student´s choice of a certain type of study materials and tools is influenced by the detected pattern. A simple questionnaire consisting of nine questions was prepared for this purpose in which students defined their relation to following types of study materials:

- books and professional literature;
- electronic study texts;
- presentations;
- video-recorded lectures;
- animations;
- selftests;
- hands-on tasks and examples
- other supportive materials, e.g. dictionary.

Students were asked to define what type of study materials they prefer when preparing for lessons during the term and studying for exams. Single items were in the form of statements and evaluated by a five-degree scale, e.g. question N. 4:

4. *If there exists a full eLearning support for the subject containing PowerPoint presentations, I used them:*

1	2	3	4	5
never	*hardly any time*	*sometimes*	*almost always*	*always*

Examples of all types of study materials were provided so that no misunderstandings may appear. The questionnaire was distributed during the summer term in 2009/10 academic year to 107 students of the Faculty of Informatics and Management, University of Hradec Králové, in study programmes Applied Informatics and Information management, who also filled in the LCI. So consequently mutual relations can be researched among single patterns and preferred types of study materials.

The Received Results Proved Some Expectations

Today´s students, mainly those of technical specializations, seldom work with printed sources. Only 1% of students almost always buy the recommended books, one third (33 %) does this sometimes and two thirds (66 %) do not buy books at all. This fact could be influenced by the price. Nevertheless, similar results appeared in question dealing with borrowing printed sources which are available in university library. Only 7% of students borrow books regularly, half of them (48 %) do this sometimes and 45 % never or hardly any time borrow the recommended books. (see Figure 1)
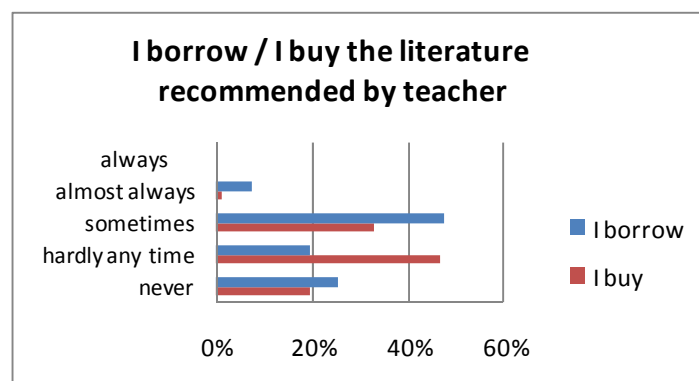

Figure 1: The use of printed books.

The results show the students prefer work with electronic materials if they are provided by the teacher in LMS, which is not surprising because students participating in the research were of Informatics study programme.

Nearly all students (93 %) always and almost always use presentations of the topics, 5 % use them sometimes and only 2 % of students never use the presentations. Vast majority of students (87 %) always and almost always works with electronic study texts, 10 % use them sometimes, 2 % hardly any time and only 1 % never uses electronic study texts. Other types of study materials (e.g. dictionary) are used in a considerably little extent. 42 % of students always and almost always use them, another 41 % sometimes, 17 % of students say they never and hardly any time work with other types of study materials. (see Figure 2)
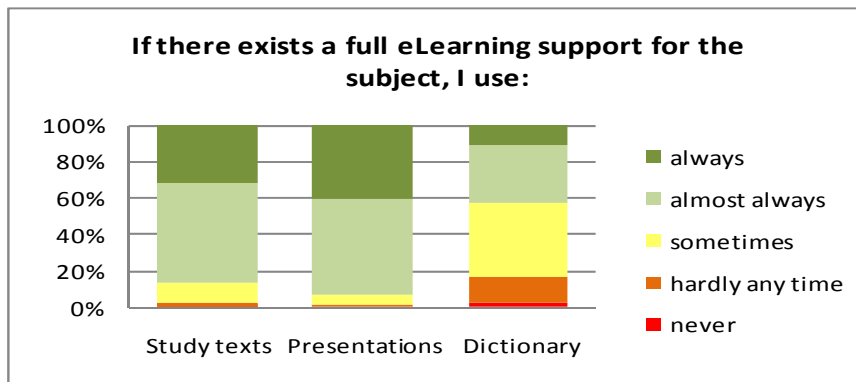
Figure 2: The use of electronic study texts, presentations and other supportive materials.

In some eLearning courses animations, video-recorded lectures or case studies are available which make some difficult parts of learning content easier to understand. These materials are used less than presentations or study texts. Animations are more frequently used; more than half of students always and almost always uses them (53 %) if they are available, one third of students (34 %) sometimes and only 13 % never and hardly any time work with them. Video-recordings, which are more demanding to be prepared and can be found only in selected eLearning courses, are less popular among students. More than one third of students (38 %) never and hardly any time uses them, one third (33 %) sometimes and even fewer students (29 %) always and almost always work with them if they are available. (see Figure 3)
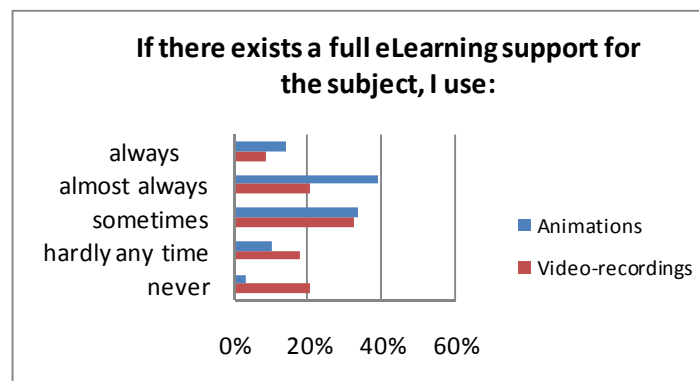
Figure 3: The use of animations and video-recorded lectures.

Designers of eLearning courses include various feedback-providing tools, such as selftests and numerous hands-on examples or tasks. Although these are to help students understand the problem, they are used less frequently than study texts and presentations. More than two thirds of students (68 %) always and almost always use the provided examples, 28 % sometimes and 4 % never work with them. Selftests are even less used. More than one fourth never and hardly any time uses them, 39 % sometimes and only fewer than one third (31 %) always and almost always work with them. (see Figure 4)
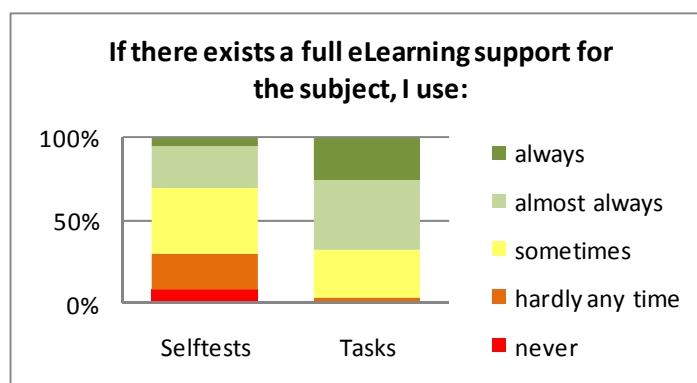
Figure 4: The use of selftests and hands-on tasks.

Conclusions

University education, which has been changing under the influence of latest technology development, can be researched from various, different points of view. Currently it is obvious that education supported by ICT enables easier and more complex realization of the instructional process, it offers choice of place, time and pace for studying. At the same time the ICT-supported education allows an individual approach to students preferring various learning styles. These are the key values important for the effectiveness of the process. The main objective of the project "A flexible model of the ICT supported educational process reflecting individual learning styles" is to contribute to this process.(Šimonová and Bílek, 2010) In following phases of the research the team is going to pay attention to discovering relations between the preferring/rejecting single patterns and liking for certain types of study materials.

Acknowledgement

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Track 1 – New Technologies for E-Learning

The Use of Simulation Game in Education Process and Its Interconnection to LMS

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Keywords: simulation game, virtual prediction market, lms moodle, stocks

Abstract: Virtual prediction market is an online simulation game running in the Faculty of Economics since autumn 2007 as a support education process in the selected course. Prediction market is a speculative market created for purpose of making predictions. Assets are created according to the final cash value that is tied to a particular event (e.g. Barack Obama will become U.S. president) or to estimate a score (e.g. the close value of PX index on Friday February 19th). The current market prices can be also interpreted as predictions of the probability of the event or the expected value of the score. In the paper this simulation game FreeMarket is presented as the part of courses Financial Mathematics and Capital Markets Analysis. The prediction market and quality of prediction estimates depend on the amount of the market participants and their trade activity. That's why it's necessary to motivate students to trade on such market. The paper introduces some methods to increase activity of students (market participants). First of all the results of market trades are supplement to final students' evaluation in these courses in the form of points that are added to total score of every student. In reality the FreeMarket credits (money), that student earns on the market, are transferred to points according to the declared rate. These points help students to increase their score for credit and final exam. The interconnection between simulation game and LMS Moodle is described together with description of transfer process. All these processes automatically and periodically update the students' score of assignment that is created in Moodle course for these purposes. Next in the paper the other tools to increase students' motivation are presented. As support of trade volume and market liquidity to increase the automatic process of stocks order regulations are introduced. This regulation is realized in two ways. In the first case the amount of stocks of already emitted events on the market is increased according to users market demand. In the second approach the list of events is prepared as external data file, the data are loaded to the system and then selected events are automatically placed to the market according to the demanded start date of every event. Next motivation factor for student activity showed is "FreeMarket inflation" that depends on the amount of free money in the system compared to the amount of orders and current stocks value. The way of inflation calculation is presented and its influence to the increased volume trades is explained. Finally other characteristics of FreeMarket are presented. The calculation of FreeMarket index and volume of trades are explained. Some of these characteristics became subject of students' interest in the form of proposed events. Thanks to this interest the premises were created for future automatic generation and sophisticated estimated opening prices not only for internal FreeMarket characteristics but also for external real financial market or economic indicators.

Introduction

In the paper the simulation game FreeMarket (FM) on the base of virtual prediction market is presented. The main system functionality is presented e.g. selected event or parameters prediction. The right system function – precise prediction – is conditional on the number of active market participants. That's why it is needed to motivate market participants (mostly students of financial mathematics and capital markets analysis courses) to increase their trade activities. In the paper some of motivate tools are explained. First of all we show the interconnection of the market with LMS system and students' evaluation. Next the increasing of trade volume and market liquidity is supported by the automatic process of supply stocks

regulations. Next explained motivation factor, "FM inflation", became very useful for student activity increasing. Finally the main characteristics of FM are presented. Some of these characteristics became subject of students' interest in the form of proposed events. Thanks to this interest the premises for future automatic generation and sophisticated estimated opening prices were created.

Virtual Prediction Market

Prediction markets are speculative markets created for the purpose of making predictions. Assets are created whose final cash value is tied to a particular event (e.g., the winner of next Czech Parliament election will be Civic Democratic Party) or parameter (e.g., the close value of PX index on Friday 16.4.2010). Other names for these markets are predictive markets, information markets, decision markets, idea futures, event derivatives, or virtual markets. The current market prices can then be interpreted as predictions of the probability of the event or the expected value of the parameter. People who buy low and sell high are rewarded for improving the market prediction, while those who buy high and sell low are punished for degrading the market prediction (Wikipedia, 2010).

Many prediction market are open to the public. Betfair is the world's biggest prediction exchange, with around $28 billion traded in 2007. Intrade is a for-profit company with a large variety of contracts not including sports. The Iowa Electronic Markets is an academic market examining elections where positions are limited to $500. This market was opened in 1988 (I.E.M., 2008). The I.E.M. routinely outperforms major national polls. In the last four presidential elections, for instance, almost six hundred different polls were conducted, and the I.E.M.'s market price on the day each of them was released turned out to be closer to the election results seventy-five per cent of the time. And the I.E.M.'s election-eve predictions in those four contests were off by an average of just 1.37 per cent.

Other prediction market, the Hollywood Stock Exchange, which allows people to speculate on box-office returns, opening-weekend performance, and the Oscars, has also been prescient. Traders' predictions of opening-weekend returns are more accurate than the movie industry's forecasts, and the Exchange has done a good job of foreseeing nominations as well. Last year, its traders correctly predicted thirty-five of the forty Oscar nominees in the top eight categories. The participants of these markets also "decide" the results of Iraq war and the Sadam Hussain's destiny. (Surowiecki, 2003)

Why do decision markets work so well? They are extremely efficient at aggregating information and tapping into the collective wisdom of a group of traders, and groups are almost always smarter than the smartest people in them. As in financial markets, the incentive to get the better of others (whether the reward is profit or mere satisfaction) causes traders to seek out good information. The absence of hierarchy - markets don't have vice-presidents - insures that no single person has too much influence and that diverse viewpoints don't get shut out. (Surowiecki, 2003)

Virtual Prediction Market on the Faculty of Economics

Electronic prediction market has run since November 2007 on the Faculty of Economics, UWB in Pilsen. To this time 612 users are registered and 468 of them, participants of course Financial Mathematics, registered in fall semester 2009/2010. On the market 1530 shares were emitted and 1445 of them were closed (begin of March 2010).

The shares are divided in 4 areas
- Policy
- Sport
- Entertainment
- Economy

Each participant receives 5000 credits (money units, points) hen registering or 1000 credit hen passes final exam for FM broker and receives FM broker concession number. The applicant can pass the exam together studying the trading ways in e-learning course that is supplement of the FM system. (Gangur, 2008, Gangur, 2009) The current winner earns 130000 pt. during 4 months. The examples of selected shares follow

Closed shares

- B. Obama will win nomination for president in Democratic Party
- H. Clinton will win nomination for president in Democratic Party
- J. McCain will win nomination for president in Republican Party
- B. Obama will win USA presidential election
- H. Clinton will win USA presidential election
- J. McCain will win USA presidential election

Opened current shares

- ČSSD (Czech Social Democratic Party) will become member of Czech parliament
- ODS (Civic Democratic Party) will become member of Czech parliament
- GP (Green Party) will become member of Czech parliament
- Other party ('Small' parties) will become member of Czech parliament

Interconnection Between FM and Moodle

From fall semester 2009/2010 the FM system was interconnected with the LMS Moodle. The reasons for this connection are to increase student motivation and to prevent some students from "black" trade realization.

In the first case thanks to this connection the students could transfer their earned points to Financial Mathematics course credits in announced rate (1:5000 for inclusion and 1:50000 for exam). The credits are put as evaluation of offline assignment in the course. These points help to students to reach inclusion and also were added to final result of exam as additional credit. The students can set the amount of transfer points in any time during semester. The whole process is automatic without any intervention of course teacher.

Some students created "black" accounts, they receive more start points from every such account and then they transfer points to one official account with help of illegal trade. The connection to LMS Moodle with the course Financial Mathematics allows control the number of created account. Every participant of FM has to be enrolled in selected courses in LMS Moodle and then can create only one account. The interconnection is shown on the Fig. 1.
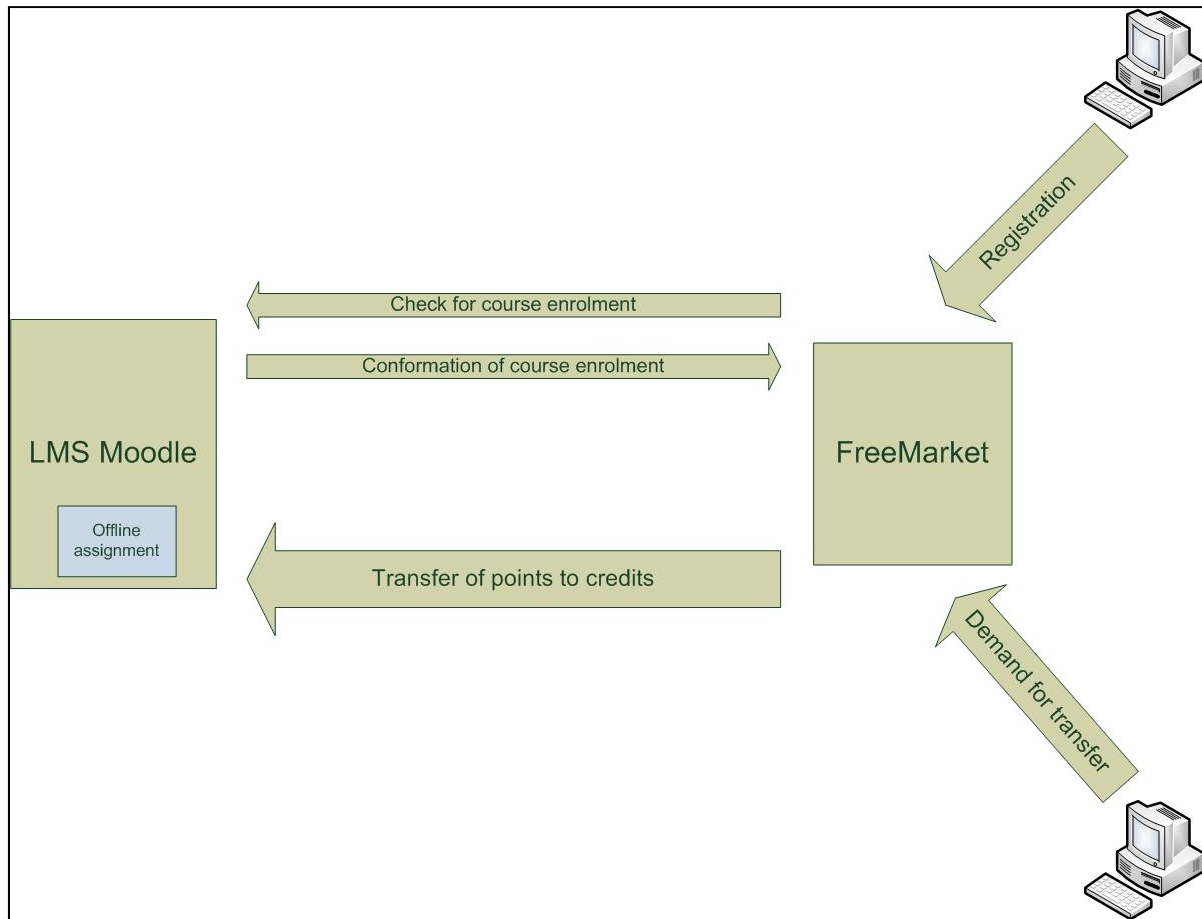
Figure 1: Principles of interconnection between FM and Moodle (Source: own)

FM Indices

We propose own indices of this market that describes the market beahavor according to trade volume. The value of indices is updated one time per day and it is calculated by iteration method from the following formula

$$I(t+1) = I(t)*KT(t+1)/KB(t+1)$$

where

- $KT(t+1) = M_{curr}(t+1)/M_{curr}(t)$ is the coefficient of market capitalization change
- $KB(t+1) = M_{open}(t+1)/M_{open}(t)$ is the coefficient of base capitalization change
- $M_{curr}(t+1)$ – current market capitalization of opened shares in the day according to their current market price e.g. the number of shares multiplied by their current price
- $M_{open}(t+1)$ – market capitalization of opened shares in the day according to their opening price e.g. the number of shares multiplied by their opening price

The progess of FM indices in fall semestr 2009/2010 is shown on Fig. 2. We can see on the figure the indices increase at the fall semester beginning, the increase after 11.10.2009 when the inflation was implemented to system and the increase at the end during exam period when some students needed to collect additional points for exam.
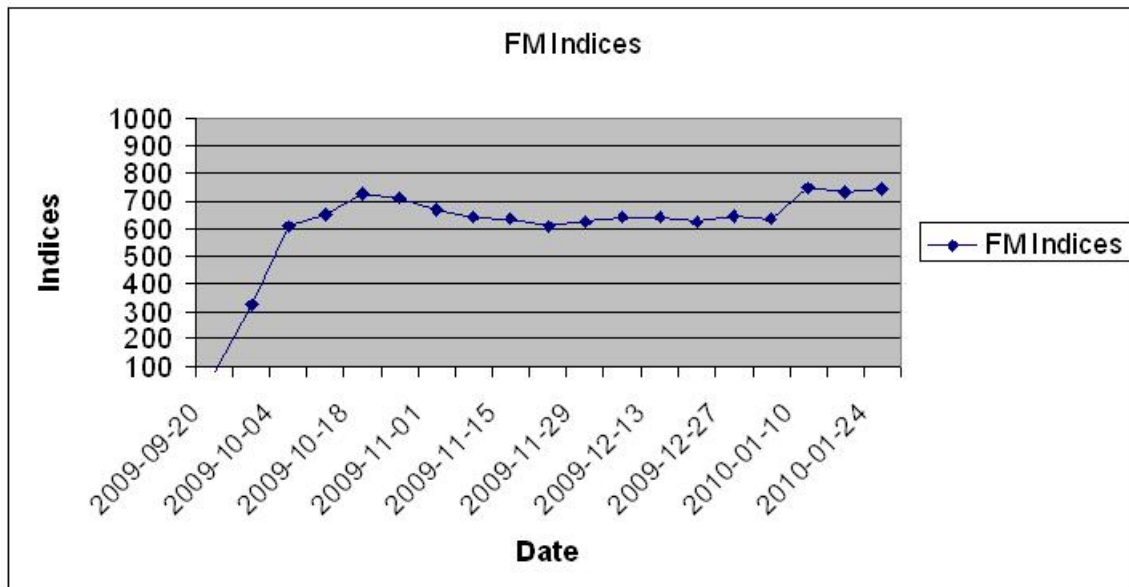
Figure 2: FM Indices for period 09/2009-01/2010 (Source: own)

FM Inflation

The most of FM participants, the student of Financial Mathematics course, registered to FM and by this act their activities in the system finish. They were satisfied by profit of start 10000 points (2 credits for inclusion) and they don't need to trade on the market. That's why the inflation was implemented to the FM system. The main reason for inflation implementation was encouragement of the trade volume. A lot of free cash money were in the FM system.

The FM participants would have to try to decrease this free cash money and by this way to decrease also inflation, that decreases every day the nominal value of the participants' points in FM followin the formula

$$CM = CM*(1-R_f/360)$$

where

- CM is free cash points on participant's account
- R_f is inflation ratio

According to described reasons and setting inflation source the formula for inflation ratio was constructed

$$R_f = (TC – TD)/TO – 1$$

where

- TC is total free cash on the accounts
- TD is total demand = the number of demnaded shares * buy price
- TO is is total supply = the number of shares emited by system administrator (new shares) * their current price + total value of stock-in-trade (the number of stock-in-trade * their current price)

11th October 2009 the first news about inflation was published in the FM system. The R_f value was published every day. Každý den je aktualizována zpráva o inflaci v podobě roční sazby. During 1 month

period the inflation was decreased from start 296% to inflation about 0. The progess of FM inflation in fall semestr 2009/2010 is shown on Fig. 3

The figure shows opening depression of inflation and low values of inflation ratio during semester, and also increasing of ratio at the end of semester when the most participants transferred their free cash points to credits and finished trading. Some free cash points were transferred out of the FM system, but the influence of decreasing number of demands and stock-in-trade was too large.

Other Motivation Tools

According to students' suggestions the other motivate tools were implemented to the system during fall semester 2009/2010. The tools were developed in the area of new edition of shares. We proposed and implemented two automatic methods for managing edition.

- Automatic issue of new stocks of existing emission on the market
- Automatic issue of new emission from prepared store of events.

In the first case the system response to demands for next shares if nobody offers them including system administrator. The system automatically issues next stocks of the demanded emission every day. The price of these new shares is set up as maximum of 95 and maximum of all prices in the demand. The number of new stocks is determined according to total demanded volume, maximum demanded price and price 95. For example if somebody demands 10 stocks for maximum price 70, the total demanded volume is 700 and the amount of shares is calculated as round(700/95) + 10.

In the second case we prepare the store of events together with issuing date for every event and load this store to the FM system. The system then checks the new possible shares with respect of issuing date every day and places them on the market.
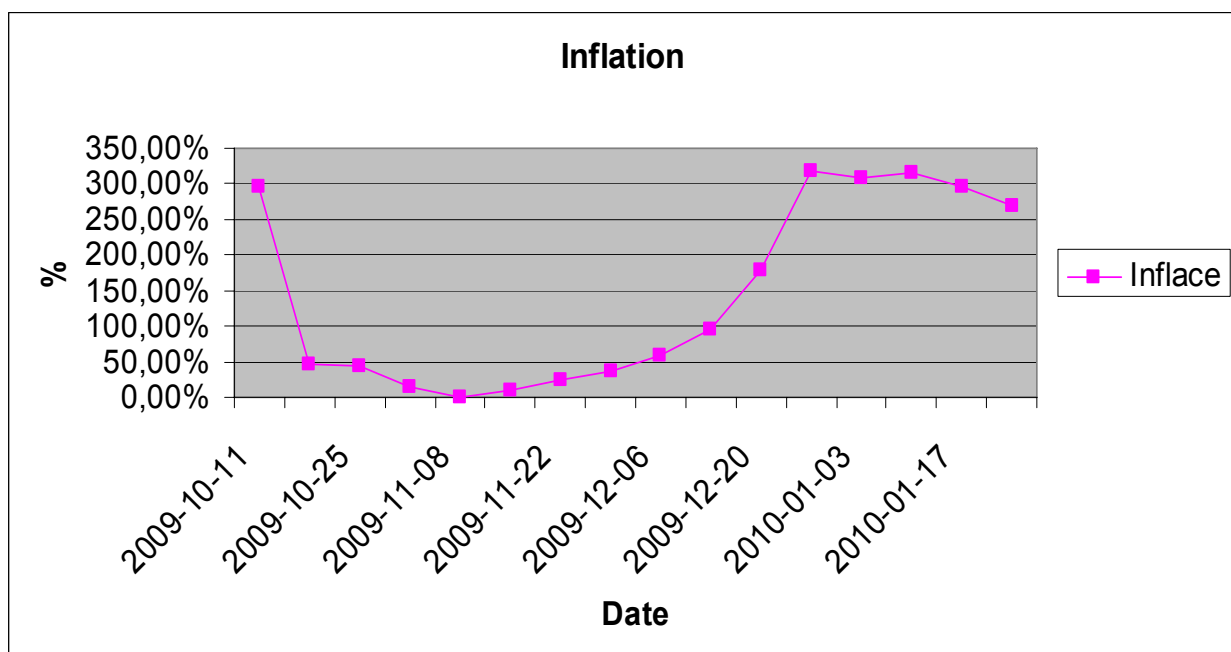

Figure 3: FM Inflation for period 10/2009-01/2010 (Source: own)

Conclusion

The most important thing in prediction market processing is active trade of market participants. On prediction market of Faculty of Economics UWB we use several tools for the increasing these participants (students) activities on the market. The proposed interconnection of market with the final evaluation of supported course is one of them. The second one, including the FreeMarket inflation to the system, is also very useful tool. The influence of the inflation is shown on the progress of proposed FreeMarket index and its correlation with inflation progress is presented. Described tools create precondition for the use of virtual market system for prediction.

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Semantic Utilities and E-Learning

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Abstract: Machines knowing content of the documents, i.e. the idea of semantic web, could help with transmitting the knowledge. The lack of user-friendly tools for acquiring, storing and utilizing document semantics inflicts very rare usage of semantics among non-specialized users. Semantic-web research concerns with theoretical issues. We designed the project SELE (Semantic e-learning) to cope with some of these issues. This project allows user to create open source light-weight tools for gathering semantics from real usage, usable in further research, and to use these tools (and also their development) in the learning. This paper describes a structure of the framework, their basic processes and developed tools and modules.

Introduction

Semantic web (Berners-Lee, 2001) remains still the subject of academic discussions rather than usable technology. Its need of metadata leads to unrealistic requirements on the users or excessive requirements on resources and time due to incorporation of sophisticated automatic methods. Real-life applications incorporated much simpler methods for describing the document content – tagging and folksonomies (Li et al., 2008). That is Web 2.0 technology building up the semantics from the low level, combining "atoms" of knowledge of each user. Using Web 2.0 tools in the learning corresponds with the *Connectivism* learning theory (Pitner, 2007).

Semantic E-learning Project

The goal of SELE project is a framework of tools combining Web 2.0 approach, more elaborate backbone technology, and higher usability than semantic-web prototype tools. Requirements evolved as a result of semantic tools survey:

- The user experience is more important than level of contemporary semantic technology usage, i.e. ontologies used in tools are lighter, tools shall use a set of corresponding collaborating specialized ontologies rather than one heavy-weight;
- Standardized technology (OWL for semantics, Fresnel for visualization etc.), open-source and open interfaces to other processes (learning etc.) are vital. Framework should have modular architecture.
- Tool, as a part of the learning process, should be easy to understand, correct, concise. That eases the shared consensus creation of the concepts of the learned domain. It is very important requirement, because students do not dispose any base knowledge in the beginning.

Any Web 2.0 service is centered on repository of some interesting data – maps, wiki pages, documents etc. In SELE it is the (e-learning) document repository. There are plenty of legacy learning documents on web or specialized data not initially intended to be used as learning resource. The work with general formats allows users to use corresponding processors with better abilities and user experience than web CMSs have.

As our team teaches a couple of well-attended courses (Java Programming, Mark-up languages), another requirement is to use tools not even FOR the learning processes, but also to use their development in the learning (as Master, Bachelor theses or interim projects) – as a part of the *Inclusive*

universal access methodology (Pitner et al., 2007); and to integrate learning tools already used – like project management system (Gregar et al., 2009).

Document Structure

We view the document as a general multimedia container, containing the (structured) text, set of binary data, and semantic metadata (like EXIF, ID3 etc.) in SELE:

$$D = T + S + B \qquad (1)$$

Where T is the textual content, set of words T_i, S is the set ($\{S_1 \dots S_m\}$) of semantic information about the document or some of its parts; B is the set of binary data. I.e. metadata could describe text in wiki page, pictures, or document per se.

The goal is to identify, to detect and to reveal this logical structure in every type of document the framework could be engaged. Maximizing the dimension of T (and S) allows better computerization and utilization – i.e. to use same processes on the documents originally from different processors. We designed the XML format (DocBook derivate) for the formatted text description. It allows profiting from semantic web and Web 2.0 technologies with preservation of easy document authoring in known user interface. The main issue is importing and exporting various document types. The easier process is indeed for the XML-based documents like ODF (first implemented module), Office Open XML or DocBook, where XSLT can be incorporated. But every document type t_{import} identifies unambiguously the function f_{trans}, which for the input document can return its sub-elements:

$$D = f_{trans}(t_{import}, t_{DocBook}, D_{import}) \qquad (2)$$

That transformation is not always symmetrical (DocBook can have lower descriptive power, API of the format can be incomplete, i.e. reverse transformation of the D into t_{import} do not end with D_{import}. Hence we store also copy of initial document state: $B = \{B, D_{import}\}$).

Semantic description of the document has two subsets. There are general level metadata (subset S_G, major part is gained within the import, using standards like Dublin Core), and results of voluntary annotation of terms T_j, binary elements B_k, or its segments (subset S_A). Annotation function SF_A declares the projection of term to its semantic representation.

$$S_A = \{S_j \mid S_j = SF_A(T_j), T_j \subseteq T\} \cup \{S_k \mid S_k = \qquad (3)$$
$$SF_A(B_k), B_k \subseteq B \mid\mid B_k \subseteq B_l \subseteq B\}$$

Binary structures are bound to the document by the DocBook vocabulary. Semantic data are connected by standard RDF structures and Linked Data rules. Export from the internal structure can be performed to the initial format, or any other known by the system. The storage of semantics gives us the opportunity to show formerly hidden knowledge of the documents (i.e. S), sometimes as the only information to export (Gregar, 2009).
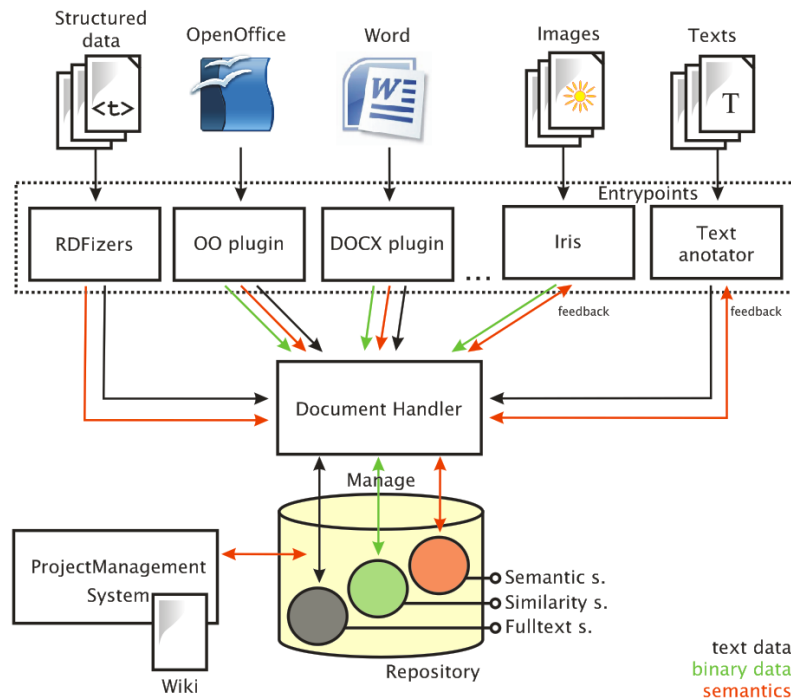
Figure 1: Framework structure – importing documents.

Content Management System

The module responsible for the processing of the documents, their importing and exporting, is called ASCMS (Apache Servicemix Content Management System) (Mudrák, 2009). The internal structure of the system is based on Service oriented architecture (SOA). ASCMS use Apache ServiceMix ESB framework and Apache ODE for service orchestration and BPEL language for service composition. Because of ServiceMix bug, system is temporarily exposed in Apache Tomcat via Codehouse XFire.

Framework works with *Entrypoint* interface for describing services, which can import (*Capture process* in ECM terminology) documents (see Figure 1). Such services implement transforming function f_{trans}. Reference *Entrypoint* implementation (called *DocTransformer*) works with OpenOffice.org (OOo) server side instance. It use library ASCMS2OO to access it and transform content of OOo processable formats into internal structure. But such interface could be implemented also in dedicated modules (DOCX, DocBook, XHTML is under development). The *Entrypoint* services can be used also for export of the document.

Repository

Document repository is composed of the three databases:

- XML database (eXist and dbXMLTL library of the ASCMS) bound via JBI (Java Business Integration). XML structure allows text mining, indexing, simple fulltext search (implemented by ASCMS module XMLDocStorage).
- Relation database (Apache Derby, persistency is based on JPA+ implementation EclipseLink). It stores initial version of the document and binary parts of it. Binary data can be searched via the similarity search.
- Semantic database (OpenRDF Sesame 2 and eXist). Smaller part stored in XML database is the directory service for managing the documents in CMS (managed by ASCMS module Metadata). Data store for the document metadata and stored semantics is OWL repository Sesame 2. Module SemanticMetadata use it in CMS-related processes for storing document-metadata in Dublin Core vocabulary. Sesame 2 was selected as a result of our internal survey.

We selected the lightweight approach of semantic storage via instantiating the set of domain ontologies (Al-Khalifa, 2008) – for example project development description ontology should annotate only bits of document which have some value (project author, collaborators etc.). Such instantiating of independent ontologies creates the set of independent semantic views. And that independence restricts future utilization. But it can be withdrawn with Linked Data (http://linkeddata.org/) principles or use of upper ontologies. The semantic utilization also needs different views on the declared semantics. We use Fresnel Lens (Pietriga, 2005) for defining the intention-ruled sub-graphs.

Visualization

For better knowledge transition we need to visualize the semantics. There are more attempts to visualize the RDF data. It became obvious that RDF browsers are almost always solving the same issues: selection of relevant subset of RDF data and adding visual information to it. Hence W3C started an effort to provide a declarative and universal way to handle these common issues, to standardize visualizing approaches and avoid reimplementation. As a result Fresnel standard was developed in June 2005. It is a display vocabulary for RDF (Pietriga, 2005), capable to select the data (Fresnel Lens) and visual style and data binding (Fresnel Format).

Some applications already used parts of Fresnel standard, for example RDF Browser IsaViz (http://www.w3.org/2001/11/IsaViz/). There is Java library JFresnel implementing the basic vocabulary of the standard. The nonexistence of authoring tool inhibited the standard. We developed the modular application Fresnel Editor (FE) for semi-WYSIWYG editation and further visualization. JFresnel was used as a technological base (It was extended during development). FE uses framework Spring on the application level and component Lobo for the web-visualization.

FE creates an environment for the accessing the semantic data (stored in Sesame 2 repository). It also use the repository of Fresnel definitions (also in RDF, hence these two data connections can point to one repository). The initial version of the system implements the modules for definition of Lens and Formats in semi-WYSIWYG way. It allows binding them in Groups and activating the visualization. The alternative Lens and Formats modules for full WYSIWYG definition (for non-IT specialists) are under development, as well as alternative visualizer capable to export the output in SVG, or the set of specialized Fresnel Stylesheets. More information about this can be found in (Gregar et al., 2010).
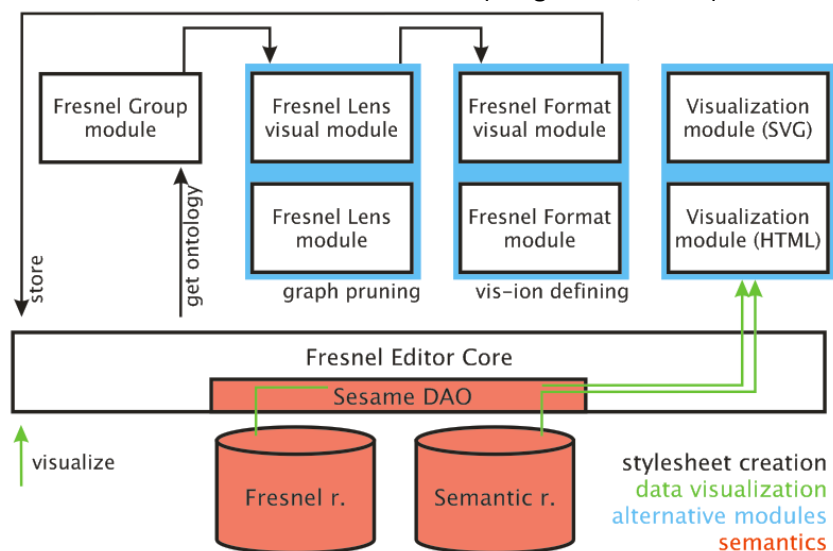
Figure 2: Fresnel Editor, structure.

Project Management System

We analyzed the requirements for different project categories managed at MU (Gregar et al., 2009) and described the processes identified and used to cope with them.

We used the framework of *Subversion* for storage of the research projects, *Wiki* for output presentation (with light usage of Wiki as a blended learning system), project describability and project

status examining, and *Maven 2* for quality measurements of the project. Later we created a fork of the Open Source system Trac called Deep Thought (DT). DT can manage multiple projects and integrate the former distinct tools in one *mash* (Pitner et al. 2007). The second-level integration comes with the utilization of the semantic repository in the wiki module. The module utilizes library RDFLib and RDFAlchemy to connect to semantics repository of the framework (Sesame 2).

The system gained the set of wiki-macros to annotate the content or visualize automatically selected semantic information (like automatically generated list of software projects or project calendar). The macros are ready for a set of widely used, Linked Data aware ontologies, like DOAP (description of the project) or FOAF (Friend of the friend), O3 (ontology metadata), GEO (geographical localization), DC (Dublin Core metadata vocabulary) etc. But the content can be annotated with any RDF-based ontology.

Recently we started to develop the GUI for easy annotation of the content. The wiki-module, as well as the system itself is under testing now. It is used for the management of the interim student projects.

Iris, Image Annotation

Framework subsystem for picture annotation is called Iris. It is the simple graphic editor capable of segment the images automatically, describe their content via MPEG-7 descriptors, store that information and also suggest concepts for picture segments depending on the selected semantic domain. User can follow that suggestion, or assign semantics independently. The semantic information about the graphic segmentation, its properties and also the resulting annotation is stored in general multimedia ontology *COMM* (Core Ontology for Multimedia, http://comm.semanticweb.org/) (Arndt et al., 2007). The tool has two distinct prototypes – one developed in .NET framework (Java API of COMM was translated in C#), another is under development in Java. The MPEG-7 descriptors are extracted via library *Caliph and Emir*.

Contribution of Iris is its more mature user interface than existing image-annotation tools. It also works as a browser of already defined annotations. The semiautomatic proposition of the concept is based on the computer vision techniques, uses MPEG-7 standard descriptors, COMM ontologies for describing the picture structure and semantics, and processes of machine learning (Gregar and Pospíšilová, 2006).

Conclusion

The paper gave you the brief overview of the framework structure and their modules in particular. Its development continues. This semester we started to use the semantically enriched project management system in the learning, so some interesting usage data will follow. The mayor part of the tools were developed as Master or Bachelor theses, the visualization editor came public and it is available on sourceforge.org. There are also other modules, like ontology editing interface into editor Protégé, or newly designed web interface for browsing stored RDF definitions LinkedData-friendly, i.e. in the human readable way.

Acknowledgement

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New Possibilities for Virtualization Not Only in Education

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Abstract: In the field of ICT management is the use of foreign computing sources a relatively new trend. This trend is more and more current and in future there will be a problem to escape from it. Today the administration of decentralized IT environment forces companies to employ new IT workers, because the current administrators are not able to handle the increasing number of a PC stations, applications, operating systems, databases, information systems, etc. We usually meet the situation when one employee has not only PC station, but also the notebook, PDA and others. On each of these devices there are different data and different applications installed on different operating systems. The most acceptable solution is to start gradual centralization by moving user operating systems and their applications to the powerful data centres, and then providing personalized operating system and applications to end users. The personalized OS "runs" on a powerful computing cluster and the user will be able to access it anytime and anywhere he wants. The purpose of this article is to inform about new management options using the new ICT possibilities of applying virtualization, to sketch a possible implementation in the classroom under administration of the Department of Informatics, and then to present virtualization tools Citrix XenServer and Citrix XenDesktop and the possibility of deployment. At the beginning it is necessary to consider the rate of deployment of virtualization technologies, whether to move the whole infrastructure or only some part into the datacentre. It should also be chosen the appropriate virtualization tool. The chosen solution passes through the phases of implementation and testing, which proves the propriety of the solution.

Introduction

Rising popularity of utilization of foreign computing resources forces us to deal with the idea of using these techniques of the Department of informatics FBE Mendel University in Brno and take advantages of the benefits which this solution brings. Also thanks to still increasing demand from the fields of study focusing on informatics and computer technology, the Department of Informatics FBE MUAF in Brno have experienced and is still experiencing great expansion and in these days there is a need to solve new demands from the staff and students constantly. We have already decided to solve this problem through virtualization. The aim of this paper is to inform about the new possibilities of ICT control with using new possibilities of application virtualization, to propose a possible implementation of classroom management at the Department of Informatics. I want to point out possibilities of further use of virtualization itself in teaching at the FBE Mendel in Brno.

The concept of virtualization has increasingly begun to appear in the sixties. Virtualization is essentially an illusion, which is a source (eg. memory, processor, disk and other peripherals) multiplied (create multiple copies) and each user gets one or more of these copies. We have virtual memory, virtual disk and of course the virtual processor. Ultimately, we are able to offer users a full virtual machine which consists of virtual components. The user has the feeling of total control (ownership) but in real it he shares specific physical resources with other users. This creates a very dynamic IT infrastructure (Halamíček, 2009).

In recent years, the processor manufacturer like Intel and AMD recognize the growing importance of virtualization and extend the processor instruction set IA-32 platforms, IA-64 and AMD64. This leads to

better support a full virtualization, which is difficult to exercise. They extend the technology Silvervale, AMD Pacifica and Intel's Vanderpool (Halamíček, 2009).

The Benefits of Virtualization Used

- Server consolidation – the process of consolidating small independent server systems in large systems, usually from the transfer of physical server to virtual machine (P2V).
- Dynamic distribution of power – for web servers is usual to run on many servers, we call it Cluster Server, which together works on user requirements. However, if we run two or more Web servers which are loaded at different times, we can load and put out dynamically increase or reduce the number of virtual machines in the cluster.
- Migration – if the virtual interface is sufficiently independent of the physical interface, we can consider the possibility of saving the current state of whole virtual machines and transfer (migration) of this state to another physical machine. This allows us to make changes to the hardware configuration on a physical machine without noticeable loss of service availability. Migration also serves as a way how to increase reliability of service.
- Possibility of separation of the development environment – the original main need, why the virtualization originated, was the need for rigorous separation of development environments. Before the development of software for mass market, it is necessary to test characteristics in the environment of many various operating systems. These goal can be achieved with minimal cost in time and finance with this virtualization help.

Possibilities of Virtual Desktops at the Department of Informatics FBE Mendel University

Continuous expansion of the Institute of Informatics in recent years, which is due to the growing interest of students studying the IT field, has brought along a boom in the IT infrastructure of the Department of Informatics FBE Mendel in Brno. We usually meet with the situation when one employee has not only a PC station, but also the notebook, PDA and others. Therefore the system administration of this extensive IT infrastructure is becoming very difficult. Because of that we have decided to centralize this current decentralized IT infrastructure by technology of virtual desktops.

Today this administration of desktops means manual, time-consuming and expensive work. The ensuring data security is a complex task in the case of desktops layout throughout the organization of the Mendel University size. The more users use their computers, the more the application performance is degraded because patches and application updates inevitably contribute to the "proliferation" of the whole system. Possible and currently used solution is to replace the computer or reinstall the whole system, but this is very time consuming and mentally demanding for administrators.

Desktop virtualization technology enables the centralization of desktops in the datacenters which facilitates their security and backup. Desktop virtualization provides a comprehensive system for desktop delivery. Virtualization tools like Citrix XenDesktop builds a dynamic virtual desktop on demand while each user's logging and always provides a new and original personalized desktop which ensure never decreasing performance. We can arbitrarily connect individual applications according to needs of users. These applications are kept as images in the data centre (Citrix, 2009).

Figure 1: Diagram for virtual desktop. (Citrix.com, 2009)

The administrator takes care of only a few operating systems, keeping them updated, secure and efficient in case of computing virtual desktop technology. These operating systems are stored as image files in the data centres and they are called "gold image". For each user or each group of users (for example, a group of students studying a particular subject) the administrator establishes a group consisting of a gold image and required applications for teaching the subject. That is way the assembled OS is published. When the user logs, he is verified by an MS Active Directory and then user profile, settings and data are connected. Only now there is a complete virtual desktop personalized and ready to run. The customized OS runs in a virtual environment on the server cluster, assigned applications, the user profile and data are loaded into the OS. These virtual desktops run in the data centres and they can benefit from the robust performance of servers which run on. We can use existing PCs, light workstations or thin clients - as end stations. It depends on the degree of shift in the IT computing environment. We can use the current workstations like the Desktop Receiver, enabling communication with a remote desktop while using its current OS installed on the workstation. The logging dialog is offered in the case of the thin client technology as the first time. Communication between servers and workstations is provided by high-speed protocols such as ICA, HDX. It suffices a bandwidth 30 Kbps for the continuous transmission. By using this technology in the future we would like to administer (at least partially) IT management at of the Department Informatics FBE Mendel University in Brno.

It was applied for grant IGA 2010 for preparation of this technology and creating methodology of virtual desktops implementation and in other to deploy this technology is submission project FRVŠ 2011 of name "Virtual Classroom".

Possibilities of Virtualization in the Education

The idea of using virtualization as a tool for support of the teaching in courses as Innovation for computer specialist and Operating systems, have been already started to deal in the first mention of server virtualization in 2006. For these purposes there were bought two servers Dell Power Edge SC1435 in the framework of the project FRVŠ 2578/2009. On the server there is installed Citrix XenServer virtualization. Students can learn practically test this virtualization tool, also they can install and then configure many differential operating systems. After finishing the courses these systems are simply removed. The usage is evident when teaching the course Operating systems.

For each student can be created a separate server, any OS and of any distribution, in which the student gets the administrator rights and then can work with the operation system as an administrator, without risk of damaging anything else than the virtual image. After the end of the semester the virtual images are removed and created new "clean" operation systems at the beginning next semester. This access resembles using a file for storing user data and only the owner has an access into this file. Anything of this would not be possible without the usage of virtualization techniques.

Summary

Virtualization allows reflecting one of the promises of informatics science - full individualisation of the environment with highly efficient use of resources. Virtualization reduces costs associated with managing, purchasing hardware and electricity bills. Today the deploy of some forms of virtualization is becoming as common as using the operating systems with virtual memory. It enables more efficient utilization of hardware resources, easier administration, greater availability of services and greater security. If the established trend continues, we will not only virtual servers, but also user operating systems and application programs. This transforming of computing environment from the user to the network is called Cloud Computing.

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Adaptive E-Learning in Area Operating and Database Systems

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Keywords: e-learning, operating systems, database systems, oracle, unix.

Abstract: Students and other people interested in the area of operating and database systems have to their disposal specialized books, manuals, and web pages. The user's problem is orientation oneself in the themes and practical implementation of new methods and products. The purpose of education is to search useful methods and aspects for supporting optimal knowledge in multicultural and global societies based on multidimensional methodology. Effective aspects are visualisation and the use of interactive elements in presentations and simulations. Communication is important from the shared experiences point of view and special themed knowledge. E-learning requires the same. Optimal integration of interactive elements into communication with students is helped by simulation the real situation with Petri Nets. Adaptation the static offer of education materials by dynamic and interactive elements is not automatic. In the way of searching a well-balanced method is the inspirational access for contact mapping in a study by IBM called "Advocacy in the customer focused enterprise". Specific metrics are important for controlling the seriousness and prestige of given firms. E-learning also constitutes prestige of a given university, their educators, and others employees. The recommendation is that students must experience interest, topicality, plasticity, and efficiency. Students are also clients; clients of e-learning.

Introduction

Information systems in firms and organizations generate a wide spectrum of data. The data is transferred into information for decision-making. The optimal decision based on correct information and skills in today's dynamic and global world creates differential factors of fruitfulness. This process is closely linked with competitive advantage and knowledge. *Information is everywhere, but knowledge is hard to come by.* (Know how, The Economist Intelligence Unit 2005) The optimal resolution to gain knowledge, skill, or know-how is through continual education. Information technologies can help. Ways of using this technology depend on general factors in how users use different types of information for realized activities. Knowledge is often hidden within information of database and information systems, reports, and dashboards.

Students and users learn how to use information not only from a manual of one thousands pages. They use the Internet's services with online help, discussion groups, video recordings, and simulations. Simulation training constitutes an effective method for resolution of the ever-repeating queries of students and users of supported software. A number of commercial and free downloadable products such as Free Screen Recorder, AVI Screen Capture, or Adobe Captivate are available. The advantage of these tools is that students can replay a given simulation from a selected interest area without worrying that they will get information that is not relevant to their situation.

Database and Operating Systems Needs and Challenges

Information is omnipresent and its quantity is unlimited. We must decide what information will be processed and what information will be forgotten. Everyone is aware about information's value and its need in decision-making. Computers help information technology users in various categories. The majority of these computers use an operating system as a basic optimal environment for hosting applications like Internet browsers, mailers, text editors, or database systems. Installation, upgrade, and

optimization of an operating system are for many of users a standard activity. Good help-matter is online help, video animations, simulations, or discussion groups. This situation is similar in area database systems.

Database systems offer a wide variety of products with useful level adaptability and optimization. Users can select easy resolution with the support of MS Excel, MS Access, or another product from the open-source area. These options do not offer further ability as analysis tools in the area of business intelligence. It necessary to shift from easy resolution to a complex resolution on the basis of a database system. Business intelligence products offer a next dimension of database systems. This dimension is one form of the aspects for active use of a database system in the majority of situations in our activities. Many users have doubts about implementation and database system operation. These doubts include the level of expert knowledge required, needed time, and financial sources. Such aspects and others are the aim of various studies and research as for example research on the theme "*Small and midsized firms are not doing everything they can to secure information*". (Průzkum, Computerworld-Aktuality 2009)

The challenge for operating and database systems is how they can help: how to increase influence and adaptability for new resolutions. These questions are important for area education, and further training of all users and students. The principle is to have organized ideas and to know what it is important do, how and what to apply of information technology products for active use. Basically, the key is a correct philosophy of the given process – methodics, and methods. A good starting point is the optimal philosophy of education with multidimension access as *Multidimensional Development of Information System (MDIS)*. (Voříšek, 2002) It is centred on data decomposition and functioning with this data within global architecture. Correct education requires similar elements with well-balanced methods.

Well-Balanced Methods for Optimal Education

Education is a service with the aim to provide facility, tools, menus, new ideas, and visual exercises to create a better resolution in practice. This task belongs to the complicated decisions of students. Education is adapted for the clients (students) in the aspect of time, place, and theme division of smaller sentences for better receipt of new information. New information must be presented well. A good presentation is the start of education. Some time and repetition is needed to master new information with a transfer to true application and skills.

Searching for well-balanced methods for optimal education requires a wide view on education with all useful aspects. Offered courses and study plans must be adapted for various students with different goals, preferences, and possibilities. One must resolve the process of backing up a database system; next, he or she must realize the size change of database files, and others seek active expansion of the database system in the area of security. Mentioned examples are cases from theme diversity. The time limit needed for understanding a given theme is another aspect. Some students periodically attend the course, some students use distance education or e-learning with a few tutorials. Both wish to optimally master a selected course and given theme. Both need to communicate about the course theme and need to share and verify acquired experiences.

We can identify a similar connection in the area of managing customer relationship. Managing customer relationships has an important place in any firm or organization. Applications addressing this area fall under systems of Customer Relationship Management (CRM). Every firm needs loyal consumers and they are a valuable benefit. These consumers bring continuous profit and they usually recommend the vendor's next potential clients. This is solved through positive care for clients. This care is more than periodically sending offers or promotion materials. *Analysis of consumer experience is key for contact with a firm.* (Zákazníkova loajalita rozumem a citem, THINK! 2008) Contact with the firm is clearly defined with scalable and emotion metrics. A reason for integration of emotion metrics is experience and feeling services from the contact with vendors – contact is serious; the firm offers maximum service and interest. The given theme is described in the IBM study "*Advocacy in the customer focused enterprise*", which is accessed on www.ibm.com. Authors of this study defined four dimensions to decide about a

consumer feeling for firm. IBM CEM Framework associates use these aspects for analysis and building of optimal and consistent consumer feelings. The selected aspects are:

- Scaleable output with efficiency, consistency, availability, credibility, flexibility, and comfort,
- Quality products and services with useful and essential services, trademark, and price,
- Navigation for communication and point of contact with branch offices, telephone, Internet, SMS services, and employees for contact with consumers,
- Emotional effort with respect, integrity, authenticity, empathy, sincerity, and importunateness.

Similarly, one can see a transparent shift to education with integration of a multidimensional view on the usage in practice. An important interest of universities is to remain in contact with the student. This process leads to student loyalty based on experience, and optimal knowledge and skill of students with better use in practice. Every user values user-friendly interface offered information systems for support education. The form of the user environment has an important influence on the realized method of work with information and data. Optimal analysis of a user's environment in interface form is realized by Petri Nets. Petri Nets are relevant tools for simulating realized activities with model systems such as network, operating, or database systems. *Study based on simulation and model enables focus on important characteristics of system with regard to simulation target and better understands modelled systems.* (Kochaníčková, 2008) Created models use basic elements of Petri Nets. These elements create places and transitions. Places are displayed in the form of circles and transitions are depicted as rectangle. Places and transitions are linked with oriented arcs. Benefit is easily demonstrated by offered activities and their confrontation. Realized own models are created in *simulating program of Petri Nets HPSim*. (Klimeš and Balogh, 2008)

Support Interactive Communications

Support interactive communication for distance education and e-learning is often based on the Moodle system. This system serves for creating Internet-based courses and web sites and supports a social constructionist framework of education. Moodle is open-source software. *The word Moodle was originally an acronym for Modular Object-Oriented Dynamic Learning Environment, which is mostly useful to programmers* and *education theorists.* (Moodle, 2010) Standard structure of actual courses creates information about the name of the course, course tutors, communication possibilities, course (goal, syllabus, literature), important notifications (accreditation, place of delivery seminar paper), and own teaching materials divided into chapters. Teaching materials are offered available in various formats. For adding teaching materials, the teacher has the menu "Add teaching materials" at his or her disposal with items such as Create legend, Create text page, Create web pages, Link to file or web. The useful menu is Create legend for the creation of titles, and Link to file or web for the creation of link labels to study materials. These options create static facilities for downloading needed teaching materials without interactive communication. This communication is important for the correct understanding of new information and the transfer of this information into skills and knowledge. Optimal communication between the tutor and students is background for useful educational aspects like respect, authenticity, integrity, empathy, sincerity, and importunateness.

The Moodle system offers learning activities to support interactive communication. These abilities are offered for teachers via the "Add an activity" menu with items like Public inquiry, Database, List of questions, Forum, Chat, Test, Wiki, Lesson, SCORM, and Glossary. Conversational activities are supported by live chat and an asynchronous discussion forum. Wiki enables students to work together on a given theme. Online tests offer options for automatic and manual rating of defined questions. Lesson and SCORM activities transmit content and serve for individualizing presentations based upon a student's selections. A glossary of keywords can be created by the teacher for further editing by students. The Database activity allows the teacher and students to create a collection of records about a given theme. Format and structure entries are unlimited. Records can include images, files, URLs, or numbers and text.

An optimal view describing the given reality it is created through the model with elements of Petri Nets. The model for simulating the course environment in the Moodle system is displayed in Figure 1.

The start point is place P1_List_Courses. This place displays the screen with registered courses of teacher. The next route leads through the transition T1_Select_Course to place P2_Identification_Course. The transition rests in the selection of a course by the mouse and the scroll-bar. Place P2_Identification_Course displays on the screen a visually marked record of the course. Next steps are intuitive.

Model build follows defined places:

- P1_List_Courses – displays a list of registered courses.
- P2_Identification_Course – displays a visually marked name of the specified course.
- P3_Information_Course – displays specified groups of information, materials, and activities for editing.
- P4_Name_Course,   P5_Tutors_Course,   P6_Possibillities_Communication,   P7_Course, P8_Important – accesses edited base information about the course.
- P9_Study_Materials – accesses offered documents.
- P11_Create_Label,   P12_Create_Text_Page,   P13_Create_Web_Page,   P14_LinkToFile_Web, P15_Display_Directory – accesses needed information for the creation of legend, text page, web pages, link to file or web, and display directory.
- P10_Study_Activities – accesses offered activities.
- P16_PublicInquiry, P17_ListOfQuestions, P18_Database, P19_Chat, P20_Forum, P21_Glossary, P22_Test, P23_Wiki, P24_SCORM, P25_Lesson – accesses needed information for creation of public inquiry, list of questions, database, chat, forum, glossary, test, Wiki, SCORM, and lesson.
- P26_DisplayContent_Course – displays actual information about the course.

Needed transitions of the defined model are:

- T1_Select_Course – searches specified course (specified via scroll bar).
- T2_Display_Content_Course – selects needed information about selected course (selects course by mouse).
- T3_Editing_Course – specifies the edit mode of needed information, materials, and activities of a course (button Activate edit mode).
- T4_Add_Study_Material – specifies the menu for the creation of a legend, text page, web pages, link to file or web, and display directory in a course (menu Add teaching materials).
- T5_Add_Study_Activity – specifies the menu for the creation of a public inquiry, list of questions, database, chats, forums, glossaries, tests, Wikis, SCORM, and lessons (menu Add an activity).
- T6_EndEditing_Course – confirms registered information, materials, and activities created by edit process (button Deactivate edit mode).
- T7_Return_ListCourses – displays all registered courses of teacher for next course select (specified via scroll bar).

The validity of the defined model is verified by starting the given simulation. A route cycle is built from place P1 via specified transitions and places. Places P4, P5, and P8 create sections for editing base information like the name of the course, course tutors, communication possibilities, course (goal, syllabus, literature), important notifications (accreditation, place of delivery seminar paper) about a course by the Edit icons. Place P9 and P10 serve as abilities for adding or editing study materials and activities. The teacher can select from various types of study materials (place P11 – P15) and activities (place P16 – P25). If the teacher ends the edit mode, it is important to confirm the "Deactivate edit mode" button. This activity is represented by transition T6. The next route returns to place P1.
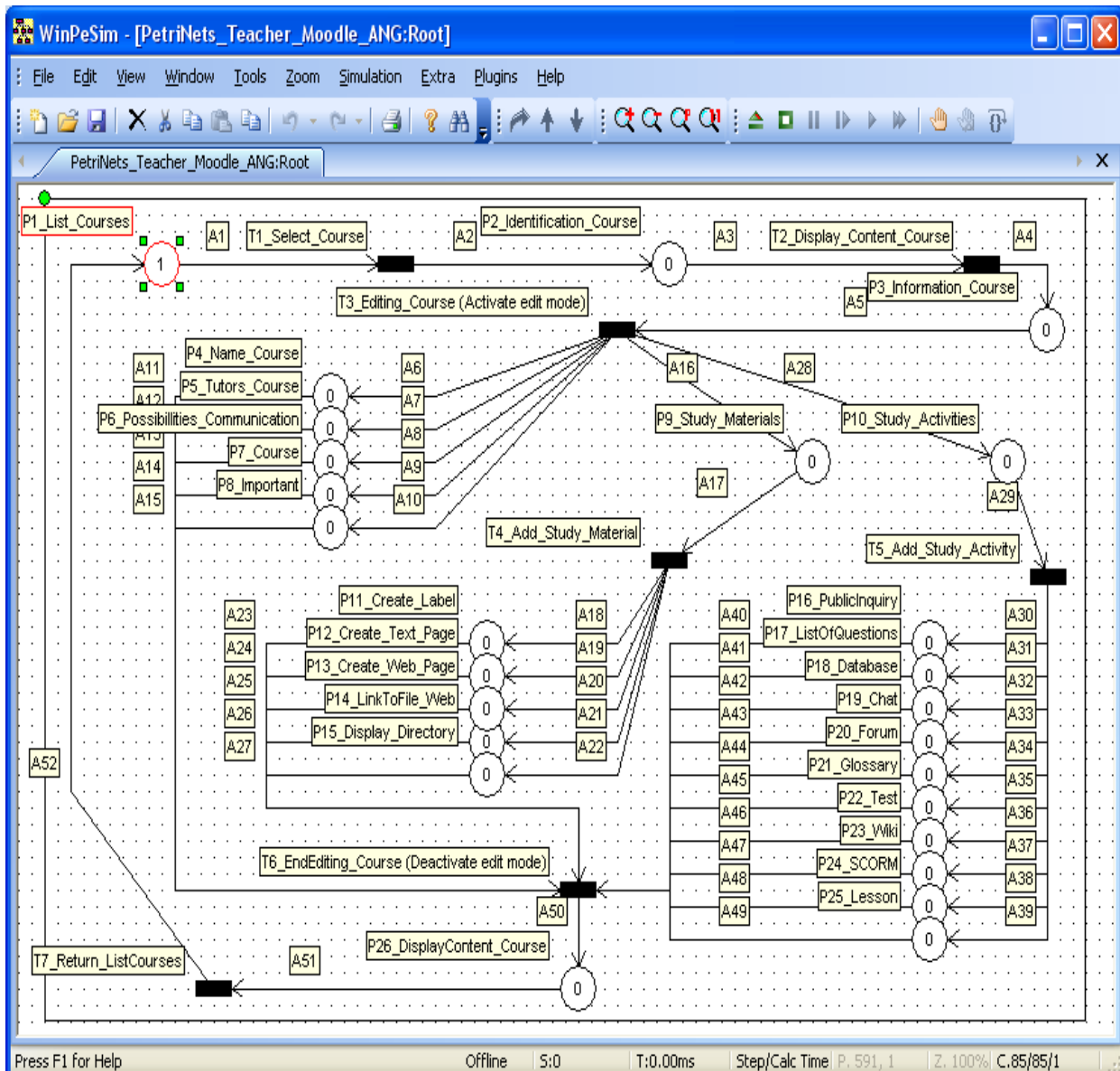
Figure 1: A model of a course environment in the Moodle system

Conclusion

The aim of education is to help all interested persons (students and users) to utilize selected products and processes. Optimal application of education in the area of operating and database systems needs effective knowledge about the software, relevant components, and functions. The correct education of all software products requires access to new versions of products, documentation, and to global communication. Interactive communication is important for correct understanding of new information and the transfer of this information into skills and knowledge. Hidden knowledge is valueless and it is lost for further use. Education avails needed methods, tools, and sources for unblocking the true value of knowledge and skills to all students. The key is contact with students and the search for new possibilities on the basis of interactive communication with the inclusion of simulation by Petri Nets. Systems that support education like Moodle offer learning activities for interactive communication such as Public inquiry, Database, List of questions, Forum, Chat, Test, Wiki, Glossary, Lesson, and SCORM. Lessons and SCORM activities transmit content and serve for individualizing presentations based upon a student's selections. Students gain benefit from our knowledge and skills by applying new methods and products in firms and organizations.

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Adaptive Techniques Usage Dependency for the Curriculum

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Abstract: The aim of adaptive hypermedia systems is present personalized information for the user which are relevant and the way, which is the most suitable for him. In the article we analyse usage of adaptive techniques Direct Guidance and Links Annotation for e-course personalization. The aim of the analysis is to find out, which technique is more effective in meaning of didactic efficiency. We aimed at the analysis of suitability of each adaptive technique depending on the type of educational material. In the experiment, we evaluated whether using of direct adaptive technique (e.g. technique of Direct Guidance, Hiding Links) is preferable in the lessons which are aimed at modification of the previous students` knowledge as in the lesson aimed at acquiring new knowledge.

Úvod

Problematika adaptívnych hypermediálnych systémov (AHS) vo vzdelávaní v sebe zahŕňa nielen ich technickú časť, t.j. potrebu vyriešenia a implementácie AHS, návrh adaptivity a štruktúry AHS, ale aj didaktickú, ktorá hľadá nové možnosti v podpore výučby s IKT metódou e-learningu a pedagogicko-psychologickú súvisiacu s tvorbou materiálov pre podporu výučby, hľadaním vhodnej osnovy učiva, efektívneho podania študovanej problematiky a pod.

Prispôsobovanie v AHS je založené na vedomostiach o obsahu jednotlivých výučbových stránok, väzbách medzi nimi a predpokladoch o vedomostiach, preferenciách a ďalších charakteristikách študenta (Brusilovsky, 2001). Podstatnou činnosťou pri tvorbe AHS je práve vytvorenie obsahu a tiež získanie a reprezentácia vedomostí o prispôsobovaní. V súčasnosti sa využívajú najmä prístupy založené na explicitnej reprezentácii vedomostí prostredníctvom pravidiel (Bureš, 2005).

Adaptívna podpora navigácie

AHS sú založené na dvoch skupinách techník prispôsobovania: adaptívna prezentácia a adaptívna podpora navigácie. Hlavným spôsobom adaptívnej prezentácie je adaptívna prezentácia textu. Do adaptívnej prezentácie preto patria techniky alternatívneho zobrazovania fragmentov stránok alebo celých stránok, alternatívne zobrazenie obrázkov, alternatívny text, rozbaľovací text a iné (Brusilovsky, 2003). Uskutočnený experiment sa venuje dvom technikám adaptívnej podpory navigácie, z toho dôvodu sa budeme v ďalšom texte venovať hlavne týmto technikám.

Adaptívna podpora navigácie spočíva v ovplyvňovaní cesty používateľa v informačnom priestore. Pri tejto technike vyhodnocuje adaptačné jadro systému vhodnosť každého zobrazovaného odkazu pre používateľa a predkladá mu výsledok, na základe ktorého ovplyvňuje cestu používateľa v systéme dokumentov. Toto ovplyvňovanie môže byť direktívne v tom zmysle, že systém znemožní cesty, ktoré nie sú pre používateľa v danom kontexte „vhodné" alebo nedirektívne, kedy rôznymi prostriedkami používateľského rozhrania systém prezentuje používateľovi odporúčané (alebo neodporúčané) cesty v informačnom priestore. Pri nedirektívnom prístupe systém odkazy iba usporiada podľa dôležitosti, resp. inak odlíši dôležitý odkaz (Brusilovsky, 2001).

Na realizáciu uvedených metód navigácie v informačnom obsahu, či už pri direktívnom alebo nedirektívnom prístupe, sa používajú najmä tieto techniky:

- priame vedenie: AHS vedie používateľa v informačnom priestore, t.j. vyberá najvhodnejšie koncepty a fragmenty im priradené. Realizuje sa pomocou typického tlačidla „Ďalej",

- usporiadanie odkazov: odkazy na ďalšie stránky sa hierarchicky usporiadajú podľa vhodnosti,
- anotácia odkazov: adaptívny systém označuje odkazy „vhodné" pre používateľa (De Bra a Calvi, 1998),
- skrývanie odkazov: odkazy, ktoré vedú k neodporúčaným informáciám sa skryjú. Skrývanie možno realizovať niekoľkými formami: odkaz sa nezobrazí (zobrazí sa iba text odkazu), odkaz sa blokuje (spôsob prezentácie závisí od kombinácie nezobrazenia odkazu a anotácie odkazu), alebo odkaz sa zruší z prezentácie,
- generovanie odkazov: AHS dynamicky generuje nové odkazy (napr. objavuje súvislosti medzi jednotlivými konceptmi),
- adaptácia máp: AHS na základe modelu používateľa a/alebo modelu prostredia dynamicky vytvára mapu domény (Bieliková a Šaloun, 2007)(Kaplan, 1998)(Paterno a Mancini, 1999).

Realizované experimenty s podobným zameraním

Pri analýze článkov z dostupných digitálnych knižníc sme našli niekoľko experimentov zameraných na využitie AHS vo vzdelávaní a na porovnanie adaptívnych techník.

Medzi prvými bol experiment, ktorý realizoval M. Specht v roku 1998 na Institute for Applied Information Technology v Sankt Augustin v Nemecku (Specht, 1998). Zaujímavosťou je, že sám M. Specht priznáva, že boli realizované dva experimenty, pričom jeden sa skončil neúspechom, pretože viacero študentov nedokončilo záverečný test. V úspešne realizovanom experimente sa kombinácia adaptívnej anotácie a skrývania liniek javila ako najlepšia kombinácia pre získavanie nových vedomostí. Autor dospel k záveru, že kombinácia viacerých foriem adaptácie dokáže študentom vytvoriť dobré a hlavne motivačné študijné prostredie, ktoré ich núti k štúdiu. Ako najzaujímavejšie techniky študenti označili adaptívne odporúčanie liniek a kombináciu odporúčania liniek a skrývania liniek.

Podobné výsledky mal i experiment, ktorý bol realizovaný v roku 1998. K. Höök a M. Svensson sa v ňom zamerali nielen na porovnanie rozdielov medzi výučbou s podporou AHS a výučbou bez adaptívnej podpory, ale aj na možnosti adaptivity výučby v prvom ročníku štúdia v porovnaní s ostatnými ročníkmi (Höök a Svensson, 1998). Výsledky experimentu ukázali významný vzťah medzi predchádzajúcimi vedomosťami študentov a adaptívnou anotáciou študijných materiálov. Výskumom sa zistilo, že študenti s dobrými vstupnými vedomosťami z predkladanej študijnej problematiky skôr preferovali adaptívnu techniku odporúčania odkazov, oproti študentom so slabšími vedomosťami, ktorí skôr preferovali techniku priameho vedenia.

Podobné experimenty boli realizované aj na Katedre informatiky FPV UKF v Nitre (Kapusta a Munk, 2009), (Kapusta, 2009). V nich sme overili didaktickú účinnosť použitia adaptívnych hyperemediálnych systémov vo vysokoškolskom vzdelávaní. Štatisticky sme preukázali, že nasadenie systému s priamym vedením malo pozitívny vplyv na výsledky záverečného testu u študentov študujúcich s touto podporou. Tiež pri technike adaptívneho odporúčania odkazov, napriek tomu, že sa nepotvrdil štatisticky významný rozdiel, bolo na základe výsledkov popisnej štatistiky vidieť lepšie výsledky v záverečnom teste. Z adaptívnych techník sa ako najvhodnejšia z hľadiska didaktickej účinnosti javí práve technika priameho vedenia.

Vhodnosť adaptívnych techník v závislosti od vzdelávacieho obsahu

Pri analýze našich predchádzajúcich experimentov sme si všimli rozdiely vo výsledkoch záverečného testu aj v parciálnom porovnaní úspešnosti študentov v jednotlivých kapitolách kurzu. Z tohto faktu sme usúdili, že vhodnosť aplikovania adaptívnych techník je závislá aj na type vzdelávacieho obsahu.

Pri výučbe programovacích jazykov majú niekedy študenti výhodu, že niektoré oblasti problémov výučby programovacích jazykov sú skoro totožné. Napr. syntax jazyka PHP vychádza z jazyka C, t.j. študenti poznajúci programovací jazyk C si veľmi ľahko osvoja aj syntax programovacích jazykov, ktoré z neho vychádzajú. Je zrejmé, že podobnú úvahu je možné urobiť asi v každom predmete (nie iba v predmete zameranom na programovacie jazyky), t.j. že niektoré časti predmetov vychádzajú z iných, predchádzajúcich vedomostí, ktoré si už študenti osvojili.

V skúmanej časti nášho kurzu zameraného na programovanie v jazyku PHP je možné vzdelávacie materiály a zároveň lekcie kurzu rozdeliť na dve skupiny. Prvou sú lekcie, v ktorých získané vedomosti študentov vychádzajú, resp. dopĺňajú vedomosti predchádzajúce, získané v iných kurzoch. V programovaní v jazyku PHP to je napr. základná syntax vychádzajúca z jazyka C alebo problematika práce so súborovým systémov, ktorá je tiež skoro rovnaká vo všetkých programovacích jazykoch. Sú to lekcie, v ktorých študenti získavajú nové vedomosti tak, že modifikujú svoje predchádzajúce. Okrem nich sa samozrejme v každom kurze nachádzajú aj lekcie, v ktorých využitie predchádzajúcich vedomostí nie je také významné. Napr. práca z databázami pomocou jazyka PHP je téma, ktorá je pre predmet špecifická, pretože na prácu z databázami v rôznych programovacích jazykoch je viacero prístupov (napr. aj v závislosti od typu programovania – komponentové, objektové, procedurálne a pod.).

Podľa nášho názoru je vhodnosť použitia konkrétnej adaptívnej techniky závislá na type vzdelávacieho obsahu. Myslíme si, že pri lekciách ktoré sú zamerané na modifikáciu predchádzajúcich vedomostí študentov je vhodnejšie použiť direktívnejšie techniky, napr. techniku priameho vedenia, skrývania odkazov, pretože tieto techniky zabránia povrchnému štúdiu.

Tento fakt sme overili pomocou experimentu. Experiment sme realizovali v letnom semestri 2008/2009 na vzorke 42 študentov v predmete Programovanie internetových aplikácií v kombinovanej forme bakalárskeho štúdia v odbore Aplikovaná informatika. V tomto predmete sme skúmali 3 tematické celky zamerané na programovanie v jazyku PHP.

Realizovaný experiment

Cieľom experimentu je porovnať vzájomný vzťah medzi vybranými adaptívnymi technikami v závislosti od vzdelávacieho obsahu. Skúmané adaptívne techniky Adaptívna anotácia liniek a Priame vedenie (*Links Annotation* and *Direct Guidance*) predstavujú nezávislé vzorky a relatívna úspešnosť z jednotlivých tematických celkov (*Post-Test 1*, *Post-Test 2*, *Post-Test 3*) predstavuje závislé vzorky. Mieru osvojených vedomostí budeme zisťovať vytvorenými didaktickými testami z nasledovných tematických celkov, ktoré zároveň predstavujú rôzne typy vzdelávacieho obsahu:

- tematicky celok 1: Základy programovania v PHP – téma zameraná na syntax jazyka PHP. Keďže táto syntax je podobná jazyku C, niektoré časti tematického celku sú iba modifikáciou už nadobudnutých vedomostí, t.j. tieto vedomosti sú univerzálne pre viaceré programovacie jazyk. Je tu však aj viacero rozdielnych častí t.j. špecifických pre daný jazyk ako napr. deklarácia premenných a pod.
- tematicky celok 2: Práca so súborovým systémom – téma zameraná na problematiku práce so súbormi, adresármi a súborovým systémom. Logika práce so súborovým systémom je univerzálna pre väčšinu programovacích jazykov, rozdiel je zvyčajne iba v názve funkcií určených pre prácu so súborovým systémom.
- tematicky celok 3: Práca s databázami v jazyku PHP – téma zameraná na problematiku databáz a ich programovania pomocou jazyka PHP. Väčšina učebného materiálu je špecifická pre jazyk PHP.

Realizovaný experiment pozostával z nasledovných krokov:

- Vytvorenie kontrolnej a experimentálnej skupiny
- Vytvorenie meracích procedúr a analýza spoľahlivosti:
  - o odhad reliability použitých didaktických testov
  - o identifikácia podozrivých úloh
- Realizácia experimentu:
  - o realizácia pretestu v skúmaných skupinách,
  - o podrobenie experimentálnej skupiny intervencii
  - o realizácia posttestu v skúmaných skupinách
- Porozumenie údajom.
- Overovanie validity použitých štatistických metód
- Analýza údajov a interpretácia výsledkov

Pre experiment bolo zvolené prostredie LMS Moodle. Tento manažovací vzdelávací systém bol vybraný nielen z dôvodu jeho implemtácie na našej univerzite ako univerzitného systému pre e-learning a elektronickú podporu štúdia, ale aj širokého používania v akademickej oblasti pri riadení výučby. Okrem viacerých dostupných aktivít v systéme, ktoré sme použili pre tvorbu e-kurzu chceme vyzdvihnúť modul Prednáška, ktorý sme použili na tvorbu lekcie pre priame vedenie študentov a modul iLMS, ktorý sme pre potreby experimentu implementovali do LMS Moodle. Tento modul bol použitý ako adaptívny systém pre odporúčanie odkazov.

Počas semestra sme v predmete „Programovanie internetových aplikácií" sledovali dve skupiny študentov, ktoré boli vytvorené štandardným zadelením do skupín. Študenti boli rozdelení na nasledovné skupiny:

1. s podporou modulu pre priame vedenie študenta (Direct Guidance) – skupina, ktorá študovala e-kurz s využitím modulu pre priame vedenie,
2. s podporou adaptívneho systému pre odporúčanie odkazov (Links Annotation) – skupina, v ktorej bol nasadený adaptívny systém iLMS.

Pre takéto zatriedenie do skupín sme sa rozhodli z dôvodu, že zvolené skupiny majú už vytvorené svoje virtuálne triedy v rámci systému. Kurzy v oboch skupinách mali jednotnú štruktúru aj obsah. Rozdiel v jednotlivých kurzoch bol v rozdielnej forme predkladania obsahu výučbového materiálu podľa použitej adaptívnej techniky. Učivo tematickej oblasti bolo rozdelené do malých častí, tak aby bola časť pri klasickom rozlíšení obrazovky vysoká na max. 1,5 zobraziteľnej plochy. Po každej časti nasledovala kontrolná otázka. Napriek tomu, že adaptívne systémy poskytujú možnosti pre vytvorenie oveľa zaujímavejšej štruktúry kurzu, takáto jednoduchá štruktúra kurzu bola použitá zámerne, aby sme „obohacovaním" adaptívnych kurzov neskresľovali výsledky.

Výsledky experimentu

Rovnocennosť skupín sme overili analýzou pretestu. Pretest bol realizovaný formou vstupného testu overujúceho základné vedomosti potrebné na zvládnutie preberanej problematiky. Vo vstupnom teste, ktorý pozostával z 15 otázok, sme sledovali skóre a čas, za ktorý jednotlivý študenti test vypracovali. Na základe výsledkov MANOVA sme potvrdili, že rozdiel v skóre pretestu a času potrebnom na jeho spracovanie medzi skupinami, nie je štatisticky významný, t.j. že skupiny sú rovnocenné.

Po ukončení štúdia sme vyhodnotili znalosti študentov pomocou záverečného testu. Záverečný test pozostával zo siedmych úloh. Tieto boli zamerané na kontrolu zvládnutia jednotlivých tematických oblastí predmetu.

Nulové hypotézy tvrdia, že relatívna úspešnosť – skóre nezávisí od obsahu učiva a od interakcii tohto faktora a použitej adaptívnej techniky na personalizáciu kurzu. Na testovanie hypotéz sme použili analýzu rozptylu, kde vnútro - skupinový faktor POSTTEST (*Post-Test 1*, *Post-Test 2*, *Post-Test 3*) predstavuje opakované merania/závislé vzorky a medzi - skupinový faktor Group (*Links Annotation*, *Direct Guidance*) predstavuje nezávislé vzorky.

Tabuľka 1 Upravené univariačné testy pre opakované merania

	G-G Epsilon	G-G Adj.df1	G-G Adj.df2	G-G Adj.p
POSTTEST	0.9287	1.8574	74.2952	0.2550
POST*Group	0.9287	1.8574	74.2952	0.0171

Na základe výsledkov analýzy rozptylu pre opakované merania (Tabuľka 1) nezamietame nulovú hypotézu (p > 0.05), ktorá tvrdí, že nie je štatisticky významný rozdiel v skóre testov, t. j. nepreukázali sa rozdiely v osvojených vedomostiach z preberaných tématických celkov.

Nasledujúci graf (Obrázok 1) vizualizuje výsledky analýzy rozptylu pre vnútro - skupinový faktor POSTTEST (*Post-Test 1*, *Post-Test 2*, *Post-Test 3*).
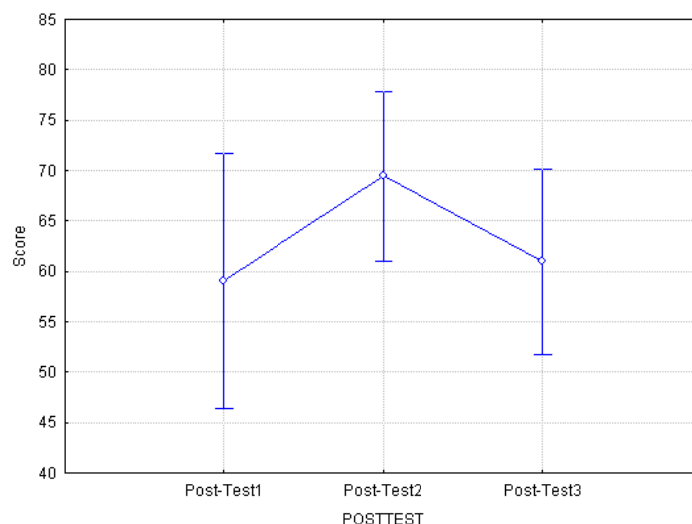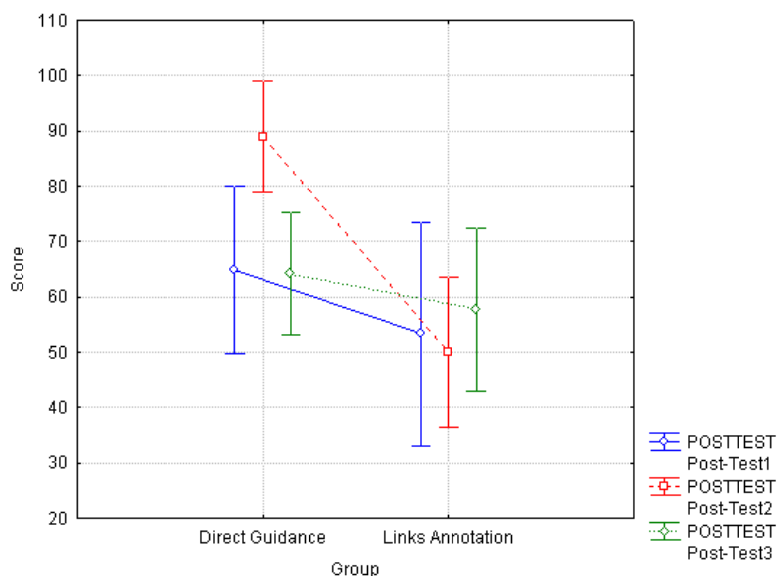
Obrázok 1 Graf priemeru a intervalu spoľahlivosti pre premennú POSTTEST

Naopak (Tabuľka 1) zamietame nulovú hypotézu s 95% spoľahlivosťou (p < 0.05), ktorá tvrdí, že nie je štatisticky významný rozdiel v kombinácii skóre testov a použitej adaptívnej techniky. Preukázali sa rozdiely v osvojených vedomostiach z preberaných tematických celkov v závislosti od použitej adaptívnej techniky na personalizáciu kurzov.

Nasledujúci graf (Obrázok 2) vizualizuje výsledky analýzy rozptylu pre kombináciu faktorov POSTTEST (*Post-Test 1*, *Post-Test 2*, *Post-Test 3*) a Group (*Links Annotation*, *Direct Guidance*).

Obrázok 2 Graf priemeru a intervalu spoľahlivosti pre parciálne výsledky premennej POSTTEST

Medzi ktorými tematickými celkami z hľadiska relatívnej úspešnosti a v závislosti od použitej adaptívnej techniky je štatisticky významný rozdiel zistíme z viacnásobného porovnávania.

Table 2 LSD test: Identifikácia homogénnych skupín

Group	POSTTEST	Mean	1	2
Links Annotation	Post-Test2	50.00	****	
Links Annotation	Post-Test1	53.33	****	
Links Annotation	Post-Test3	57.78	****	
Direct Guidance	Post-Test3	64.20	****	
Direct Guidance	Post-Test1	64.82	****	
Direct Guidance	Post-Test2	88.89		****

Z viacnásobného porovnávania (Tabuľka 2) sme identifikovali jednu homogénnu skupinu, v zmysle relatívnej úspešnosti z preberaných celkov, kde bola dosiahnutá rovnaká úspešnosť vo všetkých troch tematických celkoch v prípade použitia adaptívnej techniky Links Annotation a v prvom a treťom tématickom celku v prípade použitia Direct Guidance. Naopak bol preukázaný štatisticky významný rozdiel medzi úspešnosťou z druhého celku s použitím techniky Direct Guidance na personalizáciu kurzu a všetkými ostatnámi bez ohľadu na použitú techniku (p < 0.05).

Aby sme neznižovali silu štatistických testov overili sme predpoklady validity analýzy rozptylu pre opakované merania. Na testovanie podmienky sféricity kovariančnej matice sme použili Mauchleyov test sféricity, ktorý je určený pre opakované merania analýzy rozptylu s viac ako dvoma úrovňami.

Table 3 Mauchleyov test sféricity pre POSTTEST*Group

	W	Chi-Sqr.	df	p
POSTTEST	0,923214	3,115887	2	0,210569

Test (Tabuľka 3) nie je štatisticky významný, predpoklad nie je porušený.

Záver

V našom experimente sme porovnali a analyzovali vzájomný vzťah medzi vybranými adaptívnymi technikami v závislosti od vzdelávacieho obsahu. Štatisticky sme preukázali, že pri lekciách, ktoré hlavne modifikujú už získané vedomosti študentov, t.j. v programovaní sú to lekcie zamerané na univerzálne vedomosti rovnaké vo väčšine jazykov, bolo didakticky účinnejšie nasadenie systému priameho vedenia v porovnaní so systémom pre anotáciu liniek. Tento fakt bol preukázaný pri lekcii zameranej na prácu so súborovým systémom, ktorá je všeobecná u väčšiny programovacích jazykov. Z popisnej štatistiky je tiež vidieť lepšie výsledky aj pri lekcii Základy programovania v PHP, ktorá tiež vychádza z už existujúcich znalostí študentov z jazyka C.

Pri učebných materiáloch zameraných na získanie špecifických nových vedomostí pre konkrétny jazyk nie je použitie adaptívnej techniky tak dôležité ako pri univerzálnych vedomostiach. Štatistické výsledky experimentu si odôvodňujeme faktom, že pri vzdelávacích materiáloch, ktoré sú zamerané na modifikáciu už získaných vedomostí majú študenti sklon k povrchnému štúdiu. Systém pre anotáciu liniek im toto povrchné štúdium „umožní", keďže im učebné materiáli iba odporúča. Práve adaptívny systém priameho vedenia však študentom nedovolí povrchné štúdium, pretože preštudovanie a zobrazenie nasledujúcej časti je podmienené správnou odpoveďou na jednoduchú otázku, úspešným testom alebo úlohou.

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Decision Support System under Indeterminacy and Its Incorporation into LMS

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Abstract: Managing a learning process by means of an LMS (Learning Management System) requires solving complex decision processes which can be handled by using the System for support of decision-making (DSS). The DSSs are interactive computer systems which help decision-making subjects use data and models to solve unstructured problems. These systems are mostly based on risk analysis with usage of experience, judgement, and intuition and they allow a very fast and flexible analysis with fair response, which enables the use of intuition and judgement of an experienced teacher. Such decisions are frequently led by undetermined information, which requires other decision models. We presume a learning process with a closed management cycle using the DSS. The DSS is then influenced by outside limiting conditions, among others time conditions, minimal qualitative conditions, etc, as the main and determining for proper securing of the educational process. The LMS is then roofed by the DSS, which suggests and chooses the most optimal alternative of the educational process. The DSS is joined by independent parameters which characterize both the current status of the educational process and restricting conditions and objectives of the top management. With respect to the fact that the combination of their occurrence has various probability incidence, we evaluate them by means of expert systems. Independent parameters and expert knowledge enter the so-called statistic evaluation of probability of the individual suggested alternatives. The output is a vector of the alternatives which is structured according to the probability magnitude of the individual alternatives. In addition, each alternative has defined particular indicators which describe the given alternative. The system of the indicators then enters the mathematical model which teaches the standard of the given alternative. One of the most used methods for modelling of such systems uses a functional relation to describe the development of the parameter in the monitored period. The functional relation, which stems from the behaviour of dependent and independent parameters, must then necessarily copy various and mostly significant deviances in the magnitude of the independent parameters. This trend is then automatically transmitted, for no reason, into the behaviour prognosis of the given parameter. The most usual cause of such a status is the effort to achieve the best approximation of the time series defining the behaviour of the given parameters. The aim of the paper is to propose a method eliminating the above-mentioned, mostly incidental, deviances in behaviour of unknown parameters and thus to create a model which would simulate the main trends in the parameter behaviour more authentically.

Úvod

Řízení výukového procesu pomocí LMS (Learning Management System) vyžaduje řešení složitých rozhodovacích procesů, které lze zvládnout s využitím Systému na podporu rozhodování (SNPR). SNPR jsou interaktivní počítačové systémy, které pomáhají rozhodovacím subjektům využívat data a modely k řešení nestrukturovaných problémů. Tyto systémy jsou převážně založeny na analýze rizik s využitím

zkušeností, úsudku a intuice a umožňující velmi rychlou a flexibilní analýzu s dobrou odezvou, čímž umožňují uplatnění manažerské intuice a úsudku. Taková to rozhodování jsou však vedena mnohdy s neurčitými informacemi, což vyžaduje jiné modely rozhodování. Článek seznamuje se základními principy výstavby takového SNPR a jeho začlenění do LMS.

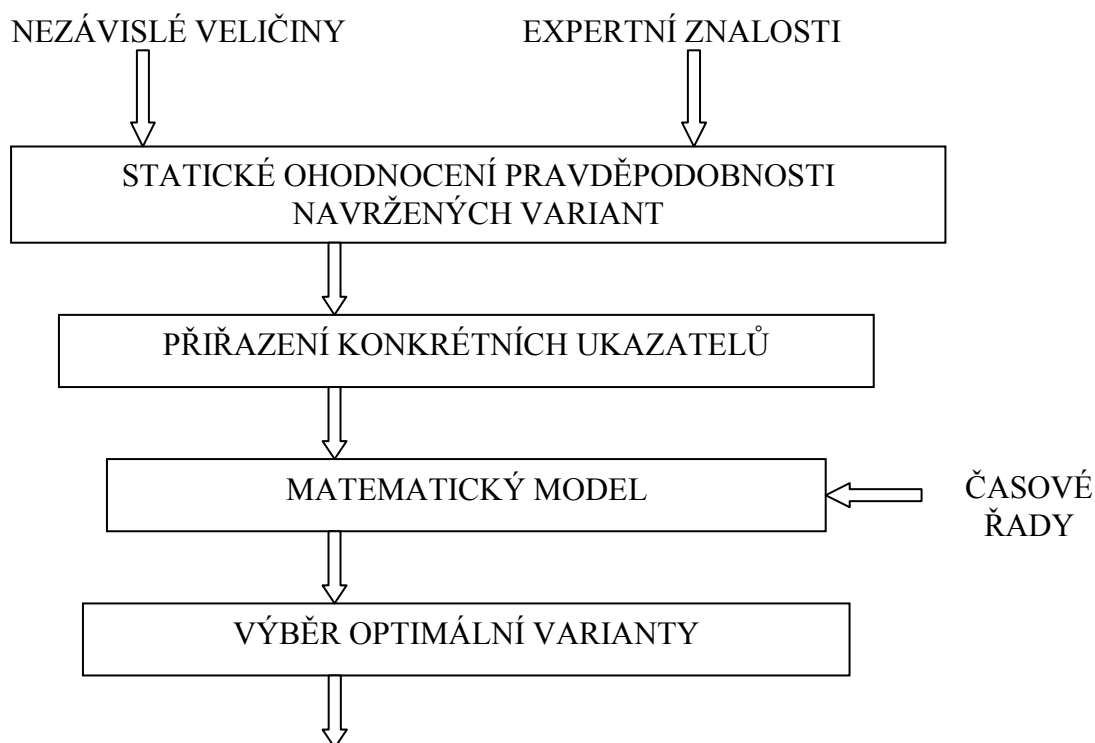## Funkce systému na podporu rozhodování ve výukovém procesu

Předpokládejme výukový proces v němž vyžadujeme uzavřený cyklus řízení prostřednictvím systému na podporu rozhodování. Struktura na obr. 1 vychází z potřeb optimálního řízení výuky na základě vnějších, tzv. omezujících podmínek a koncepčních cílů vzdělávací akce.
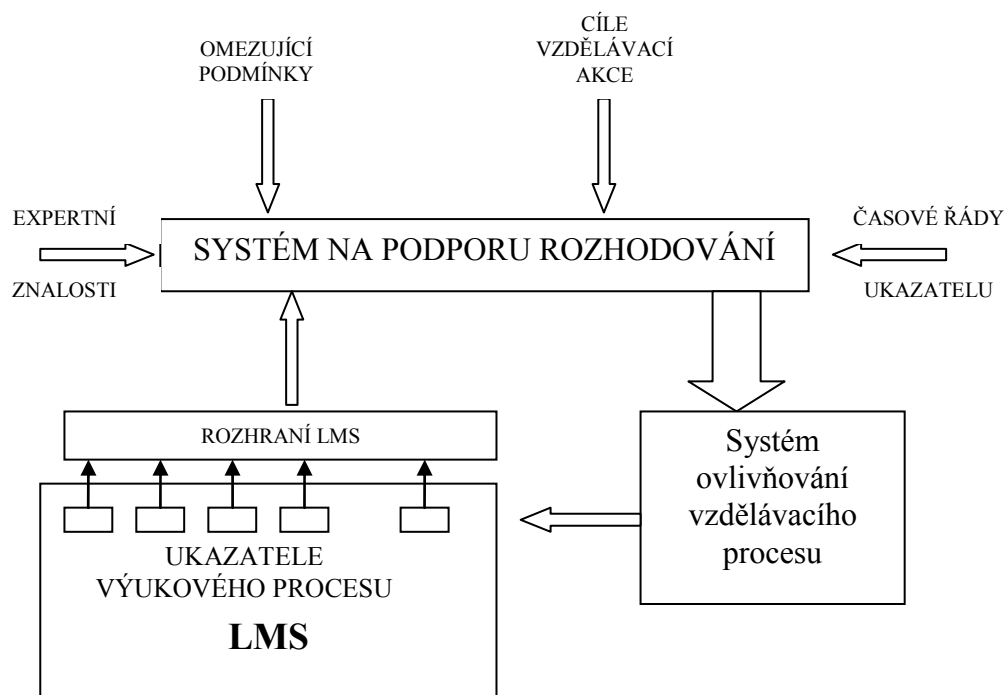
Obr 1. Obecná struktura řízení výuky v LMS

Okamžitý stav chování výukového procesu je zjišťován pomocí rozhraní, které poskytuje vybrané informace systému na podporu rozhodování a ten provádí ohodnocení jeho stavu. Do systému na podporu rozhodování dále vstupují vnější omezující podmínky, mezi které se řadí např. časové podmínky (časový rozvrh výuky), minimální kvalitativní podmínky apod. jako hlavní a určující pro zajištění patřičné kvality výukového procesu. Určující pro chování celého systému řízení jsou cíle vzdělávací akce. Dále se vychází z té skutečnosti, že jsou známy časové řady různých ukazatelů, charakterizujících chování vzdělávacího procesu v dřívějších obdobích. LMS je pak zastřešen systémem na podporu rozhodování, který navrhuje a vybírá nejoptimálnější variantu vzdělávacího procesu.

Vlastní funkce systému na podporu rozhodování je naznačeny na obr. 2.

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┌─────────────────────────────────┐        ┌─────────────────────────────────┐
│      NEZÁVISLÉ VELIČINY          │        │      EXPERTNÍ ZNALOSTI          │
└─────────────────────────────────┘        └─────────────────────────────────┘
                │                                           │
                ▼                                           ▼
┌───────────────────────────────────────────────────────────────────┐
│          STATICKÉ OHODNOCENÍ PRAVDĚPODOBNOSTI                       │
│                  NAVRŽENÝCH VARIANT                                 │
└───────────────────────────────────────────────────────────────────┘
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│               PŘIŘAZENÍ KONKRÉTNÍCH UKAZATELŮ                       │
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┌───────────────────────────────────────────────────────────────┐
│                   MATEMATICKÝ MODEL                            │◄──── ČASOVÉ ŘADY
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│               VÝBĚR OPTIMÁLNÍ VARIANTY                        │
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Obr. 2. Funkce systému na podporu rozhodování

Do systému na podporu rozhodování vstupují nezávislé veličiny, které charakterizují jednak současný stav vzdělávacího procesu (zjišťovaný rozhraním LMS) a jednak omezující podmínky a cíle vzdělávací akce. Vzhledem k tomu, že kombinace jejich výskytu má různou pravděpodobnost výskytu, pak je pomocí expertních znalostí ohodnotíme. Nezávislé veličiny a expertní znalosti vstupují do tzv. statického ohodnocení pravděpodobnosti jednotlivých navržených variant. Výstupem je vektor variant, uspořádaný podle velikosti pravděpodobnosti se kterou mohou tyto varianty nastat. Dále pro jednotlivé varianty jsou určeny konkrétní ukazatele, které popisují patřičnou variantu. Systém ukazatelů dále vstupuje do matematického modelu, který na bázi učících ukazatelů, tzn. jejich časových řad z minulosti určí normu příslušné varianty. Výpočet se provádí pro všechny varianty, z nichž je nutné v dalším kroku nalézt optimální variantu kombinace ukazatelů pro následné řízení výukového procesu.

Vymezení pojmů

Systém reprezentuje určitou abstrakci reálného objektu, který nezkoumáme v jeho komplexnosti, ale zkoumáme jen tu část, která nás zajímá a která je pro chování objektů, jež sledujeme, relevantní. Samotný systém může být popsán mnoha způsoby a různí řešitelé problematiky systémů chápají systém na různých informačních a strukturálních úrovních, což snadno vede k nedorozumění. Proto jistě nebude bez užitku pro další práci zavést popis systému pomocí hierarchie tzv. epistemologických úrovní. Jednotlivé úrovně je nutné volit tak, aby přechod z nižší na vyšší úroveň snížil neurčitost chování systému.

Zdrojový systém

Na nejnižší epistomologické úrovni je systém definován jako zdroj dat, a proto je také označován jako zdrojový systém. Je určen množinou veličin, časových okamžiků a hodnot. Jednotlivé veličiny na úrovni

zdrojového systému chápeme jako zdroje informací, které v daných časových okamžicích nabývají některého údaje z množiny hodnot. Na této úrovni není k dispozici žádná relace mezi jednotlivými veličinami. Na úrovni zdrojového systému mají všechny hodnoty stejnou pravděpodobnost.

Data systém

Je-li zdrojový systém doplněn daty, a to buď naměřenými nebo požadovanými, které jsou hodnotami veličin v určitých časových okamžicích, pak je tento systém označován jako data systém. Data systém je tedy definován jako dvojice S1 = (S0, Ma), kde S0 je definice systému na úrovni zdrojového systému a Ma je tzv. matice aktivity. Každý řádek uvedené matice je tvořen množinou hodnot, kterých nabývá určitá veličina během experimentu. Znalost těchto hodnot nám umožní odhadnout jednotlivé pravděpodobnosti, což sníží neurčitost popisu systému.

Generativní systém

Cílem přechodu od data systému ke generativnímu systému je vytvoření časově invariantních vztahů mezi jejich veličinami, a to tak, abychom byli schopni generovat stejná data (za stejných podmínek) jako jsou obsažena v matici aktivity Ma data systému. Generativní systém neobsahuje žádná data, obsahuje pouze relace, které data generují. Relace lze vyjádřit např. ve formě podmíněných pravděpodobností.

Strukturní systém

V definici generativního systému jsou vyjádřeny pouze různé druhy pravděpodobností. Cílem přechodu mezi generativní a strukturní úrovní je vystižení kauzálních vazeb mezi veličinami, specifikace struktury systému a formalizace kvalitativních vlastností jednotlivých vazeb.

Po zavedení systému epistemologických úrovní lze problémy z oblasti teorie systémů rozdělit na dvě disjunktní množiny - analýzu a syntézu. Problém spojený s transformací popisu systému z vyšší do nižší epistemologické úrovně je označován jako systémová analýza. Problém spojený s transformací popisu systému z nižší do vyšší epistemologické úrovně je označován jako systémová syntéza. Systémová analýza tedy obsahuje takové problémy, kdy hledáme vlastnosti systému na nižší úrovni při znalostech reprezentace systému na vyšší úrovni. Systémová syntéza pak obsahuje takové problémy, kdy hledáme vlastnosti systému na vyšší úrovni při znalostech reprezentace systému na nižší úrovni. Do oblasti analýzy spadá problematika diagnostiky, simulace atd. Do oblasti syntézy spadá problematika tvorby hypotéz, plánování a návrhu.

Systém na podporu rozhodování (SNPR) chápeme jako soubor mechanismů (nikoliv pouze technických) pro zabezpečení optimálního řízení. Systém na podporu rozhodování je determinován reálným objektem, pro jehož řízení je budován. Obecně lze na něj nahlížet jako na systém zpracování informace, který je jak horizontálně, tak vertikálně bohatě členěn. Horizontální členění přitom respektuje takové účelové abstrakce, které jsou na dané úrovni zpracování relevantní. Vertikální členění vystihuje problematiku zpracování informace od jejího vzniku až po využití výsledků jejího zpracování. Jednotlivé vrstvy vertikálního členění jsou uvedeny na obr. 3.

Rozhodovací vrstva
Vrstva
Analytická vrstva
Vrstva monitorovacích systémů
Vrstva zdrojů

Obr. 3. Vertikální členění SNPR

Nejvyšší "rozhodovací vrstva" zahrnuje aktivity pro volby optimálních řídících zásahů a jejich aplikaci při řízení daného systému. Pro tuto činnost jsou nezbytné jak informace o stavu systému, případně trendy jeho vývoje, tak i znalosti o zákonitostech, kterými se chování systému řídí, tzn. popis na úrovni strukturního systému. Tento popis musí být již v počátcích činnosti SNPR k dispozici s tím, že v průběhu

práce SNPR může být dále zdokonalován. Informace o stavu systému jsou produktem nižších vrstev SNPR.

Vrstva zdrojů informací reprezentuje reálný objekt ve formě data systému. Význam uvedené vrstvy je v tom, že je jediným zdrojem informace. Pro efektivní činnosti SNPR je tedy nezbytné, aby vrstva zdrojů informací obsahovala veškerou (reálně dostupnou) informaci o chování reálného objektu, a to jak množiny sledovaných nositelů informace (veškeré relevantní veličiny), tak kvality informace jednotlivých nositelů (co do přesnosti i co do času).

Základní manipulací s informací obsaženou v jednotlivých nositelů informace vrstvy zdrojů je jejich tzv. sběr (monitorování), který spočívá v transformaci informace do určité datové struktury. Dále předpokládejme, že uvedené operace budou realizovány pomocí tzv. monitorovacích systémů, tedy technických prostředků pro měření, převod, přenos a ukládání dat. Tato vrstva poskytuje monitorovaná data v tvaru vhodném pro další zpracování na úrovni vyšších vrstev.

Obecně je nutno monitorovaná data dále zpracovávat. Jednak mohou být zatížena různými chybami, ale hlavně v řadě případů není technicky možné měřit požadované veličiny přímo, nýbrž je nutno provést měření takových veličin, ze kterých lze požadované stanovit. Tento proces monitorování není obecně triviální a v řadě případů je jím kvalita SNPR podstatně ovlivněna. Monitorovaná data, která produkuje vrstva monitorovacích systémů, se na úrovních analytické vrstvy a vrstvy syntéz dále zpracovává a výsledkem je informace o stavu systému, a to na základě syntézy analyzovaných monitorovaných dat, případně opakované syntézy spojené se simulací a v nejkomplikovanějších případech výsledkem víceúrovňové syntézy a simulace.

Využití SNPR je vhodné v takových aplikacích, kde uvažovaný řízený systém je natolik složitý, že jednak samotný automatický provoz monitorovacích systémů a následné vyhodnocení monitorovaných dat je na daném stupni rozvoje vědy a techniky nereálné a jednak nejsou dostupné úplné znalosti pro generaci opatření pro řízení uvažovaného systému. V tomto případě je nezbytná spolupráce příslušných specialistů jak v procesu identifikace stavu řízeného systému, tak v generaci a výběru varianty řídícího zásahu. Na druhou stranu SNPR prostřednictvím svých technických, programových a znalostních prostředků tvoři pro složité systémy prostředek, bez něhož je proces řízení systému nemyslitelný.

Matematický model strategického rozhodování za neurčitosti

Při strategickém rozhodování o směrování výuky je velice výhodné využít informace z dřívějšího vývoje, neboť v nich jsou zakódovány závislosti jejich jednotlivých složek. Těchto informací lze také s výhodou využít i pro predikování vývoje různých ukazatelů učení a jejich následnou optimalizaci. Jedná se o úlohy modelování závislostí různých ukazatelů a následné vyhodnocování variant z hlediska určitých optimalizačních kritérií.

Jedna z možností, jak modelovat výukové systémy, vychází z popisu vývoje veličiny ve sledovaném období funkčního vztahu, vycházejícího z chování závislé a nezávislých veličin, který pak nutně musí kopírovat různé a většinou značné výchylky ve velikosti nezávislých veličin. Tento trend se pak automaticky přenáší zcela bezdůvodně i do prognózy chování dané veličiny. Nejčastější příčinou tohoto stavu je snaha o nejlepší aproximaci časových řad charakterizujících chování daných veličin.

Cílem této části je navrhnout metodu eliminace uvedených většinou náhodných výchylek v chování nezávislých veličin a vytvořit tak model, který by věrněji simuloval hlavní trendy v chování veličin.

Předpokládejme, že je dáno n veličin $x_1, ..x_n$ a každá je popsána časovou řadou $x_i=\{x_{it} : t \in T\}$ a dále je dána veličina y závislá na $x_1,...,x_n$ rovněž s časovou řadou $y=\{y_t : t \in T\}$.

Naším cílem je určit algoritmus (lineárního typu), který by z obecných hodnot $x_1,...,x_n$ určil veličinu y,

$$(x_1,...,x_n) \rightarrow y,$$

a to v souladu s průběhem časových řad $x_1, ...,x_n, y$ v období T.

Za tímto účelem si provedeme nejdříve určité kvalitativní rozdělení universa každé nezávislé veličiny x_i s cílem popsat zóny v těchto universech, které mají kvalitativně různé vlivy na chování závislé veličiny y. K tomuto cíli nám nejlépe poslouží teorie fuzzy množin.

Pro každou proměnnou x_i budeme tedy v množině reálných čísel *Re* definovat fuzzy relaci $R_{ik} \cong \mathrm{Re}^2, k = 1,...,m_i$ popisující hodnoty proměnné x_i s přibližně stejným vlivem na chování veličiny *y*. Vzhledem k předpokládanému hladkému průběhu funkcí R_{ik} budeme předpokládat, že R_{ik} je kartézským součinem nějaké fuzzy množiny $A_{ik} \cong \mathrm{Re}$, tj.

$$R_{ik}(x, x') = A_{ik}(x) \wedge A_{ik}(x').$$

Z hlediska vlastní interpretace této relace budeme dále předpokládat, že dvě hodnoty *x,x´* nezávisle proměnné x_i mají přibližně stejný vliv na chování *y*, pokud existuje $k, 1 \le k \le m_i$ \5k, 1 \), tak, že

$$x, x' \in Supp(R_{ik}) = \left\{ (z, z') \in \mathrm{Re}^2 : R_{ik}(z, z') > 0 \right\}$$

Po fuzzy relacích R_{ik} resp. fuzzy množinách A_{ik} budeme požadovat, aby splňovaly následující axiomy:

(1) Pro každé $i, 1 \le i \le n$, každé $t \in T$ a každé $x_{it} \in X_i$ existuje $k, 1 \le k \le m_i$ tak, že $A_{ik}(x_{it}) \succ 0$.

(2) Jestliže $R_{ik}(x, x') > 0$, pak změna veličiny *y* způsobená změnou veličiny x_i z hodnoty *x* na *x´* je **„malá"**.

(3) Stupeň pravdivosti výroku (2) závisí pozitivně na hodnotě výrazu $R_{ik}(x, x')$.

Uvedené axiomy (s výjimkou (1)) jsou nepřesně formulovány a převážně vyjadřují intuitivní význam zavedení fuzzy relací $R_{ik.}$.

Zásadním problémem je určení změny veličiny *y* při změně veličiny x_i z hodnoty *x* na *x´*, když k dispozici jsou pouze hodnoty diskrétních časových řad X_i, Y. Za účelem přesnější formulace uvedených axiomů budeme uvažovat klasický model závislosti x_i a *y*, získaný např. metodou nejmenších čtverců, tj.

$$y = \sum_{i=1}^{n} a_i x_i + a_0 \quad (1)$$

pomocí časových řad x_i, y. Na tomto místě se dopouštíme chyby tak, jak jsme se o tom zmínili v úvodu. Vzhledem k tomu, že vztah (1) **nepoužíváme pro predikci**, ale pouze pro analýzu závislosti *y* na x_i v daném období *T* a dále pro určení fuzzy množin A_{ik}, jejichž další využití je velmi robustní a bez zásadního vlivu na výsledek, není důsledek využití vztahu (1) tak závažný, jako při klasickém použití. Pomocí této úvahy můžeme formulovat axiomy (2), (3) přesně a to následujícím způsobem.

Jestliže dvě hodnoty *x,x´* veličiny x_i leží v jádru fuzzy relace $R_{ik,}$, tj. $R_{ik}(x,x') = 1$ (tj. mají vskutku analogický vliv na chování *y*), pak budeme požadovat, aby platilo

$$|d(x, x')| = |y(x_1,...,x,...,x_n) - y(x_1,...,x',...,x_n)| < \varepsilon$$

pro všechny $x_1,...,x_n$ a dané $\varepsilon > 0$. Jestliže ale *x,x´* mají jen přibližně stejný vliv, tj. $0 < R_{ik}(x, x') < 1$, pak připouštíme, že hodnota ε se může zvětšit o určité procento tím větší, čím menší je hodnota $R_{ik}(x,x')$, tj. lze psát

$$|d(x, x')| < \varepsilon + (1 - R_{ik}(x, x'))\varepsilon.$$

Vzhledem k tomu, že pro určení $d_i(x,x')$ používáme vztah (1), je $|d_i(x, x')| = |a_i(x, x')|$ a tedy axiomy (2) a (3) můžeme přepsat do následujícího sjednocujícího axiomu:

(2') Existuje $\varepsilon > 0$ takové, že pro každé *i* a hodnoty $x_1,...,x_{i-1}, x_{i+1}...,x_n$, *x,x´* $\in Re$ splňující podmínku

$$R_{ik}(x, x') > 0 \text{ platí } |x - x'| < \frac{\varepsilon}{|a_i|}.(2 - A_{ik}(x') \wedge A_{ik}(x)).$$

Axiomy (1), (2') nám nyní dávají dobrý předpoklad pro konstrukci fuzzy množin A_{ik}. K určení A_{ik} je zapotřebí specifikovat:

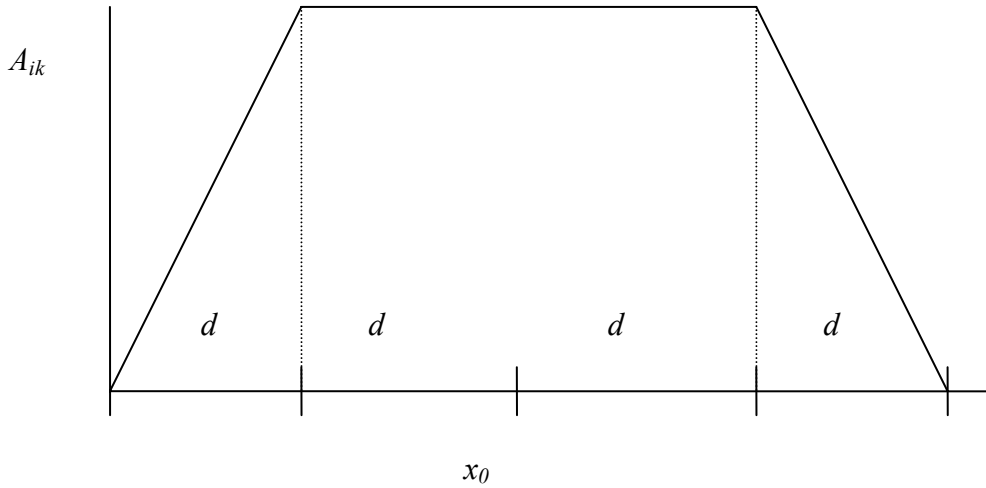(a) tvar funkce A_{ik},
(b) polohu funkce A_{ik} v *Re*.

Předpokládejme, že *Supp(A$_{ik}$)=(b$_1$,b$_2$)*, pak podle axiomu (2') musí platit

$$\left|b_1 - b_2\right| < \frac{\varepsilon}{\left|a_i\right|}(2 - R_{ik}(b_1, b_2)) \le 2.\frac{\varepsilon}{\left|a_i\right|}$$

a podobně jestliže *Ker A$_{ik}$ = (c$_1$,c$_2$)*, musí platit

$$\left|c_1 - c_2\right| < \frac{\varepsilon}{\left|a_i\right|}(2 - R_{ik}(c_1, c_2)) = \frac{\varepsilon}{\left|a_i\right|}.$$

Pokud budeme předpokládat, že *A$_{ik}$* je symetrická, můžeme tvar *A$_{ik}$* definovat následujícím způsobem

x_0

Obr. 4. Tvar fuzzy množiny *A$_{ik}$*

Přičemž $d = 2\frac{\varepsilon}{\left|a_i\right|}$.

Platí pak následující věta (bez důkazu):

Fuzzy množina *A$_{ik}$* definovaná výše uvedeným způsobem splňuje axiom (2') pro každé *x$_0$*.

Pro řešení úlohy (b) se zaměříme na analýzu časové řady *X$_i$* vzhledem ke shlukům délky 2c = délka *Supp A$_{ik}$* a tím m.j. získáme i číslo *m$_i$.*

Řekneme tedy, že *S* je c-shluk v *X$_i$*, jestliže existují *x,x´, ∈ X$_i$* takové, že platí

1) *S=[x,x´] ∩ X$_i$*
2) *|x-x´| < 2c*

Pro dva shluky *S, S´* můžeme psát *S ≤ S´* právě, když pro každé *x ∈ S, x´ ∈ S´, x ≤ x´*.
Pak zřejmě existuje jediný systém c-shluků *{S$_i$}* takový, že

$$S_1 < S_2 < \ldots. < S_{mi}, \bigcup S_k = X_i$$

Konstrukce *S$_k$* je zřejmá:

$$S_1 = \left\{x \in X_i : x - x_{\min} < 2c\right\}$$

kde *x$_{min}$* je nejmenší prvek v *X$_i$*. Jestliže jsou již dány *S$_1$,.....,S$_k$*, pak

$$S_{k+1} = \left\{x \in X_i : x \ge x_k, x - x_k < 2c\right\},$$

kde *x$_k$* je nejmenší prvek v *X$_i$*, větší než všechny prvky v *S$_k$*

Tento postup se opakuje dokud $\bigcup S_k \ne X_i$. Pak za prvek *x$_0$* z konstrukce fuzzy množiny *A$_{ik}$* volíme těžiště c-shluku *S$_k$*, tj.

$$x_0 = \sum_{x \in S_k} x / Card.S_{k.}$$

Další krok spočívá v určení chování výsledné veličiny *y* při různých kvalitativních vstupech jednotlivých proměnných x_i. Protože každá proměnná x_i má celkem m_i druhů kvalitativně odlišných hodnot, dostáváme celkem $m_1,…,m_n$ vztahů, vyjadřujících všechny možné kombinace. Je možné, že z praktického hlediska jsou některé kombinace nereálné, vyloučit je však při této obecné úvaze nemůžeme.

Pro všechny možné kombinace fuzzy množin *(A₁ₖ₁,…,Aₘₖₘ)*, označované vektorem $k = [k_1,….,k_m]$, kde $1 \le k_i \le m_i$, je nutné určit koeficienty v následující implikaci.

Jestliže $k = [k_1,...,k_m]$, pak $y(x,k) = \sum_{i=1}^{m} a_{k,i}.x_i + a_{k,0}$

kde $a_{k,i}$ jsou nějaké koeficienty, přičemž kriteriem bude, aby vztah (2) byl nejtěsnější pro ty hodnoty časových řad $X_1,….,X_m$ a *Y*, které jsou nejvystiženěji popsány kvalitativní charakteristikou *k*, tj. pro ty hodnoty $x_1,….,x_m$ pro než je hodnota výrazu $A_{1k1}(x_1) \wedge ….A_{mkm}(x_m)$ maximální ze všech

ostatních možných voleb kvalitativních charakteristik *k*.

Mějme danou kvalitativní charakteristiku $k = [k_1,….,k_m]$. Pro každý časový okamžik *t* $\in$ *T* si určíme váhu ω_t vztahem

$$\omega_t = A_{1k1}(x_{1t}) \wedge … \wedge A_{mkm}(x_{mt}).$$

Pak koeficienty ze vztahu (2) určíme tak, aby

$$\frac{\sum_{t \in T} \left[y_t - (\sum_{i=1}^{m} a_{k,i} \times_{i,t} + a_{k,0}) \right]^2 .\omega_t}{\sum_{t \in T} \omega_t} \xrightarrow{!} \min$$

Jinými slovy, nejvíce na zřetel bereme vzniklé chyby u těch časových okamžiků *t* $\in$ *T*, u nichž hodnoty veličin $x_1,…,x_m$ nejlépe odpovídají charakteristice *k*.

Pro vlastní určení koeficientů $a_{k,i}$ je možno použít klasický postup, tj. koeficienty jsou řešením systému lineárních rovnic s maticí

$$\left\| \begin{matrix} \sum \omega_t & \sum \omega_t x_{1t} & ….. & \sum \omega_t x_{mt} & \vdots & \sum \omega_t y_t \\ \sum \omega_t x_{1t} & \sum \omega_t x_{1t}^2 & ….. & \sum \omega_1 x_{1t} x_{mt} & \vdots & \sum \omega_t y_t x_{1t} \\ \vdots & & & & \vdots & \vdots \\ \sum \omega_t x_{mt} & \sum \omega_t x_{1t} x_{mt} & ….. & \sum \omega_t x_{mt}^2 & \vdots & \sum \omega_t y_t x_{mt} \end{matrix} \right\|$$

Tímto způsobem dostaneme pro každou kvalitativní charakteristiku *k* popis funkční závislosti *y(x,k)*, která daleko věrněji popisuje chování *y* v závislosti na $x_1,…,x_m$.

Další postup spočívá v určení funkční závislosti *y=y(x)* pomocí systému implikací $k = [k_1,...,k_m] \Rightarrow y(x,k)$. Pro každou kvalitativní charakteristiku *k* a vektor hodnot *x* položíme

$$[k,x] := A_{1k1}(x_1) \wedge … \wedge A_{mkm}(x_m)$$

Pak určení hodnoty *y=y(x)* obdržíme následujícím způsobem:

Rozdělme si nejdříve množinu indexů $J = \{1,...,m\}$ v závislosti na vektoru *x*, na tři disjunktní podmnožiny:

$$J_1 = \left\{ j \in J : x_j \in \bigcup_{t=1}^{mj} SuppA_{j,t} =: S_j \right\}$$

$$J_2 = \left\{ j \in J : x_j \in \left[x_{j,\min}, x_{j,\max} \right] - S_j \right\}$$

$$J_3 = \left\{ j \in J : x_j \notin \left[x_{j,\min}, x_{j,\max} \right] \right\}$$

kde veličiny $x_{j,\min}, x_{j,\max}$ jsou definovány následovně:

$$x_{j,\min} = \min(\bigcup_{t=1}^{mj} SupA_{j,t})$$

$$x_{j,\max} = \max(\bigcup_{t=1}^{mj} SuppA_{j,t}).$$
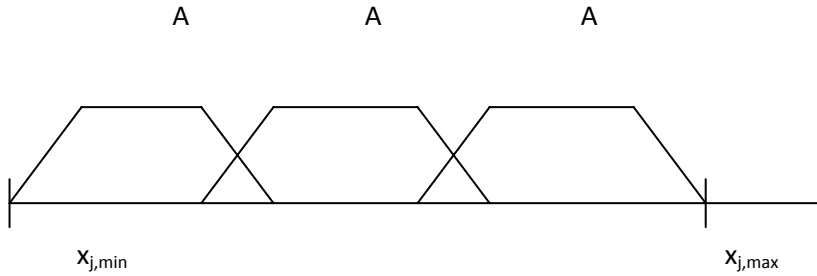
Obr. 5. Rozložení fuzzy množin

Pro každý index $j \in J$ definujme čtveřici hodnot k_j, p_j, w_j, v_j, kde $1 \le k_j, p_j \le m_j, v_j, w_1 \in \text{Re}$, následujícím způsobem:

1. $j \in J_1$

Pak existuje index k_j takový, že $x_j \in Supp\, A_{j,kj}$. Položíme $P_j= k_j$, $v_{j=}\ w_j=x_j$.

2. $j \in J_2$

Pak existují dvě fuzzy množiny $A_{j,kj}$, $A_{j,pj}$, jejichž nosiče jsou nejblíže hodnotě x_j. Za hodnoty v_j, w_j volíme největší, resp. nejmenší prvek v jádrech těchto fuzzy množin.
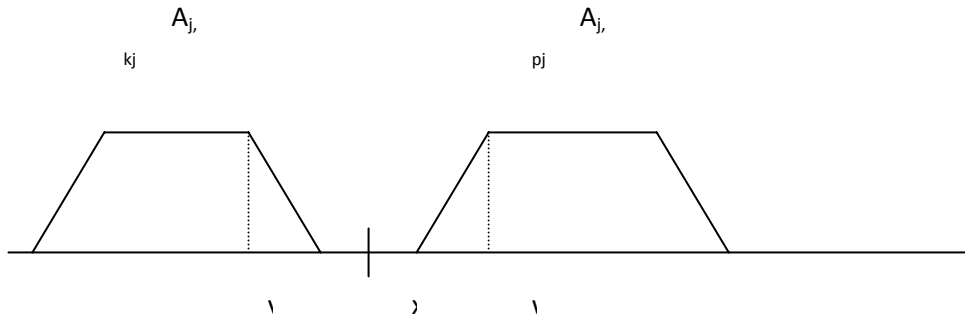
Obr. 6. Rozložení fuzzy množin pro $j \in J_2$

3. $j \in J_3$

Pak rovněž existují dvě fuzzy množiny $A_{j,kj}$, $A_{j,pj}$, jejichž nosiče jsou nejblíže hodnotě x_j. Za hodnoty v_j, w_j volíme největší prvky v jádrech těchto fuzzy množin.
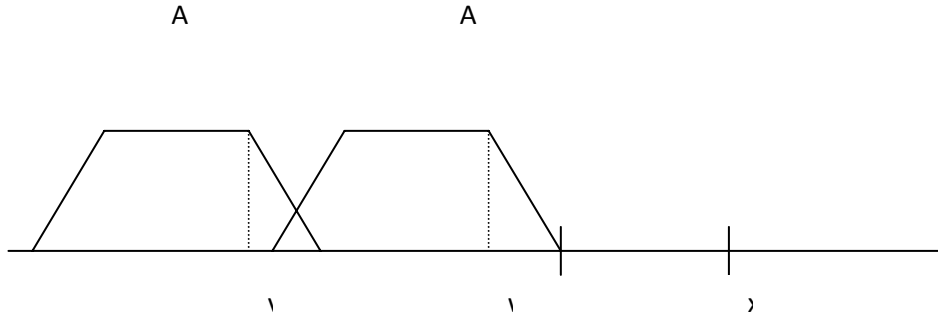
Obr. 7. Rozložení fuzzy množin pro $j \in J_3$

Pak kvalitativní charakteristika $k = [k_1, \ldots, k_m]$, resp. $p = [p_1, \ldots, p_m]$ nejvěrněji popisují veličinu x ze všech dostupných popisů a hodnoty $v = [v_1, \ldots, v_m]$, resp. $w = [w_1, \ldots, w_m]$ nejlépe odpovídají těmto kvalitativním charakteristikám. Proto k vytvoření hodnoty $y=y(x)$ je přirozené použít hodnot $y(v,k)$ a $y(w,p)$ a to s váhami, určenými "vzdáleností" vektoru x od w a v.

Položme tedy

$$h_1 = \sum_{j \in J_1} |x_j| + \sum_{j \in J_2} (w_j - x_j) + \sum_{j \in J_3} (x_j + w_j)$$

$$h_2 = \sum_{j \in J_2} (x_j - v_j) + \sum_{j \in J_3} (x_j - v_j).$$

Nechť dále pro dané *x* je *K(x)* následující systém dvojic kvalitativních charakteristik

$$K(x) = \left\{ (r,s) \in K^2 : r_1 = k_i, s_i = p_i, i \in J_2 \cup J_3 \right\}$$

kde *K* je množina všech kvalitativních charakteristik. Pak položíme

$$y(x) = \frac{\sum_{(r,s) \in K(x)} (y(v,r).[r,v]h_1 + y(w,s).[s,w]h_2)}{\sum_{(r,s) \in K(x)} ([r,v]h_1 + [s,w]h_2)}$$

Tímto způsobem na základě znalosti časových řad *X* a *Y* určíme pro konkrétní hodnoty *x* výslednou veličinu *y*. Uvedený systém může m.j. sloužit jako podklad pro generování různých alternativ vývoje určitých ukazatelů, přičemž každé z vygenerovaných variant lze přiřadit určitou pravděpodobnost její existence. Důležitou otázkou pak je, jak za těchto předpokladů zvolit optimální variantu.

Předpokládejme tedy, že každá varianta $v \in V$ je ohodnocena následujícím vektorem *V*

$$V = (v_1, \ldots, v_m, p_v)$$

kde v_i jsou hodnoty jednotlivých výsledných proměnných

a p_v je pravděpodobnost varianty $v \in V$.

Pro vektory *V* budeme nyní definovat relaci uspořádání následujícím způsobem.

Nechť $J = \{1, \ldots, m\}$ a nechť $\{J_1, \ldots, J_r\}$ je disjunktní rozklad množiny *J*, tj.

$$\bigcup_i J_i = J, J_i \cap J_j = \varnothing \text{ pro každé } 1 \le i, j \le r \,.$$

Množiny J_i budeme interpretovat jako třídy preference jednotlivých veličin v_k. Tedy všechny veličiny v_k takové, že $k \in J_i$ mají větší význam než libovolná veličina v_s taková, že $s \in J_j$, kde $j > i$. Veličiny, jejichž indexy patři do stejné skupiny J_i mají stejný význam.

V dalším kroku se každé skupině J_i přiřadí **váha** h_i této skupiny, kde $h_i \in \langle 0,1 \rangle$, která vyjadřuje skutečnost, nakolik je skupina J_i důležitější, než ostatní skupiny. Zhruba lze říci, že z celkového významu vektoru *V* má skupina indexů J_i význam $h_i.100\%$. Zřejmě musí platit $\sum_i h_i = 1$.

Pro každý index $i \in J$ si označme symbolem q_i následující hodnotu

$$q_i = \begin{cases} +1, \text{pokud vyšší hodnota } v_i \text{ je výhodná} \\ -1, \text{jinak.} \end{cases}$$

Nechť dále symboly P_i, Q_i mají následující význam:

$$P_i = \begin{cases} \max\{v_i : v \in V\}, pokud.q_i > 0, \\ \min\{v_i : v \in V\}, pokud.q_i < 0, \end{cases}$$

$$Q_i = \begin{cases} \min\{v_i : v \in V\}, pokud.q_i > 0, \\ \max\{v_i : v \in V\}, pokud.q_i < 0. \end{cases}$$

Pak položíme

$$d(v,w) = \sum_{i=1}^{r} h_i (\sum_{j \in J_i} q_j . \frac{v_j - w_j}{w_j})$$

kde $v, w \in V$.

Dostáváme pak

$$d(v,w) = \sum_{i=1}^{r} h_i (\sum_{j \in J_i} q_j . \frac{v_j}{w_j}) - \sum_{i=1}^{r} h_i (\sum q_j) \le \sum_{i=1}^{r} h_i (\sum_{j \in J_i} q_j . \frac{P_j}{Q_j}) - \sum_{i=1}^{r} h_i (\sum q_j) = K$$

Zavedeme si nyní dvě fuzzy lingvistické proměnné χ_1, χ_2 takové, že

$$\chi_1 = \langle U_1 = (0,1), \tau_1, M_1 \rangle$$
$$\chi_2 = \langle U_2 = (0,K), \tau_2, M_2 \rangle$$

kde *U* je universum těchto proměnných, τ je množina termů a *M* je sémantika. Položme

$$\tau_1 = \{malý, velmi, a, ne, velký\} = \tau_2$$

a sémantiky definujme následovně:
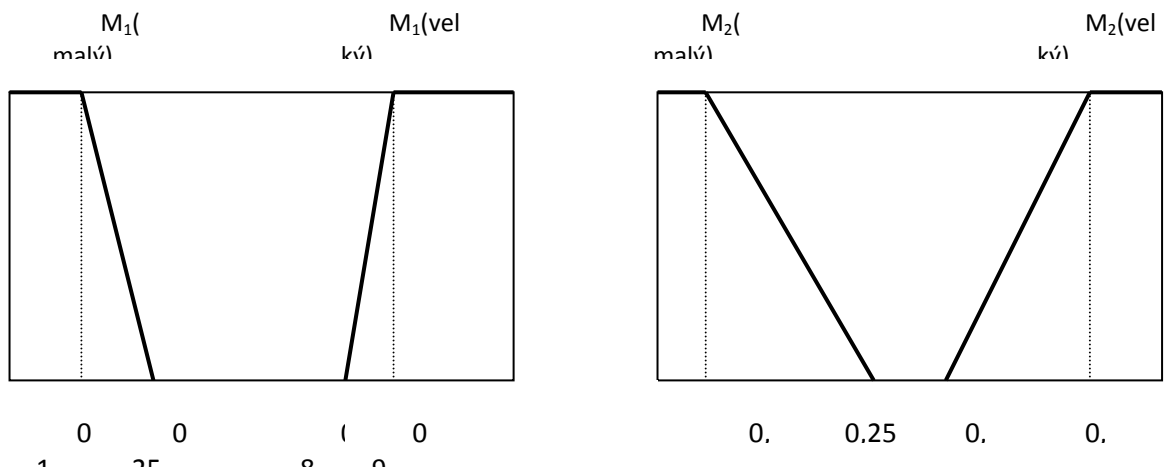
Obr. 8. Rozložení sémantik *M*

Ostatní hodnoty se definují klasicky, tj.

$M_i(velmi\ X)(a)=[M_i(X)(a)]^2$

$M_i(ne\ X)(a)=1-M_i(X)(a)$

$M_i(X\ a\ Y)(b)=min(M_i(X)(b),M_i(Y)(b)).$

Nechť jsou dále dána následující pravidla:

$$X \in \chi_1, Y \in \chi_2$$

$R_1 \equiv X=velká \Rightarrow Y= velmi\ velmi\ velká$

$R_2 \equiv X=ne\ velmi\ velká\ a\ ne\ velmi\ malá \Rightarrow Y= velmi\ velká$

$R_3 \equiv X= ne\ malá\ a\ ne\ velká \Rightarrow Y\ ne\ malá$

$R_4 \equiv X= malá \Rightarrow Y\ ne\ velmi\ malá$

$R_5 \equiv X = velmi\ malá \Rightarrow Y\ ne\ velmi\ velmi\ malá$

Každé z těchto fuzzy pravidel R_i pak představuje fuzzy relaci v universu $U_1 \times U_2, R_i \widetilde{\subset} U_1 \times U_2$.

Mějme nyní dvě varianty *v, w* $\in$ *V* a definujme si vlastní relaci $\leq$ následovně. Položíme

$$x = P_w - P_v, y = d(v,w)$$

Rozlišme následující případy.

I. $x \geq 0, y \geq 0.$

Určíme pak hodnotu

$$\alpha(x.y) = \overset{5}{\underset{i=1}{V}} R_i(x,y)$$

Pokud $\alpha(x,y) \geq \alpha_0$, položíme $v \geq w$ (kde α_0 je hladina významnosti).

II. $\quad x \leq 0, y \geq 0$.

Pak $v \geq w$

III. $\quad x \leq 0, y \leq 0$.

Určíme pak hodnotu

$$\alpha(-x,-y) = \overset{5}{\underset{i=1}{V}} R_i(-x,-y)$$

Pokud $\alpha(-x,-y) \geq \alpha_0$, položíme $v \leq w$.

IV. $\qquad x \geq 0, y \leq 0.$

Pak položíme $w \geq v$.

Pokud nenastane $w \geq v$ ani $w \leq v$, položíme $w \| v$.

Aplikace matematického modelu na řízení výukového procesu

Uvedený postup popsaný v předcházející části si ukážeme na příkladě:
Nechť varianty *V = {v, w}* jsou ohodnoceny vektory s následujícími složkami:

1. složka = **zisk počtu bodů z testu znalostí**
2. složka = **doba výuky ve dnech**
3. složka = **počet stran výukového textu**

a nechť konkrétně je
    V = (300, 10, 100, 0.7),
    W = (250, 8, 150, 0.82).

Indexy *J = {1,2,3}* rozdělíme do dvou skupin
$$J_1 = \{1\}, J_2 = \{2,3\}$$
$$h_1 = 0.6, h_2 = 0.4$$

Z hlediska významu jednotlivých složek vektorů z *V* je jistě
$$q_1 = 1, q_2 = -1, q_3 = -1$$

Dostáváme tedy následující hodnoty

i	*1*	*2*	**3**
q	1	-1	-1
h_i	0.6	0.4	
Q	250	10	150
P	300	8	100

Pak je

$$K = 0.6(1.\frac{300}{250}) + 0.4((-1).\frac{8}{10} + (-1).\frac{100}{150}) - 0.6(1) - 0.4(-2) = 0.34$$

Příslušné fuzzy množiny pro χ_2 jsou tedy
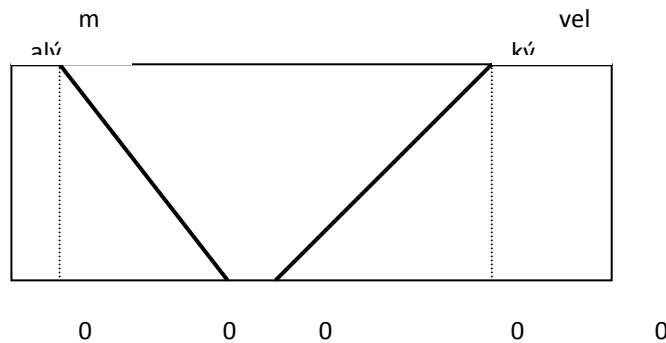
Obr. 9. Rozložení fuzzy množin pro příklad

$$x = p_w - p_v = 0.12$$

$$y = d(v, w) = 0.6(1.\frac{300 - 250}{250}) + 0.4((-1).\frac{10 - 8}{8} + (-1).\frac{100 - 150}{150}) = 0.15 \geq 0$$

Pak určíme *α(x,y)*:

i	$X_{(x)}$	$Y_{(y)}$	$R_{(x,y)}$
1	0		0
2	0.2	0	0
3	0.1	1	0.1
4	0.9	1	0.9
5	0.8		0.8

Tedy $\alpha(x, y) = 0.9 \geq \alpha_0 \, 0.8$. Tedy $v \geq w$.

Závěr

Článek seznamuje se základními principy výstavby takového SNPR a jeho začlenění do LMS. Je předpokládán výukový proces s uzavřeným cyklem řízení prostřednictvím SNPR. Okamžitý stav chování výukového procesu je zjišťován pomocí rozhraní, které poskytuje vybrané informace SNPR a ten provádí ohodnocení jeho stavu. Do SNPR dále vstupují vnější omezující podmínky, mezi které se řadí např. časové podmínky (časový rozvrh výuky), minimální kvalitativní podmínky apod. jako hlavní a určující pro zajištění patřičné kvality výukového procesu. Určující pro chování celého systému řízení jsou cíle vzdělávací akce. Dále se vychází z té skutečnosti, že jsou známy časové řady různých ukazatelů, charakterizujících chování vzdělávacího procesu z dřívějších období. LMS je pak zastřešen SNPR, který navrhuje a vybírá nejoptimálnější variantu vzdělávacího procesu. Do SNPR vstupují nezávislé veličiny, které charakterizují jednak současný stav vzdělávacího procesu (zjišťovaný rozhraním LMS) a jednak omezující podmínky a cíle vrcholového řízení. Vzhledem k tomu, že kombinace jejich výskytu má různou pravděpodobnost výskytu, pak je pomocí expertních znalostí ohodnotíme. Nezávislé veličiny a expertní znalosti vstupují do tzv. statického ohodnocení pravděpodobnosti jednotlivých navržených variant. Výstupem je vektor variant, uspořádaný podle velikosti pravděpodobnosti se kterou mohou tyto varianty nastat. Dále pro jednotlivé varianty jsou určeny konkrétní ukazatele, které popisují patřičnou variantu. Systém ukazatelů dále vstupuje do matematického modelu, který na bázi učících ukazatelů, tzn. jejich časových řad z minulosti určí normu příslušné varianty. Výpočet se provádí pro všechny varianty, z nichž je nutné v dalším kroku nalézt optimální variantu kombinace ukazatelů pro následné řízení výukového procesu. Jedna z nejvíce používaných metod modelování takových systémů využívá pro popis vývoje veličiny ve sledovaném období funkčního vztahu, vycházejícího z chování závislé a nezávislých veličin, který pak

nutně musí kopírovat různé a většinou značné výchylky ve velikosti nezávislých veličin. Tento trend se pak automaticky přenáší zcela bezdůvodně i do prognózy chování dané veličiny. Nejčastější příčinou tohoto stavu je snaha o nejlepší aproximaci časových řad charakterizujících chování daných veličin. Cílem příspěvku je také navrhnout metodu eliminace uvedených většinou náhodných výchylek v chování nezávislých veličin a vytvořit tak model, který by věrněji simuloval hlavní trendy v chování veličin.

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Managing Educational Process in LMS with Using Petri Nets

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Abstract: The final function of the learning management system (LMS) is routing the communication depending on the student´s knowledge and abilities and according to that changing the quantity and ambitiousness of the material offered to the student. In the theory of management there can be seen the evident transition from combinative practices to sequenced rows and optimized processes (strategy of continuous assessment of the reflection of student's schooling and based on that adapting the further education is equal with the dual principle of identification and adaptable management). For the description and subsequent management in this way of learning Petri nets are advantageously utilised. Another approach to describe actual and real educational processes is utilising fuzzy modelling. If we want to describe the complicated reality we may decide between the relevance of the information that would be less accurate and accurateness of the information which would be less relevant. In the process of increasing the accuracy of description of educational process we get to a point where accuracy and relevance become mutually excepted characteristics. We may describe educational process in some sentences where we globally describe the parts of educational equipment and the educational process itself. Hereby we have learned how to teach human some knowledge but we will know nothing about linking of the steps of education, its components and/or people. If we want to know details we have to specify it in detail, provide the ability to absorb knowledge, quality of education, etc. with numbers. Therefore the number of information raises and because they are accurate we learn more but only about a small part of the educational process. As far as we want to describe all educational processes in detail it would lead up to a huge number of detailed information which nobody would be able to read. And if yes, to understand the essence which is described he would need natural language, i.e. he would return to inaccurate characteristics. On the contrary, he would badly lose in accurate details because human psychic has limited possibilities. Namely, it turns out that accuracy is just fancy or is on principle unavailable. All these facts are behind the considerations of founders of fuzzy logics. A strong device arises applying fuzzy logics into Petri nets for modelling educational process mainly for simple intelligibility and well-created mathematical apparatus, relatively simple design and for modularity of the solution (it is possible to add and remove the modules without the need to remake the whole system) and for robustness of design (in case the parameters of solving the task in a particular surroundings it is not necessary to modify the system).The article is solving the problem of implementation of fuzzy Petri nets into the concepts of LMS.

Úvod

Pre aplikáciu LMS pre získavanie znalostí je nevyhnutné, aby interakcia medzi zdrojom poskytovania znalostí a úložiskom bola riadená automaticky. Aktivity vychádzajú napríklad z LMS kedy študent ovplyvňuje priebeh komunikácie prostredníctvom správ, ktoré si LMS vyžiada. Interakcia prebieha tak, že LMS postupne predkladá študentom postupnosť dotazov a z odpovedí sa potom určuje ďalší smer komunikácie. Základným stavebným kameňom, z ktorého vychádza tento dialóg, je postupnosť: otázka -

odpoveď, ktorú budeme nazývať krok dialógu. Celý dialóg potom môžeme vytvoriť ako následnosť krokov, cez ktoré LMS pri konverzácii so študentom prechádza. Priebeh dialógu potom môžeme vyjadriť orientovaným grafom, v ktorom uzly sú kroky dialógu a prechod na ďalší uzol, tj položenie ďalšej otázky je určené jednak uzlom, v ktorom sa systém nachádza a jednak odpoveďou študenta. Graf, ktorý zobrazuje všetky možné priebehy dialógu, má vo väčšine prípadov sieťovú štruktúru. Cieľovou funkciou LMS riadiaceho výučbu je smerovanie komunikácie podľa znalostí a schopností študenta a tým aj meniť množstvo a náročnosť predkladaných materiálov študentovi. V poňatí teórie riadenia je tak zrejmý prechod od kombinačných postupov k radom sekvenčným a optimalizovaným procesom (stratégia priebežného hodnotenia odrazu výučby študenta a na základe toho prispôsobenie ďalšieho výkladu je porovnateľná s duálnym princípom identifikácie a adaptívneho riadenia). Pre popis riadenie komunikácie človeka s počítačom je vhodné použiť grafické nástroje, umožňujúce vhodne popísať a vyjadriť interakciu. Interakcie pri výučbe medzi študentom a informačným systémom riadiacim výučbu je zložitý proces, pre ktorý je vhodné využiť Petriho siete. Ďalším prístupom k opisu skutočných a reálnych postupov výučby je využitie **fuzzy modelovania** [3]. Ak chceme totiž opísať zložitú realitu, potom sa môžeme rozhodnúť medzi relevanciou informácie, ktorá však bude menej presná, alebo presnosťou informácie, ktorá však bude menej relevantná. Pri zvyšovaní presnosti opisov výučbových procesov sa dostaneme k bodu, kedy presnosť a relevantnosť sa stávajú vzájomne sa vylučujúcimi charakteristikami. napr. proces výučby možno opísať niekoľkými vetami, kde globálne popíšeme časti výučbového aparátu a postup vlastného procesu výučby. Tým ‚že sme sa dozvedeli, ako naučiť človeka vedomosti, nebudeme však nič vedieť o nadväznostiach jednotlivých krokov výučby, jeho komponentoch, ľuďoch. Ak chceme spoznať detaily, musíme sa o nich podrobne rozpísať, doplniť číslami schopnosť vstrebať vedomosti, kvalitu výučby apod. Tým však množstvo informácií narastá a keďže sú presnejšie, dozvieme sa viac, avšak len o malé časti výučbového procesu. Ak by sme chceli výučbové procesy popísať detailne všetky, viedlo by to k obrovskému množstvu detailných informácií, ktoré by však nebol schopný nikto prečítať. A ak áno, potom by k pochopeniu podstaty toho, čo je v nich opísané, potreboval prirodzený jazyk, tj vrátil by sa k nepresnej charakteristike. V opačnom prípade by sa v presných detailoch nevyhnutne stratil, pretože ľudská psychika má len obmedzené možnosti. Ukazuje sa totiž, že presnosť je iba ilúzia, pretože je principiálne nedosiahnuteľná. Všetky tieto fakty stoja v pozadí úvah zakladateľov fuzzy logiky [4]. Fuzzy logika pritom vychádza z teórie fuzzy množín a je zameraná na vágnosť, ktorú matematicky opisuje. V tomto kontexte fuzzy množina je množina, ktorá okrem úplného alebo žiadneho členstva pripúšťa aj členstvo čiastočné. To znamená, že prvok patrí do množiny s istým stupňom príslušnosti. Funkcia, ktorá každému prvku univerza priradí stupeň príslušnosti sa nazýva funkcia príslušnosti. Fuzzy teória sa snaží pokryť realitu v jej nepresnosti a neurčitosti a počas svojej takmer 40-ročnej existencie sa zaslúžila o riešenie mnohých technických problémov, ktoré inými prostriedkami neboli v praxi zvládnuté. Každému prvku možno postupne priradiť tzv. stupeň príslušnosti, ktorý vyjadruje mieru príslušnosti daného prvku do fuzzy množiny. Napríklad v prípade vybavovania reklamácie na dodávateľa, možno stanovením miery príslušnosti rovnakého typu vady do fuzzy množín rozhodnúť, ktoré diely sú "dobré", ktoré je možné "ešte spracovať" a ktoré je potrebné "zošrotovať". U klasického rozhodovania je v tomto prípade stanovenia hranice toho čo je ešte prípustné a čo už nie je dosť ťažké. Možno to vykonať priradením čísla z intervalu <0,1>, ktoré vyjadruje mieru nášho presvedčenia. Úlohou fuzzy teórie je zachytiť vágne špecifikované požiadavky v dotaze a adekvátne k tomu vypočítať stupeň príslušnosti. Fuzzy logika umožňuje používať vágne buď priamo a vie ich aj jednoduchým spôsobom reprezentovať.

Súčasný stav

Podľa toho, ako záväzné sú pre vyučovaný objekt tj študenta sledy jednotlivých krokov, rozoznávame dva hlavné typy výučbových programov: lineárne a vetvené.

Lineárne výučbové programy predpisujú pre všetkých študentov pevný a záväzný sled krokov v jednej línii. Učivo sa preberá po malých kvantách informácií, najlepšie však len po jedinej informácii v každom kroku. Vytvorený pojem sa precvičuje podľa potreby, kým ho študent nezvládne. Pridávaním jedného pojmu k druhému sa študent zoznámi s celou látkou a jej problematikou. Stručnosť krokov nedovoľuje rozvinúť prozaický štýl výkladu, takže lineárne programy sú monotónne a po určitom čase sa pre

mnohých študentov stávajú nezaujímavými a únavnými. Od začiatku až ku koncu tu vedie jediná priamočiara línia, zložená z pravidiel, príkladov a odpovedí. Odporcovia lineárnych programov tiež uvádzajú, že veľmi malé kroky prerušujú nežiaducim spôsobom myšlienkové pochody študenta. Podľa praktických skúseností je lineárne programovanie vhodné najmä pre učenie základov a princípov problémov a ďalej pre vytváranie slovnej zásoby a nových pojmov.

Vetvené programy pripúšťajú pri riešení problémov rozmanitý postup. Alternatívy "vetvy" programu vedú nakoniec k úspešnému spoločnému zvládnutiu problému, každý študent však prechádza cestou, ktorej diaľka zodpovedá jeho osobnosti, znalostiam a nadaniu. Pri vyučovaní je faktom v programe zreteľná istá hlavná línie, z ktorej vybočujú a ku ktorej sa potom znova pripájajú rozlične tvarované vedľajšie línie. Na nasledujúcom obrázku je uvedená schéma vetveného programu s jednou hlavnou líniou..
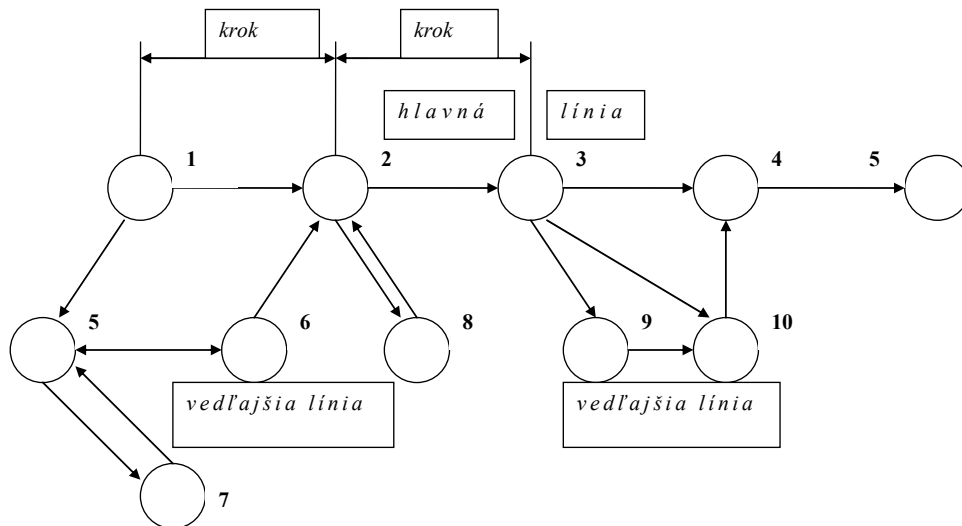
Obrázok 1: Schéma vetveného programu s jednou hlavnou líniou

Hlavná línia zvyčajne dovoľuje postup vo väčších a zložitejších krokoch, aké zvládne len nadaný študent, odpovedajúci správne na vložené kontrolné otázky. Kratšie a ľahšie kroky pre menej nadaných a pomalšie pracujúcich študentov prebiehajú vo vedľajších vetvách. Do nich sú vložené aj príklady na lepšie precvičenie látky, úlohy, inštrukcie a návody, odkazujúce študenta napr. na vykonanie pokusu či na použitie názornej pomôcky alebo sekvencie, doplňujúce učivo tak, aby sa názor alebo fakt upevnil.

Väčší informačný obsah jednotlivého kroku pri vetvenom programe pripúšťa jeho oživenie a formou dialógu študenta občas aj baví. Vetvené programy sú zvlášť výhodné tam, kde ide o poskytovanie a manipuláciu s novými pojmami. Ich základným prínosom je to, že umožňujú študentovi, aby si pri preberaní učiva zvolil individuálnu cestu po línii, ktorá zodpovedá jeho intelektu a predchádzajúcim znalostiam.

Každý z oboch základných typov programov má ešte variantu, a to podľa toho, či študent odpoveď na kontrolné otázky tvorí alebo či ich vyberá z ponúknutých variantov odpovedí.

Model riadenia výučby s využitím fuzzy Petriho sietí

Cieľovou funkciou LMS riadiaceho výučbu je smerovanie komunikácie podľa znalostí a schopností študenta a tým aj meniť množstvo a náročnosť predkladaných materiálov študentovi. V poňatí teórie riadenia je tak zrejmý prechod od kombinačných postupov k radom sekvenčných a optimalizovaných procesov (stratégie priebežného hodnotenia odrazu výučby študenta a na základe toho prispôsobenie ďalšieho výkladu je porovnateľná s duálnym princípom identifikácie a adaptívneho riadenia).

Pre popis a následné riadenie takéhoto spôsobu výučby sú s výhodou využiteľné Petriho siete.

Uveďme si príklad popisu jednoduchého procesu komunikácie s informačným systémom pomocou Petriho sietí. Jednotlivé miesta v sieti predstavujú činnosti prihlásenie, odhlásenie, zobrazenie informácií, aktualizácia informácie, vyplnenie formulára a zobrazenia formulára.
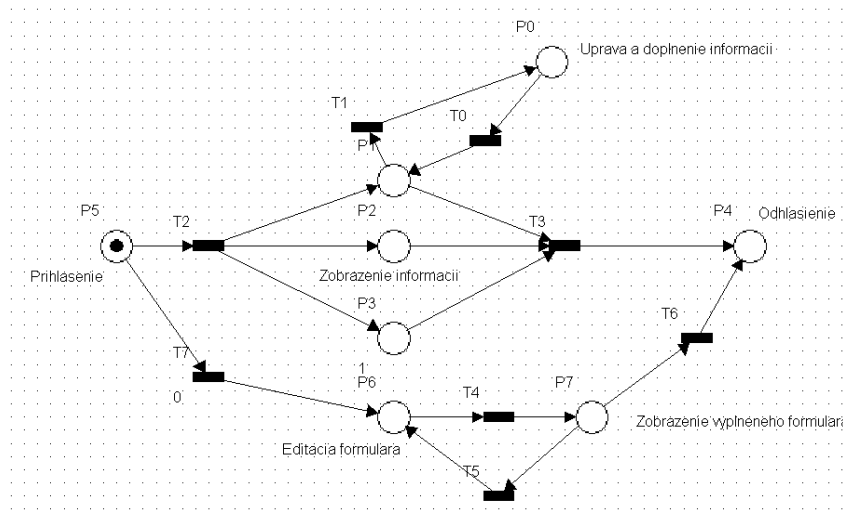
Obrázok 2: Model procesu v Petriho sieti

Pri simulácii ľubovoľných procesov pomocou Petriho sietí narazíme občas na potrebu znázorniť stav o ktorom nie sme istí či nastane alebo nenastane. Pre vytvorenie takejto siete, môžeme vyjsť z klasickej logiky a z fuzzy logiky. Klasickú logiku sme si už popísali v predchádzajúcej kapitole. Token je v mieste obsiahnutý ak je výraz true (1) alebo nie je obsiahnutý ak je false (0). Ak, ale nevieme či je obsiahnutý alebo nie, môžeme použiť fuzzy logiku, ktorá nadobúda hodnoty z množiny (0,1), tzn. že výraz môže byť splnený čiastočne, trochu, približne, málo, veľa a k tomu príslušné hodnoty 0.2, 0.4, atď.

Čo chceme v Petriho sieťach namodelovať? Pozrime sa na jeden konkrétny príklad, ktorý si popíšeme pomocou Petriho sietí.

Do výučby vedenej LMS nám príde študent a bude požadovať výučbu určitej oblasti. Bude mu dávať vstupné informácie o svojich znalostiach, časovému priestoru na výučbu a pod. – nedá sa presne určiť či má / nemá vedomosti a koľko má času venovať sa štúdiu. Budú sa objavovať vstupné informácie: mám malé znalosti, mám veľké znalosti, mám málo času, mám veľa času, atď. Na základe týchto vstupných informácií ustanovuje LMS postup výučby. Pre rýchlejšie určenie postupu výučby môžeme použiť vopred pripravenú Petriho sieť, ktorá bude popisovať jednotlivé stavy, ktoré sa môžu u študenta vyskytnúť. Zavedieme určité IF THEN pravidlá podľa ktorých bude sieť postavená. Napríklad: IF má malé znalosti AND veľa času THEN budú vybrané všetky kapitoly vyučovaného predmetu. Po zostavení tejto siete musíme ešte nejakým spôsobom určiť dôležitosť jednotlivých prechodov zo stavov do stavov. Túto dôležitosť nastavíme v Petriho sieťach hodnotou z fuzzy množiny (0,1) pri prechodoch.

V okamihu keď máme zostavenú takúto Fuzzy Petriho sieť vložíme do počiatočných stavov tokeny, ktoré budú nadobúdať opäť hodnoty z fuzzy množiny (0,1). Tieto tokeny nám budú svojou hodnotou určovať práve veľkú, malú, strednú znalosť, atď. Po simulácii Fuzzy Petriho siete pomocou pravidiel, ktoré si vypíšeme, dostane LMS postup výučby. Skôr ako začneme vkladať počiatočné tokeny, je vhodné stanoviť terminológiu vstupných údajov a priradiť príslušné hodnoty. Napríklad malý = 0.3, trochu = 0.4, veľa = 0.8 atď.

Začlenenie fuzzy logiky do klasických Petriho sietí možno realizovať takto. Vyjdeme z definície fuzzy logické Petriho siete.

FLPN = (P,T,F,M$_0$,D,h,a,θ,l) kde

P = {p$_1$, …, p$_n$} je konečná množina miest,

T = {t$_1$, …, t$_m$} je konečná množina prechodov,

F $\subseteq$ (P x T) $\cup$ (T x P) je toková relácia, kde platí

$\forall t \in T \; \exists p, q \in P : (p,t) \vee (t,q) \in F$,

M$_0$: $P \rightarrow \{0,1\}$ je počiatočné značenie,

D je konečná množina výrokov – $P \cap D = T \cap D = \varnothing, \left| P \right| = \left| D \right|$,

h: $P \rightarrow D$ je asociovaná funkcia, reprezentujúca bijekciu z miesta k výroku,

a: $P \rightarrow [0,1]$ je asociovaná funkcia reprezentujúca hodnotu v mieste z množiny reálnych čísel 0 až 1,
θ, l: $T \rightarrow [0,1]$ je asociovaná funkcia reprezentujúca prechod hodnotou z množiny 0 až 1.
Pre $\forall p \in P$, platí pre následné značenie:

$M'(p) = M(p) + 1$, ak $p \in t^{\bullet} - {}^{\bullet}t$;

$M'(p) = M(p) - 1$, ak $p \in {}^{\bullet}t - t^{\bullet}$;

$M'(p) = M(p)$, inak,

$\alpha(p) = \lambda_t \alpha(p')$ ak $\alpha_1 \geq \theta_t \wedge p \in t^{\bullet} \wedge p' \in {}^{\bullet}t$.

Pre $t \in T^{AND}$ platí $\alpha(p) = \lambda_t \min\limits_{\forall p' \in {}^{\bullet}t} \alpha(p')$ ak

$\min\limits_{\forall p' \in {}^{\bullet}t} \{\alpha(p')\} \geq \theta_t \wedge p \in t^{\bullet}$

a pre $t \in T^{OR}$ platí $\alpha(p) = \lambda_t \max\limits_{\forall p' \in {}^{\bullet}t} \alpha(p')$ ak

$\max\limits_{\forall p' \in {}^{\bullet}t} \{\alpha(p')\} \geq \theta_t \wedge p \in t^{\bullet}$.

Teraz si vyjadríme pomocou Petriho sietí pravidlá typu IF-THEN a ich transformáciu do fuzzy logiky
Pravidlo IF p1 THEN p2 vyjadríme
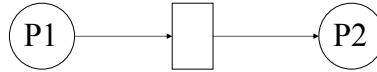
a vo fuzzy logike $\qquad \alpha_2 = \lambda_t \alpha_1$ ak $\alpha_1 \geq \theta_t$.

Pravidlo IF p1 AND p2 THEN p3 vyjadríme
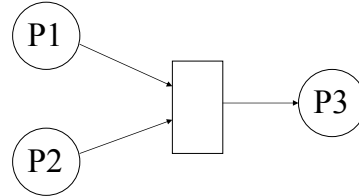
a vo fuzzy logike $\qquad \alpha_3 = \lambda_t \min\limits_{\alpha_i \geq \theta_{t AND}} \{\alpha_1 \alpha_2\}$ pre i=1 $\wedge$ 2.

Pravidlo IF p1 OR p2 THEN p3 vyjadríme s pomocou inhibičných hrán
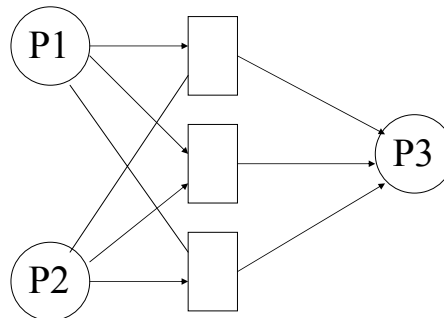
a vo fuzzy logike $\qquad \alpha_3 = \lambda_{t^{OR}} \max\limits_{\alpha_i \geq \theta_{t OR}} \{\alpha_1 \alpha_2\}$ pre i=1 $\vee$ 2.

Pravidlo IF p1 XOR p2 THEN p3 vyjadríme s pomocou inhibičných hrán
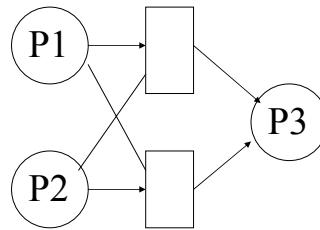
a vo fuzzy logike $\quad \alpha_3 = \lambda_{t_{XOR}} \alpha_1$ ak $\alpha_1 \geq \theta_{t_{XOR}} \wedge \alpha_2 = 0$,

$\alpha_3 = \lambda_{t_{XOR}} \alpha_2$ ak $\alpha_2 \geq \theta_{t_{XOR}} \wedge \alpha_1 = 0$.

Takéto určenie FPN vychádza z definícií prevodu klasickej logiky na fuzzy logiku.
V nasledujúcej tabuľke si popíšeme prehľad základných funkcií.

Tabuľka 1: Prehľad základných funkcií logických pravidiel Petriho sietí

No.	Rules	Logical Petri Nets	Fuzzy Computing
1	IF d_1 THEN d_2		$\alpha_2 = \lambda_t \alpha_1 \quad if \ \alpha_1 \geq \theta_t$
2	IF d_1 AND d_2 THEN d_3		$\alpha_3 = \lambda_{t_{OR}} \min_{\substack{\alpha_i \geq \theta_{OR} \\ i=1 \wedge 2}} \{\alpha_1, \alpha_2\}$
3	IF d_1 OR d_2 THEN d_3		$\alpha_3 = \lambda_{t_{OR}} \max_{\substack{\alpha_i \geq \theta_{OR} \\ i=1 \vee 2}} \{\alpha_1, \alpha_2\}$
4	IF d_1 XOR d_2 THEN d_3		$\alpha_3 = \begin{cases} \lambda_{t_{XOR}} \alpha_1 \ if \ \alpha_1 \geq \theta_{t_{XOR}} \\ \qquad \wedge \alpha_2 = 0 \\ \lambda_{t_{XOR}} \alpha_2 \ if \ \alpha_2 \geq \theta_{t_{XOR}} \\ \qquad \wedge \alpha_1 = 0 \end{cases}$

Aplikácie s využitím FPN

Pre ukážku využitia Fuzzy Petriho sietí si najskôr ukážme príklad pri určovaní chýb v motore auta. Príklad je uvádzaný pre pochopenie zápisu pravidiel u lepšie popísateľnom príklade. Nasledujúce dve tabuľky budú popisovať miesta a prechody pomocou IF THEN pravidiel.

Tabuľka 2: Príklad pravidiel typu IF - THEN

No.	Rules	Transitions
1	IF pist-ring-state(worn) OR pist-state(worn) THEN oil-cons(incr)	t_1^{OR}
	IF oil-cons(incr) THEN ex-smoke(black)	t_2
2	IF oil-cons(incr) THEN lack-of-oil(sev)	t_3
3	IF lack-of-oil(sev) THEN eng-temp(incr)	t_4
4	IF lack-of-oil(sev) THEN oil-light(red)	t_5
5	IF eng-temp(incr) THEN temp-ind(red)	t_6
6	IF eng-temp(incr) THEN accel-resp(del)	t_7
7	IF road-cond(poor) AND ground-clear(low) THEN oil-sump(holed)	t_8^{AND}
8	IF oil-sump(holed) THEN lack-of-oil(sev)	t_9
	IF oil-sump(holed) THEN hole-oil-sump(yes)	t_{10}
9	IF spark-plug-mileage(high) THEN spark-plugs(used-up)	t_{11}
10	IF spark-plugs(used-up) THEN spark-ign(irr)	t_{12}
11	IF spark-ign(irr) THEN accel-resp(del)	t_{13}
12		
13		

Tabuľka 3: Význam miest

No.	Propositions	Places	No.	Propositions	Places
1	pist-ring-state(worn)	p_1	9	accel-resp(del)	p_9
	pist-state(worn)	p_2	10	road-cond(poor)	p_{10}
2	oil-cons(incr)	p_3	11	ground-clear(low)	p_{11}
3	ex-smoke(black)		12	oil-sump(holed)	p_{12}
4	lack-of-oil(sev)	p_4	13	hole-oil-sump(yes)	p_{13}
5	eng-temp(incr)	p_5	14	spark-plug-mileage(high)	p_{14}
6	oil-light(red)	p_6	15	spark- plugs(used-up)	
7	temp-ind(red)	p_7		spark-ign(irr)	p_{15}
8		p_8	16		p_{16}

Teraz vytvoríme LFPN
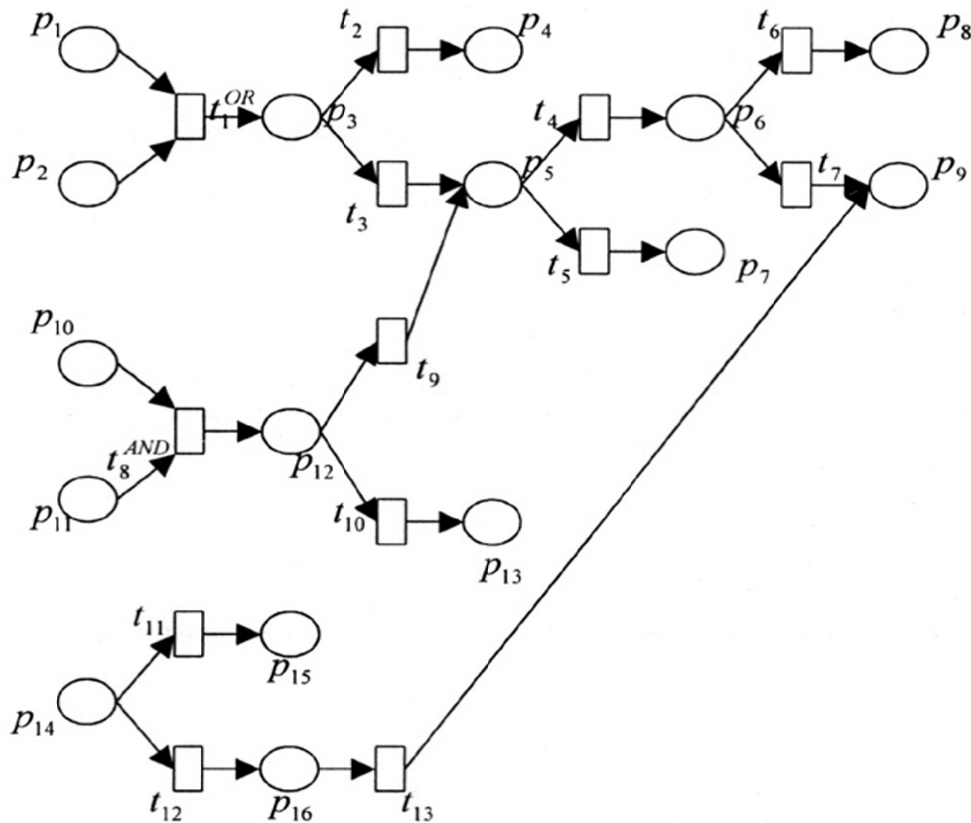
Obrázok 3: Príklad Petriho sietí s pravidlami IF -THEN

Zvolíme si hodnoty podľa dôležitosti pri prechodoch a počiatočné hodnoty v miestach p_1, p_2, p_{10}, p_{11}, p_{14}.

Počiatočné a výsledné hodnoty vypočítané podľa pravidiel sú znázornené v tabuľkách.

Tabuľka 4: Príklad počiatočných hodnôt podľa pravidiel

t	t_1^{OR}	t_8^{AND}	t_{12}	t_3	t_9	t_{13}	t_4	t_5	t_7
	0.82	0.67	0.75	0.77	0.95	0.88	0.83	0.71	0.86
$\theta(t)$	0.34	0.55	0.29	0.51	0.45	0.56	0.42	0.39	0.40

Tabuľka 5: Príklad výsledných hodnôt podľa pravidiel

p_s	p_1	p_2	p_{10}	p_{11}	p_{14}	p_3	p_{12}	p_{16}	p_5	p_6	p_7	p_9
$\alpha(p_s)$	0.92	0.85	0.88	0.79	0.82	0.75	0.53	0.58	0.62	0.48	0.41	0.55

Obdobným spôsobom možno popísať jednotlivé kroky výučby, kedy stavy vyjadrujú výučbové aktivity a prechody testovania vedomostí.

Záver

Aplikáciou fuzzy logiky do Petriho sietí vzniká silný nástroj pre modelovanie výučbových procesov a to najmä pre:

- Ľahkú zrozumiteľnosť a prepracovaný matematický aparát,
- Pomerne jednoduchý návrh,
- Modulárnosť riešenia - je možné pridávať a odstraňovať jednotlivé moduly bez nutnosti úplne prepracovať celý systém,

- Robustnosť návrhu, tj systém nie je nutné upravovať v prípade zmeny parametrov riešenia úlohy v rámci istého okolia.

Acknowledgement

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Neural Network Simulation of Optimal Control Problem

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Abstract

A neural network based optimal control synthesis is presented for solving optimal control problems with control and state constraints. The optimal control problem is transcribed into nonlinear programming problem which is implemented with adaptive critic neural network. The proposed simulation methods is illustrated by the optimal control problem of feeding adaptation of filter feeders of Daphnia. Results show that adaptive critic based systematic approach holds promise for obtaining the optimal control with control and state constraints.

I. Introduction

Optimal control of nonlinear systems is one of the most active subjects in control theory. There is rarely an analytical solutions although several numerical computation approaches have been proposed (for example, see [9], [3]). The most of the literature dealing with numerical methods for the solution of general optimal control problems focuses on algorithms for solving discretized problems. The basic idea of these methods is to apply nonlinear programming techniques to the resulting finite dimensional optimization problem [1]. When *Euler* integration methods are used, the recursive structure of the resulting discrete time dynamic can be exploited in computing first-order necessary condition.

In the recent years the neural networks are used for obtaining numerical solutions to optimal control problem [7], [8]. For the network, a feed forward network with one hidden layer, a steepest descent error backpropagation rule, a hyperbolic tangent sigmoid transfer function and a linear transfer function were used.

The paper presented extends adaptive critic neural network architecture proposed by [7] to the optimal control problems with control and state constraints. The organization of the paper is as follows. In Section 2 optimal control problems with control and state constraints are being introduced. We summarize necessary optimality conditions and give a short overview on basic result including iterative numerical methods and discussed discretization methods for given optimal control problem and a form of resulting *nonlinear programming problems*. Section 3 presented a short description of *adaptive critic neural network synthesis* for optimal problem with state and control constraints. Section 4 consists of model of feeding adaptation. In section 5 and 6 we apply the methods to the model presented in section 4 to compare short-term and long-term strategy of feeding adaptation of filter feeders. Conclusions are being presented in Section 7.

II. Optimal control problem

We consider nonlinear control problem subject to control and state constraints. Let $x(t) \in R^n$ denote the state of a system and $u(t) \in R^m$ the control in a given time interval $[t_0, t_f]$.

Optimal control problem is to minimize

$$F(x, u) \quad = \quad g(x(t_f)) + \int_{t_0}^{t_f} f_0(x(t), u(t))dt \tag{1}$$

subject to

$$\dot{x}(t) \quad = \quad f(x(t), u(t)),$$
$$x(t_0) \quad = \quad x_0,$$
$$\psi(x(t_f)) \quad = \quad 0,$$
$$c(x(t), u(t)) \quad \leq \quad 0, \quad t \in [t_0, t_f].$$

The functions $g : R^n \to R$, $f_0 : R^{n+m} \to R$, $f : R^{n+m} \to R^n$, $c : R^{n+m} \to R^q$ and $\psi : R^{n+m} \to R^r$, $0 \leq r \leq n$ are assumed to be sufficiently smooth on appropriate open sets. The theory of necessary conditions for optimal control problem of form (1) is well developed (cf. [10], [3]).

We introduce an additional state variable

$$x_0(t) \quad = \quad \int_0^t f_0(x(s), u(s)) ds$$

defined by the

$$\dot{x}_0(t) = f_0(x(t), u(t)), \quad x_0(0) = 0.$$

Then the *augmented Hamiltonian function* for problem (1) is

$$H(x, \lambda, \mu, u) \quad = \quad \sum_{j=0}^n \lambda_j f_j(x, u) \tag{2}$$
$$+ \sum_{j=0}^q \mu_j c_j(x, u),$$

where $\lambda \in R^{n+1}$ is the adjoint variable and $\mu \in R^q$ is a multiplier associated to the inequality constraints. Let $(\hat{x}, \hat{u})$ be an optimal solution for (1) then the necessary condition for (1) (cf. [3], [10]) implies that there exist a piecewise continuous and piecewise continuously differentiable *adjoint function* $\lambda : [t_0, t_f] \rightarrow R^{n+1}$, a piecewise continuous *multiplier function* $\mu : [t_0, t_f] \rightarrow R^q$, $\mu(t) \geq 0$ and a multiplier $\sigma \in R^r$ satisfying

$$\dot{\lambda}_j(t) \quad = \quad -\frac{\partial H}{\partial x_j}(\hat{x}(t), \lambda(t), \mu(t), \hat{u}(t))$$
$$\lambda_j(t_f) \quad = \quad g_{x_j}(\hat{x}(t_f)) + \sigma \psi_{x_j}(\hat{x}(t_f)) \tag{3}$$
$$j = 0, \dots, n$$
$$\dot{\lambda}_0(t) \quad = \quad 0$$
$$0 \quad = \quad \frac{\partial H}{\partial u}(\hat{x}(t), \lambda(t), \mu(t), \hat{u}(t)).$$

For free terminal time t_f, an additional condition need to be satisfied:

$$H(t_f) = (\sum_{j=0}^n \lambda_j f_j(x, u) + \sum_{j=0}^q \mu_j c_j(x, u))|_{t_f} = 0$$

Furthermore, the complementary conditions hold a.e. in $t \in [t_0, t_f]$ $\mu \geq 0$, $c(x, u) \leq 0$ *and* $\mu\, c(x, u) = 0$. Herein, the subscript x or u denotes the partial derivative with respect to x or u.

A. Discretization of optimal control problem

Direct optimization methods for solving the optimal control problem are based on a suitable discretization of (1). Choose a natural number N and let $t_i \in [t_0, t_f]$, $i = 0, \dots, N$, be a equidistant mesh point with $t_i = t_0 + ih, i = 1, \dots, N$, where $h = \frac{t_f - t_0}{N}$. Let the vectors $x^i \in R^{n+1}$, $u^i \in R^m$, $i = 1, \dots, N$, be approximation of state variable and control variable $x(t_i)$, $u(t_i)$, respectively at the mesh point. *Euler's* approximation applied to the differential equations yields

$$x^{i+1} \quad = \quad x^i + hf(x^i, u^i), \; i = 0, \dots, N - 1.$$

Choosing the optimal variable
$z := (x^0, x^1, \dots, x^{N-1}, u^0, \dots, u^{N-1},) \in R^{N_s}$, $N_s = (n + 1 + m)N$, the optimal control problem is replaced by the following discretized control problem in the form of nonlinear programming problem with inequality constraints:

$$Minimize \; J(z) \quad = \quad G(x^N),$$

where

$$G(x^N) \quad = \quad g((x_1, \dots, x_n)^N) + x_0^N,$$

subject to

$$-x^{i+1} + x^i + hf(x^i, u^i) \quad = \quad 0, \tag{4}$$
$$x^0 \quad = \quad x(t_0)$$
$$\psi(x^N)) \quad = \quad 0,$$
$$c(x^i, u^i) \quad \leq \quad 0,$$
$$i \quad = \quad 0, \dots, N - 1.$$

A free final time t_f can be handled as an additional optimization variable in z. In a discrete-time formulation we want to find an admissible control which minimize object function (4). Let us introduce the $Lagrangian\ function$ for the nonlinear optimization problem (4):

$$L(z, \lambda, \sigma, \mu) = \sum_{i=0}^{N-1} \lambda^{i+1}(-x^{i+1} + x^i + hf(x^i, u^i)) +$$

$$G(x^N) + \sum_{i=0}^{N-1} \mu^i c(x^i, u^i) + \sigma\psi(x^N). \tag{5}$$

The first order optimality conditions of Karush-Kuhn-Tucker [9] for the problem (4) are:

$$\begin{aligned}
0 = L_{x^i}(s, \lambda, \mu) &= \lambda^{i+1} + h\lambda^{i+1}f_{x^i}(x^i, u^i) - \\
&\quad \lambda^i + \mu^i c_{x^i}(x^i, u^i), \\
&\quad i = 0, \ldots, N-1,
\end{aligned} \tag{6}$$

$$\begin{aligned}
0 = L_{x^N}(s, \lambda, \mu) &= G_{x^N}(x^N) + \\
&\quad \sigma\psi_{x_N}(x_N) - \lambda^N,
\end{aligned} \tag{7}$$

$$\begin{aligned}
0 = L_{u^i}(s, \lambda, \mu) &= h\lambda^{i+1}f_{u^i}(x^i, u^i) \\
&\quad + \mu^i c_{u^i}(x^i, u^i), \\
&\quad i = 0, \ldots, N-1.
\end{aligned} \tag{8}$$

Eq. $(6-8)$ represents the discrete version of necessary condition (3) for optimal control problem (1).

III. Adaptive critic neural network for optimal control problem with control and state constraints and free terminal condition

It is well known that a neural network can be used to approximate smooth time-invariant functions and uniformly time-varying function [2] . Neurons are grouped into distinct layers and interconnected according to a given architecture Fig. (1). Each connection between two neurons has a weight coefficient attached to it. The standard network structure for an approximation function is the multiple-layer perceptron (or feed forward network). The feed forward network often has one or more hidden layers of sigmoid neurons followed by an output layer of linear neurons.
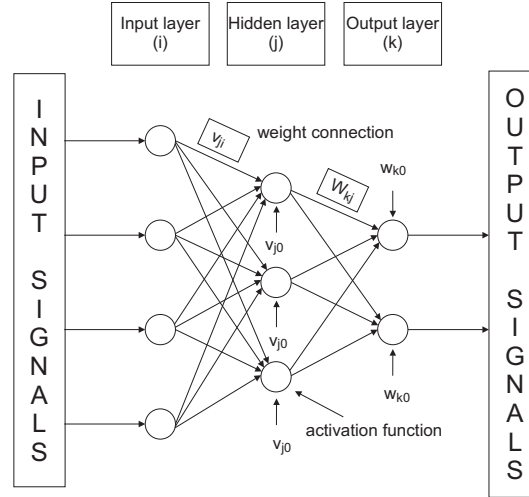
Fig. 1. Feed forward neural network topology with one hidden layer, v_{ji}, w_{kj} are values of connection weights, v_{j0}, w_{k0} are values of bias

Fig. (1) shows a feed forward neural network with n_i inputs nodes one layer of n_{hl} hidden units and n_o output units. Let $in = [in_1, \ldots, in_{n_i}]$ and $out = [out_1, \ldots, out_{n_o}]$ be the input and output vectors of the network, respectively. Let $V = [v_1, \ldots, v_{n_{hl}}]$ be the matrix of synaptic weights between the input nodes and the hidden units, where $v_j = [v_{j0}, v_{j1} \ldots, v_{jn_i}]$, v_{j0} is the bias of the jth hidden unit, and v_{ji} is the weight that connects the ith input node to the jth hidden unit.

Let also $W = [w_1, \ldots, w_{n_o}]$ be the matrix of synaptic weights between the hidden and output units, where $w_k = [w_{k0}, w_{k1} \ldots, w_{kn_o}]$, w_{k0} is the bias of the kth output unit, and w_{kj} is the weight that connects the jth hidden units to the kth output unit.

The response of the jth hidden unit is given by

$$hl_j \quad = \quad tanh(\sum_{i=0}^{n_i} v_{ji} in_k),$$

where $tanh(.)$ is the activation function for the hidden units. The response of the kth output unit is given by

$$out_k = \sum_{j=0}^{n_{hl}} w_{kj} hl_j.$$

Multiple layers of neurons with nonlinear transfer functions allow the network to learn nonlinear and linear relationships between input and output vectors. The number of neurons in the input and output layers is given, respectively, by the number of input and output variables in the process under investigation.
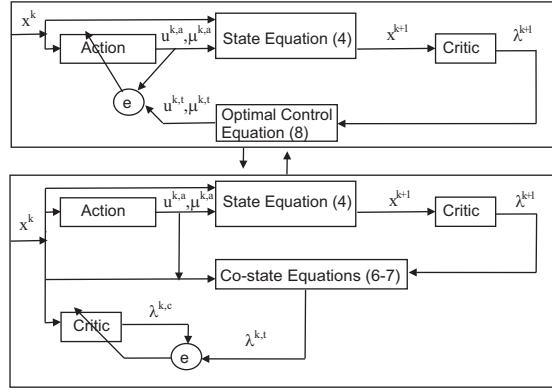
Fig. 2.   Architecture of adaptive critic network synthesis

The multi-layered feed forward network shown in Fig. (2) is training using the steepest descent error backpropagation rule. Basically, it is a gradient descent, parallel distributed optimization technique to minimise the error between the network and the target output [11].

In the Pontryagin's maximum principle for deriving an optimal control law, the interdependence of the state, costate and control dynamics is made clear. Indeed, the optimal control $\hat{u}$ and multiplier $\hat{\mu}$ is given by Eq. (8), while the costate Eqs. (6-7) evolves backward in time and depends on the state and control. The *adaptive critic neural network* is based on this relationship. It consists of two network at each node: an *action* network the inputs of which are the current states and outputs are the corresponding control $\hat{u}$ and multiplier $\hat{\mu}$, and the *critic* network for which the current states are inputs and current costates are outputs for normalizing the inputs and targets (zero mean and standard deviations). For detail explanation see [11].

From free terminal condition ($\psi(x) \equiv 0$) and from Eqs. (6-7) we obtain that $\lambda_0^i = -1$, $for\ i = N, \ldots, 0$ and $\lambda_j^N = 0$, $for\ j = 1, \ldots, n$. We use this observation before proceeding to the actual training of the *adaptive critic neural network*.

The steps for training the action network are as follows:

1) Generate set S. For all $x^k \in S$, follow the steps below:
(1.i) Input x^k to the action network to obtain $u^{k,a}$ and $\mu^{k,a}$.
(1.ii) Using x^k and $u^{k,a}$ solve state equation (4) to get x^{k+1}.
(1.iii) Input x^{k+1} to the critic network to obtain λ^{k+1}.
(1.iv) Using x^k and λ^{k+1} solve (8) to calculate $u^{k,t}$ and $\mu^{k,t}$.

When

$$||(u^{k,a}, \mu^{k,a}) - (u^{k,t}, \mu^{k,t})|| / ||(u^{k,t}, \mu^{k,t}))|| \quad < \quad \epsilon_a,$$

the convergence criterion for the action network training is met.

The training procedure for the critic network which expresses the relation between x^k and λ^k is as follows:

1) Generate set S. For all $x^k \in S$, follow the steps below:

(1.i) Input x^k to the action network to obtain $u^{k,a}$ and $\mu^{k,a}$.

(1.ii) Using x^k and $u^{k,a}$ solve state equation (4) to get x^{k+1}.

(1.iii) Input x^{k+1} to the critic network to obtain λ^{k+1}.

(1.iv) Using x^k, $u^{k,a}$, $\mu^{k,a}$ and λ^{k+1} solve (6) to calculate $\lambda^{k,t}$.

(1.v) Input x^k to the critic network to obtain $\lambda^{k,c}$.

When

$$||\lambda^{k,c} - \lambda^{k,t}||/||\lambda^{k,t}|| \quad < \quad \epsilon_c,$$

the convergence criterion for the critic network training is met.

Further discussion and detail explanation of this adaptive critic methods can be found in [14], [5], [7], [8].

IV. MODEL OF FEEDING ADAPTATION

The model consists of phosphorus (x_1) as a limiting nutrient for growth of four species of algae of different size $(x_2 - x_5)$ and zooplankton (x_6). Similar models of n species of microorganisms competing exploitatively for a one, two or more growth-limiting nutrients are used to study continuous culture of microorganisms in chemostat under constant condition [13] without of any predators. Functions occouring in the model are given in Tables II in ecological and mathematical notation, respectively. The model is described by the following system of ordinary differential equation (9):

$$
\begin{aligned}
\dot{x}_1 &= a_7(a_8 - x_1) - \sum_{i=2}^{5}\left(\frac{d_1 x_i p_i x_1}{x_1 + s_i}\right. \\
&\quad \left. + r_i f_2 x_i + x_i x_6 C_i\left(1 - \frac{d_4}{a_4 + x_i}\right)\right) \\
\dot{x}_i &= \frac{d_1 x_i p_i x_1}{x_1 + s_i)} - r_i f_2 x_i - x_i x_6 E_i - d_2 x_i + a_{i+9} a_7 \\
&\quad \text{for } i = 2 \ldots 5 \\
\dot{x}_6 &= x_6\left(d_3 \sum_{i=2}^{5}\frac{C_i x_i}{a_4 + x_i} - a_5\right) + a_6
\end{aligned}
\tag{9}
$$

For detail explanation see [6]. It is derived from the models of the series AQUAMOD [12] modified by the inclusion of several "species"of algae. The description of the light dependence of algae is highly simplified. Instead of an approximative integration of the algal growth over depth and time distribution of light intensity only a simple function $g(I)$ is used, describing a Michaelis-Menten type dependence with the halfsaturation constant for light IKM. We consider this oversimplification appropriate for the purposes of this paper.

Four species of algae were considered during the computations performed:
$x_2, \ldots, x_5$. Each "species"is represented by a particular algal cell (or colony) volume. The volumes were set arbitrarily to $(V_i = 50, 500, 2500$ and 5000 $\mu m^3)$, to approximate the set of "edible" algal sizes commonly occurring in our reservoirs. The ecological parameters of the algae are considered functions of V_i ([12]). Table I gives the corresponding values used in the present simulations.

However, for other values of V_i it is possible to derive the parameters from the functions $P_{max}(V_i)$, $KS(V_i)$ and $Resp(V_i)$ given in Table III. It is to be noted that P_{max} corresponds to light saturation and temperature of $0°C$; for $20°C$ the growth rate will be about 7.2 times higher. The high values of $PRFOS$ are used to simulate eutrophic conditions. For the filtration capability of zooplankton we assume that algal volumes selected at a given setting of the filtratory apparatus have log-normal distribution. This is identical with the "size limited predators"and the function we propose is approximately identical with the "selectivity" by this class of predators as given by [15].

The description of selectivity E_i is as follows:

$$E_i(u) = exp(-0.1 \ (u - u_i)^2)$$

TABLE I

VALUES OF PARAMETERS

a_1	0.05	sedimentation rate$[day^{-1}]$
a_2	0.6	maximum efficiency of zooplankton assimilation
a_3	0.05	recalculation from units of algae to units of zooplankton
a_4	60	half saturation constant for zooplankton feeding [mg.m^{-3} CHA]
a_5	0.03	zooplankton mortality$[d^{-1}]$
a_6	0.002	inflow of zooplankton$[m^{-3}C.day^{-1}]$
a_7	0.1	hydraulic loading$[d^{-1}]$
a_8	200	inflow phosphorus concentration$[mg.m^{-3}P]$
a_9	0.9	zooplankton filtration rate $[m^{-3}C.day^{-1}]$
a_{10}	120	half saturation constant for light [cal.$cm^{-2}.day^{-1}$]
$a_{11} - a_{14}$	0.	inflow of phytoplankton concentration [mg.m^{-3}CHA]

TABLE II

SIZE-SPECIFIC PARAMETERS OF ALGAE

	V_i	algal cell volume$[\mu m^3)]$
	$u_i = 2 * \sqrt[1/3]{\frac{3*V_i}{4*\pi}}$	diameter corr. toV_i
	$E_i(u) = exp(-0.1\ (u - u_i)^2)$	selectivity
C_i	$Frz(V_i) = a_9 * E_i(u)$	forcing function
p_i	$P_{max}(V_i) = 0.5 - 0.05 LOG(V_i)$	spec. growth rate$[d^{-1}]$
r_i	$Resp(V_i) = 0.02 + 0.002 LOG(V_i)$	spec. resp.rate of algae $[d^{-1}]$
s_i	$KS(V_i) = -5 + 10 LOG(V_i)$	half sat. constant for P $[mg.m^{-3}P]$
f_1	$Faz = 0.8 + 0.25 cos(t) + 0.12 cos(2t)$	sedimentation func.
f_2	$Temp = 12 + 10 sin(t + 220)$	water temperature$[^oC]$
f_3	$I_0 = 280 + 210 sin(t + 240)$	light intensity $[cal.cm^{-2}.day^{-1}]$
	$f(Temp) = e^{(0.09*Temp)}$	$g(I_0) = \frac{I_0}{I_0 + IKM}$
	$d_1 = f * g$	$d_2 = a_1 * f_1$
	$d_4 = a_2 * a_4$	$d_3 = a_3 * d_4$

where u is the value of setal density directly related to the algal diameter for which selectivity is maximal and u_i is the diameter corresponding to each algal cell volume V_i. The specific filtration rate of algae of different sizes (volumes) of the population adapted to certain condition (i.e., with certain values of u becomes

$$Frz(V_i) = FRZ * E_i(u)$$

where FRZ is the filtration rate for algae of the optimal size, i. e., those which are filtered with the selectivity factors $E_i(u_i) = 1$.

V. OPTIMIZATION

In this section we are interested in the ability of Cladocera to adapt both the filtration area and filter density to the amount and size structure of the food particles (algae) population. We assume that filtration in aquatic filter feeders is an optimal process of maximal feeding strategy. We will investigate two strategies [4], [6]:

1) instantaneous maximal biomass production as a goal function (local optimality), i.e.,

$$\dot{x}_6 = f_6(x, u, t) \rightarrow max$$

for all t, under the constraints

$$u \in [u_{min}, u_{max}].$$

TABLE III
PARAMETERS FOR FOUR "SPECIES" OF ALGEA

V_i	50	500	2500	5000
u_i	4.57	9.85	16.84	21.22
p_i	0.4151	0.3651	0.3301	0.3151
s_i	11.99	21.99	28.98	31.99
r_i	0.023	0.025	0.027	0.028

2) integral maximal biomass (global optimality), i.e.,

$$J(u) = \int_0^T x_6(t) \ dt,$$

under the constraints

$$u \quad \in \quad [u_{min}, u_{max}].$$

A. Local optimality

In the case of strategy 1, we maximize the following function

$$J(u) = \sum_{i=2}^{5} \frac{E_i(u)d_3 x_i a_9}{(x_i + a_4)}.$$

under the constraints

$$u \quad \in \quad [u_{min}, u_{max}].$$

B. Global optimality

In case of strategy 2, we have the following optimal control problem: to find a function $\hat{u}(t)$, for which the goal function

$$J(\hat{u}) = \int_0^T x_6(t) \ dt$$

attains its maximum, where T denotes the lifetime of an individual Daphnia. We introduce an additional state variable

$$x_0(t) \quad = \quad \int_0^t x_6(s)ds \tag{10}$$

defined by the

$$\dot{x}_0(t) = x_6(t), \ x_0(0) = 0.$$

We are led to the following optimal control problems: Maximize

$$x_0(t_f) \tag{11}$$

under the constraints

$$c_1(x, u) \quad = \quad u_{min} - u \leq 0$$
$$c_2(x, u) \quad = \quad u - u_{max} \leq 0.$$

Discretization of Eqs. (9 - 11) using Eqs. (6- 8) and state equation (4) leads to

$$Minimize \quad - x_0^N$$

subject to

$$
\begin{aligned}
x^{i+1} &= x^i + hf(x^i, u^i) \\
& \qquad i = 0, \ldots, N-1, \\
\lambda^i &= \lambda^{i+1} + h\lambda^{i+1} f_{x^i}(x^i, u^i) \\
& \quad + \mu^i c_{x^i}(x^i, u^i), \\
& \qquad i = N-1, \ldots, 0, \\
\lambda_0^i &= -1, \; i = 0, \ldots, N-1 \\
\lambda^N &= (-1, 0, 0, 0, 0, 0, 0), \\
0 &= h\lambda^{i+1} f_{u^i}(x^i, u^i) \\
& \quad + \mu^i c_{u^i}(x^i, u^i),
\end{aligned}
$$

where the vector function

$$
F(x, u) = (-x_6, f_1(x, u), \ldots, f_6(x, u))
$$

is given by Eq. (10) and by right-hand side of Eq. (9).

VI. NUMERICAL RESULTS

In the adaptive critic synthesis, the critic and action network were selected such that they consist of six and two subnetworks, respectively, each having 6-18-1 structure (i.e. six neurons in the input layer, eighteen neurons in the hidden layer and one neuron in the output layer). The proposed *adaptive critic neural network* is able to meet the convergence tolerance values that we choose, which led to satisfactory simulation results. Simulations, using MATLAB show that proposed neural network is able to solve nonlinear optimal control problem with state and control constraints. Our results are quite similar to those obtained in [6].

The results of numerical solutions (Figs. 3 - 8) have shown that the optimal strategies $\tilde{u}(t)$ and $\hat{u}(t)$ based on short or long-term perspective, respectively, have different time trajectory for different values of Faz - sedimentation function, $Temp$ - water temperature, and I_0 - light intensity ($t = 120, 210$).

When $\hat{u}(t)$ is optimal (what is valid according to numerical results) then $J(\hat{u}(t)) \geq J(\tilde{u}(t))$, i.e., the total biomass for the short-term perspective is smaller or maximally equal to the biomass for the long-term perspective. The numerical results have shown, that for the initial conditions considered $J(\hat{u}(t)) > J(\tilde{u}(t))$, (see Table IV). The higher biomass of zooplankton obtained in the case of integral formulation points towards the assumption that the organisms do better if not reacting only to the immediate changes, but having developed mechanisms consistent with more long-term consideration.

TABLE IV

RESULTS OF GOAL FUNCTION EVALUATIONS FOR LOCAL AND GLOBAL OPTIMALITY

Value of goal function	t=120	t=210
local $J(\tilde{u})$	18.4 (Fig.5)	105.1 (Fig. 8)
global $J(\hat{u})$	27.9 (Fig. 5)	178.4 (Fig. 8)

VII. CONCLUSION

In this paper, the optimal control problem with control and state constraints has been investigated. Using adaptive critic approach we extend the adaptive critic neural network proposed by [14],[8] to solve the optimal control problem with control and state constraints. The extended adaptive critic neural network is a good solver for a wide class of optimal control problems. We have formulated, analysed and solved an optimal control problem related to the optimal food screening process by Daphnia. Using MATLAB, a simple simulation model based on adaptive critic neural network approach was constructed. Numerical simulations have shown that adaptive critic neural network is able to solve nonlinear optimal control problem with control and state constraints and it explains feeding adaptation of filter feeders of Dapnia. Illustrative example further show that the extended adaptive critic neural network can be applied for an optimal control problem in a ecologic-oriented domain.
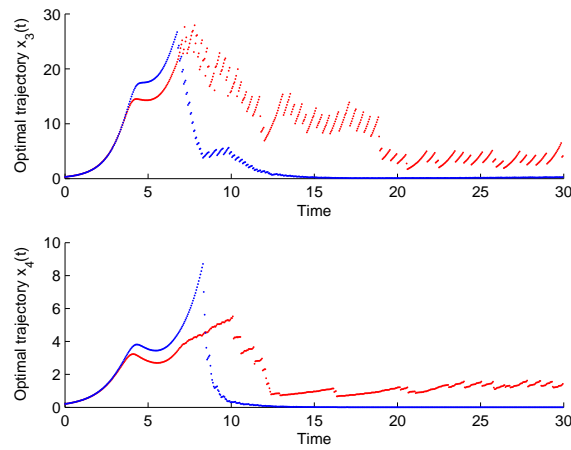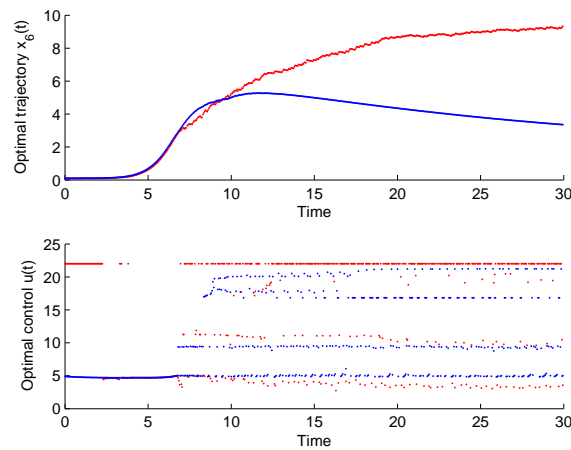
ACKNOWLEDGMENT
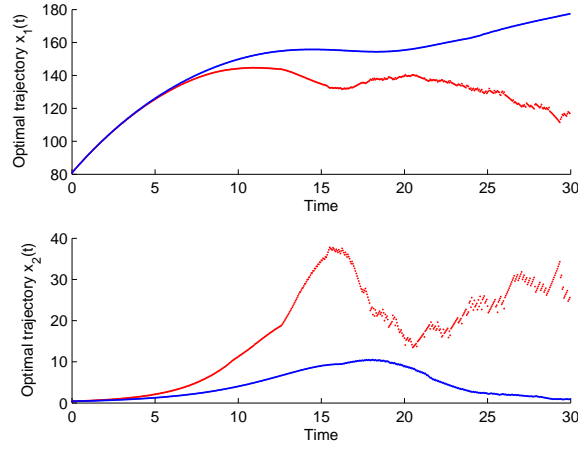
Fig. 3.   Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 120$
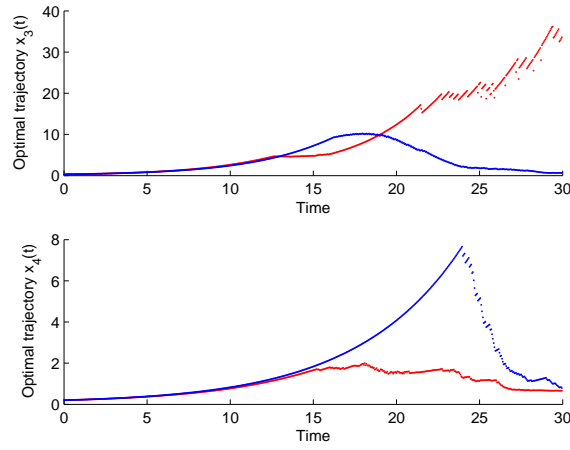
Fig. 4.   Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 120$
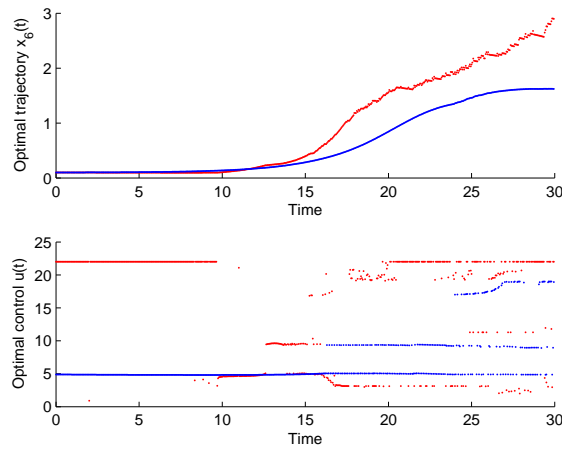

Fig. 5.   Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 120$
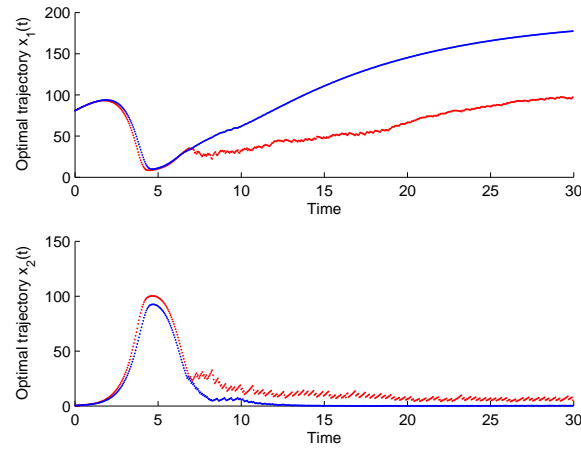
Fig. 6. Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 210$

Fig. 7. Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 210$

Fig. 8. Simulation results - local optimality (blue line), global optimality (red line) $x_1^0 = 80.4$, $x_2^0 = 0.4$, $x_3^0 = 0.3$, $x_4^0 = 0.2$, $x_5^0 = 0.1$, $x_6^0 = 0.1$, $t = 210$
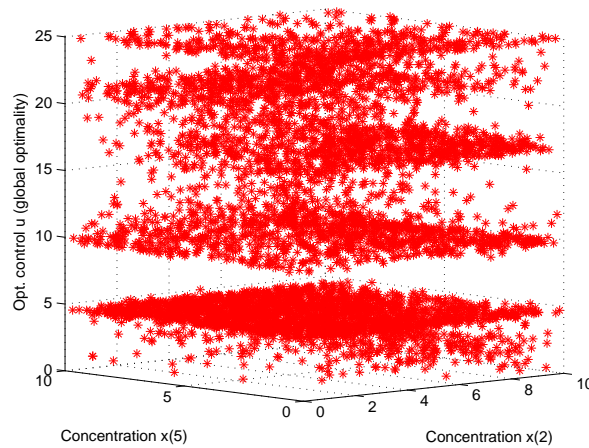
Fig. 9.   Adaptive critic neural network simulation of optimal feedback law for 6000 x^k states input signal (optimal control for global optimality $\hat{u}$ in dependence on x).
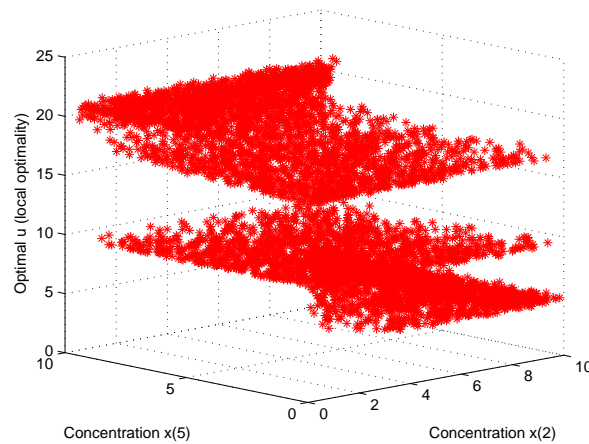
Fig. 10.   Optimal u in dependence on x for 6000 x states (local optimality)

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On History of Information Visualization

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Keywords: abstract data, data visualization, distant learning, graphics

Abstract: Information visualization is a new discipline using computer graphics technologies and based on piece of knowledge in statistics, informatics, geometry and psychology. Visualization offers technique for creating images, charts and animations for communicate some information. This is the merit of information visualization doing it extremely important for distant learning. Good and powerful visual representation of abstract data may help in communicating, analyzing data and confirming hypotheses and can substitute many pages of explanatory text. Examples from history give inspirations for building excellent visual representations, but wrong examples should be avoided in next creation of visualization.

Introduction

The history of visualization is that of the search for new artefacts to amplify the ability to know; it is the history of writing and of maps, the history of knowledge (Dürsteler, 2002). Since humans perceive visual attributes very well, we can represent a great deal of different data visually. The graphic representation of abstract data has deep roots reaching into the history of the earliest cartography. The first known city plan was created in the late 7th millennium BCE in Çatal Höyük in Anatolia (modern Turkey) and was painted onto a wall.

Visual Representation of Knowledge

We can find many examples of the developments and innovations related to the visual representation of knowledge. An exemplary use of map to chart patterns of disease was the famous dot map of Dr. John Snow, who plotted the location of deaths from cholera in central London for September 1854 (Tufte, 2001). Examining the map on the Figure 1, Snow observed that cholera had spread among those who lived near and drank from the Broad Street water pump. This is an example, where graphical analysis of data is more efficient as a math calculation.

Competently remake cartography maps can have narrative graphic function too. An example of excellent space-time story graphic is from French engineer, Charles Joseph Minard (1781-1870) who visualized Napoleon´s Russian campaign of 1812 (Figure 2) with combination of data map and time-series.

Figure 1: Snow´s map of location of deaths from cholera in central London in 1854.
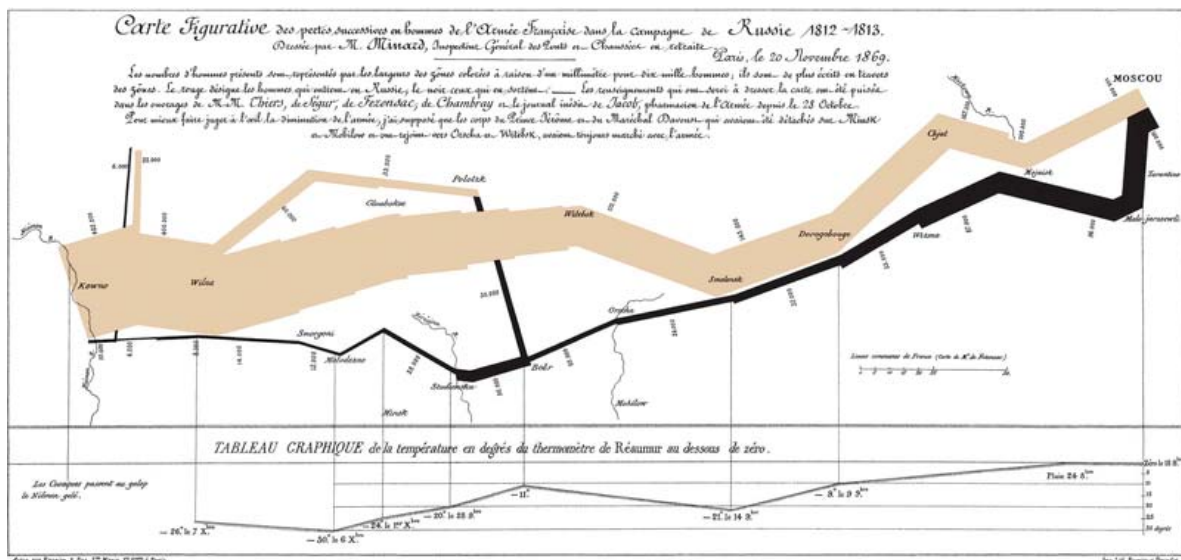
Figure 2: Minard´s visualization of Napoleon´s Russian campaign of 1812, drawn in 1861.

Six variables are plotted: the size of the army, its geographic location (2 variables), direction of the army´s movement, and the temperature on various dates during the retreat from Moscow. This excellent space-time story graphic illustrates, "how multivariate complexity can be subtly integrated into graphical architecture, integrated so gently and unobtrusively that viewers are hardly aware that they are looking into a world of four or five dimensions" (Tufte, 2001).

Knowledge visualization is an important part of information visualization. Visual representations are used very successfully for transfer the knowledge between teacher and students. Both, computer and non-computer based visualization methods can be used in learning process and can substitute many pages of explanatory text. A simple and well-known example of visualization of mathematical proof (cited from (Šedivý et al., 2000)) is shown on the Figure 3. Tufte emphasizes the role of colours in this type of visual representation (Tufte, 1990, Chapter 5: Color and Information).
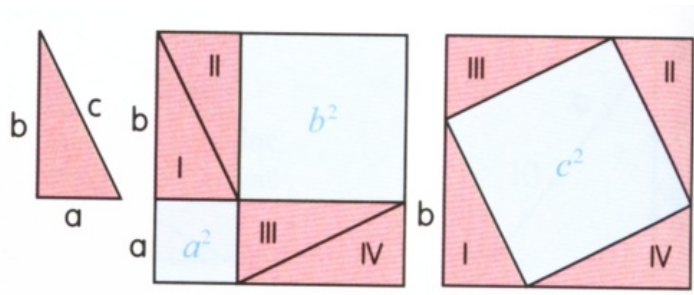
Figure 3: The visual proof of Pythagorean Theorem.

Data Visualization

The first author, who dedicated his book (The Visual Display of Quantitative Information, 1983) to information visualization, was E. R. Tufte, political economist and statistician from Yale and Princeton University and the member of American Statistical Association. He is considered as a founder of this new discipline. The recent emphasis on visualization started in 1987 with the special issue of Computer Graphics on Visualization in Scientific Computing. Since then there have been several conferences and workshops, co-sponsored by the IEEE Computer Society and ACM SIGGRAPH. They have been devoted to the general topics of data visualization, information visualization and scientific visualization, and more specific areas such as volume visualization.

Quantitative Data Visualization

The simplest way to depict and organize quantitative data is a table. However, if the data set has several dimensions, the table became confused. Since the 16th century, techniques for precise observation were well developed and then we can see the effort to show mathematical variables graphically. In the 18th century, new forms of visualization of economics, demography and health data appear. Technological innovations (colour, press) open new possibilities of data representation in printed media. The first half of the 19th century was responsible for an explosion in the growth of statistical graphics. All forms of statistic charts known today were developed at this time (Friendly, 2005). One of the famous economic data visualization is Playfair´s chart (Figure 4), where three parallel time-series are plotted: prices, wages, and the reigns of British kings and queens for 250 years, from 1565 to 1821.

Second half of 19th century is known as the golden age of data graphics (Friendly, 2005). Minard´s flow maps, pie chart, cartogram, polar coordinates chart, three-dimensional stereogram, and modern weather maps arise all from 19th century.
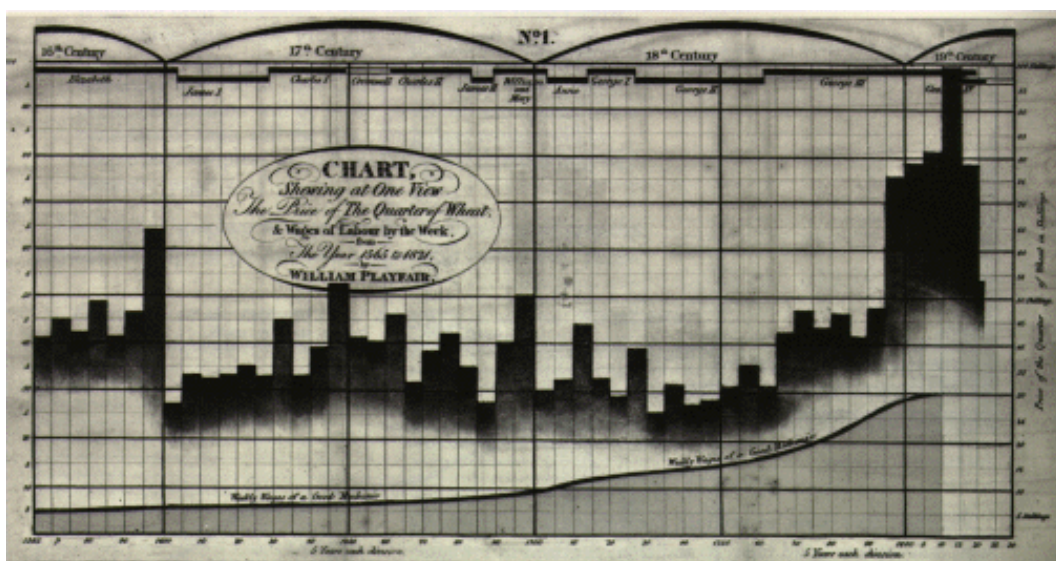
Figure 4: Chart with economic data. William Playfair (1759-1823), England.

The development of software and computer systems brought possibility of visualization of very large multidimensional data sets and manipulation with them. Geometer Alfred Inselberg, researcher at IBM, had the idea of defining a geometric space for representation of multivariate data as an *n*-space through an arbitrary number of axes, arranging them parallel. This was the origin of parallel coordinates, the one of today´s most common technique of visual representation of multivariate data (Mazza, 2008). Parallel coordinates display high-dimensional data points. A traditional, Cartesian scatter-plot of high-dimensional points only shows two or three dimensions at a time. A parallel coordinate view represents each data point as a line that traverses parallel axes mentioned above. Each line crosses each axis at the location determined by the point's value in that dimension. With this view all dimensions are represented at once and they show the correlation between adjacent dimensions.

Ordinal and Categorical Data Visualization

Ordinal and categorical data are not characterized numerically, but they are given in order (not necessary linear, can be organized in a network too) or as a member of category (belongs to). Visualization of this type of data is not so frequent as the visualization of quantitative data, but we know very different visual representations of such data, for instance Venn-diagrams, flow-charts, trees, and so on. An example of a brilliant representation of network data is the Map of the London subway from year 1933, which became a world-recognized symbol for its simplicity and clarity (see Figure 5 cited from http://www.probertencyclopaedia.com).

A new method for representation of mainly categorical data is the so-called parallel sets, a technique developed by a group of researchers from the VRVis (Virtual Reality and Visualization) Institute of Vienna in 2006.

Figure 5: Map of London Underground created by Harry Beck, 1933.

Parallel sets take inspiration from the parallel coordinates but, in contrast, the frequency of the values in the dataset substitutes for the representation of each single instance. This type of representation, unlike the parallel coordinates, turns out to be more appropriate in the case of

categorical data. It can manage very large dataset without the problem of space (Mazza, 2008). Figure 6 shows a representation in parallel sets of a dataset derived from the victims of the Titanic disaster. The attributes arranged next to each other are linked by connections such that they represent the values of frequencies in which the conditions are verified. There are shown 3 categorical attributes of the dataset: the class in which they travelled, the sex, and whether they survived. The figure very clearly shows that most of the first-class passengers survived, while the majority of the third-class passengers and the crew died in the disaster (Mazza, 2008).

Conclusion

The graphic representation of abstract data has deep roots reaching into the history of the earliest cartography, later into economics and statistical graphics, medicine and other fields. Developments in printing, reproduction and practical observation enabled the wider use of graphics along the way. From earliest history there are known town maps and navigation maps mainly. In the 16th century, techniques for precise observation were well developed and then we can see the effort to show ideas and mathematical variables graphically. In the 18th century, new forms of visualization of economics, demography and health data appear.
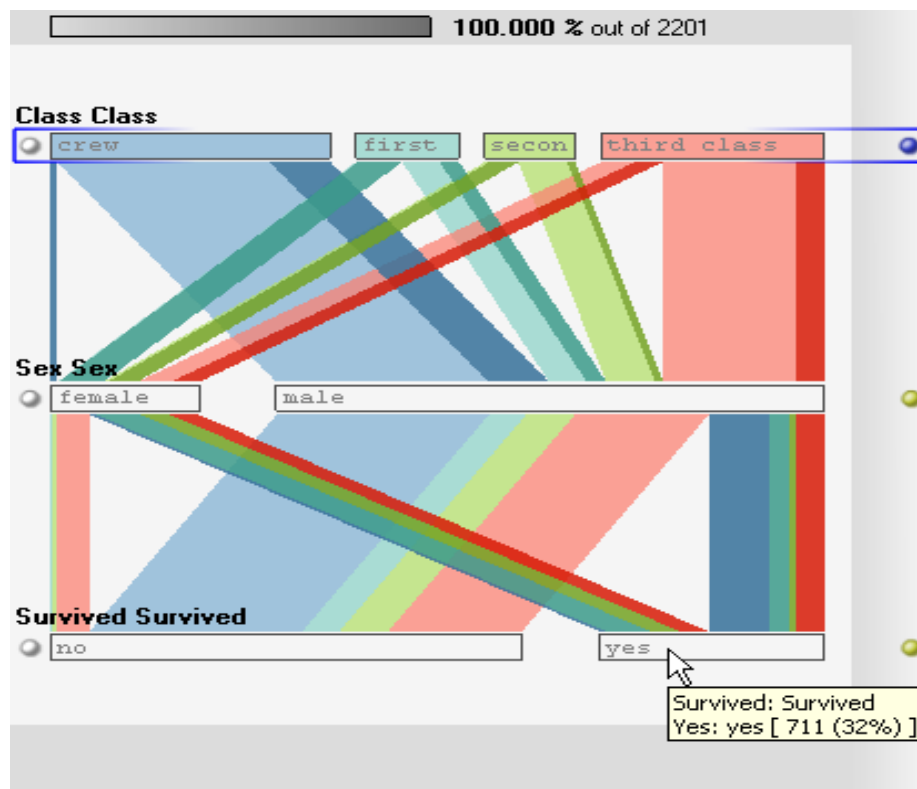
Figure 6: The Titanic disaster visualization by parallel sets (http://srvac.uncc.edu/research/parallelSets.html).

Technological innovations (colour, press) open new possibilities. Explosion in quantum of data implies the beginning of modern infographics in the first half of 19th century. All forms of statistic charts known today were developed at this time. Second half of 19th century is known as the golden age of data graphics. Minardi's illustration of Napoleon's campaign against Russia arises from this time. This is "the best graphic ever made" according to evaluation of E.R. Tufte.

Nowadays, the development of software and computer systems influences the invention of graphic techniques and methods of multidimensional visualization.

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The Possibilities of Evaluation and Implementation of Statistics Module in the LMS Moodle

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Keywords: evaluation, statistic, lms moodle, e-learning

Abstract: In the contribution authors draw attention to e-learning courses evaluation from the standpoint of making and implementing new Statistics modul in the environment of LMS MOODLE system. In the present time, great emphasis is layed on gathering new information in a very short time, but also on a possibility of testing or certification of gained knowledge with its automatic interpretation and giving a feedback. For gathering new information are used various statistics methods. The authors decide to concern their attention on LMS MOODLE system, which belongs to one of the most used e-learning systems.

Posúdenie súčasného stavu

V dnešnej uponáhľanej dobe sa čoraz viac začína klásť dôraz na získavanie a upevňovanie nových informácií, vedomostí v čo najkratšom čase a nielen v oblasti školstva ale aj širokého spektra zamestnancov. Samotné nadobúdanie nových vedomostí nie je kľúčom k úspechu, preto je potrebná nielen spätná väzba, ale aj priebežné testovanie a vyhodnocovanie aktivít v priebehu vzdelávania. Získavanie vedomostí je možné viacerými spôsobmi. V súčasnej dobe sa popri klasickom vzdelávaní presadzuje najmä využitie informačno-komunikačných technológií (ďalej len ICT), v spojení s e-learningom. Myšlienka využitia e-learningu nie je ľudstvu neznáma, predchádzalo jej učenie na diaľku (angl. Distance Learning), ktoré má svoje počiatky takmer pred 100 rokmi. Dištančnou metódou nazývame metódu vedenia vzdelávacieho procesu, pri ktorej či už učiteľ alebo žiaci sa nenachádzajú v jednej spoločnej miestnosti, ale sú od seba určitým spôsobom vzdialení. Aj keď pojem e-learning úzko súvisí s dištančným vzdelávaním, netreba si tieto pojmy navzájom zamieňať a prikladať im tak rovnocenný význam. Pod e-learningom rozumieme formu dištančného štúdia, teda metódu, resp. spôsob, akým je možné dištančné vzdelávanie organizovať.Realizácia e-learningovej formy vzdelávania predstavuje moderný spôsob nadobúdania vedomostí, ktorý sa napevno ukotvil aj na Katedre informatiky na Univerzite Konštantína Filozofa v Nitre kde tvorí už neoddeliteľnú súčasť vzdelávania. Vyučovanie prebieha za výdatnej podpory a využitia e-learningových kurzov v systéme LMS MOODLE, ktorý v súčasnosti predstavuje jeden z najpoužívanejších opensource e-learningových systémov.

Monitoring práce študenta v systéme LMS MOODLE

Monitoring práce študenta (aktivita) v systéme LMS Moodle je daný činnosťou a akciou, ktorá bola s touto činnosťou realizovaná. V module Záznamy sú zaznamenávané len tie aktivity, ktoré boli vykonané z hlavnej stránky kurzu, tj. pri vykonávaní určitej činnosti v rámci niektorého z modulov. Nezaznamenávajú sa však aktivity ako je napr. štúdium knihy, teda vlastný pohyb v rámci knihy a tiež čas, ktorý študujúci strávil štúdiom jednotlivých kapitol v rámci knihy. Systém však štatisticky vyhodnocuje a poskytuje celkové hodnotenie jednotlivých študentov, ako aj kompletné hodnotenie celej skupiny, do ktorej daný študent patrí.

Sledovanie práce môžeme rozdeliť do štyroch základných častí :

1, živé prihlásenia z poslednej hodiny

2, správa o aktivitách

3, záznamy o účastníkoch

4, štatistika (obr.1) :   4.1, Čas – deň a čas prihlásenia používateľa do systému,

4.2, IP adresa - adresa z ktorej pristupoval používateľ do systému,

4.3, Celé meno – Meno a priezvisko používateľa,

4.4, Akcia – akú akciu používateľ vykonal,

4.5, Informácie – doplňujúce informácie.

Obr. 1: Štatistika

Štatistika ktorú poskytuje LMS MOODLE je prevažne zameraná na sledovanie práce so systémom. To znamená, že systém monitoruje prácu študenta a nie proces nadobúdania vedomostí.

Pre výskum autorov je ale dôležité získať údaje a štatisticky ich vyhodnotiť, ako študent nadobúdal nové vedomosti a zručnosti, informácie o tom, ako študent prechádzal jednotlivými lekciami. Faktory, ktoré vplývajú na nadobúdanie nových vedomostí pomocou LMS MOODLE môžeme rozdeliť do dvoch skupín :

a)   priamo ovplyvniteľné faktory,

b)   nepriamo ovplyvniteľné faktory.

Priamo ovplyvniteľné faktory má vyučujúci možnosť priamo ovplyvniť. Závisia od spôsobu spracovania e-learningového kurzu (obsah i forma), cez zabezpečenie interaktivity študujúceho so študijným materiálom, až po možnosť študujúceho riadiť určitým spôsobom výučbu, teda prispôsobovať množstvo preberanej učebnej látky jeho potrebám pri rozvoji kognitívnych a intelektuálnych schopností.

Nepriamo ovplyvniteľné faktory nemá vyučujúci možnosť ovplyvniť. Predstavujú napr. čas, kedy sa študent prihlasuje do systému a skutočnosť, či dané materiály naozaj študuje alebo ich má len zobrazené.

Pre prácu oboch autorov je dôležite sa zamerať práve na skupinu faktorov, ktoré môžu priamo ovplyvniť proces nadobúdania nových vedomostí. Ďalšou dôležitou úlohou je overovanie takto nadobudnutých vedomosti a spätná väzba pri vytváraní, resp. úprave študijných materiálov. Nadobudnuté informácie je potrebné štatisticky vyhodnotiť. Na základe analýzy e-learningového systému LMS MOODLE sa naskytujú dve možnosti riešenia dopracovania modulu pre štatistické spracovanie:

1.   evaluácia a implementácia štatistického modulu do LMS Moodle

2.   návrh a realizácia externého modulu pre štatistické vyhodnocovanie.

Pod pojmom evaluácia (z angl. evaluation = hodnotenie) rozumieme proces hodnotenia. Ak používame tento termín v spojení s e-learningovým kurzom, máme na mysli hodnotenie, ktoré je najčastejšie realizované externým evaluátorom s cieľom porovnať pôvodné zámery so skutočnosťou. V súčasnosti sa viaceré publikácie z oblasti e-learningu zameriavajú najmä na problematikou vytvárania e-learningových kurzov, málo z nich sa však skutočne zaoberá aj evaluáciou, pre dosiahnutie plnohodnotného výučbového produktu.
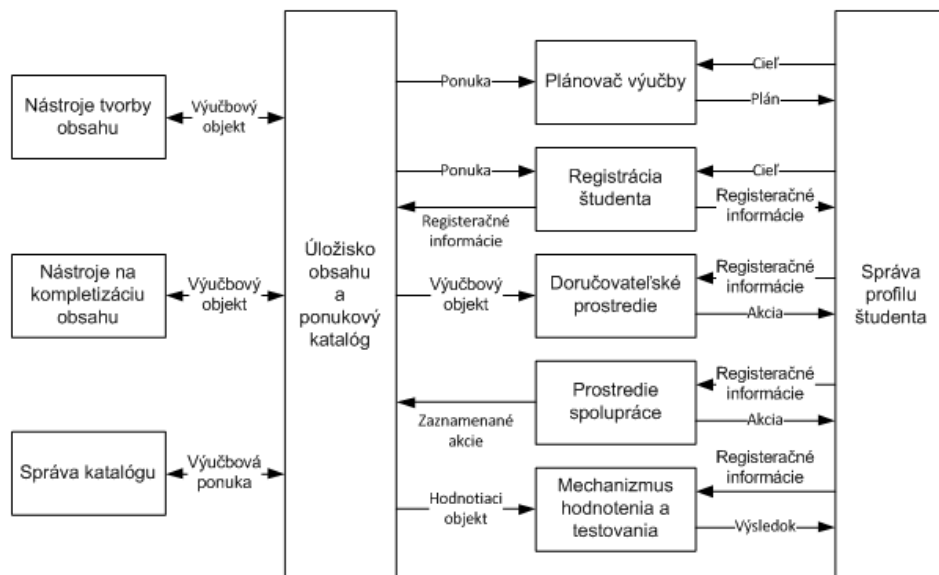
Obr. 2: Funkčný model e-learningového systému

Z blokovej schémy funkčného modelu e-learningového systému je zrejmé, že pri správe profilu študenta je nutné nielen zaznamenávať jednotlivé akcie (aktivity) v rámci modulov, ale taktiež sa zamerať na mechanizmus hodnotenia a testovania.

Dopracovanie štatistického modulu do LMS MOODLE

Prvou možnosťou je vytvorenie a implementácia špeciálneho štatistického modulu do LMS MOODLE, čo súvisí s rozširovaním možností tohto systému a súčasne aj s riešením prípadných problémov, ktoré vznikajú pri jeho zavádzaní do praxe.

Jedným z navrhnutých spôsobov, ako zabezpečiť zápis do databázy, je vytvoriť:

- evaluačný formulár (vo forme html) pre študujúcich v rámci kurzu,
- uloženie prichádzajúceho súboru do adresárovej štruktúry LMS Moodle,
- samotné zobrazenie evaluovaných materiálov na základe vyplneného formuláru,
- štatistické vyhodnocovanie nadobudnutých vedomosti a zručností na základe porovnávania času potrebného na zvládnutie preberaného učiva pred a po evaluácii materiálov.

Zdrojové kódy LMS Moodle sú však veľmi spletité a neprehľadné a ich detailné štúdium tak zaberá priveľa času. Preto pri zmene a doplnení tohto typu modulu čerpáme poznatky už z vytvorených a sprístupnených modulov na stránke http://moodle.org.

Vypracovanie externého modulu pre štatistické vyhodnocovanie

Druhou možnosťou je získané informácie vyexportovať do externého systému, kde sa budú štatisticky spracovávať. Získané výsledky sa však po štatistickom vyhodnotení musia naspäť odoslať do

LMS Moodle, kde sa zapíšu do databázy pre konkrétneho študujúceho. Toto je možné zrealizovať na základe JAVA apletu, ktorý dokáže odosielať súbory podobne ako klasický formulár v HTML. Odoslanie spočíva v zavolaní skriptu (čo je ekvivalentné otvoreniu URL skriptu), ktorý potom súbor prijme a uloží na server. Pomocou skriptu sa vytvorí spojenie a otvorí výstupný prúd, cez ktorý bude možné zapisovať požadované dáta. Po zapísaní všetkých dát sa musí však tento výstupný prúd uzatvoriť, čím server získa informáciu, že skončil zápis dát a môže ich teda spracovať. Kvôli ochrane prenášaných údajov medzi LMS Moodle a serverom, na ktorom sa vykonalo štatistické vyhodnotenie, je potrebné zabezpečiť odozvu o informácii o priebehu ukladania súboru. Samotné preberanie a ukladanie súboru na serveri musí zabezpečiť skript schopný spracovať posielaný súbor. Keďže LMS Moodle plne podporuje jazyk PHP, spracovanie prijímaných súborov je v ňom veľmi jednoduché.

```php
<?php
$adresar = '/var/www/uploads/';
$subor = $adresar . basename($_FILES['userfile']['name']);
echo '<pre>';
if (move_uploaded_file($_FILES['userfile']['tmp_name'], $subor)) {
   echo "Subor bol uspesne uploadovany.\n";
} else {
   echo "Chyba pri uploade suboru!\n";
}
print "</pre>";
?>
```

V premennej adresar sa nachádza cesta, kam bude súbor uložený. Samotný presun do tohto adresára zabezpečuje funkcia move_uploaded_file.

Záver

Obe riešenia sú náročné nielen z programátorského hľadiska, ale najmä z dôvodu pochopenia štruktúry systému, z možnosti organizácie a ukladania údajov v databáze LMS MOODLE. V prípade realizácie druhej možnosti je však potrebné počítať nielen s viacerými obmedzeniami, ktoré pri takomto spôsobe štatistického vyhodnocovania môžu nastať, ale najmä s potrebou dodatočného zabezpečenia proti neželanému úniku informácií medzi systémom LMS MOODLE a vytvoreným externým prostredím.

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A Proposal for Adaptation Implementation within E-Learning Systems

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Abstract: E-learning systems are mostly one of the most important parts of university information systems. Within these systems a lot of functions are enabled for student's or teacher's activities during their educational interactions, nowadays often including any kind of adaptation. Using adaptation within e-learning systems is very important because this is the way how to: Increase eLearning efficiency – Information delivered by the preferred way are for students more understandable, one person likes for example text with pictures other elects audio records. Generally, that is why students don't need so much time in comparison with common learning. The support of individual teaching i.e. adaptation extents e-Learning advantages also in the area of individualization. There is no limitation to use eLearning course as a tool within face-to-face teaching for example for explanation of new problems, preparation for discussion and other activities. Respect students' needs – Traditional teaching often doesn't suit to all students because each of them must more or less conform to teacher's style. Learning styles adaptation enables enforcing students' needs. Reduction of "bad" influence of the teacher – What to do if teacher (or prepared course) are not optimal? Adaptation is also one of the solutions which can reduce this state. Described possibilities are the reason why adaptation should be considered at least as a possible future benefit. It is a domain that could bring more flexible and useful way of learning together with efficiency and easier motivation of students. The general questions are what and how to adapt and where are the limits for the whole implementation. It is clear that architecture of e-learning system has to cover up basic components common for adaptive systems. It means adaptive engine with rules of adaptation, user model, domain model and monitor of users' actions (behavior). The paper describes a proposal for implementing adaptation mechanisms for optimizing study and learning activities of students using various applications of e-learning systems. Basic classification and description of advantages and disadvantages of possible types of adaptation is also part of this paper. The e-learning system ELIS is considered as a concrete platform and the example of system with potential to extend its current functionality with adaptation.

LMS Moodle as the Tool for Evaluation of Presentations by the Audience

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Abstract: In the paper we discuss the possibilities of realization of the evaluation that is composed of several partial evaluations, especially if they were carried out by different evaluators. This type of evaluation can be used for example in evaluating the presentations, if we want also the audience (e.g. the other students) to join the evaluation process. Our intention is to introduce the possibilities that the learning management system, particularly LMS Moodle that we use to manage the education, offers to make the process of gathering data for evaluation, processing them and publishing the results to the students easier, more transparent for the students, more effective and less time-consuming for the teacher. We propose the usage of the Feedback activity in LSM Moodle as the tool for gathering the input data for evaluation from the students, the spreadsheet for processing the data and getting the final evaluation and the Grades module in LMS Moodle to publish the results to the students.

Úvod

Zmeny v oblasti vzdelávania, ktoré v posledných rokoch ovplyvnili nielen jeho obsah, ale aj realizáciu, poznačili aj oblasť hodnotenia. Kritériá hodnotenia sú pestrejšie a samotný proces hodnotenia komplexnejší.

Jedným z hodnotení, ktoré sa využívajú najmä v poslednom období, je hodnotenie tvorené ako priemer viacerých hodnotení, resp. hodnotení od rôznych hodnotiteľov. Typickým príkladom takejto situácie je hodnotenie prezentácií, s ktorými sa môžeme stretnúť na rôznych predmetoch, od jazykov, cez rôzne praktické predmety až po informatiku. Prezentácia je veľmi zriedka určená pre jednotlivca (učiteľa), zvyčajne sú jej adresátmi viacerí diváci – žiaci triedy, príp. ročníka, učitelia, rodičia a pod. Hodnotenie sa však zvyčajne obmedzuje na prezentácie v rámci triedy, kedy sú adresátmi spolužiaci a učiteľ, pretože pri ostatných typoch prezentácií sa hodnotenie len málokedy vyjadruje známkou.

Pri klasickom hodnotení by svoj názor na prezentáciu zverejňoval len učiteľ. V rámci moderného hodnotenia môžeme do procesu hodnotenia zahrnúť aj ostatných divákov prezentácie – spolužiakov. Takéto hodnotenie potom pozostáva z dvoch častí – hodnotenia učiteľa a hodnotenia žiakov. Z hľadiska realizácie musí teda učiteľ zabezpečiť nielen zverejnenie svojho hodnotenia, ale aj zozbieranie podkladov pre hodnotenie od spolužiakov, tieto vyhodnotiť a interpretovať (napr. známkou alebo bodmi) a určiť záverečné hodnotenie, ktoré vznikne spojením obidvoch zložiek hodnotenia.

Nie je naším cieľom rozoberať didaktickú stránku takéhoto hodnotenia. Budeme predpokladať, že kritériá hodnotenia sú už stanovené, rovnako ako aj podiel jednotlivých zložiek na celkovom hodnotení. Pozornosť teda budeme venovať realizácii tohto typu hodnotenia v triede, podľa možnosti čo najjednoduchšej a najefektívnejšej.

Podobne ako pri zverejňovaní študijných materiálov, testovaní, komunikácii alebo administrácii dochádzky, aj pri hodnotení prác študentov môže byť veľmi užitočným pomocníkom systém pre administráciu vzdelávania (Learning Management System – LMS). Hlavným dôvodom je to, že umožňuje prístup zaregistrovaným používateľom (učiteľom aj žiakom) a tvorca kurzu môže veľmi prehľadne a relatívne jednoducho nastaviť príslušné aktivity a oprávnenia prístupu k nim pre jednotlivých

účastníkov. Možnosti spracovania hodnotenia prezentácií budeme popisovať na príklade systému LMS Moodle, ktorý používame už niekoľko rokov a máme s ním dobré skúsenosti.

V rámci obsahového kontextu využijeme záverečné práce z predmetu Anglický jazyk, ktoré sú realizované formou prezentácií, ktoré študenti prezentujú pred svojou študijnou skupinou. Samozrejme, cudzie jazyky nie sú jedinou oblasťou, v ktorej je možné hodnotiť prezentácie, tak ako prezentácie nie sú jedinou možnosťou, ako hodnotiť prácu z pohľadu viacerých hodnotiteľov. Je preto potrebné si uvedomiť, že uvádzané situácie slúžia len pre ilustráciu využitia uvedených nástrojov pre administráciu tohto typu hodnotenia a nie ako ojedinelá situácia, v ktorej je ho možné využiť.

Podmienky hodnotenia

Skôr, než začneme realizovať proces hodnotenia, musia byť jednoznačne stanovené kritériá a spôsob hodnotenia. V našej modelovej situácii bolo hodnotenia rozdelené do piatich oblastí:

- Content of the presentation/Obsah prezentácie
- Visuals – slide-show/vizuálne pomôcky, prezentácia
- Delivery – speech, phrases/Prednes – prejav, frázy
- Discussion – answering Qs, work with the audience/Diskusia – odpovedanie na otázky, práca s publikom
- Glossary entries – usefulness, elaboration/Záznamy v slovníku – užitočnosť, vypracovanie

Poslednou oblasťou hodnotenia boli takzvané Bonus points/Bonusové body, ktoré boli udeľované za veľmi dobré spracovanie niektorej oblasti, príp. za oblasti, ktoré neboli spomenuté v hodnotení. Považujeme za potrebné podotknúť, že celkové hodnotenie bolo vypočítané z piatich hlavných oblastí, bonusové body slúžili ako body navyše, t.j. mohli celkové hodnotenie zlepšiť, ale nie zhoršiť. Išlo najmä o motiváciu k lepším výkonom študentov, ale aj možnosť oceniť tých, ktorí pri príprave alebo samotnej prezentácii prejavili veľmi dobré zručnosti, veľkú snahu alebo kreatívne nápady.

Hodnotenie jednotlivých oblastí bolo rozdelené na dve časti – hodnotenie učiteľom a hodnotenie študentmi-spolužiakmi. V rámci celkového hodnotenia sa väčšia váha prikladala hodnoteniu učiteľom, ktorý sa sústreďoval na viacero faktorov v rámci každej z uvedených oblastí – jeho hodnotenie bolo preto komplexnejšie a vyjadrené s väčšou presnosťou, doplnené aj o slovný komentár priamo na hodine. Taktiež nesmieme zabudnúť, že snahou učiteľa je zostať v každej situácii nestranný a objektívne posúdiť prácu jednotlivých študentov, zatiaľ čo spolužiaci v mnohých prípadoch hodnotia aj na základe subjektívnych pocitov. Našou snahou však nie je skúmať objektívnosť tohto typu hodnotenia, ale možnosť jeho realizácie, preto budeme predpokladať, že hodnotenie, ktoré budú študenti priraďovať k jednotlivým prácam, bude do veľkej miery objektívne, čomu by malo napomôcť aj stanovenie oblastí hodnotenia a kritérií, ktoré majú v rámci jednotlivých oblastí posudzovať – tieto sú stanovené vždy na niektorom z úvodných stretnutí daného predmetu, aby už pri príprave svojich prezentácií študenti vedeli, čo a ako bude na ich prezentáciách hodnotené.

Zbieranie podkladov pre hodnotenie

Je zrejmé, že pri zhromažďovaní informácií od rôznych hodnotiteľov (študentov), navyše v rôznych oblastiach hodnotenia, je potrebný prepracovaný systém zverejňovania a vyhodnocovania týchto čiastkových hodnotení. Keďže pri výučbe využívame LMS Moodle, máme k dispozícii priestor, do ktorého majú prístup všetci študenti, môžu získavať, ale aj zverejňovať informácie, ktoré potom môže učiteľ použiť pre ďalšie spracovanie.

V rámci hodnotenia prezentácií sa ako najvhodnejšia javí aktivita Spätná väzba, ktorá umožňuje vyjadrenie názoru jednotlivých účastníkov príslušného kurzu na určitú otázku, v našom prípade na konkrétnu oblasť hodnotenia. Dôvodov pre jej výber je niekoľko:

- možnosť vytvoriť otázky rôznych typov (výber odpovede, textové pole a pod.),

- možnosť bodového hodnotenia odpovedí (tzv. rated questions),
- možnosť obmedziť odpovedanie na otázky len na jeden pokus pre každého študenta,
- možnosť povoliť prístup do aktivity len pre vybraných ľudí, resp. zabrániť prístupu niektorých účastníkov,
- možnosť obmedziť odpovedanie na otázky na určitý časový interval,
- jednoduché vyhodnocovanie zozbieraných odpovedí formou percentuálneho vyjadrenia jednotlivých možností pri otázkach s výberom odpovede,
- výpočet priemeru odovzdaných odpovedí pri otázkach s bodovanými možnosťami,
- elektronický zber údajov bez potreby vytvárať „papierové" kópie,
- jednoduchá možnosť úpravy otázok, rýchla aktualizácia (aj priamo na hodine),
- možnosť využívať šablóny s otázkami.

S využitím aktivity Spätná väzba teda dokážeme vytvoriť priestor pre hodnotenie všetkých stanovených oblastí, a to prostredníctvom otázok s výberom odpovede pre päť hlavných oblastí a textového poľa pre bonusové body – tu môžu študenti uvádzať akékoľvek komentáre k prezentácii (pozitívne alebo negatívne) a na základe týchto pripomienok budú pridelené bonusové body k celkovému hodnoteniu prezentácie. Je dôležité vybrať otázky s bodovým hodnotením odpovedí (rated), kde je možné vhodným nastavením bodovania jednotlivých možností odpovede vytvoriť čo najvhodnejší základ pre vypočítanie priemerného hodnotenia tej ktorej oblasti od všetkých hodnotiteľov.

V našom prípade sme pri piatich hlavných oblastiach hodnotenia využili 5-stupňovú stupnicu:
- Very bad/Veľmi zlé,
- Poor/Slabé,
- I don't know/Neviem – táto voľba reprezentovala strednú hodnotu, ani dobré, ani zlé,
- Sufficient/Dostatočné,
- Great/Výborné,

S bodovým hodnotením jednotlivých možností od -2 do 2, ktoré sme zvolili najmä z dôvodu vizuálneho odlíšenia negatívneho a pozitívneho hodnotenia prezentácie a taktiež kvôli univerzálnosti úpravy celkových pridelených bodov za príslušnú oblasť na základe priemeru hodnotení všetkých hodnotiteľov – spolužiakov (pozri *Spracovanie podkladov pre hodnotenie od študentov*).

Nie je však nevyhnutné zvoliť práve takéto bodové hodnotenie jednotlivých ponúkaných možností. Pre jednoduchšie spracovanie môžeme odporúčať nastaviť na jednotlivé možnosti také bodové hodnoty, ktoré už potom nebude potrebné prepočítavať za účelom zistenia konečného hodnotenia. Napr. ak za niektorú oblasť je možné získať 5 bodov, môžeme už v rámci možností hodnotenia využiť bodovanie 0 až 5 bodov, z ktorých hodnotitelia vyberajú konkrétnu hodnotu. Nevýhodou je, že v prípade rôzneho bodového hodnotenia jednotlivých oblastí musíme pre každú oblasť nastaviť iné bodové hodnoty, čím si môžeme výrazne skomplikovať tvorbu otázok pre hodnotenie. Takto tiež spôsobíme, že v rámci jednotlivých oblastí hodnotenia budú mať hodnotitelia rôzne možnosti, čo môže za určitých okolností (najmä v prípade mladších žiakov) viesť k neprehľadnosti a v konečnom dôsledku aj k nesprávnemu hodnoteniu. V neposlednom rade treba pripomenúť, že takýmto spôsobom obmedzujeme využitie vytvorenej spätnej väzby len na určitý typ prezentácie s príslušným bodovým hodnotením jednotlivých oblastí. K univerzálnemu použitiu vytvorenej šablóny spätnej väzby prispieva práve vytvorenie všeobecne platných otázok a najmä univerzálne použiteľných možností odpovede, ktoré nebudú závislé na bodoch určených pre tú ktorú oblasť hodnotenia, ale bude ich možné použiť pri rôznych prezentáciách. Keďže aktivita Spätná väzba v rámci systému LMS Moodle je prístupná elektronicky, postačí v budúcnosti len opätovne použiť vytvorenú šablónu hodnotenia pre vytvorenie nového „hárku hodnotenia", nastaviť parametre zobrazovania aktivity a prístupové práva jednotlivých študentov, a hodnotenie môže byť zrealizované.

Nastavenia prístupu do aktivity Spätná väzba

Pri využívaní spätnej väzby na zozbieranie podkladov pre hodnotenie je veľmi dôležité zabezpečiť správne zobrazovanie aktivity a taktiež prístupové práva jednotlivých študentov. Ide o nastavenie niekoľkých základných parametrov:

- zobrazovanie spätnej väzby študijnej skupine,
- časové obmedzenie možnosti odpovedať na otázky,
- zamedzenie možnosti hodnotiť študentom, ktorí prezentovali.

V prípade, že elektronický kurz využívame pre študentov z rôznych skupín, je vhodné mať študentov rozdelených do skupín aj v samotnom kurze. Vďaka tomu môžeme v kurze vytvárať zoskupenia pozostávajúce z jednej alebo viacerých študijných skupín. Hoci sa môže zdať zbytočné, aby sme vytvorili zoskupenie, v ktorom bude len jediná študijná skupina, nie je to tak. Väčšina aktivít totiž v rámci rozšírených nastavení umožňuje obmedziť jej zobrazovanie len pre vybrané zoskupenie, čím zabezpečíme, že k hodnoteniu budú mať prístup len študenti tej ktorej skupiny napriek tomu, že v kurze existuje skupín viacero.

V spomínanej modelovej situácii sú vytvorené tri študijné skupiny označené podľa toho, kedy študenti majú hodinu zaradenú v rozvrhu:

- 1st group (Wed1) – študenti 1. hodiny v stredu,
- 2nd group (Wed2) – študenti 2. hodiny v stredu,
- 3rd group (Wed5) – študenti 5. hodiny v stredu.

K týmto skupinám sú vytvorené aj zoskupenia obsahujúce jednotlivé skupiny: 1st group, 2nd group, 3rd group (Obrázok 1).


Obrázok 3 Zoskupenia

K prezentáciám, ktoré sú predmetom hodnotenia, je vždy vytvorená samostatná aktivita pre každú študijnú skupinu, v ktorej je nastavené, že je dostupná len tomu zoskupeniu, do ktorého je príslušná skupina zaradená. Študenti ostatných skupín teda túto aktivitu v kurze nevidia. Z učiteľského pohľadu potom môže kurz obsahovať niekoľko hodnotení v rámci jednotlivých lekcií (Obrázok 2), ale študenti vidia len tú aktivitu hodnotenia, ktorá je určená pre ich študijnú skupinu (Obrázok 3).
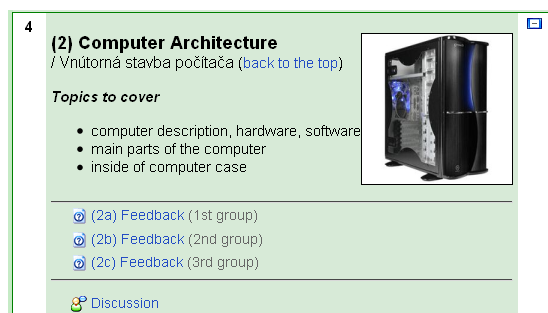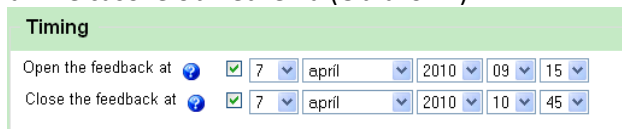

Obrázok 4 Pohľad učiteľa
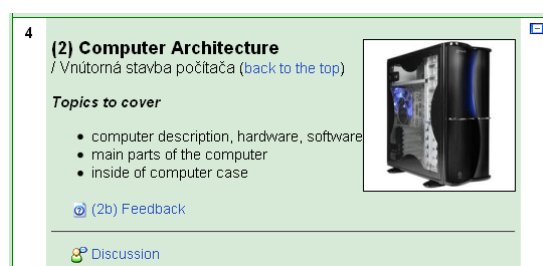
Obrázok 5 Pohľad študenta

Ak chceme zabezpečiť, aby sa hodnotenie realizovalo len v určitom čase (napr. tesne po prezentácii), v nastaveniach aktivity upravíme časové obmedzenia (Obrázok 4).
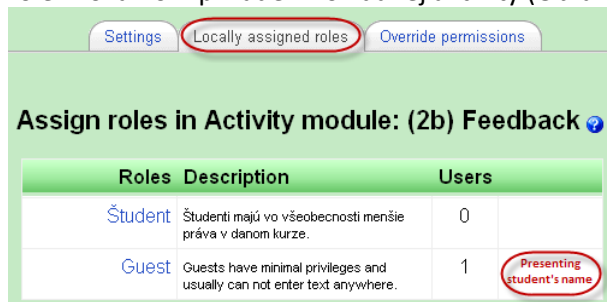

Obrázok 6 Nastavenie časových obmedzení

Posledným dôležitým nastavením je zamedzenie možnosti hodnotiť študentovi/študentom, ktorí prezentovali svoju prácu – v tomto prípade môžeme sebahodnotenie realizovať buď ústne priamo na hodine, alebo, ak ho chceme mať zaznamenané, vytvoríme samostatnú aktivitu pre všetkých študentov, v ktorej budú hodnotiť svoju vlastnú prácu. V tomto prípade sa otvárajú možnosti na vyhodnotenie spokojnosti, resp. nespokojnosti s vlastnými prezentáciami. Učiteľ môže napríklad špecifikovať problémové miesta, uvedené viacerými študentmi, a tieto potom zaradiť do ďalšej výučby, aby sa problémy odstránili.

Obmedzenie prístupu do aktivity pre určených študentov je možné zrealizovať na karte Lokálne priradenie rolí v rámci nastavení príslušnej aktivity.

Rola Študent (Student) je zvyčajne rolou s najmenšími právami v kurze. Ak je však v rámci systému povolený hosťovský prístup, teda obsahuje rolu Hosť (Guest), je možné túto rolu využiť na obmedzenie prístupu do vybraných aktivít – hosť má totiž ešte väčšie obmedzenia než študent, nakoľko si môže prezerať obsah kurzu, ale pri štandardných nastaveniach role sa nemôže zapájať do aktivít. Realizácia obmedzení potom zahŕňa priradenie príslušného študenta/študentov, ktorí sa nemajú zapojiť do hodnotenia, do hosťovskej role v lokálnom priradení rolí danej aktivity (Obrázok 5).


Obrázok 7 Lokálne priradenie rolí

Spracovanie podkladov pre hodnotenie od študentov

Po realizácii všetkých potrebných nastavení môžeme spustiť hodnotenie v rámci jednotlivých študijných skupín. Výstupom hodnotenia priamo v systéme LMS Moodle je prehľadné znázornenie zozbieraných údajov formou pruhového grafu s uvedením počtu a percentuálneho vyjadrenia zastúpenia jednotlivých možností. V spodnej časti každej otázky spätnej väzby je uvedená priemerná hodnota zo všetkých odpovedí na danú otázku (Obrázok 6).
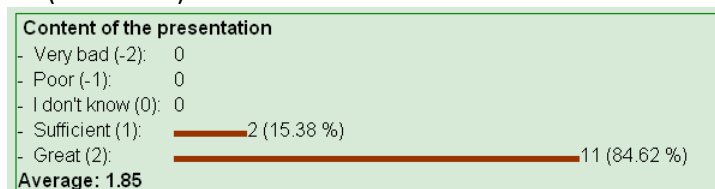
Obrázok 8 Vyhodnotenie otázky v aktivite Spätná väzba

Pre potreby získania celkového hodnotenia od študentov v príslušnej oblasti je dôležitá práve hodnota priemeru bodových hodnotení jednotlivých možností v danej otázke – ak by ju systém neuvádzal, museli by sme počty hlasov za každú z ponúkaných možností najskôr spriemerovať a potom pristúpiť k výpočtu bodov prislúchajúcich tomuto hodnoteniu.

Ak sme pri tvorbe otázok priradili každej možnosti hodnotenia finálny počet bodov, ktoré môžu prideliť študenti (napr. od 0 do 5), stačí priemerné hodnoty všetkých oblastí hodnotenia (všetkých otázok) zverejniť študentom a započítať do celkového hodnotenia.

V opačnom prípade je ešte potrebné získané hodnotenie prepočítať na body, ak používame bodové hodnotenie ako v našej modelovej situácii. Tu je vhodné využiť tabuľkový kalkulátor, v ktorom pomocou vzorcov môžeme veľmi rýchlo potrebné bodové hodnotenie vypočítať. V našom prípade sme vytvorili vzorec:

$$=IF(R4<>"";ROUND((R4+2)*5/4;2);"") \qquad (1)$$

kde

- bunka R4 obsahuje priemer hodnotení získaných zo systému,
- súčet (R4+2) zabezpečuje posunutie hodnôt do kladnej časti číselnej osi (do intervalu <0;4>),
- násobenie zlomkom 5/4 zodpovedá prepočítaniu na bodový rozsah, ktorý chceme získať; 5 je počet položiek (bez nuly) nového rozsahu a 4 počet položiek (bez nuly) pôvodného rozsahu,
- funkcia ROUND zabezpečuje zaokrúhlenie na 2 desatinné miesta,
- funkcia IF umožňuje nastaviť celý výpočet tak, aby zobrazoval výsledok v príslušnej bunke len v tom prípade, že zdrojová bunka (R4) obsahuje nejakú hodnotu, inak sa zobrazuje prázdna bunka (bez tejto funkcie by sa totiž už na začiatku vo všetkých bunkách zobrazovali čísla 0,00).

Ak je hodnotenie napr. 1,85, potom výsledná bodová hodnota, ktorá bude pripočítaná k hodnoteniu prezentácie, bude 4,81, nakoľko tento vzorec prepočítava hodnotu z intervalu <-2;2> na bodovú hodnotu z intervalu <0;5>. Ide totiž nielen o posunutie bodovej hodnoty, ale aj o prepočet v prípade, že rozsah hodnotenia (4+1 položiek – položka v tomto prípade zodpovedá celému číslu nachádzajúcemu sa v danom rozsahu; jednou položkou je číslo 0 a ostatné zodpovedajú číslam 1 až 4) nie je rovnaký ako rozsah bodového hodnotenia (5+1 položiek).

Ak by sme potrebovali hodnoteniu priradiť body z rozsahu <0;10>, čo zodpovedá 10+1 položkám, potom by vzorec vyzeral nasledovne:
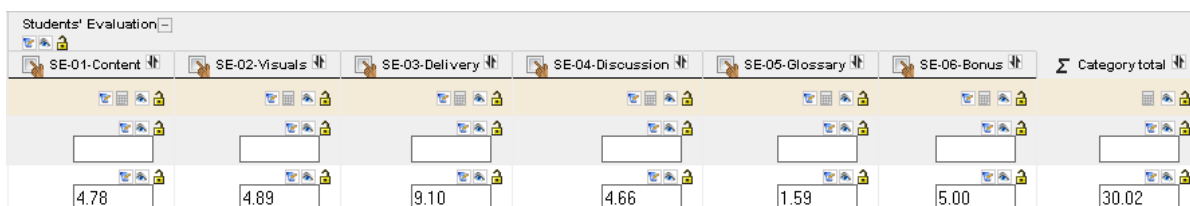
$$=IF(R4<>"";ROUND((R4+2)*10/4;2);"") \qquad (2)$$

Tieto výpočty sú zrealizované v tabuľkovom kalkulátore, pričom tabuľka môže byť pripravená vopred a učiteľ v rámci jednotlivých hodín už len dopĺňa príslušné priemerné hodnoty získané zo systému.

Zverejnenie výsledkov študentom

Spracovaním hodnotenia z aktivity Spätná väzba do konečného hodnotenia od študentov však proces nekončí. Ešte je potrebné zverejniť výsledky študentom. Systém LMS Moodle opäť môže byť užitočným prostriedkom na realizáciu tohto kroku.

V rámci modulu Známky (Grades) je potrebné pridať položky hodnotenia zodpovedajúce stanoveným oblastiam, v ktorých boli prezentácie hodnotené. V našom prípade bolo pridaných šesť položiek – päť základných a jedna s bonusovými bodmi. Zadávanie hodnôt prebieha priamo v module Známky, kde sa po zapnutí režimu úprav objavia polia, do ktorých dopíšeme počet bodov priradený jednotlivým oblastiam hodnotenia (Obrázok 7).

Obrázok 9 Vkladanie hodnotenia

Celkový súčet bodov nie je potrebné počítať, postará sa o to opäť samotný systém. Vhodným nastavením kategórií známok a parametrov ich vyhodnocovania je možné zabezpečiť aj spojenie

hodnotenia od učiteľa a hodnotenia od spolužiakov, takže študent vidí čiastkové hodnotenia ako aj celkový výsledok (Obrázok 8).

Obrázok 10 Ukážka hodnotenia prezentácie

Záver

Ako možno vidieť, nástroje LMS Moodle umožňujú zefektívniť, zrýchliť a sprehľadniť získavanie, spracovanie a zverejňovanie výsledkov hodnotenia, a to aj v prípade, že je potrebné spojiť hodnotenie od viacerých hodnotiteľov vo viacerých oblastiach. Aktivita Spätná väzba sa ukázala byť veľmi vhodným nástrojom nielen pre zisťovanie a vyhodnocovanie názorov v rámci rôznych prieskumov, ale je využiteľná aj pri hodnotení.

Poďakovanie

Multimedia Support in Artificial Intelligence and Robotics Courses

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Keywords: animations, interactive applications, artificial intelligence, neural networks, state space searching, games

Abstract: In this paper we present our approach and achievements in e-learning materials for artificial intelligence courses at FBE at Mendel University. There are three courses focused on the subject of artificial intelligence – Artificial Intelligence I and II and Neural networks in Applications and Handling Equipment. For these courses we have created an e-learning course consisting of an introductory text and many multimedia objects. The course itself is not directly correlated to any of the courses of full-time study. Rather they form a consistent introduction to artificial intelligence itself making them very suitable for lifelong learning. Specific subjects covered by the course are state space searching, heuristics, learning algorithms and neural networks. We have invested a great effort in making the content of the e-learning course attractive. Another part of our effort went into making the e-learning course interactive and generally fun to work with. To achieve this, the course contains several applications and interactive animations and some recordings of artificial intelligence in action. All of these objects are usable both in online and offline browsing mode. We have chosen a game of tic-tac-toe to demonstrate the creation of artificial intelligence computer player. Apart from this the course contains interactive animations created using Adobe Flash.

Introduction

In this paper we present our approach and achievements in e-learning materials for artificial intelligence and robotic courses at Faculty of Business and Economics (FBE) at Mendel University in Brno. This involves creation of several multimedia objects, videos and other graphics. Main advantage of graphical information is that it enables complex problems to be easily understood. The advantage comes out from the basic and simple expressions of different objects. Clark and Lyons (2004) formally define graphics as iconic expressions of content that are designed to optimize learning and performance in ways which improve bottom-line performance of organizations. The exact form of graphic support depends on the purpose of the visual. Graphics that are intended to support learning or improve performance include screens, dimensions and texts used on learning *web screens*. These contain two types of graphics – static art and dynamic art. Static art includes illustrations (such as diagrams and charts), photography (e.g. screen captures) and computer generated models (typically three-dimension representations). Dynamic art includes animations (demonstration of steps in a software procedure), video and virtual reality (simulated walkthrough different objects). For the artificial intelligence and robotics courses, we have chosen several of these options depending on the problem being explained. In the next chapters we will describe the course itself and its' multimedia extensions.

Course Structure

At FBE there are three courses focused on the subject of artificial intelligence – Artificial Intelligence I and II and Neural networks in Applications. Furthermore there are courses focused on robotics and handling equipment which are using artificial intelligence to some extent, these subjects are Handling Equipment, Measurements I and II. For these courses we have created an e-learning course consisting of an introductory text to artificial intelligence and multimedia objects. The course itself is not directly correlated to any of the courses of full-time study. Rather they form a consistent introduction to artificial intelligence itself making them very suitable for lifelong learning. Specific subjects covered by the course

are state space searching, heuristics, learning algorithms and neural networks. Main sections of the course are: *What is artificial intelligence?*, *Complex problems*, *State space representation of a problem*, *Learning algorithms*, *Examples*.

Although the course is designed primarily for students of computer science it is composed so that it is intelligible for any university student. The chapters are divided and marked clearly so that formal definitions and descriptions of problems can be jumped over without breaking the structure of the text. Still it has to be noted that the course is aimed at students with some interest in computer science.

Our effort went into making the e-learning course interactive and generally fun to study. To achieve this, the course contains several applications and interactive animations and some recordings of artificial intelligence in action.

Technologies Used

To implement interactive objects we first had to choose a suitable technology. Our focus concentrated on three – Adobe Flash, Microsoft Silverlight and Adobe Air. These technologies were selected by the ability to work as Rich Internet Applications (RIA). Adobe defines RIA as engaging experience that improves user satisfaction and increases productivity (Accessible from URL: http://www.adobe.com/resources/business/rich_internet_apps/). Using the broad reach of the Internet, RIAs can be deployed across browsers and desktops. RIA is also standardized under the W3 Consorcium in the working draft Accessible Rich Internet Applications (WAI-ARIA) 1.0 (Accessible from URL: http://www.w3.org/TR/wai-aria/).

Adobe Flash was previously used for short animation such as banners or live advertisement. Currently this technology includes many different extensions which make it very complex. Adobe Flash uses ActionScript programming language to make the animations interactive and user friendly. Furthermore Adobe Flash can be combined with extensions to form a complex development environment for dynamic learning animations. Adobe Air allows combining different web technologies (i.e. HTML, CSS, AJAX or Adobe Flash animations) and produces them in form of a standalone application.

Other possibility is Microsoft Silverlight – a programming model for developing and distributing rich Internet applications that use graphics, animations or video within the .NET framework. Silverlight shifts development from a desktop-centric environment to one based upon the Web browser. The Silverlight plug-in is both cross-browser and cross-platform.
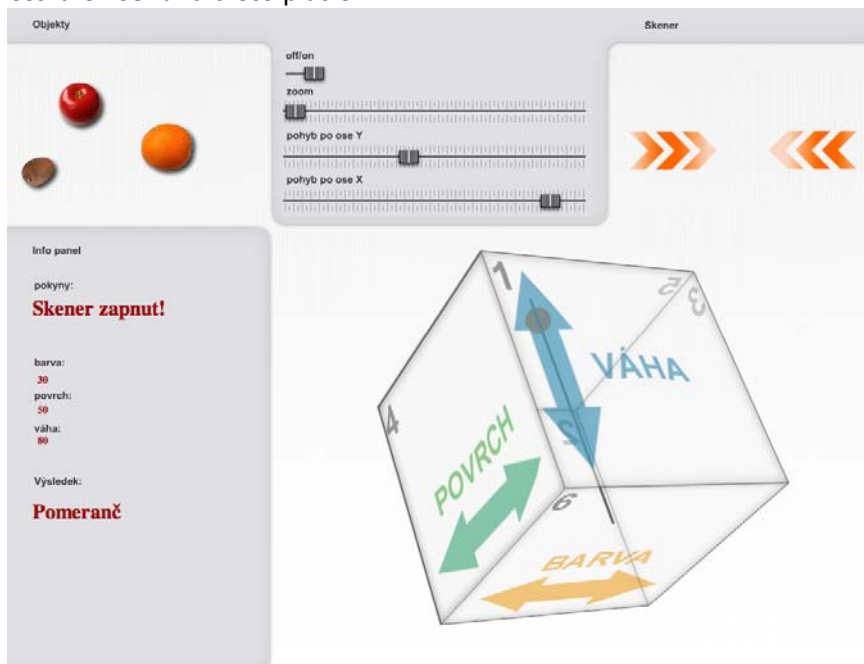

Figure 1: Fruit classification animation using PaperVision3D (Source: own design).

Other aspect of effective learning animations is the presentation form. Learning process should be not boring. Regarding that fact, we decided to follow up the learning environment plan based on simple games. Such applications must fit the learning environments plan that

1. are fast-paced with the advantage of fast information processing capabilities,
2. emphasize high learner control and multiple tracks to leverage multitasking abilities,
3. actively engage participants in highly visual environments that encourage learning by exploration. (Clark and Mayer, 2008).

The goal in game-based or animation-based learning is to provide an institutional environment that is both enjoyable and achieves the learning objectives. Requirements to be met were specified as:

- standalone application working on all operating systems,
- design independent of the operating system,
- application should be runable both off-line and on-line,
- intuitive GUI.

For the interactive animations our technology of choice was Adobe Flash. Animation made with Flash works as standalone applications either as part of the web-based learning course. As supporting technology ActionScript (v3.0) has been used in cooperation with PaperVision3D (v2.0)(PAPERVISION3D – Open source real-time 3D engine for Flash [on-line]. 2010. http://code.google.com/p/papervision3d/). The PaperVision3D classes allow development of three dimensional objects inside the Flash animation.
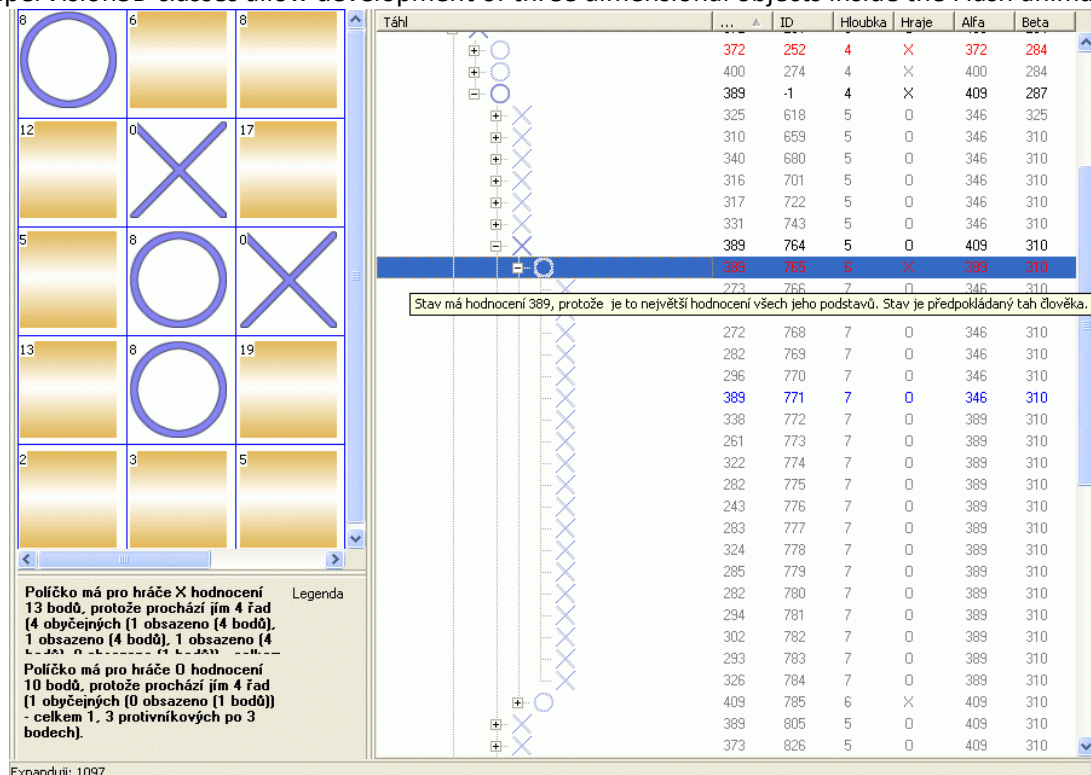

Figure 2: Tic-tac-toe game with shown state space (Source: own design).

Apart from the interactive animations there are also standalone applications which show the implementation of state space searching algorithms. This approach is among other things suitable for programming artificial intelligence in games for two players. We have chosen a game of tic-tac-toe to demonstrate the creation of artificial intelligence computer player. The application allows the human player to play the generic (arbitrary sized field) tic-tac-toe game while observing the approach of the computer opponent and all the steps of the algorithm. This application has been written using the Delphi language. This was chosen because the source code is available to students so that they can further experiment with the algorithm and heuristics. For this reason a language and IDE known and available in

our environment was chosen (TurboExplorer Delphi – Embarcadero tech. [on-line]. 2010. http://www.turboexplorer.com/). The application still meets the criteria mentioned above.
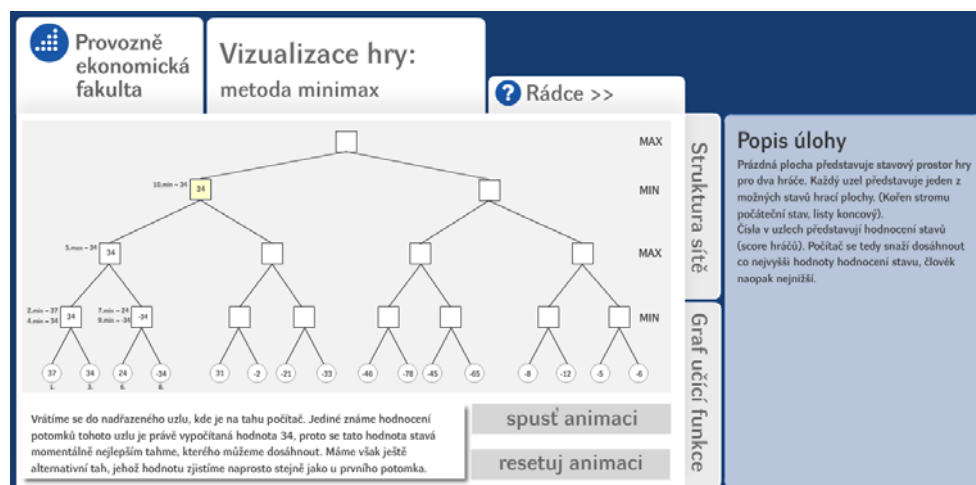
Figure 3: State space searching using min-max (Source: own design).

Results

In the first three sections (What is artificial intelligence?, Complex problems, State space representation of a problem) of the course we make an introduction to where and why artificial intelligence is needed. This is demonstrated using various modifications of the tic-tac-toe game which is implemented in an application which enables the student to play the game and in the mean time he can closely follow each step of the algorithm of the computer (Fig. 2). Furthermore the state space is shown, where the application shows the expected human and computer moves and the reasons for such expectations.

The applications also explains how heuristic function is constructed and what might be its' weaknesses. Specifically the min-max searching method is explained together with alpha-beta pruning. This is further explained more generically using an animation (Fig. 3).

The next section of the course – Learning Algorithms – focuses on neural networks and genetic algorithms. These algorithms are explained and demonstrated using Flash animations (Figure 1 and Figure 4). The first animation (Figure 1) explains to the learner the fruit classification shown on three-dimension space. First dimension represents the measured values of surface of the object (green colour), the second dimension shows values of colour (yellow colour) and the third weight (blue colour). By clicking on the on/off switch the scanner is turned on, the object (fruit) can then be moved from basket to the scanner. Then the process of fruit classification starts – the orange bulb starts moving inside the cube as new values are scanned for surface, weight and colour.

These animations also demonstrate solving of classification and prediction problems and generally the process of learning of a MLP neural network. The animations are currently being used in Czech spoken lectures, so all the descriptions on the animations are in Czech. Apart from the mentioned applications and animations the course also features some videos of toy robots using these algorithms and other videos.
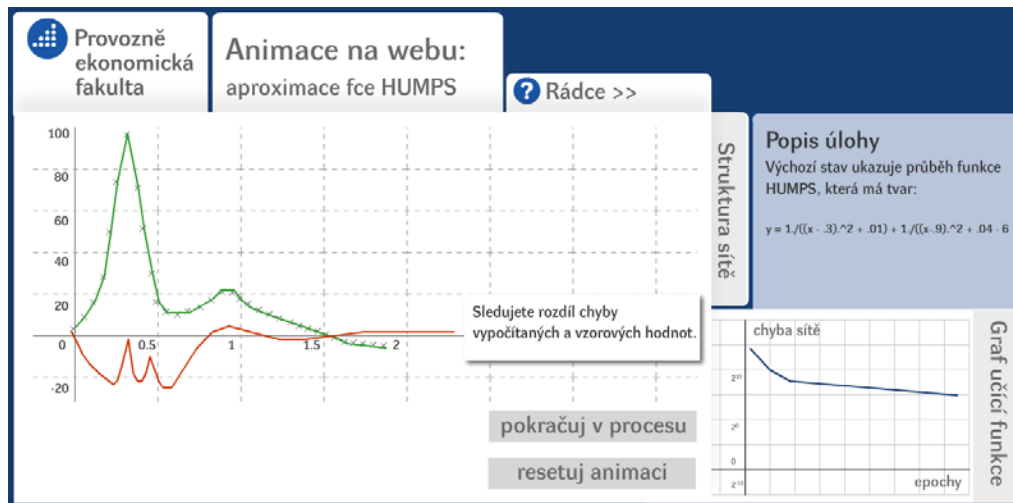
Figure 4: Neural network learning (Source: own design).

Discussion

We have described some of the multimedia features which we use in our e-learning course. The whole course is available both to students of Mendel University in Brno and to general public (Umělá Inteligence (Úvod) – [on-line]. 2010). The subject itself should be quite attractive for life long learning, since it is a constantly evolving field of research. It forms a consistent introduction to artificial intelligence making it very suitable for lifelong learning. Specific subjects covered by the course are state space searching, heuristics, learning algorithms and neural networks. We have invested a great effort in making the content of the e-learning course attractive and enjoyable. It is composed so that it is intelligible for any university student. However it is aimed at students with some interest in computer science.

All these interactive objects are designed to make this e-learning course an enjoyable experience. Parts of this course were published in earlier conferences (Štencl, Sedláček, Popelka, 2009). So far we have been testing the course in full-time study subjects and the feedback from students and colleagues was very positive.

Acknowledgements

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Business Architecture Modelling in Education

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Abstract: All organizations are in commercial pressure that dictates that they must become more efficient in the way that they are able to exploit their data assets. One of the most challenging problems facing companies today is the ability to quickly and accurately answer the most basic of business questions. In fact, the larger and more distributed the organization, the more complex this problem appears to become. The model of business processes and model of other business concepts describes how the business intends to conduct itself. Many factors that crucially affect business operations are defined in business process description and business concepts specifications. Processes are often embedded in information systems without solid description or process model prepared to change registration. Students of informatics and managements domains at universities have to be good prepared for demands of external business environment. Requirements from praxis are inclement and they call for the knowledge of analytical procedures at level of information systems and at business level. That's why procedures and methods of business process modeling and enterprise architecture modeling are created and implemented in our education. The article deals with experience and pieces of knowledge from Information System Modelling, subject of education at UKF in Nitra. Business modelling creates an abstraction of complex business and establishes a common understanding that can be communicated to the business's stakeholders. Models help to identify new business opportunities (business improvement or innovation). We use in education UML as a very suitable language for modelling, because it has the ability to describe both the structural aspects of a business, the behavioral aspects of business and also the business rules that affect both structure and behavioral. We learn approach and extensions, the Eriksson Penker Business extensions to UML that extend UML with adapted model elements for business modelling. Method empower mapping of relationships between process diagrams and use case diagram and indicates which process will be support which functions of system in use case diagram. In Erriksson-Penker approach appears term of business architecture (enterprise architecture) as a complex composed of four different views (abstraction) of business each of which captures information about specific aspect of the business. In lectures we present (excepting business process diagrams) number of UML diagrams that show a specific part of business structure or a specific business situation. The diagrams contain and express the objects, processes, rules, goals and visions defined in business situation. The article presents some interesting diagrams of business processes and their elements. Our approach to education could provide students and future business analysts with an essential approach to understanding, redesigning and communicating what really happens in business processes.

Úvod

Nejbohatším zdrojem informací v podniku jsou data, která sbírá a uchovává podnikový informační systém. Ten je nedílnou součástí podniku a jeho podoba je závislá na podnikových procesech, které podporuje. Význam analýzy podnikových potřeb a zvyklostí s ohledem na druh výroby není třeba zdůrazňovat. Analýzu lze provádět mnoha způsoby a mnoha nástroji. Než organizace začne navrhovat, optimalizovat a automatizovat své podnikové procesy, je nutné zanalyzovat a zhodnotit procesy existující. Modelování podnikových procesů může pomoci podnikovým analytikům rychle shromáždit a objektivně analyzovat informaci o operacích organizace a efektivně komunikovat o této informaci s exekutivou a IT personálem a poskytuje mechanismus pro zahrnutí klíčových podnikových znalostí, pro

popis a identifikaci problémů v aktuálních operacích. Posluchači vysokých škol by měli alespoň na základní úrovni být seznámeni s principy a postupy při analýze a modelování podnikových architektur a proto se do výuky tato témata zařazují. UML jako standardní jazyk pro modelování prakticky čehokoliv patří k oblíbené a často využívané notaci pro tvorbu podnikových modelů.

Erikssonův a Penkerův přístup k rozšíření UML umožňuje nejen modelování podniku, ale také rozhraní informačního systému za účelem informační podpory modelovaných procesů. V tomto smyslu se jedná o metodu vývoje informačního systému, zaměřenou na jeho základní část – modelování organizace. Metoda umožňuje mapovat vztahy mezi diagramem případu užití a procesním diagramem. Vyjadřuje tak, který proces (procesní diagram) bude podporován kterými funkcemi systému (diagram případu užití). V Erikssonově pojetí se objevuje pojem podniková architektura jako komplex, který se skládá ze čtyř základních pohledů na podnik, kde každý pohled se soustřeďuje na určité specifické aspekty a charakteristiky podniku. Pohledy jsou ilustrovány pomocí diagramů UML a doplněny textovým dokumentem s použitím rozšiřujících mechanismů, které UML nabízí pro oblast podnikového modelování. Pohledy obsahují podnikové koncepty cíl, zdroj, proces a pravidlo.

Výuka velké části předmětu Modelování informačních systémů je zaměřena na objektovou analýzu, notaci standardního jazyka UML, který se pro procesní modelování obecně doporučuje vedle dalších notací. Na UKF tento předmět navštěvují studenti oboru Aplikovaná informatika, kteří by měli být vybaveni znalostmi spíše praktickými, aplikačními. Tomuto požadavku odpovídá i zaměření ve výuce. Model podnikových procesů zde bude chápán jako sada dynamických výkresů struktury podniku, ve kterém jsou zachyceny všechny podstatné objekty podnikové reality a jejich vazby, především pohled na strategii a cíle podniku, podnikové procesy, podniková pravidla, organizační struktury, znalosti, rizika a služby IT. Jednotlivé modely a výkresy jsou doplněny kompletujícími texty pro specifikace jednotlivých prvků v modelech. Nový koncept výuky klade důraz na logickou analýzu a vztahy jednotlivých diagramů UML, vše vysvětleno na připravených příkladech a modelech pro vybrané problémové domény od procesního diagramu po datové modely.

Příspěvek představí nejen metodická doporučení pro výuku, ale především výběr modelů a diagramů, na kterých jsou jednotlivé postupy a vztahy studentům vysvětlovány. Jde o diagram procesní, diagramy případů užití a detailnější diagramy aktivit resp. Akcí, nechybí diagram sekvenční a stavový. Ze zkušeností vyučujících z výuky i z praxe vyplývá také potřeba jednotného metodického rámce pro podnikové modelování, proto je do výuky zařazeno stručné pojednání o metodice Select Perspective, která tvorbu objektových modelů metodicky podporuje.

Vzhledem k tomu, že autorka, vyučující a garantující tento předmět i předměty související, zaznamenává postupný růst potřeby po univerzálnějším řešení řízení podnikových procesů, oproti workflow systémům, které jsou převážně zaměřené na procesy s lidskou interakcí, považuje tuto výuku za smysluplnou a potřebnou a vzhledem k neustále se měnícím podmínkám ve společnosti hodlá tento předmět i nadále inovovat, zlepšovat a rozšiřovat.

Materiál a metody

Pro výuku se nabízí několik metodik modelování podnikových procesů. Například již zmíněná metoda Select Perstective (http://objekty.vse.cz/Objekty/MetodikyANotace), Ericsson Penkerovo rozšíření UML pro podnikové modelování (Ericsson Penker, 2000) , metodika ARIS (http://www.ids-scheer.cz/cz/ARIS/ARIS_ARIS_Platform/84388.html) a další. Business Process Modeling Notation (BPMN) http://www.omg.org/spec/BPMN je grafická notace (soubor grafických objektů a pravidel, podle nichž mohou být mezi sebou spojovány), která slouží k modelování procesů a využívá se v podnicích poměrně často. Protože však studenti znají z předchozích předmětů základní diagramy standardní notace UML, pro výuku jsou vybrány ty metodiky, které v sobě právě UML diagramy podporují.

Na obrázku 1 je znázorněna šablona pro základní popis podnikového procesu, kterou studenti aplikují na své problémové domény. Zamyslet se nad cílem, vstupem, výstupem a zdroji v procesu vede studenty k obecnější analýze, než je analýza informačních systémů. Protože v podniku bývá procesů více a ne každý musí být podpořen informačním systémem, je vhodné do modelu vložit procesy všechny a označit, ty, pro které bude provedeno nasazení nebo naprogramování automatizace.

Obrázek 2 ukazuje aplikaci konkrétních prvků procesu podle šablony na vybrané podnikového prostředí. Zde jde o procesy související s evidencí a nákupem materiálu.Každý takový proces je možné ještě dále modelovat. Nabízí se k tomu tři diagramy UML. Diagram případů užití, diagram sekvenční a diagram aktivit. Všechny tyto diagramy jsou vhodné pro modelování dynamiky procesu. Přesto je mezi nimi rozdíl. Srovnejme nejprve dva posledně jmenované.

Zatímco diagram sekvenční lze doporučit tam, kde chceme zdůraznit spolupráci mezi účastníky procesu nebo budoucími třídami v informačním systému nebo také časové následnosti posílání si jednotlivých zpráv mezi uvedenými koncepty, diagramy aktivit jsou zaměřeny jinak. Nemají původ v technikách autorů UML a jsou to spíše vývojové diagramy ukazující tok řízení z jedné aktivity do druhé. Zároveň jsou obdobou stavového diagramu, v němž stavy reprezentují vykonávání aktivit a přechody jsou vyvolány ukončením aktivity a popisují řazení aktivit s podporou jak sekvenčního, tak paralelního chování. Diagramy aktivit sice neříkají nic o přiřazení aktivit objektům tříd ale mají v praxi nezaměnitelný význam pro svoji srozumitelnost a názornost.
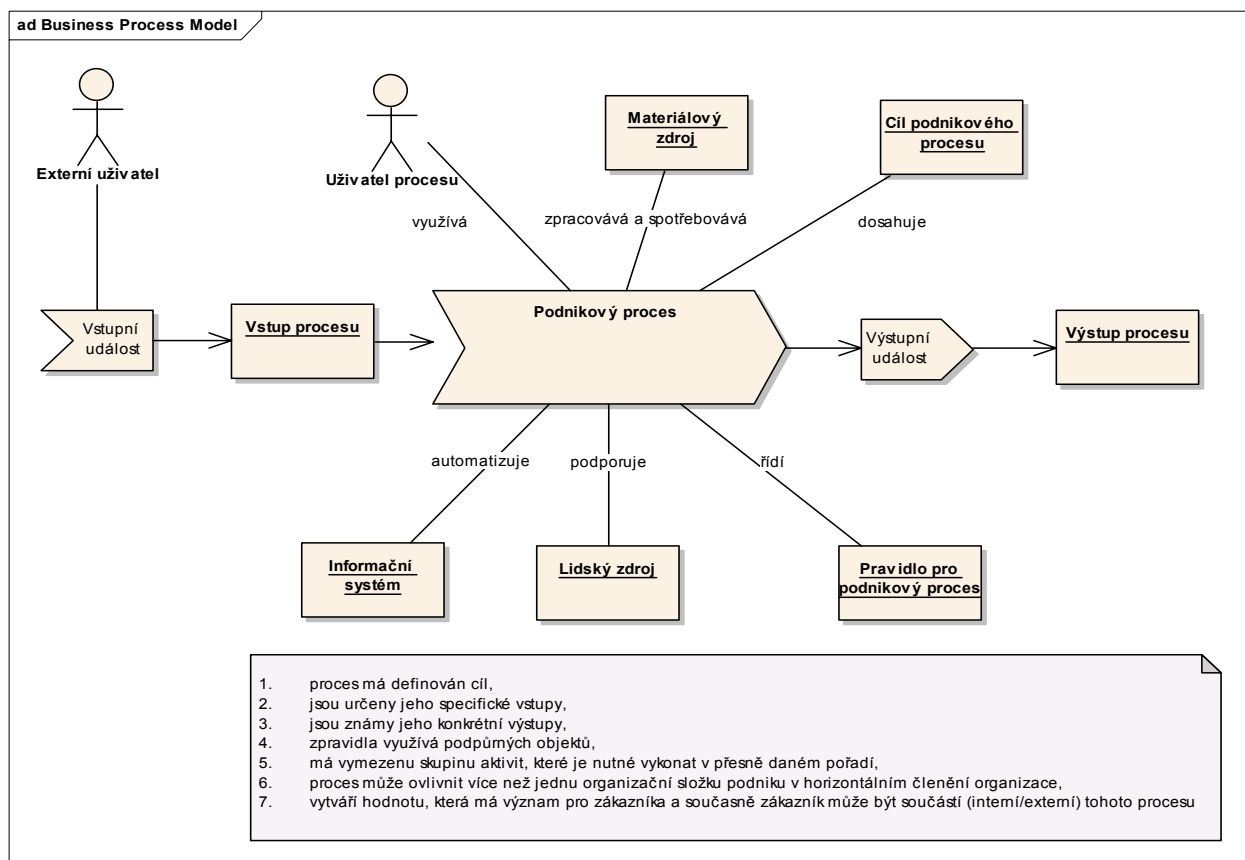
**Obrázek 1: Šablona pro základní popis podnikového procesu**

Metoda primárního namodelování základních podnikových procesů a jejich konceptů umožňuje modelování prostředí organizace, její strategii resp. pravidla, ale navíc díky propracované notaci jazyka UML jsme schopni pomocí ní namodelovat také rozhraní informačního systému za účelem informační podpory modelovaných procesů. K tomu nás vede další jmenovaný diagram, diagram případů užití (use case).

Diagram use case obecně je prezentací požadavků na informační systém, ale lze ho použít také pro detailnější modelování procesů. V naší výuce doporučujeme jeho použití tam, kde se v reálném podnikovém procesu musí provést inovace a tato inovace spočívá v nasazení nového softwarového produktu. Někdy je výsledkem analýzy podnikových procesů komplexní reengineering, pro některé procesy se použije inovace stávajícího informačního systému a některé vyžadují tvorbu automatizované softwarové podpory na míru. V případě, kdy je třeba modelovat strukturu dat a funkce informačního

systému, doporučujeme použít use case diagram, jehož prvky a principy tvorby najdeme v mnoha dostupných publikacích (Arlow, 2005).

Obrázek 3 prezentuje velmi jednoduchý diagram use case, který je modelem požadavků na informační systém pro podnikový proces, který bude implementován, aby zautomatizoval stávající ruční zpracování. Diagramy na obrázcích 2 a 3 jsou výstupy z práce (Klíma, 2009), která podporuje popisovanou metodiku.

Každý z namodelovaných případů užití takového diagramu je dále specifikován buď textem nebo sekvenčním diagramem, který je pro tuto příležitost ideálním modelem, protože popisuje spolupráci objektů, instancí tříd v diagramu tříd, který je základním diagramem pro strukturu databáze a identifikaci odpovědností, které vedou k funkční části aplikace.
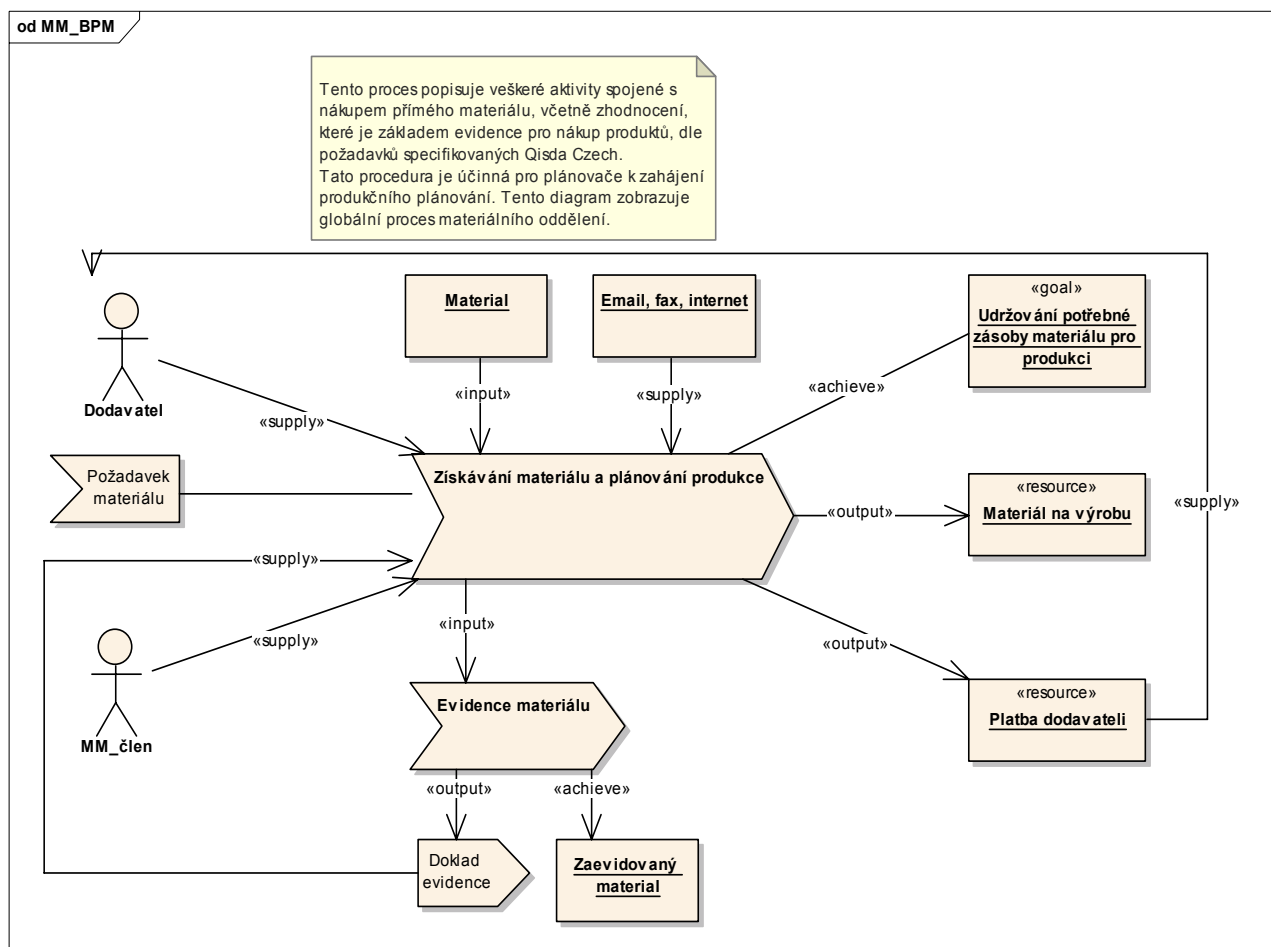
Obrázek 2: Konkrétní podnikový proces a jeho prvky
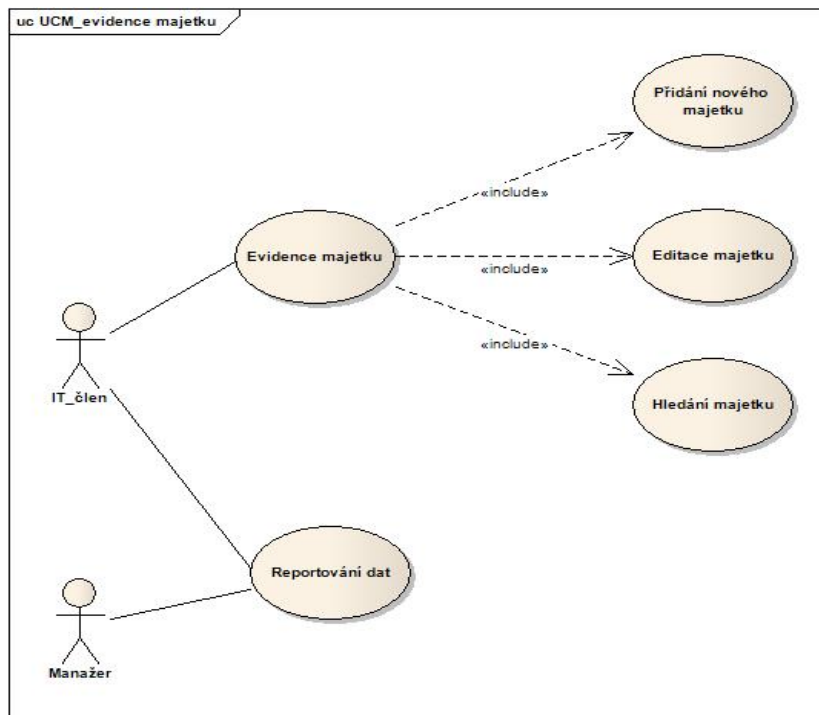
Obrázek 3: Diagram use case pro podnikový proces Evidence majetku a jeho SW podporu

Výsledky a diskuze

Výukou by studenti měli pochopit následující. Kvalitní model podnikových procesů (BPM, Business Process Model) musí jednoznačně identifikovat potřebu změny v podnikových procesech a názorně ukázat strukturu inovovaného systému. Model se stává součásti podnikové strategie, která je dlouhodobá. Změny mají často radikální povahu, proto je důležitá neustálá komunikace se zadavatelem. Ten musí být reprezentován zástupci na všech manažerských úrovních. V momentu, kdy se zadavatel přímo účastní návrhu, mnohem snadněji akceptuje změny. Kvalitní model musí jednoznačně také ukázat i možnosti implementace. Ke všem těmto aspektům je třeba přihlédnout při modelování. Jmenované rozšíření je založeno na čtyřech základních pohledech na organizaci, které zohledňují předchozí aspekty jako je strategický pohled (vize organizace), procesní pohled, strukturní pohled a pohled na chování organizace (Štencl, 2009).

Doporučený postup s využitím jazyka UML umožňuje modelování prostředí organizace, ale díky propracované notaci také rozhraní a strukturu informačního systému podporujícího modelované procesy.

Představený koncept, kterým zamýšlíme výuku předmětu Modelování informačních systémů obohatit, klade důraz na logiku v podnikových procesech. Není jeho cílem představit UML jako standard, očekává se, že studenti již tyto znalosti nabyli předchozím studiem. Jsou připraveny materiály pro eLearningovou podporu, které obsahují dílčí ukázky modelů, komplexně zpracované od procesního diagramu až po datový model, jejich popis a postup tvorby na základě metodiky Select Perspective a za využití rozšíření UML pro procesní model.

Zkušenosti vyučujících vedou k inovacím v souladu s celospolečenskými trendy a požadavky z praxe a nabízí nové perspektivy pro posluchače tohoto předmětu. S pomocí použitých modelů procesů se snaží o obecné představení systémové analýzy jako globálního nástroje pro lepší řízení v podnicích. Komplexní modely nejen z prostředí informačních systémů (v užším slova smyslu tedy určené k implementaci), ale také z např. z prostředí výrobního podniku a logistiky, ukázky již namodelovaných diagramů a jejich porozumění povedou k zásadní změně ve vnímání analýzy samotné, protože analýza a její principy dnes už nemohu sloužit pouze k vývoji a implementaci nového informačního systému, ale mají daleko zásadnější význam.

Pojem informační strategie, jako globální podniková strategie podpořená informačními technologiemi, již není pojmem neznámým. Na jejím počátku by měly být modely procesů, cílů, zdrojů či pravidel jako výchozí bod, jako prezentace současného stavu. Představa toho, kam podnik směřuje, je také součástí dokumentu informační strategie a může být opět modelováno pomocí procesních diagramů.

Toto je třeba studentům vysvětlit, dokázat a to nejen ve výuce jmenovaného předmětu. Považujeme za vhodné zdůraznit, že především v dnešní dynamické, nejisté a neustálými změnami postiženém hospodářském prostředí je naprosto zásadní vědět, kde jsme, jaký je náš cíl a jak tohoto cíle chceme dosáhnout. A k tomu nám nepochybně pomohou také procesní diagramy, jejichž prvky, vztahy a ostatní náležitosti jim kvalitní výuka našich předmětů nabídne.

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Virtualization as New Approach for Raising Efficiency in Distance Learning

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Abstract: Virtualization is a way to abstract applications and their underlying components away from the hardware supporting them and present a logical view of these resources. Virtual machine software and operating system virtualization technology can both help increase the utilization of physical resources by consolidating functions onto a smaller number of systems. There are some unspoken rules that affect implementation of new technologies. We are discussing these rules in this paper and analyzing their impact for implementation of virtualised environment at our university. As the e-learning solution, we are using LMS Moodle. That system has quite big requirements for hardware; not only the amount of memory installed but also the storage capacity. There are two approaches to virtual processing commonly used; the virtual machine software and partitioned operating systems. We are discussing what approach is the best for our e-learning solution and what virtualisation technology fits for us. We can choose from five virtualisation technologies; access virtualization that allows nearly any device to access any application without either having to know too much about the other; application virtualization allowing applications to run on many different operating systems and hardware platforms; processing virtualization that hides physical hardware configuration from system services, operating systems or applications; storage virtualization that hides where storage systems are and what type of device is actually supporting applications and data; network virtualization that presents a view of the network that differs from the physical view.

Úvod

Vo všeobecnosti rozumieme pod virtualizáciou používanie hardvéru a softvéru tak, aby pre vývojárov, administrátorov a koncových používateľov toto používanie prezentovalo logický pohľad na používané prostriedky. Tento logický pohľad je vo väčšine prípadov iný ako fyzický. Práve oddelenie fyzického a logického pohľadu na prostriedky umožňuje nasadzovať informačné systémy tak, aby sa dosahovala ich vyššia dostupnosť, spoľahlivosť a výkonnosť. Virtualizácia je v súčasnej dobe skloňovaná najmä z ekologického pohľadu, najmä je to spôsob ako znižovať spotrebu elektrickej energie jednak znížením počtu fyzických serverov z čoho vyplývajú aj nižšie náklady na klimatizovanie dátového centra, tzv. *green IT.* V prostredí Univerzity Konštantína Filozofa v Nitre (ďalej len UKF) sa z množstva bežiacich informačných systémov zameriavame v tomto článku na možnosti a spôsoby použitia virtualizačných technológií v systémoch na podporu e-learningu. V úvode popisujeme súčasný stav nasadenia informačných systémov, ďalej rozoberáme dôvody, prečo je ťažké zmeniť súčasný stav a následne popisujeme akým spôsobom by sme mohli implementovať jednotlivé virtualizačné technológie.

Univerzita je pripojená k sieti Internet prostredníctvom 1Gb/s optickej linky. Dlhodobý zámer univerzity na roky 2007 – 2017 predpokladá navýšenie tejto kapacity 10 násobne. Táto optická linka predstavuje jediné pripojenie do Internetu a v prípade jej výpadku alebo prerušenia nie sú z Internetu dostupné žiadne informačné systémy. Vytvorenie záložného pripojenia k sieti Internet je problém komplexný a v tomto článku samu venovať nebudeme. Všetky pracoviská univerzity sú navzájom prepojené optickou sieťou, čím sa stáva chrbticová sieť dostatočne priepustnou aj pre veľké objemy dát. K tejto sieti sú pripojené nasledovné informačné systémy:

- Evidencia študentov – Akademický informačný systém
- Knižničný informačný systém
- Evidencia publikačnej činnosti
- Evidencia projektovej činnosti
- Systém pre správu dokumentov
- E-mailový systém
- Elektronické záverečné práce
- E-learningové systémy
- Stravovací, prístupový a dochádzkový systém

Chod počítačovej siete a prevádzku týchto informačných systémov zabezpečuje niekoľko desiatok serverov, ktoré sa neustále rozširujú. Môžeme povedať, že na každý systém je vyhradený aspoň jeden server. V prípade ich zlyhania je komplikované presunúť informačný systém na iný server. Vo väčšine prípadov presun pozostáva z nasledovných krokov:

- Inštalácia operačného systému na nový server
- Inštalácia a konfigurácia aplikácií
- Obnovenie dát zo zálohy

Dôsledkom tohto procesu je aj niekoľkodňová nedostupnosť služieb poskytovaných samotným IS. V prípade fungujúcich virtualizačných metód, by sa virtuálny stroj len preniesol na funkčný hardvér, pričom by sa doba nedostupnosti skrátila na minimum.

Nasadenie virtualizácie so sebou prináša komplexnú zmenu vo fungovaní organizácie. Pokúsme sa identifikovať dôvody, ktoré vo všeobecnosti bránia týmto zmenám. Nazývame ich aj *zlaté pravidlá IT* (Kusnetzky 2007)

Pravidlo 1: Ak to nie je pokazené, neopravujte to. Množstvo organizácia nemá vyčlenené prostriedky, či už finančné alebo pracovný čas na to, aby reimplementovali veci, ktoré fungujú.

Správa informačných systémov je na UKF v kompetencii Centra informačných a komunikačných technológií (ďalej len CIKT). Zo štatútu CIKT vyplýva, že má zabezpečuje rozvoj počítačovej siete [citovať štatút], avšak personálne zloženie a vyťaženosť neumožňuje jeho pracovníkom experimentovať, alebo len vo veľmi malej miere.

Pravidlo 2: Nechytajte to, pokazíte to. Organizácie používajú systémy, ktoré boli vyvíjané niekoľko rokov. Zmeny v systémoch, ktoré sa spoliehajú na staršie technológie, staršie architektúry alebo metodológie, sa musia robiť veľmi opatrne.

Pravidlo 3: Ak sa toho chytíme a pokazíme to, opraviť to bude trvať dlhšie a bude to drahé. Pravidlo je podobné predošlému a závisí od množstva rôznych použitých technológií.

Z pohľadu UKF sú nasadené informačné systémy od rôznych dodávateľov alebo sú to systémy vyvíjané vlastnými kapacitami po niekoľko rokov. Niektoré systémy sú úzko špecifické a ich presun na novšie technológie by mohol spôsobiť ich nefunkčnosť. Analýza dôvodov tejto nefunkčnosti alebo možností ich presunu je časovo veľmi náročná z dôvodu neexistencie programovej dokumentácie.

Pravidlo 4: Dostatočne dobré je postačujúce. Predstava, že máme k dispozícií nekonečne veľa času a prostriedkov na vývoj rôznych vymožeností je ideálna ale v skutočnosti je možné akceptovať len asi 50 až 60% požiadaviek na novú funkcionalitu. Zvyšok je potrebné vyhradiť na zabezpečenie a udržiavanie aktuálneho stavu.

Pravidlo 5: Nerobiť veľké zmeny pokiaľ ľudia nekričia. Kým používatelia nekričia aby dosiahli zmeny v systémoch, riadime sa pravidlom 4. V prípade, že používatelia postupne začínajú vyžadovať nové funkcionality, riadime sa pravidlami 2 a 3.

E-learning na UKF

Univerzita používa ako e-learningové prostredie systém Moodle. V rámci univerzity majú niektoré pracoviská svoje vlastné riešenia, najmä moodle ale aj iné LMS systémy (class server, itutor), ktoré im

slúžia prevažne na vlastné potreby, vývoj alebo výskum ich možností. Centrálne sú podporované dva moodle systémy, jeden (edu.ukf.sk) pre priamu výučbu akreditovaných predmetov a druhý (amos.ukf.sk) určený prevažne na podporu projektov a poskytovanie kurzov aj študentom ďalšieho vzdelávania. Oba systémy sú prepojené (Obr. 1) na LDAP server, ktorý čerpá údaje z akademického informačného systému (študenti) a systému SAP/SOFIA (učitelia).
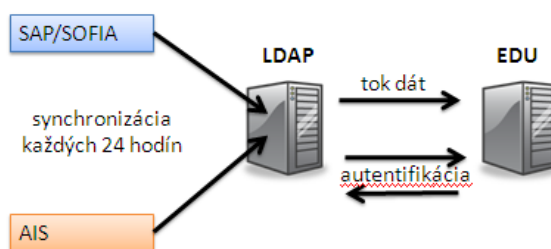
Obrázok 1: Prepojenie portálu na ďalšie systémy

Z technického hľadiska portály edu aj amos bežia na jednom fyzickom serveri s operačným systémom solaris. Aplikačnú vrstvu tvorí apache webový server s virtuálnymi hostami a mysql databázový server. Samotná mysql databáza nie je replikovaná. Zálohovanie systému sa vykonáva raz za 24 hodín, pričom obsahom záloh systému sú sql sekvencie slúžiace na obnovenie stavu databázy, kompletná záloha databázového systému a zdrojové kódy LMS systému. Na úrovni LMS sa vytvára vlastná zip záloha z každého bežiaceho kurzu. Všetky vytvorené zálohy sa denne presúvajú na iný server jednak z dôvodu zabezpečenia reduntantnosti záloh, ako aj z dôvodu nepostačujúcej diskovej kapacity na samotnom serveri. V prípade zlyhania hardvéru a nutnosti presunúť LMS na iný by bolo potrebné nainštalovať samotný operačný systém, aplikačné vybavenia a znovunakonfigurovanie LMS. V ďalšom texte si priblížime samotný návrh virtuálneho prostredia.

Metódy virtualizácie

V princípe poznáme dve metódy virtualizácie, **virtuálny stroj a rozdelený operačný systém.** Softvér pre podporu virtuálnych strojov (virtual machine) je softvérový nástroj, ktorý skrýva akékoľvek detaily samotného hostiteľského operačného systému a obslužných softvérových nástrojov, čím sa umožňuje, aby sa vytvárali oddelené jednotky, tzv. virtuálne stroje. Každý virtuálny stroj môže mať vlastný operačný systém a vytvára sa mu ilúzia fyzického hardvéru, ktorá je iný ak je hardvér hostiteľského servera (virtuálnemu stroju prideľujeme časť fyzického hardvéru, napr. počet jadier procesora, veľkosť fyzickej pamäte, atď.) Veľkou výhodou tohto riešenia je jednoduchý presun virtualizovaného stroja na iný fyzický hardvér.

Rozdelený operačný systém vytvára samostatné zóny, ktoré sú na jednej strane nezávislé a na strane druhej zdieľajú spoločné jadro operačného systému. Zóna je virtuálnou inštanciou operačného systému, v ktorej bežiace aplikácie a používatelia sa tvária akoby pracovali v samostatnom systéme. Nie je možné vidieť a ovplyvňovať procesy mimo aktuálnej zóny, všetky operácie aplikácií sú uzavreté v danej zóne. Jednotlivé zóny pritom môžeme presúvať medzi fyzickými servermi. Zóny sú spravované globálnou zónou, ktorá je hlavnou inštanciou operačného systému na danom fyzickom serveri. Samotné virtualizované prostredia predstavujú neglobálne zóny. Akékoľvek operácie v globálnej zóne môžu mať vplyv na virtualizované zóny, avšak operácie v rámci neglobálnej zóny nemajú vplyv na ostatné zóny.(Solter, Jelinek et al. 2005)

Pri oboch metódach môžeme použiť niekoľko virtualizačných technológií (Kusnetzky 2007; Ruest and Ruest 2009; Chowdhury and Boutaba 2010).

Obrázok 2: Virtualizačné technológie (Kusnetzky 2007)

Virtualizácia prístupu je hardvérová a softvérová technológia, ktorá umožňuje ľubovoľnému zariadeniu pristupovať k ľubovoľnej aplikácii bez toho aby navzájom niečo o sebe vedeli. Tejto metóde sa z pohľadu e-learningu nebudeme venovať.

Aplikačná virtualizácia je softvérová technológia umožňujúca beh aplikácie na rôznych operačných systémoch a hardvérových platformách. Väčšinou to znamená, že aplikácia bola napísaná tak aby používala nejaký aplikačný framework. Tiež to znamená, že aplikácie, ktoré tento framework nepoužívajú a bežia na danom serveri, nemôžu výhody aplikačnej virtualizácie využívať. Výhodou aplikačnej virtualizácie je možnosť spúšťať zastavovať rôzne inštancie danej aplikácie, alebo rozkladať záťaž na viacero inštancií. Najsofistikovanejšie systémy aplikačnej virtualizácie umožňujú týmto spôsobom virtualizovať aplikácie bez toho aby museli byť preprogramované.

LMS Moodle je naprogramovaný v skriptovacom jazyku php a pre svoju činnosť potrebuje webový server s jeho podporou. Na UKF používame ako webový server apache vo verzii 2. Apache podporuje aplikačnú virtualizáciu avšak, len pre tzv. webapps, čo vyžaduje používať variant Tomacat (java). Z toho nám vyplýva, že samotný moodle nemôžeme nasadiť do prostredia aplikačnej virtualizácie.
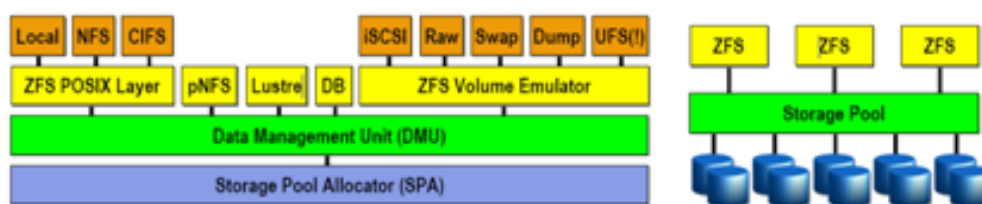
Výpočtová virtualizácia je hardvérová a softvérová technológia, ktorá operačnému systému a jeho službám alebo aplikáciám skrýva fyzickú konfiguráciu hardvéru. Tento spôsob virtualizácie umožňuje sa jeden systém vyzeral ako mnoho systémov, alebo aby mnoho systémov vyzeralo ako jeden, čím sa dosahuje vysoká úroveň rozšíriteľnosti, spoľahlivosti, a dostupnosti. Na obrázku 3 sme naznačili, akým spôsobom by mohol byť realizovaný systém výpočtovej virtualizácie pre prípad použitia LMS Moodle v kombinácii s apache webovým serverom a mysql databázovým systémom.
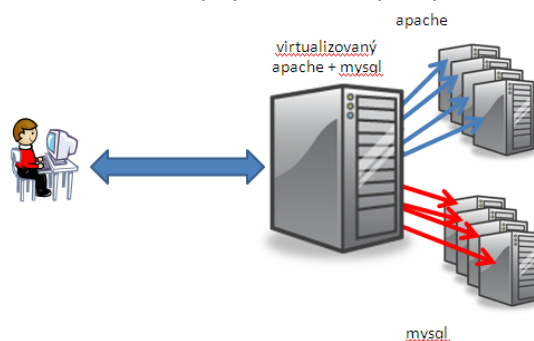
**Obrázok 3: Príklad výpočtovej virtualizácie**

Virtualizácia úložiska je hardvérová a softvérová technológia, ktorá skrýva umiestnenie úložných systémov ako aj typ zariadenia, ktorá na ktorom sú uložené dáta aplikácií. Táto technológia tiež umožňuje aby jednotlivé systémy zdieľali rovnaké úložiská bez toho aby vedeli, či na ne pristupuje ešte iná aplikácia. Výhodou tejto technológie je, že umožňuje vytváranie tzv. snímok dát, ktoré slúžia na zálohovanie údajov. Snímky sa môžu vytvárať aj nad bežiacimi aplikáciami. Na obrázku 4 je zobrazené virtuálne úložisko tvorené ZFS súborovým systémom. Samotný ZFS virtualizuje jednotlivé diskové zariadenia. ZFS jednotky sú vytvárane nad tzv. virtuálnymi poolmi, zvanými zpool. Zpool sa skladá z

virtuálnych zariadení, ktoré samotné sa skladajú z fyzických diskov, súborov a partícií (Bonwick and Moore 2007).

Obrázok 4: Virtuálne ZFS úložisko (Bonwick and Moore 2007)

Sieťová virtualizácia je hardvérová a softvérová technológia, ktorá prezentuje iný pohľad na sieť ako je fyzický (počítač vidí len tie zariadenia, na ktoré je oprávnený sa pripojiť, viacnásobné sieťové prepojenia sa tvária ako jedno prepojenie, atď.) Použitím sieťovej virtualizácie môžeme umiestniť jednotlivé servre na v rôznych geografických oblastiach. Obrázok 5 zobrazuje princíp sieťovej virtualizácie.
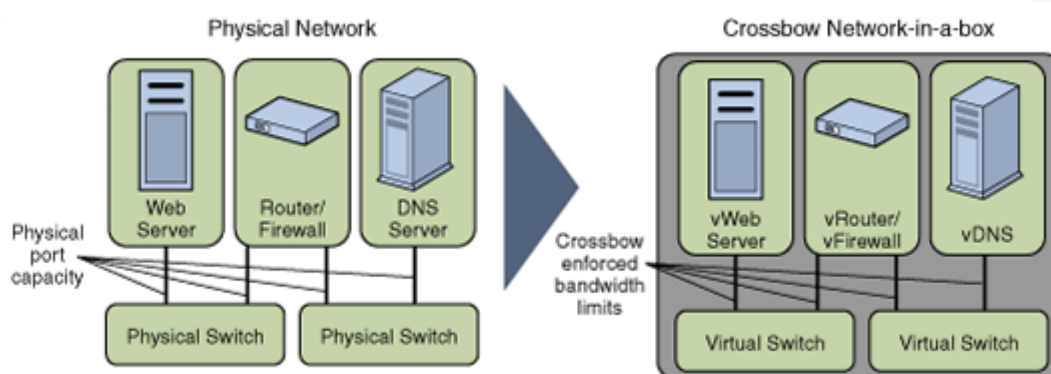
Obrázok 5: Princíp sieťovej virtualizácie

Záver

V tomto článku sme sa snažili načrtnúť dostupné možnosti implementovania virtualizačných metód, ktoré by sa dali nasadiť pre podporu LMS Moodle. Analýzou sme dospeli k dvom možným variantom riešenia. Jedným je realizácia solarisových zón na jednom fyzikom systéme spolu so systémom rozloženia záťaže a virtualizovaným dátovým úložiskom. Druhým je výpočtová virtualizácia, ktorá by na jednom fyzickom systéme umožňovala beh jedného webového servera pre každý LMS, pričom databáza by bežala ako separátny virtualizovaný systém. Prepojenie medzi webovým a databázovým serverom by bolo realizované prostredníctvom virtuálnej siete.

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Designing and Creating Educational Activities Using the Methods of Modelling for Combined Form of Education with E-Learning Support

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Abstract: The subject of our interest is educational process, which can be considered as dynamic process, changing in time, which can be examined from various viewpoints. We can focus on participants of this process, i.e. on students and lecturers, and observe their mutual relations and interactions. Educational process understood as a dynamic system is an insofar extensive sphere that it provides almost limitless opportunities of observation, modelling and simulation. In this contribution we shall focus mainly on the special part of educational processes – on teaching of subjects focusing on technical and system issues (Logical systems, Architecture of computers, Operating systems and Computer networks), which are specific with their focus on adopting the knowledge on principles and functionality of computer systems for the processing and transfer of information within the studies of informatics.

Úvod

V konkrétnej výučbe uvedených predmetov nie je možné obsah predmetu oddeliť od formy a použitých vyučovacích metód. Je snahou aplikovať moderné vyučovacie formy a s nimi súvisiace metódy (distančná forma vzdelávania, kombinovaná forma vzdelávania s podporou e-learningu, konštruktivisticky orientovanú výučbu apod.), s ktorými sa takto budú môcť študenti sprostredkovane zoznámiť počas štúdia, získať potrebné skúsenosti a prípadne ich následne využiť (ďalšie vzdelávanie, celoživotné vzdelávanie). Cieľom príspevku je po úspešnom zvládnutí návrhu a tvorby e-learningových kurzov pre podporu výučby informatických predmetov, predstaviť možnosti personalizácie uvedených aktivít formou modelovania vzdelávacích aktivít v prostredí LMS Moodle. Návrh štruktúry predmetov, ktoré sú v našom výbere bude vykonaný pomocou vhodne aplikovaných modelovacích nástrojov, ako je modelovanie s využitím Petriho sietí a modelovanie s prvkami Adaptívnych hypermediálnych systémov (AHS). Vzhľadom k neustálemu vývoju v oblasti IKT musí vytvorený e-learningový kurz pre vybrané predmety zostať otvorený novým technológiám, možnostiam a postupom, uplatniteľným pri riešení projektov. Problematika a teória modelovania s Petriho sieťami je bohatá a pomerne kvalitne rozpracovaná. Predpokladáme tvorbu rozsiahlych sietí, ktorých analýza je veľmi náročná a preto vhodný softvérový produkt pre naše potreby nemusí nevyhnutne obsahovať analytické prostriedky. Adaptivita v navrhovaných e-aktivitách je dôležitým prvkom personalizácie výučby, v ktorej dominujú dve role. Rola tútora, ktorý je zodpovený za obsah aj manažovanie vytvorenej e-aktivity a rola používateľa t.j. toho, kto vstupuje do vzdelávania a prechádza vzdelávacím e-produktom. Snahou autorov je poukázať na možnosti tvorby a aplikovania modelu používateľa. Ten by mal spĺňať tieto kritériá: mal by to byť hypertextový alebo hypermediálny systém, a mal by byť schopný prispôsobiť hypermédia použitím tohto modelu. Pri modelovaní používateľa dávajú hlavnú váhu tieto systémy na študenta. Predpokladáme, že učenie človeka sa realizuje prevažne v situáciách pedagogického typu, t.j. tam, kde tento proces niekto zámerne riadi, t.j. zasahuje do jeho priebehu a organizuje jeho podmienky tak, aby bolo čo najúčinnejšie a zároveň rozvíjalo aj osobnosť učiaceho sa. Ak môžu existovať rôzne úrovne, typy, modely a stratégie učenia, ako k

nim priradiť primerané a najúčinnejšie modely, typy a stratégie riadenia? Hľadaniu odpovede sa venuje nie len pedagogická psychológia o teórii učenia, ale aj oblasť kybernetiky a modelovania procesov riadenia.

Súčasný stav modelovania vzdelávania

Predmetom nášho záujmu bude vzdelávací proces, na ktorý tiež môžeme nazerať ako na dynamický, v čase sa meniaci systém a skúmať ho z rôznych pohľadov. Môžeme sa zamerať na účastníkov tohoto procesu, tj. na študujúcich a vyučujúcich a skúmať ich vzájomné vzťahy a interakcie. Alebo môžeme nazerať na vzdelávanie ako na proces, ktorého prvky sú jednotlivé vzdelávacie aktivity (výklad, cvičenia, samostatné práce, štúdium apod.) a sledovať náväznosť a postupnosť týchto aktivít s cieľom nájsť ich najvhodnejšie usporiadanie.

Vzdelávací proces chápaný ako dynamický systém je natoľko rozsiahlou oblasťou, že poskytuje takmer neobmedzené možnosti skúmania, modelovania a simulácie. Pri modelovaní vzdelávacieho procesu je potrebné vychádzať z interakčného poňatia, zo vzájomných sociálnych interakcií účastníkov vzdelávacieho procesu. Bol tak vytvorený „obecný model vzdelávacieho procesu", zahrňujúci širšie prostredie, vstupné činitele, samotný proces a jeho produkty (bezprostredné výsledky a dlhodobé efekty).

Realizované modely sa snažia zachytiť celkový pohľad na vzdelávací proces, všetky jeho zložky a vzájomné interakcie, ktoré tu vznikajú. Žiadny z nich nechápe informačné a komunikačné technológie ako špeciálnu zložku tohoto procesu, ktorá môže vstupovať (a často vstupuje) do vzájomných vzťahov so všetkými ostatnými zložkami a tým spôsobom ovplyvňuje celkový výsledok (produkt) tohoto procesu. Naviac žiadny z uvedených modelov nevychádza z čisto exaktného štatistického spracovania údajov získaných v procese vzdelávania, môžu tak ľahko byť ovplyvnené ľudským faktorom – pozorovaním, skúsenosťami apod.

V konkrétnej praktickej výučbe predmetov študijného programu Aplikovaná informatika nie je možné obsah týchto predmetov oddeliť od formy a použitých vyučovacích metód. Aplikujeme moderné vyučovacie metódy (dištančné vzdelávanie, e-learning, konštruktivisticky orientovanú výučbu apod.), s ktorými sa takto budú mať študenti možnosť sprostredkovane zoznámiť, získať potrebné skúsenosti a prípadne ich následne využiť vo svojej praxi. Zmyslom výskumnej práce je navrhnúť a vytvoriť e-learningový kurz pro podporu výučby predmetov technickej a systémovej povahy, ktorý by mal byť realizovaný vo vzdelávacom, riadiacom prostredí LMS MOODLE.

Model riadenej kombinovanej formy výučby s podporou e-learningu

Jedným z hlavných cieľov výskumnej práce na katedre informatiky je na základe poznania procesu vzdelávania navrhnúť model riadeného učenia s podporou multimediálnych vzdelávacích aplikácií na základe detailného opisu vyučovacích operácií. Realizujeme to s pomocou schém popisujúcich etapy systémového prístupu a opis systému výučby používajúcej médiá, jednotlivé úrovne tvorby pedagogického procesu, modely učenia atď. Navrhovateľ modelu sa najprv zaujíma o štruktúru procesu výučby, potom sa pokúsi vymedziť všeobecné ciele a klasifikovať ich podľa rôznych používaných taxonómií. Ďalej si vytvorí zoznam najdôležitejších prvkov (napríklad rozdelenie študujúcich na skupiny, potrebné učebné materiály, pomôcky, programy a pod.) a to vždy s ohľadom na explicitne a jasne stanovené ciele. Ďalej získa údaje o charakteristikách študujúcich, (učebné štýly, predchádzajúce znalosti, záujmy, motivácia atd.) a potom podľa nich modifikuje metódy. Tak si vytvorí operatívny systém vzdelávacích aktivít. Nakoniec si dopredu vytvorí mechanizmy, ktoré mu umožnia v priebehu i po skončení výučby hodnotiť výsledky a používať takto získané informácie na prípadnú modifikáciu navrhnutého usporiadania systému výučby.

Všeobecný systémový model výučby obsahuje jasný a presný popis rôznych operácií, ktoré prebiehajú v pedagogickom systéme. Skupina študujúcich je podsystém, zložený z prvkov, procesov a cieľov. Hlavnými prvkami sú pedagóg (tútor) a študent. Ďalšími môže byť databáza učebných materiálov, testov, Internet, televízia, noviny a všetky ostatné veci, ktoré môžu byť súčasťou systému. Procesy popisujú všetky operácie a všetky funkcie, ktoré systému umožňujú dosahovať ciele. Podsystémy zahrňujú tri

aspekty – vyhodnotenie vstupov, vyhodnotenie výsledkov (výstupov) a spätnú väzbu. Vyhodnotenie vstupov sa týka študenta, jeho schopností, získaných zručností a motivácie. Vyhodnotenie výsledkov zase umožní vyhodnotiť fungovanie systému a prostredníctvom siete spätných väzieb vniesť do systému potrebné modifikácie.
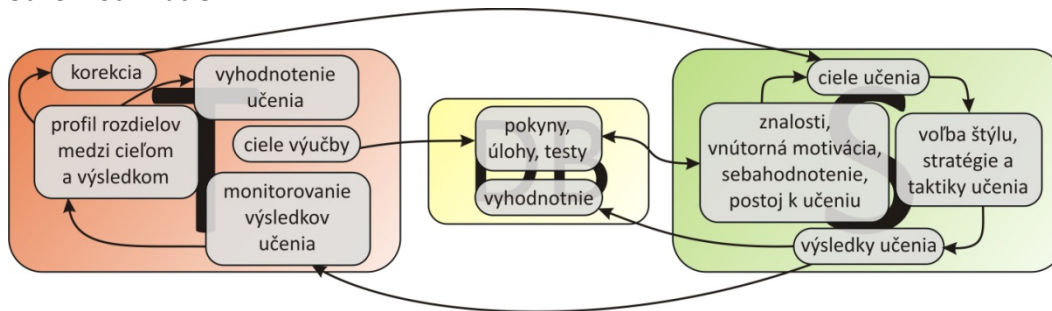
Obr. 1: Model riadenej kombinovanej formy výučby s podporou e-learningu

Model elektronickej výučby (obr. 1) vyjadruje vzdelávanie bez priameho kontaktu učiteľa a študenta, kedy sa komunikácia uskutočňuje cez elektronické prostredie, ktoré využíva databázu učebných materiálov, testov a cez ktoré sa zabezpečuje administrácia používateľov, študentov, výsledkov testov a pod.

Tútor pripraví zo vstupných informácií (informačný list predmetu, printové materiály) učebné materiály, ktoré vo forme multimediálnych dokumentov (MUME aplikácie, www stránky, MUME prezentácie, videotutoriály a pod.) uloží na server do databázy, kde budú okrem vstupov z iných zdrojov (odkazy internet, fóra), prístupné pre študenta. Komunikácia medzi tútorom a študentom sa uskutočňuje bez priamej SV, cez elektronické prostredie ako odpoveď študenta (LMS MOODLE), ktorá sa po prechode cez elektronické prostredie dostane k učiteľovi., ten koriguje študentov vstup a jeho ďalšiu reakciu. Keď tútor skontroluje žiadaný výstup študujúceho je splnený cieľ výučby. Takýto model výučby sa využíva v dištančnom vzdelávaní, v individualizovaných formách, v e-learningu a pod. (Turčáni, M., 2006).

Možnosti modelovania Petriho sieťami

Návrh štruktúry predmetov systémovej oblasti je v súčasnosti realizovaný pomocou modelovacích nástrojov Petriho sietí (viď. ďalej). Vzhľadom k neustálemu vývoju v oblasti IKT musí takto vytvorený e-learningový kurz pre uvedený predmet zostať otvorený novým technológiám, možnostiam a postupom, uplatniteľným pri riešení projektov. Navrhnutá Petriho sieť musí byť preto koncipovaná modulárne tak, aby ju v prípade potreby bolo možné doplniť alebo vhodne upraviť (Nagyová, I., 2007).

Mapovanie prvkov modelovaného systému do miest, prechodov a značiek je výsledkom abstrakcie a závisí na účele, pre ktorý je model vytváraný. Pri tvorbe modelu je potrebné mať na pamäti, že zatiaľ čo miesta a prechody a ich vzájomné väzby (hrany) existujú staticky, tokeny môžu vznikať, zanikať a pohybovať sa podľa pravidiel, daných nastavením kapacít miest a násobností hrán. Pri návrhu modelovej štruktúry e-kurzu akéhokoľvek predmetu je potrebné zaviesť dôležité pojmy, ktoré charakterizujú danú štruktúru navrhovaných kurzov. Sú to nasledovné pojmy:

- Miesto - predstavuje pasívny prvok systému, ktorý je schopný si pamätať iné objekty (tokeny). Predstavuje pamäť Petriho siete.
- Prechod - reprezentuje aktívny prvok, s ktorým sú zviazané udalosti. Jeho aktivita je podmienená aktuálnym stavom systému a môže tento stav zmeniť. Prechod modeluje procesor, udalosť, funkčný prvok systému.
- Token - (značka) reprezentuje pasívny prvok, ktorý sa môže pohybovať a môže byť uložený v mieste. Typicky modeluje dáta.

Po skúsenostiach s návrhom a tvorbou modelu vzdelávacej aktivity v predmetoch systémovej povahy sme si dovolili uviesť hodnotenie tejto metódy pre účely riadenia a formovania individuálneho prístupu k výučbe pre daný odbor na katedre informatiky.

Výhody:
- Jednoduchosť Petriho sietí a ich presný matematický model poskytujú dostatočný formálny aparát pre riešenie problémov verifikáciu (overovanie) navrhnutých modelov a zisťovanie možností priechodnosti daným modelom.
- Grafová reprezentácia Petriho sietí zjednodušuje chapanie modelovaného systému ako celku.

Nevýhody:
- Petriho sieť bola pôvodne koncipovaná ako plošný model a i napriek väčšej štrukturovanosti hierarchických Petriho sietí zostáva plošným modelom.
- Petriho sieť modeluje systém tým, že ho rozkladá do parciálnych stavov, k postupnej zmene dochádza vplyvom udalostí. Jednotlivé stavy Petriho siete sú však pevne dané, sú statické. Petriho siete umožňujú modelovať systémy s premennou štruktúrou (premennou množinou stavov) len veľmi obtiažne.

Pre potreby modelovania a simulácie vzdelávacieho procesu je často potrebné sa rozhodnúť pre vhodný softvérový produkt, ktorý umožní grafický návrh Petriho siete a ktorého simulačné prostriedky budú na vysokej úrovni. Predpokladáme tvorbu rozsiahlych sietí, ktorých analýza je veľmi náročná a preto produkt pre naše potreby nemusí nevyhnutne obsahovať analytické prostriedky.

Vhodným softvérovým prostriedkom sa ukazuje program HPSim, ktorý je zdarma k dispozícii pre výskumné a vzdelávacie účely. Jeho prednosťou je jednoduchá inštalácia, jednoduché ovládanie a výborná možnosť simulácie (hlavne paralelných procesov). HPSim umožňuje modelovanie pomocou P/T Petriho sietí s inhibítormi a testovacími hranami. Produkt nepracuje s hierarchickými Petriho sieťami, hierarchiu vo vytváraných sietiach budeme musieť udržovať sami. Výsledky práce v tejto oblasti v rámci vyskumnej činnosti na katedre informatiky sú publikované v (Klimeš C. and Balogh Z., 2005).

Úvod do problematiky adaptívnych hypermediálnych systémov (AHS)

Asi väčšina autorov chápe AHS podľa definície jedného z hlavných odborníkov tejto oblasti Brusilovského nasledovne: „by adaptive hypermedia systems we mean all hypertext and hypermedia systems which reflect some features of the user in the user model and apply this model to adapt various visible aspects of the system to the user", čo sa dá voľne preložiť: „adaptívnymi hypermediálnymi systémami sa myslia všetky hypertextové a hypermediálne systémy, ktoré odrážajú niektoré črty používateľa v modeli používateľa a používajú tento model na prispôsobenie rôznych rysov viditeľného výstupu, ktorý je systémom poskytnutý používateľovi" (Brusilovsky, P., Sosnovsky, S., et al., 2004).

Inými slovami, AHS by mal spĺňať tri kritériá: mal by to byť hypertextový alebo hypermediálny systém, mal by obsahovať model používateľa a mal by byť schopný prispôsobiť hypermédia použitím tohto modelu. AHS sleduje správanie a charakteristiku konkrétneho používateľa a na ich základe zostavuje a používateľovi poskytuje adaptovaný dokument. Pre svoju prácu potrebuje väčšina systémov poznať relevantné údaje o používateľovi. Tieto údaje poskytuje väčšine systémov samotný používateľ. Vo výučbových adaptívnych systémoch sú to hlavne testy, dotazníky a pod. Okrem informácií poskytnutých samotným používateľom využívajú systémy aj automatický zber údajov o používateľovi. Do automatického zberu údajov patrí napr. sledovanie, ktoré spojenia a aký typ spojení používateľ najčastejšie používa, ako dlho sa zdržiava v konkrétnych uzloch, ako aj počet navštívení konkrétneho uzla a pod. Všetky tieto údaje sú uložené v tzv. modeli používateľa (user model) (Bureš, M., Jelínek, I., 2003). Existujú aj systémy, ktoré od používateľa nepožadujú žiadne informácie, a model používateľa si vytvárajú iba na základe interakcií používateľa so systémom. AHS zostavuje adaptovaný dokument pre konkrétneho používateľa. Cieľom modelovania používateľa je špecifikovať charakteristiku, t.j. vlastnosti používateľa, pomocou ktorých systém vyberie pre neho najvhodnejšiu prezentáciu. Správne definovanie

vlastností, ktoré čo najvernejšie odrážajú skutočného používateľa, je veľmi dôležité pre úspešnú adaptáciu informácií pomocou AHS. Model používateľa môžeme asi najlepšie vystihnúť ako „subjektívny názor systému na používateľa, t.j. názor o jeho schopnostiach a vedomostiach, o predkladanej problematike, ale aj všeobecných vlastnostiach (Kay, J., Lum, A., 2000). Samotné prístupy k modelovaniu používateľa vychádzajú zo systémov pre výučbu, tzv. Inteligentných výučbových systémov. Tieto systémy sledujú správanie študenta a na základe spätnej väzby ho usmerňujú v jeho ďalšom štúdiu. Inteligentné výučbové systémy pozostávajú z troch častí: znalosti o predkladanej oblasti – čo učiť; špecifiká študujúceho - koho učiť; vyučovacia stratégia – ako učiť. Pri modelovaní používateľa dávajú hlavnú váhu tieto systémy na študenta. V rámci návrhu AH systému pre vzdelávaciu aktivitu v odbore Aplikovaná informatika sme použili při tvorbe e-kurzu LMS MOODLE a hlavný dôraz sme venovali návrhu používateľského modelu. Na obr. 2 je schéma návrhu vzdelávania s adaptívnym modulom DIVAI AHS.
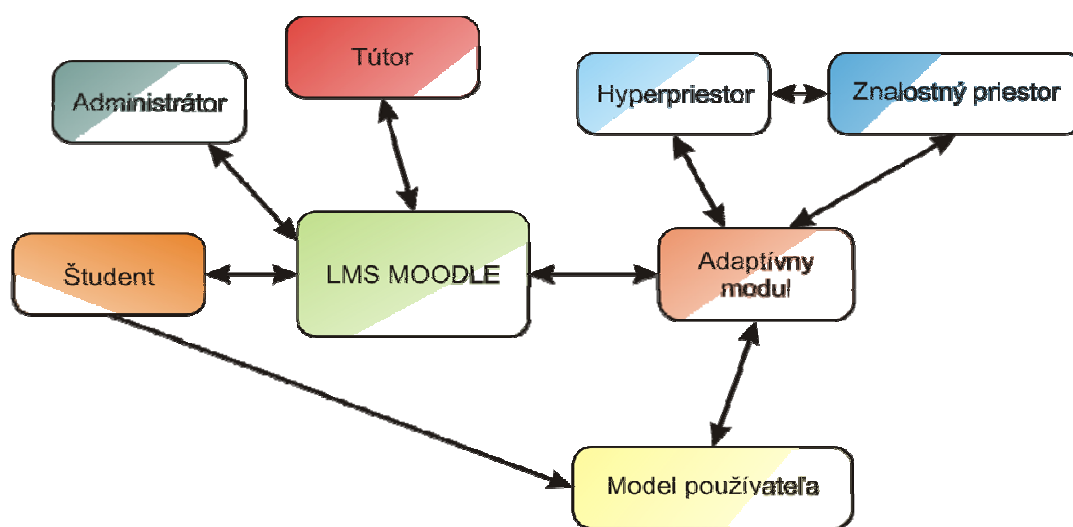
Obr. 2: Návrh systému výučby DIVAI AHS

Cieľom modelovania používateľa je preto uchovávanie hodnôt spojených s používateľom, ktoré odrážajú úroveň jeho vedomostí a ich použitie při prispôsobovaní systému. Pri prezentovaní vlastností používateľa sme vychádzali z návrhu prekryvného modelu, ktorý využíva vedomosti expertov. Model používateľa reprezentuje rôzne vlastnosti používateľa, ktoré sa dajú využiť pre adaptáciu obsahu, prezentácie alebo navigácie. Okrem správneho definovania jednotlivých atribútov pre vytvorenie modelu používateľa je potrebné tieto atribúty reálne reprezentovať pomocou prostriedkov a technológii používaných v rámci adaptívneho systému. Medzi prostriedky, pre ktoré sme sa rozhodli při návrhu modelu používateľa patrí relačná databáza. Vychádzali sme z poznatkov, že práve použitie databázy pre uchovávanie modelu používateľa je najzrejmejšie, pretože väčšina informačných systémov používa práve relačnú databázu na prácu s dátami. Model používateľa je realizovaný pomocou jednotlivých tabuliek relačnej databázy. Výhodou použitia databázy je, že dáta v nej uložené nepotrebujú ďalšie „špeciálne" úpravy na prezentáciu koncovému používateľovi. Pri príprave tvorby, ako aj samotnej realizácii adaptívneho e-kurzu všetky potrebné údaje o študentovi budú uložené vo vyhradenom úložisku na serveri. Vedomosti expertov a informácie o študujúcom budú konfrontované na základe pravidiel stanovených pre tvorbu vzdelávacej aktivity DIVAI AHS tvorenej v rámci projektu Virtuálna katedra na KI FPV UKF v Nitre (Kapusta, J., Munk, M., Turčáni, M., 2009).

Záver

Vychádzajúc zo zistení, ktoré vyplynuli z nášho výskumu a osobných skúseností navrhujeme väčšie využitie adaptívnych hypermediálnych systémov vo vzdelávaní. Uvedomujeme si, že samotné vytváranie adaptívnych systémov je veľmi náročné. Napriek tomu veríme, že čas investovaný do vývoja adaptívnych hypermediálnych e-kurzov sa určite vráti vo forme lepšie pripravených študentov. Z hľadiska adaptívnych techník odporúčame v adaptívnych e-kurzoch využívať techniku priameho vedenia. Už v súčasnosti môžeme sledovať posuny vo výskume AHS, kedy sa autori pri tvorbe materiálov začínajú zaoberať nielen technickými vylepšeniami AHS, ale väčší dôraz kladú na implementáciu pedagogicko-psychologických koncepcií, napr. krivky učenia, opakovania a zabúdania. Aj keď ideálny systém, ktorý sa úplne priblíži každému študentovi je určite utópiou, pomocou dobre navrhnutých AHS sa dokonalej personalizácii vyučovania môžeme priblížiť.

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Implementation of Interactive Equipment in Informatics Education

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Keywords: e-learning course, optimization.

Abstract: All over the world, various teaching methods are used to get better results in education. Regarding the theme of this paper we decided to use Computer-Based Learning (CBL) in the teaching-learning process. Teaching the numerical and optimizing algorithms in the traditional form (e.i. lecture) is not very attractive and motivating for students. Therefore we decided to add visual demonstrations of the function of algorithms to the explanation of the educational content. In the lessons we use the dynamic visualizations that make the teaching-learning process more dynamic and effective. Furthermore, we can motivate the students better than before. The introduced paper deals with teaching optimizing algorithms with the usage of CBL. The optimizing algorithms form the curriculum of Numerical mathematics and optimization subject that is the obligatory subject for the students of Informatics in the fourth year of study of Teaching of academic subjects on the Faculty of Natural Sciences of Constantine the Philosopher University in Nitra. The content of the subject includes basic numerical and optimizing methods. For this subject we created the study materials and electronic didactic aids. The materials for the study of Numerical mathematics and optimization consist of more components forming a complete unit in the end. At the university education portal we created course using LMS Moodle. By this way we provide access to materials for all the time. Individual lectures in the course are thematically grouped. For each method there is an interactive presentation created by graphic editor based on vector graphics, e.g. Macromedia Flash MX. Using presentations, we stimulate students' imagination, as well as, by using visual material, we facilitate their learning and understanding of the algorithm. Next lessons include teaching text in pdf format, examples of practice and a forum. To confirm our assumptions that teaching subject Numerical mathematics and optimization using the aids will be much easier and more effective we realized the research. The research was realized by questionnaire method, method of content analysis and quantitative methods of educational research. We asked students to fill up the questionnaire that was aimed at evaluation of the presentations and the application. We gained 31 evaluations that was the exact number of students undergoing the eighth term. In the paper, we mention only some of the twelve questions. On the basic of the research as well as practical experience, we can agree upon the conclusion that the described presentations and the application if sufficient aid facilitating the teaching and learning of Optimization subject. A teacher can use this material at the lectures, seminars, moreover; students can use them at home while preparing for school.

Úvod

Zaradenie výpočtovej techniky do vyučovacieho procesu ako didaktickej pomôcky spôsobilo veľký vzrast v tvorbe výučbových programov. Nielen profesionálni programátori, ale aj my učitelia dokážeme veľmi efektívne počítače využívať na skvalitnenie a zefektívnenie svojej práce napríklad prípravou prezentácií a didaktických programov, pomocou ktorých sa dá oživiť, ale hlavne zefektívniť priebeh vyučovacej hodiny, nehovoriac o lepšom chápaní a motivácii svojich študentov.

V príspevku sa zaoberáme vyučovaním numerických a optimalizačných algoritmov s využitím výpočtovej techniky, ktoré tvoria obsah predmetu Numerická matematika a optimalizácia študijného programu Učiteľstva akademických predmetov magisterského štúdia predmetu Informatika a jednoodborového študijného programu Aplikovaná informatika a Počítačové modelovanie v prírodných vedách na katedre informatiky Fakulty prírodných vied (FPV) Univerzity Konštantína Filozofa v Nitre

(UKF). K obsahu tohto predmetu sme vytvorili elektronické pomôcky a ako elektronickú podporu vyžívame e-learningový kurz.

interaktívne pomôcky a CBL

Predmet Numerická matematika a optimalizácia je veľmi úzko spätý s algoritmizáciou, nakoľko obsahom tohto predmetu je odvodzovanie algoritmov pomocou vyššej matematiky a ich programovanie v programovacom jazyku. Na dosiahnutie lepších výsledkov vo vyučovaní sa v súčasnosti používajú rôzne moderné vyučovacie metódy. My sme si zvolili Počítačom podporované vyučovanie z angl. Computer-Based Learning (CBL), ktoré sa v pedagogickej praxi uplatňuje vo viacerých formách:

- Computer Aided Instruction (CAI) - počítačom podporované prednášanie;
- Computer Monitoring Instruction (CMI) - počítačom riadené a kontrolované vyučovanie;
- Computer Aided Testing (CAT) - počítačom podporované skúšanie na zhodnotenie učiva;
- Computer Aided Learning (CAL) - počítačom podporované učenie sa.

Pozitívnou skúsenosťou z použitia takejto formy vyučovania sa javí implementácia statických a hlavne dynamických grafických prvkov do elektronických materiálov, ktoré študenti považujú za najvýznamnejšie zložky tejto formy vyučovania, a ktoré podporujú jednoduchšie pochopenie prezentovaných procesov. Práve oblasť CBL je tá, v ktorej takéto materiály vynikajú nad klasickým spôsobom vyučovania a učitelia by mali brať túto skutočnosť na vedomie pri tvorbe vlastných materiálov pre počítačom podporované vyučovanie (Overfield, Brayn-Lluka, 2008).

Po tejto analýze sme sa rozhodli vytvoriť didaktické elektronické pomôcky, pomocou ktorých doplníme výklad o chýbajúcu názornosť, a tým skvalitníme a zefektívnime priebeh vyučovacích hodín daného predmetu. Takéto pomôcky sa zároveň stanú motivačným prostriedkom pre študentov na prednáškach či cvičeniach. Sú určené jednak pre vyučujúceho, ale aj pre študentov, ktorí ich môžu používať pri opakovaní si učiva, alebo pri učení sa na skúšku. Podľa nášho názoru, v kombinácii s prednáškami a literatúrou, vytvárajú vhodný prostriedok na podporu vyučovania numerických a optimalizačných algoritmov pomocou počítača.

Vizualizácia formou interaktívnej prezentácie

Elektronické prezentácie resp. dynamické vizualizácie sa čoraz viac objavujú v technicky založených edukačných materiáloch, ako sú napríklad multimediálne vyučovacie prostredia. Na rozdiel od statických zobrazení, dynamické vizualizácie môžu priamo zobraziť zmeny v priestore v priebehu času, a to buď v jednotlivých krokoch alebo plynulým prehrávaním. Ak sú tieto dynamické zobrazenia interaktívne, študent môže za pomoci ovládacích prvkov vidieť zmeny, ktoré sú vzápätí prezentované (Ploetzner R., Lowe R., 2004).

Na tvorbu elektronických prezentácií sme použili editor Macromedia Flash MX, v ktorom sme vytvorili interaktívne prezentácie so zakomponovanými dynamickými prvkami, pomocou ktorých dokonalejšie zviditeľníme priebeh optimalizačných algoritmov. V oblasti skúmania vplyvu animácií na študentov má významný prínos Mayer R. E. (1997), ktorý na základe početného množstva experimentálnych štúdií ukázal, že učenie s použitím animácií môže byť ešte viac úspešnejšie vtedy, ak sú tieto počas prezentácie doplnené o hovorené slovo a nie písaný text. (Mayer, 1997, Mayer, 2001). Vyučujúci môže prezentácie použiť pri výklade nového učiva na prednáške alebo pri opakovaní učiva na cvičení, čím podporí u študentov lepšiu predstavivosť a tým aj dôkladnejšie zapamätanie si nových poznatkov.

Každá stránka prezentácie je opticky rozdelená na dve časti. V pravej sa nachádza učebný text resp. algoritmus optimalizačnej metódy zapísaný v krokoch. Červená šípka, ktorá sa zobrazuje naľavo od algoritmu ukazuje na časť algoritmu, ktorá sa práve vykonáva resp. vykonala. Grafický priebeh algoritmu je zobrazovaný v ľavej - multimediálnej časti na konkrétnom príklade. V tejto časti sa zobrazujú aj obrázky ku sprevádzajúcemu textu.
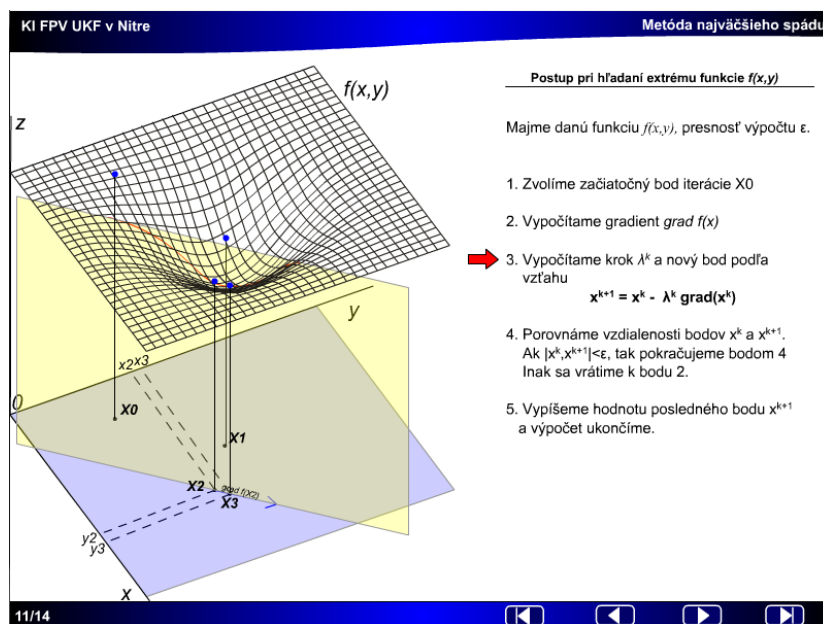
Obr. 11: Ukážka prezentácie Metódy najväčšieho spádu

Ovládanie prezentácie je riadené používateľom (učiteľ alebo študent) s použitím ovládacích prvkov umiestnených v pravej dolnej časti prezentácie. Na poslednej stránke prezentácií sa nachádza algoritmus metódy znázornený vo forme pseudokódu, ktorý študenti programujú na cvičeniach v programovacom jazyku a s jeho pomocou potom riešia zadané úlohy.

Takouto formou vizualizácie prispievame k lepšej názornosti a predstave o fungovaní vyučovaných metód a zároveň tak poskytujeme možnosť lepšieho zapamätania si obsahu vyučovacích hodín.

E-learningový kurz ako elektronická podpora vyučovania

Aby boli elektronické materiály prístupné pre študentov nepretržite, vytvorili sme v rámci softvérového balíka LMS Moodle e-learningový kurz pre tento predmet. Softvérový balík LMS Moodle sme zvolili z toho dôvodu, že na Katedre informatiky už niekoľko rokov tento výučbový systém používame na tvorbu, spravovanie a realizáciu e-learningových kurzov pre ostatné predmety.

Jednotlivé lekcie sú v našom kurze tematicky zoradené a každá z nich obsahuje materiály pre konkrétnu metódu. V každej lekcii je prístupný učebný text vo formáte pdf, ďalej tu študent nájde prezentáciu metódy vo forme akú sme opísali v predchádzajúcej kapitole. Neodmysliteľnou časťou lekcie sú úlohy, ktoré študenti riešia na cvičeniach a počas domácej prípravy. Naprogramované algoritmy prenesú pomocou aktivity prenášania súborov na e-learningový server a vyučujúci im odovzdané úlohy skontroluje a v prípade nedostatkov určí chyby, ktoré študent následne napraví.

Kompletnosť lekcie uzatvára diskusné fórum, v ktorom si študenti navzájom vymieňajú skúsenosti z programovania metód, píšu o nových programovacích technikách, či iných možnostiach ako danú metódu naprogramovať. Diskusné fórum je vytvorené zvlášť pre každú tematickú oblasť, čím sme zabezpečili kategorizáciu zasielaných príspevkov. Okrem týchto fór sú v kurze ďalšie dve fóra, z ktorých prvé Fórum ku kurzu-všeobecné otázky je zamerané na všeobecné otázky študentov a diskusiu o danom predmete, o skúške, odovzdávaní programov a pod. Obsah druhé fóra nazvané Fórum na hlásenie chýb a vylepšení, je zrejmý už z jeho názvu.

S cieľom zefektívniť skúšanie študentov a tiež dodržať objektivitu na písomnej časti skúšky sme vytvorili aparát v rámci LMS. Využili sme aktivitu Test a vytvorili kategórie otázok podľa typu úloh, do ktorých sme zadali znenia príkladov. Z týchto sa na skúške náhodne vygenerujú pre každého študenta iné otázky (príklady), ktoré sú súčasťou písomnej časti skúšky. Vzhľadom na to, že odpoveďou na otázky nie je vždy iba jedno číslo, ktoré predstavuje extrém funkcie, použili sme otázky takého typu, ktoré umožňujú voľby odpovede z viacerých možností. V prípade, kde odpoveď predstavuje iba jedno číslo (vypočítanú hodnotu), musíme toto testovať, či zadaný výsledok spadá do prípustného intervalu riešenia danej úlohy.

Po zodpovedaní všetkých otázok, resp. vyriešení všetkých príkladov a ukončení testu sú ich odpovede automaticky vyhodnotené a na základe tejto spätnej väzby študenti vedia, či vyhoveli písomnej časti skúšky.

Záver

Po implementácii opísaných interaktívnych pomôcok a použití e-learningového kurzu vo vyučovaní nás zaujímalo, aký to bude mať vplyv na študentov a na ich učenie sa. Pomocou dotazníkov sme vyhodnocovali kvalitu výučby predmetu Numerická matematika a optimalizácia a získali tak názory študentov na vytvorené didaktické pomôcky. Reprezentatívnu vzorku tvorili študenti 4. ročníka magisterského štúdia aprobácie s informatikou.

Takmer všetci opýtaní študenti (98%) prijali zaradenie prezentácií do vyučovacieho procesu, čo potvrdzuje skutočnosť, že študentom použitá vyučovacia metóda vyhovuje. Podľa analýzy odpovedí na ďalšie otázky vieme vysloviť takýto záver: bezmála polovica študentov pokladá po zavedení prezentácií do vyučovania výklad za názornejší a takmer tretina opýtaných za jednoduchšie pochopiteľný. Viac než 80% respondentov nevidí v zavedení prezentácií žiadne nevýhody a pre 84% opýtaných bola vyučovacia hodina s použitím vytvorených didaktických pomôcok zaujímavejšia.

Podľa uvedených zistení môžeme povedať, že po zaradení vytvorených didaktických pomôcok do vyučovania sa vyučovacie hodiny stali pre väčšinu študentov zaujímavejšími a efektívnejšími. Boli splnené naše predpoklady o názornejšom vyučovaní, motivácii študentov i jednoduchšom chápaní učiva.

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Track 2 - Technology Enhanced Teaching at Secondary School

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ICT in Literature Education for Children with Special Needs

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Keywords: special needs, literature education, visual support

Abstract: The development of literacy skills can provide important advantages for children with special needs. Exposes to early storytelling and learning the receptive role in literature - listening - situation provides the child with preknowledge and experiences, needed for later literacy acquisition. It cannot be assumed that if the child's language competence is not (yet) developed; he cannot learn to listen to a story and to understand it. On the contrary, ICT in literature education for children with special needs gives us the opportunity to use visual communication code to provide communication support for children with special needs, while supporting literary aesthetic experience and at the same time the process of emergent literacy. Historically educators have assumed that listening/reading to stories are skills that develop after children learn to talk. Because many children with special needs have significant delays in language development, there has been a reluctance to introduce storytelling activities to these children. However as Watson, Layton, Pierce, and Abraham (1994) point out, early exposure to literacy (also storytelling) activities are important for all children, regardless of their speech and language ability. The possibilities, given by the use of ICT, should have the consequence of rediscovering the importance of including storytelling activities in preschool curricula. This activity can support specific skills of listening, sound discrimination, and speech sound production in children who have hearing loss, communication delays, and learning disabilities. It is particularly important to realize that for some children who will never develop intelligible spoken language, use of pictures and print may be a critical alternative mode. In our paper we shall present the results of the case study, in which we used ICT as a means for literature education in a group of young adults. Our results show not only that ICT is an interesting tool, young people with special needs find nice and fancy, it does not only motivate but gives results of much higher quality regarding the understanding and interpretation of key structural elements of the literary text. Our investigation shows the connection of using visual support to the storytelling via ICT and listeners (viewers) understanding of literary persons and literary setting. Reception of the story supported with ICT shows results in understanding the moral of literary characters and the understanding of literary action, which was measured by the ability of predicting the story. On the behalf of the experiment we can conclude, many highly motivating and efficient ICT strategies can be used throughout the literature reception activities to encourage the literature understanding, language acquisition and emergent literature skills for young people with special needs

Functions, Calculus, and Linear Systems in School Mathematics with MS Excel

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Keywords: spreadsheet modelling, school mathematics, functions, linear systems

Abstract: The paper gives some examples of using Excel as an effective modelling tool for teaching and learning functions and calculus at secondary school from the view of teaching the corresponding skills in informatics lessons. They are: graphing elementary functions, graphing polynomials and general functions, finding zero points and extremes of functions, and solving systems of linear equations. Developing interactive models of parametric systems for studying their behaviour at changing inputs is a known way of using spreadsheets. Making the models, students gather new knowledge and skills in the spirit of constructivism and discovering mathematics.

Introduction

The traditional way of teaching Excel at school is making various statistical calculations and graphs. Students are sure to use the skills at evaluating physical, biological, and chemical measurements, or at analyzing geographic and economic data retrieved from somewhere. The other way of teaching and using spreadsheets is developing interactive models of parametric systems for studying the behaviour of those at changing inputs (Neuwirth and Arganbright, 2004). Making the models, students gather new knowledge and skills in the spirit of constructivism (Anhua et al., 2003) and discovering mathematics (Kalaš, 2004). Interactive models are ideal for teaching and learning mathematics (not only that; see Kalaš, 2007), and are very helpful for building up visual memory. That is why the author started developing spreadsheet applications for visualizing mathematical relations during his teaching practice at grammar school (Beňačka and Čeretková, 2009 a).

Making simple spreadsheet models only requires a few skills that are commonly taught in courses except for the Goal Seek and Solver tools; programming is not used.

The answer to the question why to use Excel for modelling at school if specialised mathematical software exists is:

1. Mathematical software can do symbolic calculations that are impossible in Excel, however, the need for that is mainly at university level.
2. Mathematical software is too expensive to get it at home but even at school while Excel is a common equipment of computers.
3. Mathematical software is a black box for students; in Excel, everything is visible.
4. The spreadsheet skills are commonly taught in school within subject Informatics.
5. Excel allows creating even sophisticated models without programming.
6. VBA makes Excel a complex developing environment.

Excel and Elementary Functions

In Fig. 1, there is the application for graphing linear function. The white cells are the inputs. The graph is drawn over 100 points from $x_{\min}$ to $x_{\max}$ by step Δx. The graph reacts interactively to the changes of parameters *a*, *b*, which enables students to investigate their meaning and remember the shape of the graph i.e. to get it in the visual memory. The root (zero point) is calculated using the formula $x = -b/a$. This allows solving inequalities of the kind $ax + b \leq 0\ (\geq, <, >)$ immediately. The special

cases when $a = 0$ or/and $b = 0$ are treated with the IF function. Teachers and students can take the advantages of the application even at lower secondary school (age 12 – 13) as the topic is a part of the mathematics curriculum.
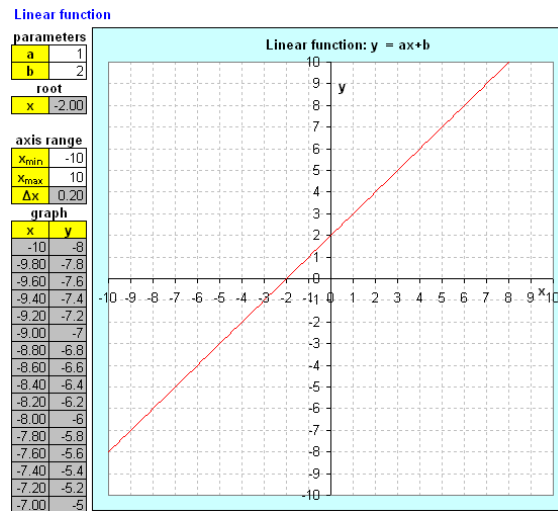

Figure 2: Linear function

The required spreadsheet skills are (see Fig. 1):
1. Writing in the formula for $\Delta x = (x_{max} - x_{min})/100$.
2. In range **graph**, putting the first x equal to x_{min}, calculating the second x as the previous one plus Δx absolutely addressed, and filling down over 100 cells until x equals x_{max}.
3. In range **graph**, calculating the first y using the function formula where a, b are absolutely addressed, and filling down over 100 cells.
4. Making the graph over columns **x**, **y** in range **graph** as a xy graph, changing the graph and chart colours, and adding the subtle grid.
5. Writing in the IF function for the root: if $a <> 0$, then the result is $-b/a$, else if $b <> 0$, then the result is "no", else the result is R.
6. Switching off the cell grid, adding cell borders, colouring the title cells yellow and bold, colouring the cells with formulas grey and leaving the input cells white.
7. Changing the axis ranges in the chart if necessary.

In Figs. 2, 3, there are two applications for graphing quadratic function. In Fig. 2, the equation is in the simplest form $y = a(x - m)^2 + n$. The vertex coordinates m, n can be obtained immediately thus the course of the graph is clear, and it is $y' = ax'^2$ in the shifted coordinate system $x'y'$. In Fig. 3, the equation is in the general form $y = ax^2 + bx + c$.
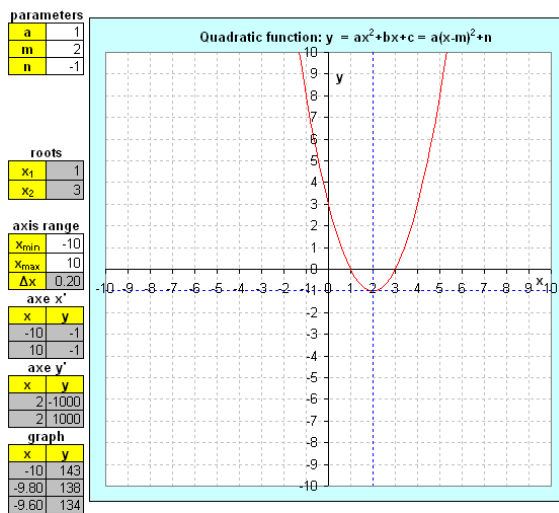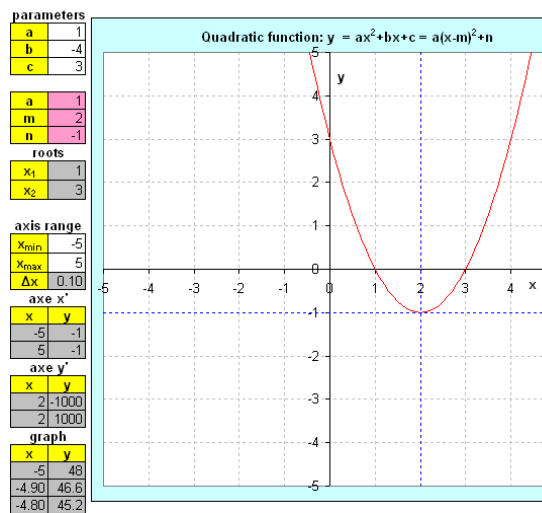
Figure 3: Quadratic function

Figure 4: Quadratic function

In case the function equation is in the form $y = ax^2 + bx + c$ and one wants to sketch the graph by hand, he/she has to recast the equation into the form $y = a(x - m)^2 + n$ to get the vertex coordinates m, n. Those are given by the formulas $m = -b/2/a$, $n = c - b^2/4/a$ (in Excel notation). The calculation is in the violet cells in Fig. 3. Parameter a is checked by the IF function. If $a = 0$, then the function is not quadratic, then "a = 0" is written in bold red below the inputs as a warning. Roots (zero points) x_1, x_2 are calculated using the IF function – if the discriminant $D = b^2 - 4ac$ is smaller that zero, then the result is "no", else $x_{1,2} = (-b \pm \mathrm{SQRT}(D))/2/a$.

The additional spreadsheet skills are

1) Adding the shifted axes x', y' as two-point xy graphs, where x' goes from the point $(x_{\min}, n)$ to $(x_{\max}, n)$, and y' goes from $(m, y_{\min})$ to $(m, y_{\max})$.

The graph reacts interactively to the changes of parameters *a*, *b*, *c*, or *a*, *m*, *n*, which enables students to investigate the meaning, and get the graph and its behaviour into the visual memory. The automatically calculated roots allow immediate solving inequalities of the kind $ax^2 + bx + c \leq 0$ $(\geq, <, >)$ that are very frequent in secondary school maths, e.g. at finding definition domains of composed functions like $y = \log_2(x^2 - x - 2)$, $y = \sqrt{1 - x - 3x^2}$, etc. Students can take the advantages of the application in all years of upper secondary school.

In Figs. 4, 5, there are the applications for graphing linear fractional function. In Fig. 4, the equation is in the simplest form $y = \dfrac{k}{x - m} + n$, where the translation vector coordinates *m, n* are clear thus the graph is $y' = \dfrac{k}{x'}$ in the translated system $x'y'$. In Fig. 5, the equation is in the general form $y = \dfrac{ax + b}{cx + d}$.
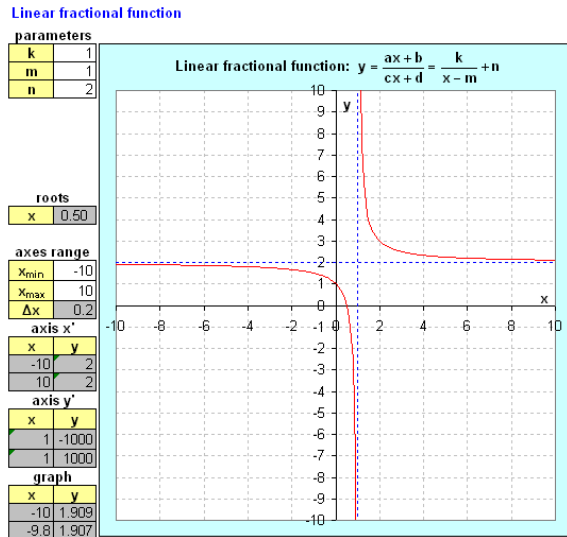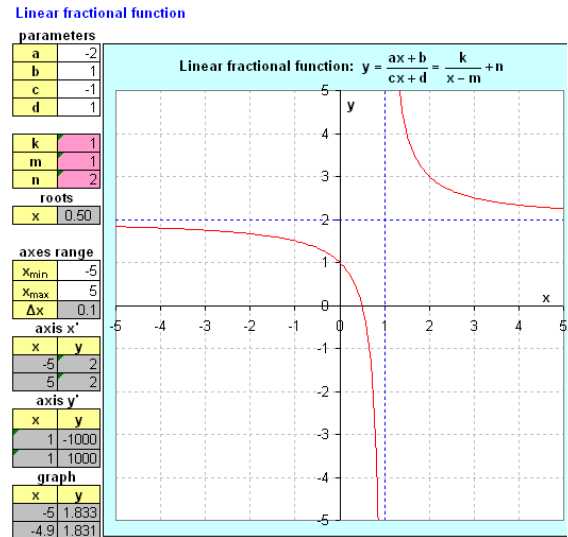
Figure 5: Linear fractional function

Figure 6: Linear fractional function

In this case the equation is in the form $y = \dfrac{ax+b}{cx+d}$ and one wants to sketch the graph by hand,

he/she has to recast the equation into the form $y = \dfrac{k}{x-m} + n$ to get parameters *k*, *m*, *n*. Those are given by the formulas $k = b/c - a*d/c/c$, $m = -d/c$, and $n = a/c$. The parameters are checked with the IF function. If $k = 0$, or $c = 0$, or $ad = bc$, then the function is not fractional, and the case is written in red bold below the inputs as a warning. The root (zero point) is calculated using the formula

$$x = m - \frac{k}{n}.$$

The graph consists of two parts the points of which are calculated in hidden columns. The left branch goes from $x_{\min}$ to $m(1 - 10^{-15})$, the right one goes from $m(1 + 10^{-15})$ to $x_{\max}$. Range **graph** is just a "table for constructing the graph", but the points are not used. The same trick can be used at other graphs of elementary functions that are not defined in R, e.g. power function, root function, logarithmic, tangent, etc. (see Fig. 6). Getting the roots automatically allows immediate solving inequalities of the kind $\dfrac{ax+b}{cx+d} \le 0 \ (\ge, <, >)$ that are frequent in secondary school maths, e.g. at finding definition
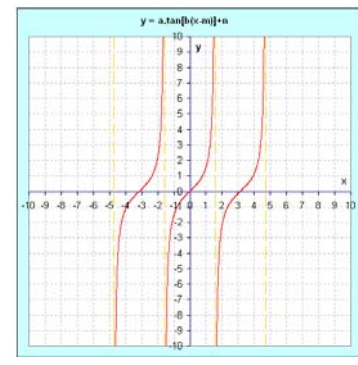
domains of composite functions like $y = \log\left(\dfrac{2x}{x+3}\right)$, $y = \sqrt{2 - \dfrac{1}{x}}$, etc.
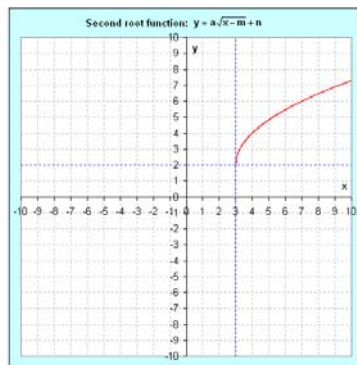

a = 2, m = 3, n = 2
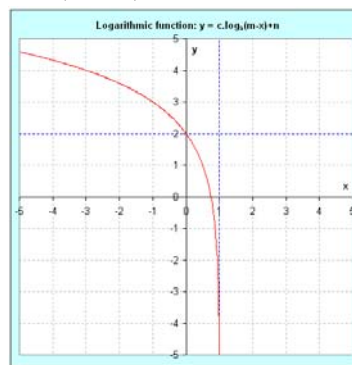
a = 1, c = 2, m = 1, n = 2

a = 1, b = 1, m = 0, n = 0

Figure 7 Graphs of elementary functions with $D \ne R$: root (left), logarithmic (middle), tangent (right)

Excel and Calculus

In Fig. 7, there is the application for analysing polynomials. The equation is written in the first **y** cell in range **graph** (using relative addresses only), and filled down. Then, the formula from the first **y** cells in range **graph** is copied to the **y** cells in ranges **roots** and **extremes**. The roots are calculated by the Goal Seek tool. First, values close to the roots are inputted in the **x** cells in range **roots**. Goal Seek is used afterwards – the "Set cell" is in column **y**, the cell "By changing cell" is the next one in column **x**, and the input "To value" is set to 0. The extremes are calculated by the Solver tool. First, values close to the stationary points are inputted in the **x** cells in range **extremes**. Then, the Solver is used – the "Set Target Cell" is in column **y**, the cell "By Changing Cell" is the next one in column **x**, and the input "Equal to:" is set to Max if the user needs to find a maximum, or Min if the user needs to find a minimum.
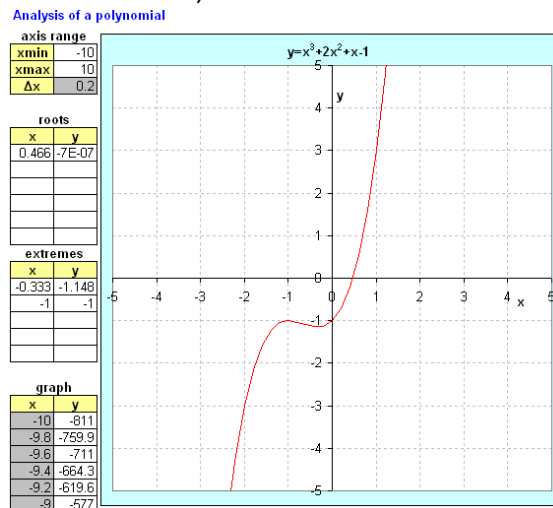
Figure 8: Polynomial

Remark: The application serves as a template for graphing and analysing any function with definition domain R – the user only needs to change the formula in the first **y** cell in range **graph** and fill down. The student question how Goal Seek and Solver work leads to a short introduction to numeric methods for solving equations; spreadsheet is an ideal environment for demonstrating the iteration process.

In Fig. 8, there is the application for analysing general function. As the definition domain is not R, point xy graph is used over 5000 points that are treated with ISERROR function.
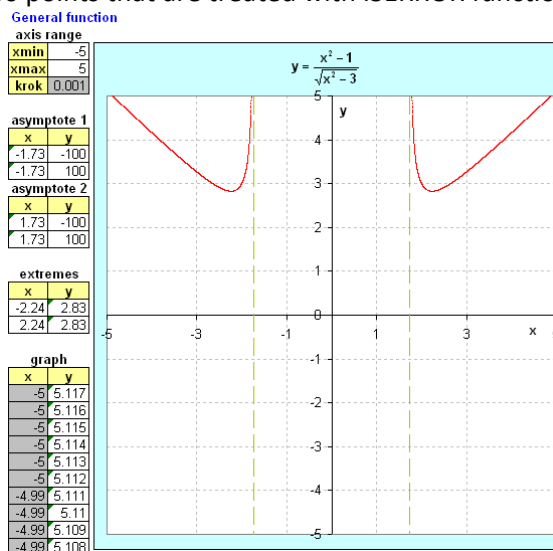
Figure 9: General function

The asymptotes are two point xy graphs. The roots nd the extremes are calculated using Goal Seek or Solver in the same way as in the previous application. Again, the application is a template – putting other

function in the first **y** cell in range **graph** and filling down gives the graph of the new function, regardless if the definition domain is R or not.

In Fig. 9, there is the application for calculating definite integrals using the rectangle method. The graph is drawn upon the same principles as in the previous application. First, the user inputs the function in the first **y** cell in range **graph**, then fills down, which gives the graph (we note that the definition domain has not to be R). Then, he/she inputs the integral bound to cells **a**, **b**. Then, he/she copies the function formula from the first **y** cell in range **graph** to the first cell **yi** in range **subintervals**, and fills down, which gives the integral.
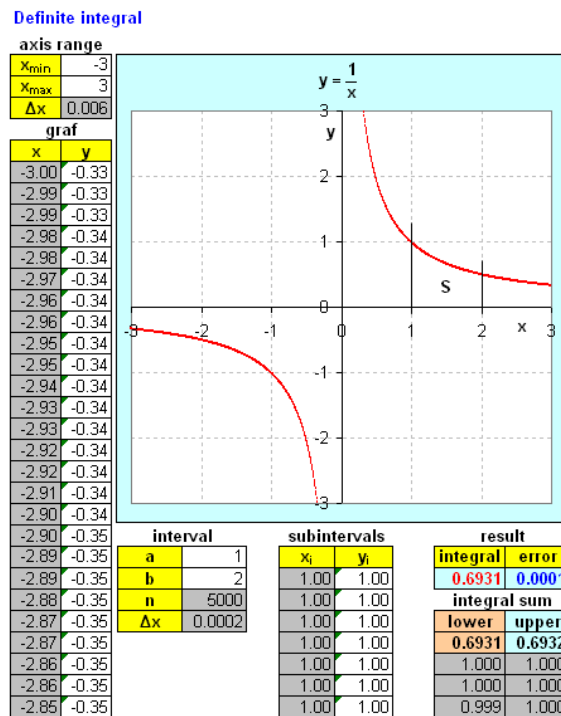

Figure 10: Calculating definite integrals

Interval $\langle a,b \rangle$ is divided to *n* subintervals of length $\Delta x = (b-a)/n$. Number *n* is set to 5,000, but the application can easily be adapted to a bigger number if the user needs to calculate the integral at higher accuracy. In column **xi**, there is *n*+1 values of x_i, where $x_0 = a$, $x_{i+1} = x_i + \Delta x$, and $x_n = b$. In column **yi**, there is *n*+1 values of y_i. The integral is calculated as the average of the lower and upper integral sums. The error is a half of the absolute difference between them. The integral sums are calculated using the IF function. The first cell in column **lower** read: If the first value in column **yi** is smaller than the second one, then address the first one, else address the second one. The first cell in column **upper** read: if the first value in column **yi** is smaller then the second one, then address the second one, else address the first one. These IF functions are filled down afterwards. The reason for using this integration method is didactical – in fact, this computation is the spirit of the definition of the Riemann integral. The lower and upper integral sums and their convergence at increasing *n* is a standard part of mathematics curriculum at grammar school.

Excel and Systems of Linear Equations

Solving systems of linear equations is a standard part of mathematics curriculum since lower secondary school where systems 2 x 2 are solved. Systems 3 x 3 and 4 x 4 are solved at higher secondary school. If the students are familiar with the principles of the methods, the solution is a boring routine, and the correct result is a question of giving attention only. In Excel, the Solver tool allows solving even large systems in short time.

Suppose the following task: Find the equation and plot the graph of the quadratic function that goes through points $(1,2)$, $(2,3)$, $(4,2)$ (see Fig. 11). Tasks of this kind are frequent in school mathematics. The task leads to the system

$$\begin{pmatrix} 1 & 1 & 1 & | & 2 \\ 4 & 2 & 1 & | & 3 \\ 16 & 4 & 1 & | & 2 \end{pmatrix}$$

that gives the coefficients of the quadratic function. The solution to the system by using The Solver tool is in Fig. 10.
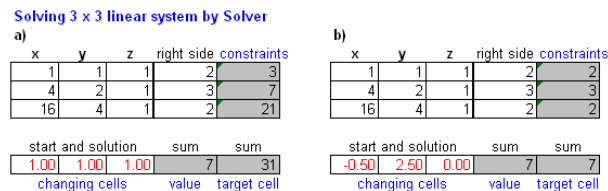
Figure 11: Solution to 3 x 3 linear systems by Solver: a) start, b) result

The user inputs the matrix in ranges **x**, **y**, **z**, and **right side**. Range **start and solution** contains the iterations of the solution. The starting iteration is written in by the user, e.g. 1, 1, 1 (see Fig. 10a). Range **constrains** contains the formulas for computing the right side of the system if the values of *x*, *y*, *z* from range **start and solution** are substituted into the system. The given (inputted) right side (range **right side**) as well as the calculated one (range **constrains**) are summarised in cells **sum**. The use of the Solver tool is clear from the labels: the changing cells are those in range **start and solution**; the target cell is that one with the sum of the computed right side (range **sum** below range **constrains**). The target cell has to equal number 7, which is the sum of the inputted right side (range **sum** below range **right side**). There are three constrains – the cells in range **constrains** have to equal the neighbouring cell in range **right side**. The solution to the system is in Fig. 10b in range **start and solution**. Thus, the equation of the function is $y = -0.5x^2 + 2.5x$. In Fig. 11, there is the graph that was made using the skills from section 2; the given points are one-point xy graphs.
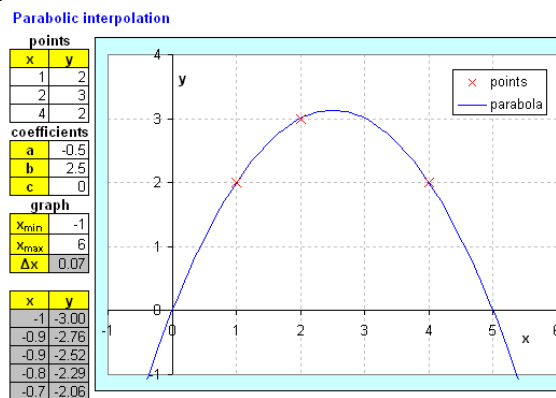
Figure 12: Parabolic interpolation using Solver (see Fig. 13)

Conclusions

Studies of teaching and learning in schools around the world identify four broad stages in the way that teachers and students learn about and gain confidence in the use of ICT (Anderson et al., 2002): discovering, learning how, understanding how and when, and specializing in the use of ICT tools. The presented applications show a way of using Excel for modelling in school mathematics from the view of the needed skills. Most of them are taught in informatics lessons within *ICT Literacy*. They enable students to go further and use Excel for higher level modelling in maths (Beňačka and Čeretková, 2009 b) and sciences (Beňačka and Štubňa, 2009), (Beňačka, 2007) within *Application of ICT in Subject Areas* and

Infusing ICT across the Curriculum, until they get captivated and go to programming in VBA (Beňačka, 2008, 2009) to create difficult applications within *ICT Specialization*.

Acknowledgement

About Author

Ján Beňačka is an assistant professor. He has 14 year experience in teaching mathematics, physics, and informatics at grammar school including specialised mathematics and informatics classes, and 7 year experience in teaching at university. He lectures on Programming, Programming for mathematicians, Didactics of informatics, Didactics of programming, and run tutorials in Modelling and simulation. His main interest in education is motivating in mathematics, informatics and physics through interactive computer models. He is a member of several international projects. Web site: http://www.ki.fpv.ukf.sk/~jbenacka/

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The Help of Visualization for Boys' Motivation Fostering in SCIENCE Education: the Results of diagnostic research

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Introduction

Every seen view requires perception. The last mentioned object should be developed because of the Media getting more difficult and not developed visual thinking will be unable to decode the views. The more images there are the better pupils understand and realize information. This happens because the scientific concepts depend on human perception which happens in the right or wrong way. For example, it is very difficult to understand the molecules in chemistry because you can not see them by "the naked eye", there is special visualization needed; "unseen" organs in biology after visualization become "visible". There are lots of concepts that are needed to be visualized in science education so that they could form the right mental models in pupils' conscious. Last mentioned objects are of service as guarantee of comprehension.

The modern visualization is created to help in education processes and is oriented to the evaluation of knowledge. It is very important for science education to have perfectly prepared aids that could show invisible phenomena and could foster *deeper motivation*. Also, visualization as a learning and teaching tool could stimulate the perception. This leads to the opinion that represented objects could be shown in the classroom as essential part of education and its organization. According to the researches it is known that visualization helps to percept information because it influences to act visual thinking. Last years visualization became one of the most popular research objects in the scientific research area therefore there are lot of scholars (Barak, 2005; Sandvoss and others, 2003; Appling, 2004; Clark, 2004; Qian, 2006) who are expanding this field. **The goal of this article** is to find out the help of visualization for boys' motivation fostering in science education process.

The object – visualization help for motivation

The research questions - does visualization help teachers to foster students' motivation to learn science? What exactly aspects does it stimulate? Are there any differences comparing students' opinion in class aspect?

Research Methodology

Theoretical Grounding

The research is appealing to the dual code theory (Hodes, 1994). It is being proposed that visual and verbal information are interconnected by some contacts. Both kinds of information are connected in the consciousness, all this conditions the circumstantial perception of the object when a child encloses the visual part of the object and the verbal information encloses the side of the concepts. Visual system evidences in perception of knowledge where the spatial abilities, visual perception, encoding and transforming act. Visual thinking theory (Arnheim, 1998) ensures that visual thinking is one of the most important kinds of thinking in the human life. Information got in the images is more precise and the perception of it takes less time. Therefore, it is necessary to see as many views as it is possible and to develop visual thinking in order that conscious could get use to activate required processes of visual thinking needful for cognition. It is natural that visual thinking skills are essential for perception, comprehension, encoding, decoding and memorizing of those images. That is why assumption that good visual thinking skills condition perfect results in learning natural science. L. M. Veker's (1976) model of genetic structural intellect. According to Veker learning individual gains experience which is very

important for other skills. Visual thinking is essential for later abilities to perceive information and to think in concepts. It means that visual thinking is a background for concept thinking. Especially it is meaningful in science education because mostly all phenomena are related with imagination and mental models in pupils' minds. There can be build the assumption that visual aids could help building original views that will be used to understand visual information and the verbal one in the future.

Research Methods

Theoretical: scientific literature analysis; **Empirical:** inquiry, open questionnaire; **Methods of data analysis:** quantitative data: descriptive statistics. The index of popularity shows the most popular rating of answers. It is counted taking the least grade of answers from the highest grade of answers (Bitinas, 2002).

Research Organization

Research instrument and research process. Research instrument is questionnaire and was build by the author. It includes 67 questions and 5 diagnostic scales. The Cronback's alpha of internal validity is 0.9278 and this shows that questions are well prepared to measure what is to do. The research was done in 2009 years during autumn months. The feedback of questionnaires was 96%. There participated 1152 students from grade ten and nine. For this article there was only boys' sample (508 boys).

Research methods. Theoretical: analysis of scientific literature. *Descriptive statistics:* index popularity. *Analytical statistics:* Mann Whitney U-test for independent sample.

Results of Research

The results of research are shown in the picture and table. Data interpretation is written under figure.
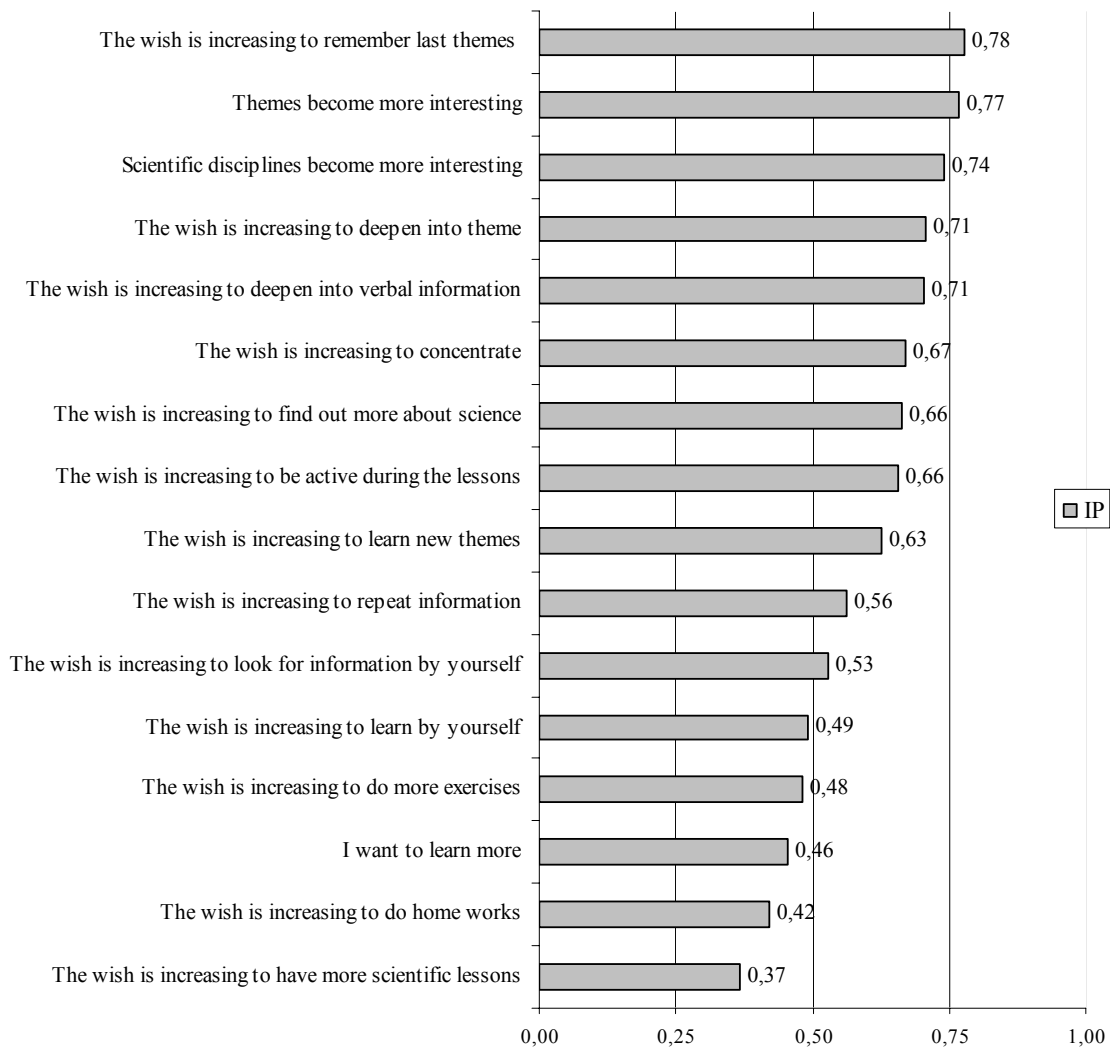
Figure 1: Visualization help for motivation

There was important to find out whether students need to learn and feel motivation if teachers use computer based visualization. There were formed sixteen questions enclosing various motivational aspects in education process. According to students, each statement was evaluated in different mean and this showed that students gave priority to some statements and, also, there were propositions that did not show high popularity. Boys from grade nine and ten were thinking that "The wish is increasing to remember the last themes and to connect them with new ones" was the most important proposition enclosing reality and daily school life (IP=0.78). In the context of dual code theory this fining could be interpreted in the assumption that visualization helps to remember phenomenon and to hold in long term memory helping to connect the old things with new ones. Other theories (visual thinking and Veckers' theory) give a possibility to state that visualization help to create visual mental models and visual representations of verbal information serving for human during detail connection processes.

Second position in the ranges was given to the statement that themes became more interesting if teacher used computer based visualization (IP=0.77). This leads to the opinion that visualization help to motivate boys in subject area. The third position was given to the statement which enclose that computer based visualization makes interest to learn scientific disciplines (IP=0.77). According to this and to the previous statement we can assume that computer based visualization stimulates interest to learn difficult and secret things that are invisible in daily life and could be seen only in visualized but not natural reality. Also, we could say that methodological theories enclose that visualization helps to create right mental models to stimulate interest and comprehension of abstract phenomenon.

Also, visualization stimulates students to deepen into themes (IP=0.71). The same index of popularity was given to the statement which enclosed that students wanted to deepen in verbal information if teachers used computer based visualization. These mentioned propositions enclose that about three quarters of students agree that visualization stimulates them to learn deeper themes and even raises motivation to understand verbal information. This absolutely deals with dual code theory representing importance to create visual and verbal mental models during learning processes. To deepen in theme and verbalized information means to learn verbalized concepts and to understand them very well.

There some positions in the middle range. Visualization stimulates students to concentrate their selves (IP=0.67), to look for more information about science (IP=0.66) and to be active during the lessons (IP=0.66). These results enclose that computer based visualization concentrate attention and raises motivation to search and to act for effective learning.

Last positions enclose that computer based visualization weakly stimulates desire to learn more (IP=0.46), to do home works (IP=0.42) and to have more scientific lessons (IP=0.37). This enclose, that students do not want to feel cognitive load during lessons and do not aim to have more regularized information which could be not interesting but certainly could be essential to learn because they would be aimed to get good mark. According to this we could assume that visualization fosters deeper motivation to learn science but only things that were recognized as interesting at the moment.

Table (appendix) shows that boys' opinion in various aspects is homogenous. Non parametric statistics enclose that there were found only two statistically significant differences. This leads us to assumption that boys in grade nine and ten were tended to think about object similarly. Comparing mean rang we can state that boys from grade ten were thinking that visualization stimulates need to learn more (mean rang 266.42, sum of rang 71400.00, when Z meaning $\int Z \int$=-2.076, o p-value p=0.038, t. y., p<δ=0.05). According to this, students from grade ten more than students from grade nine were thinking that they wanted to learn because of the seen visualization.

There was found out statistically significant difference between students' opinion about proposition which enclosed increasing activity during lessons if there had been used visualization. Visualization increased the wish to be active during the lessons for students from grade nine (mean rang 275.02, sum of rang 65730.50, when Z meaning $\int Z \int$=-3.167, o p-value p=0.002, t. y., p<δ=0.05). Boys from grade nine wanted to be more active during the lessons were visualization was used.

Conclusion

Visualization helps to remember phenomenon and to hold in long term memory helping to connect the old things with new ones: themes become more interesting and interest to learn scientific disciplines is rising if teacher uses computer based visualization. Students feel interest to understand verbal concepts in science education if teacher uses visualization. Visualization fosters deeper motivation to learn science but only things that were recognized as interesting at the moment.

Mostly visualization can foster motivation during the lesson: it can foster to interest in theme, in themes curriculums and also, to remember and to connect things that were learn in early past. Visualization as a learning tool was evaluated mostly in all aspects at the same level but boys in grade nine want statistically significantly to be more active in the lessons. Boys from ten grades statistically significantly want to learn more about scientific disciplines.

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Appendix

Table 1: Differences between students' opinion about motivation things

Propositions	*9 class* N	Mean rang	Sum of rang	*10 class* N	Mean Rang	Sum of rang	Mann-Whitney U	Z	p
Themes become more interesting	239	263.79	63047.00	268	245.26	65731.00	29685.000	-1.514	0.130
I want to learn more	239	240.08	57378.00	268	266.42	71400.00	28698.000	-2.076	**0.038**
The wish is increasing to deepen into theme	239	261.83	62576.50	268	247.02	66201.50	30155.500	-1.202	0.229
The wish is increasing to look for information by yourself	239	252.04	60237.00	268	255.75	68541.00	31557.000	-0.293	0.770
Scientific disciplines become more interesting	239	250.25	59810.50	268	257.34	68967.50	31130.500	-0.573	0.566
The wish is increasing to be active during the lessons	239	275.02	65730.50	268	235.25	63047.50	27001.500	-3.167	**0.002**
The wish is increasing to do home works	239	255.68	61108.50	268	252.50	67669.50	31623.500	-0.251	0.802
The wish is increasing to concentrate	239	262.78	62804.00	268	246.17	65974.00	29928.000	-1.326	0.185
The wish is increasing to find out more about science	239	258.06	61677.00	268	250.38	67101.00	31055.000	-0.616	0.538
The wish is increasing to do more exercises	239	250.08	59770.00	268	257.49	69008.00	31090.000	-0.583	0.560
The wish is increasing to deepen into verbal information	239	258.29	61732.00	268	250.17	67046.00	31000.000	-0.668	0.504
The wish is increasing to repeat information	239	250.58	59889.50	268	257.05	68888.50	31209.500	-0.512	0.609
The wish is increasing to remember last themes and to connect them with new ones	239	257.35	61505.50	268	251.02	67272.50	31226.500	-0.518	0.604
The wish is increasing to learn new themes	239	246.79	58983.50	268	260.43	69794.50	30303.500	-1.086	0.277
The wish is increasing to learn by yourself	239	254.98	60939.50	268	253.13	67838.50	31792.500	-0.145	0.884
The wish is increasing to have more scientific lessons	239	241.79	57788.00	268	264.89	70990.00	29108.000	-1.857	0.063

Electronic Automated Evaluated Tests in the Subjects of Programming

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Keywords: testing, online testing, automated evaluation, programming, LMS Moodle, activity Quiz

Abstract: Assessment and classification is very sensitive phase of the learning process and it is necessary to ensure the greatest possible fairness and objectivity throughout the whole process of testing. Assessment of programming knowledge and skills is especially challenging task. Testing programming, whether the practical or the theoretical part, is likely subjective. To ensure the objectivity of the assessment, possibly reducing the degree of subjectivity, it was necessary to proceed to develop a unified system, at least in the case of testing knowledge of the theoretical part. However, there was not a database of questions and tasks that would require an active application of knowledge and programming skills for correct answer, and in which the correctness of responses could be evaluated automatically. The aim of the paper is present the developed and verified model of computer-aided knowledge testing with regard to the content of programming subjects. We analyzed the possibilities of systems suitable for testing and enabling simple archiving of results and their statistical processing and we finally chose LMS Moodle as the most accessible alternative for educational organizations. We developed and implemented model of computer-aided testing specified the 28 thematic areas and defined their goals and assumptions to master them. We built up a database of 237 questions and tasks appropriate for testing knowledge of the subjects of programming formulated for implementation into the selected computer system. Our model was verified during research, which took place during three years among the students of the Department of Informatics after the completion of programming test at the end of the semester. In the last phase we realized national research among the selected group of secondary and university teachers of Informatics. We verified the efficiency and effectiveness of the testing system based on the created model. We also defined the propriety of computer usage in the process of examination of students' knowledge. According to the results, the predominance of positive perception of electronic testing is clear, but there was also not confirmed that the students clearly prefer computer testing and evaluation to teacher's assessment. The biggest complaint from the students and partially from teachers was directed to display the remaining time, which make rise of the nervousness. The results of the research show that the elaboration of the content into the thematic areas of the model, and specification of their objectives are reasonable. Recommendation of further usage of electronic tests is unquestionable.

Úvod

Hodnotenie a klasifikácia je veľmi citlivá časť vzdelávacieho procesu a je preto nutné zabezpečiť, aby bola fáza udeľovania záverečného hodnotenia objektívna ale zároveň efektívna na čas a použité zdroje. V niektorých vedných disciplínach, napr. v matematike, je možné použiť hromadný didaktický test, ako štandardizovaný nástroj objektívneho merania, bez väčších problémov. V prípade informatiky, konkrétne v oblasti programovania, je použitie didaktických testov veľmi ťažké. Ak sa rozhodneme testovať len teoretické vedomosti (pýtame sa na syntax jazyka, databázu príkazov, princípy apod.), tak nepreveríme praktické zručnosti. Alebo sa naopak zameriame len na praktické zručnosti, pričom nás nebudú zaujímať rôzne teoretické princípy.

V prípade praktického skúšania v predmetoch programovania je veľmi dôležitý aj časový faktor. Každý žiak potrebuje vlastnú pracovnú stanicu, a tak je nereálne, aby sa v daný termín vyskúšalo viac študentov ako je kapacita počítačovej učebne. Medzi časté nedostatky pri testovaní vedomostí z programovania

patrí aj subjektívnosť v posudzovaní kvality riešenia úloh, čo môže byť spôsobené rozdielnosťou v zložitosti zadaní, ale aj tým, že každý učiteľ môže prikladať inú váhu rôznym čiastkovým riešeniam. Nás preto zaujímalo, či je možné aplikovať taký spôsob testovania, ktorý by výrazne zvýšil objektivitu hodnotenia aspoň v prípade testovania teoretických vedomostí. Zároveň sme však chceli zostaviť také otázky, ktoré by na správne zodpovedanie vyžadovali aplikáciu praktických zručností. Nevyhnutnou požiadavkou tiež bolo, aby sa odpovede dali vyhodnocovať automaticky.

Implementácia automatizovaného testovania

V prvotnej fáze riešenia automatizovaného testovania z programovania sme hľadali systém, v ktorom by bolo možné fyzicky implementovať v budúcnosti vytvorené testové otázky. Cieľom bolo použiť jednoduché, štandardne podporované typy otázok, čím by sme zabezpečili ich prenositeľnosť medzi ľubovoľnými prostrediami. Zároveň sme vyžadovali, aby bol systém vhodný na on-line spracovanie údajov, ich kontrola, udelenie hodnotenia a štatistické spracovanie.

Analýzou webových stránok ako i príspevkov z časopisov a konferencií sme zistili, že autorských systémov na testovanie je pomerne dosť, uvádzame aspoň niektoré: *WBPES* (Web-Based Public Examination System, Dhaka University, Bangladesh, Dey a Mahmud, 2004), *QUIZIT* (Chemware Ltd, Nový Zéland), *ASSYST* (ASsesment SYSTem, University of Liverpool), *TRAKLA2* (Helsinky University of Technology), *PILOT* (Platform-independed Online Tools, Johs Hopkins and Brown university, Bridgeman et. al., 2000), *WOES* (The Web based Online Examination System, Zhenming et al., 2003). Každý zo systémov bol vytvorený na základe vopred špecifikovaných požiadaviek a preto sú vhodné len pre úzku oblasť použitia, prípadne sú vhodné na precvičovanie. Preto sa naša pozornosť obrátila na systémy na riadenie a správu vzdelávania LMS (CMS, LCMS). Ukázalo sa, že univerzity využívajú širokú ponuku komerčných alebo otvorených LMS (Learning Management System), ako napr. Claroline, Fle3, ILIAS, MS Class Server, WebCT, Eden, Enterprise Knowledge Platform, LearningSpace, eAmos, eDoceo, Uniforms, uLern, Aspen, Oracle iLearnin, NETOPIL School a Moodle (Cápay, 2009a). Môžeme konštatovať, že každý LMS systém ponúka ako jednu zo svojich možností, modul určený na testovanie, podporujúc otázky s výberom odpovede, doplňovačky, prípadne otázky s jednoduchou neštrukturalizovanou voľnou odpoveďou. Je preto možné uvažovať o prepojení testovania na niektorý z existujúcich LMS systémov.

LMS Moodle

Na základe analýzy automatizovaných systémov a tiež na základe zámeru katedry využívať Moodle dlhodobo bolo rozhodnuté využiť LMS Moodle aj na implementáciu navrhovaného modelu testovania. Moodle spĺňal všetky požiadavky a niekoľkoročným používaním sme overili aj jeho stabilitu. Využívanie LMS Moodle odporúčame nielen kvôli obstarávacej cene (je zadarmo), ale hlavne kvôli tomu, že je to systém, ktorý má čoraz väčšiu komunitu používateľov, vyvíja sa a neustále sú vylepšované jeho možnosti. LMS Moodle poskytuje rýchle a kvalitné štatistické vyhodnotenia testov, s možnosťou ich exportu do rôznych typov súborov. Automaticky archivuje informácie o všetkých činnostiach študenta v systéme, a tak získavame silný nástroj na analýzu jeho práce počas semestra.

V prvých rokoch používania LMS Moodle sme na konci semestra realizovali krátke prieskumy zamerané na prebiehajúcu výučbu. V prieskume boli položené otázky týkajúce sa obsahovej a formálnej stránky testovania v systéme Moodle, ale aj všeobecné otázky ohľadom elektronického testovania. Z odpovedí vyplýva, že najpriaznivejšie je Moodle vnímaný po formálnej a používateľskej stránke.

Obrázok 1: Ukážka prostredia LMS Moodle pri testovaní v predmete Programovanie 2, téma Binárne vyhľadávacie stromy

Najviac názorov na nevýhody súviselo s faktom, že pri automatickom vyhodnotení krátkych voľných odpovedí momentálne neexistuje žiadny kompromis, *"s človekom je možné trochu áno, trochu nie".* Každý preklep, môže byť nesprávne vyhodnotený.

Viditeľne ubiehajúci čas bol považovaný za maximálne stresujúci faktor. Negatívne reakcie boli smerované aj na niektoré nastavenia testu, ako napr. skrytie kompletných výsledkov okamžite po jeho absolvovaní (zobrazené bolo len dosiahnuté výsledné skóre testu). Náhľad na položkové vyhodnotenie jednotlivých otázok bol možný len v prítomnosti vyučujúceho.

Rozdelenie obsahu predmetu programovanie do kategórií testových otázok

Prvoradou úlohu pri navrhovaní modelu elektronického testovania bolo transformovať obsah predmetov programovania do bázy otázok zoskupených v kategóriách. Spolu bolo vytvorených 28 tematických oblastí (Tabuľka 1), ktoré sú bližšie špecifikované v zborníku z konferencie DidMatTech 2008 a DidaMatTech 2009.

Tabuľka 1: Názvy tematických oblastí (kategórií) testových otázok

Kategórie otázok v predmete Programovanie 1	Kategórie otázok v predmete Programovanie 2
1. Vlastnosti algoritmov	1. Počet volaní v rekurzii.
2. Jazyk vývojových diagramov	2. Výsledok rekurzívneho podprogramu.
3. Identifikátor premennej	3. Dynamická premenná a smerník.
4. Príkaz priradenia	4. Použitie dynamických údajových štruktúr.
5. Zápis logických výrazov	5. Dynamické premenné a príkazy.
6. Výsledok výrazu	6. Prehľadávanie lineárneho zoznamu.
7. Funkcie a procedúry údajového typu String	7. Úprava lineárneho zoznamu.
8. Cyklus a premenná typu reťazec znakov	8. LIFO a FIFO.
9. Fungovanie riadenia rôznych typov cyklov	9. Terminológia binárnych stromov
10. Deklarácia polí	10. Prehľadávanie binárnych stromov.
11. Určenie údajového typu	11. Binárne vyhľadávacie stromy.

12. Naplnenie dvojrozmerného poľa	12. Určenie typu triediaceho algoritmu.
13. Volanie podprogramu	13. Aplikácia triediacich algoritmov.
14. Formálne parametre	
15. Procedúry a funkcie	

Kategórie otázok boli vytvárané podľa vopred určeného cieľa testovania a boli k nim vyšpecifikované predpokladané vedomosti na úspešné zodpovedanie otázky (Tabuľka 2). Otázky v jednej kategórii boli považované za homogénne (každá otázka z celku mohla byť nahradená inou z toho istého celku). V jednom okruhu sa nenachádzajú otázky, ktoré majú rozdielne bodové ohodnotenie, a tak je možné vyberať ich do testu podľa kategórie náhodne.

Tabuľka 2: Špecifikácia tematického celku v predmete Programovanie 2

Názov témy	**Prehľadávanie binárnych stromov**
CIEĽ	Overiť schopnosť pristupovať k prvkom dynamickej údajovej štruktúry binárny strom podľa vopred určenej stratégie prechodu.
PREDPOKLADANÉ VEDOMOSTI	• rekurzívne prehľadávanie binárneho stromu, • metódy prehľadávania PreOrder (KĽP), InOrder (ĽKP) a PostOrder (ĽPK).
POUŽITÝ TYP OTÁZKY	vpísanie krátkej odpovede (short answer)
POČET BODOV	2

Keďže test bol náhodne generovaný z bázy otázok, tak z globálneho hľadiska bola každá otázka použitá náhodný počet krát, pričom dochádzalo tiež k miešaniu otázok v rámci testu a miešaniu odpovedí v rámci otázky.

Podľa odpovedí v prieskume realizovanom medzi učiteľmi informatiky stredných a vysokých škôl (prieskum týkajúci sa len modelu pre predmet Programovanie 1), je možné vyvodiť záver, že rozdelenie obsahu do tematických celkov a špecifikovanie ich cieľov je správne a ďalšie odporúčanie využívania prezentovaných elektronických testov je jednoznačné. Výsledky testu komplexne vyjadrujú úroveň vedomostí študentov v oblasti programovania. Z analýzy odpovedí, s prihliadnutím na najčastejšie sa vyskytujúcu odpoveď je zrejmé, že bodové ohodnotenie za jednotlivé tematické celky PR1.1 až PR1.15 navrhovaného modelu je nastavené správne. Jediný rozdiel bol v odporúčanom hodnotení pre kategóriu PR1.4, kde učitelia za správne zodpovedanie navrhli nižší počet bodov a v kategórii PR1.12 kde boli dokonca odporúčané body v rozpätí 1 až 5.

10
Známky: 2

Premenná K má hodnotou 3, premenná J má hodnotu 15. Akú výslednú hodnotu ma nasledujúci výraz? (2b)

```
not(j mod k < 5) and not(k div j <> 0) and (k <> j)
```

Odpoveď:

Obrázok 2: Ukážka otázky s krátkou voľnou odpoveďou, téma Výsledok výrazu

11
Známky: 1

Máme zadeklarovanú premennú: `x: array [-5..10] of string`.
Akého typu je premenná **X[0]**? (1b)

Vyberte jednu odpoveď

○ A. premenná typu reťazec znakov

○ B. pole reťazcov znakov

○ C. premenná typu reťazec znakov s nulovou dĺžkou

Obrázok 3: Ukážka otázky s možnosťou voľby správnej odpovede, téma Deklarácia polí

V niektorých odpovediach učiteľov sa vyskytovali názory na zlúčenie typov otázok, nepodstatnosť testovania niektorých pojmov, prípadne námety na rozšírenie úloh. Naopak vyskytovali sa aj veľmi pozitívne názory, ktoré poukazovali na vyváženosť otázok v skupinách.

Z voľných odpovedí jasne vyplynulo, že vytvorený model je dostatočný na klasifikáciu len v prípade, ak je doplnený praktickými testami. Model elektronického testovania je skutočne doplnený povinnými, nepovinnými a bonusovými praktickými úlohami, ktoré sú ale hodnotené učiteľom.

Záver

K automatizovanému testovaniu treba pristupovať rovnako citlivo ako pri využívaní akýchkoľvek iných metód výučby a skúšania. Elektronické testovanie môže dokonca nepriamo diskriminovať znevýhodnených študentov (napr. nevidiacich alebo slabozrakých), treba preto myslieť aj na alternatívnu možnosť, a to distribuovať testy v elektronickej podobe, kedy je možné ľahšie použiť rôzne kompenzačné pomôcky.

Snaha o automatizáciu skúšania sa môže navonok javiť ako snaha o úplné nahradenie tútora strojom. Toto však v dnešnej dobe nie je stále možné zrealizovať v takej miere, aby bol celý proces objektívny. Aj v prieskume medzi učiteľmi sa vyskytoval názor o potrebe zaangažovať učiteľa do elektronického skúšania (na KI je to realizované možnosťou osobných konzultácií bezprostredne po absolvovaní testu).

Pri počítačovom testovaní je dôležitý aj výber správneho typu testových úloh. Najrozporuplnejšie sú vnímané úlohy, na ktorých ohodnotenie je potrebná istá dávka usudzovania. Väčšina študentov by takýto typ otázok aj napriek testovaniu pomocou počítača nechala vyhodnotiť (skontrolovať) učiteľom.

Ani jedna z foriem skúšania nebude vždy plne akceptovateľná celou skupinou študentov, a preto je vhodné formy podľa príležitosti vhodne striedať.

Poďakovanie

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The Implementation of the Teaching Support System in the Complex of Economic-Gastronomic Schools for Computer Science Technicians

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Keywords: successful implementation, secondary school, e-learning, blended learning

Abstract: After reform of the curriculum in Polish schools (the eight year primary school and four- or five-year high school was transformed into six-year primary school, three-year secondary and three-or four-year upper-secondary school) a problem of the declining level of knowledge emerged among high-school graduates. The main reasons of this are several phenomena, including: insufficient number of hours in the course of science education in vocational schools, shortening of the learning time for technical subjects to one year and rapidly evolving technology. The aim of the paper is to prevent this undesirable phenomenon among computer science technician graduates from the school where the author works. The article presents several approaches to the implementation of a combined curriculum of vocational subjects for this profession in order to overcome students' difficulties with the material mastery. The results of the teaching and knowledge recording of the scope of the subject Computer Technology Devices parts Computer Arithmetic and Digital Devices for groups benefiting from traditional teaching methods were compared with the results of groups using different methods of supporting e-learning. The groups were divided into several categories, concerning: standard teaching, teaching along with standard power-assisted materials placed on the web, standard teaching with assistance e-learning Claroline platform and standard teaching with assistance e-learning platform Moodle, which allows the introduction of elements of artificial intelligence to control the learning process of students. This last mentioned group used an unfinished skeleton of Moodle course, which is still in its experimental stage. The purpose of a thorough analysis of the material consolidation were tests carried out after six - seven months since the end-of-course date. The knowledge tests were including the ability to convert numbers between different numeric systems, coding decimal numbers, recognition of symbols of digital elements and understanding of the operation of simple digital circuits. The test results were treated statistically and presented in the form of graphs and histograms. On the basis of the test results, the differences between students studying different methods were found. There were also found the dissimilarities in the efficiency of learning among high school learners and the learning competence of the students after the introduction of e-learning (based on the author's former paper). The paper presents a few conclusions: the creation of the e-learning course for pupils is much greater challenge for the author of the course than the creation of the course for students and not all learning platforms are able to fulfill properly its mission to assist the learning process. The introduction of several techniques based on the achievements of artificial intelligence (a simple expert system used in the module lesson of MOODLE) has radically improved high-school student performance. The implementation of the different teaching strategies to improve the students' results of the professional examinations was proposed in the recommendations. It proved the necessity of continuing working on the experimental platform based on the MOODLE in order to improve the learning process in the high-school.

Introduction

The reform of curriculum in the Polish schools in 1999 introduced substantial changes into the educational system in Poland. The 8 years of primary school and 3 years of vocational school, 4 years of or 5 year technical school was transformed into 6 years of primary, 3 years of high school and 2 or 3-years of vocational school, 3 years of high school or 4 years of technical school.

Changing the way of passing final exams (called Matura) allowed students entering the university without the entrance exams. There were also plans of introducing so-called educational bonus giving a chance to promote schools of higher teaching standards.

Along with the organizational modifications, the teaching hours and curriculum were changed in particular classes. This program was supposed to be compatible with the main objective for the reform – matching the school system to changing requirements of the labour market.

The results of reforms in secondary school observed by the author, completely contradict the assumptions that formed the basis of changes in the Polish education system. From year to year, the first year students at a technical high school represent lower level of knowledge, especially science, which play an important role in preparing for apprenticeship. Reduced knowledge of the candidates for technicians forces the teachers of the vocational subjects to challenge new tasks, among which three seem to be the most important: maintaining a high level of competence among graduates of technical schools; catching up with the material from the previous stages of learning and providing tools and resources to make the further the process of learning more efficient. Additional harmful factors affecting the learning process compared to the pre-reform period are: shortening of teaching vocational subjects for one year and reducing the total number of hours in a series of science teaching. This negative picture is completed with cultural changes. Among young people there are more and more teenagers from dysfunctional families, neglected and causing educational problems. The lessons with these students are difficult from many points of view and the other students tend to have problems with focusing their attention on the topic.

The aim of the research work is to propose such tools and methods of teaching in secondary vocational school to allow the graduates mastering the basis of their profession, and the course material was presented to them according to their knowledge and skills. The paper presents several approaches for the implementation of combined teaching of vocational subjects for the adepts of technical vocational schools.

Research Methodology

The research sample is divided into 5 groups taught in different ways: traditionally assisted with Moodle with underdeveloped – skeleton version of artificial intelligence (group and course named 1TA); traditionally assisted with Moodle (2TA); together with the traditionally assisted Claroline platform (3TA); traditionally provided with the materials on a regular website (4TB). The last group (4HT) has not been made available to any additional materials - accounted as a control group. The groups consist of, respectively: 29 students (1TA), 28 students (2TA), 32 students (3TA), 30 students (4th) and 26 students (4TB).

The 1TA course contains extensive, multi-track teaching modules, allowing for the individualization of learning. These modules operate on the principle similar to the expert system and adjusting the content of teaching to the student's current knowledge. The student was directed to the relevant section of the module presented as an internal quiz during the course and it turned out that he mastered the material sufficiently. This solution is experimental, which is a starting point to the creation of the course that adapts teaching modules to the level of knowledge. The 2TA course was based on lessons with the two threads for the weaker or more talented students and monitoring of the results at the end of each of them. The remaining elements of the course 2TA were the standard resources and components of Moodle. The 3TA course was based on the path of learning of a lineal platform Claroline. The 4TB course contains only html and pdf documents.

The research tested understanding of the two branches of the Computer Technology Course Equipment (UTK): the arithmetics of computers and the digital systems. In the traditional mode of both branches, the implementation takes place within, respectively: for teaching arithmetics, 12h and 17h of computers for digital circuits. The tested issues include: the ability to convert numbers between different numeric systems (test 1); knowledge of numerical codes and the ability to code (test 2); distinguishing between logic gates and understanding the rules for their operation (test 3), knowledge of the principles of multiplexers and demultipleksers (test 4) and understanding of digital circuits consisting of several

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goals (test 5). The tests include different types of questions: multiple answers, a one-answer, short answer and computing. They were made and carried on the platform Moodle. Students could receive 20 points maximum.

The test of knowledge accounted after 6 - 7 months since the end of chapter discussing digital systems. The purpose of such proceeding was a profound assessment of acquired knowledge gained during the courses.

Test results were treated statistically using the software package R. The statistical tests were carried out using the Kolgomorov – Smirnov method and the results are presented in box-and-whisker diagrams.

Achieved Results and Discussion

The tests of competence results of the students are presented in boxplot. In test 1, which checks simple calculation abilities, good results were obtained by the groups 1TA and 3TA. This shows a good mastery of course material and sustainability. The students of these groups can transform the numbers between the different systems very well. Intriguingly, the results are weaker the 2TA group, which also benefited from the support e-Learning platform, the same as the group 1TA, but with slightly different resources.
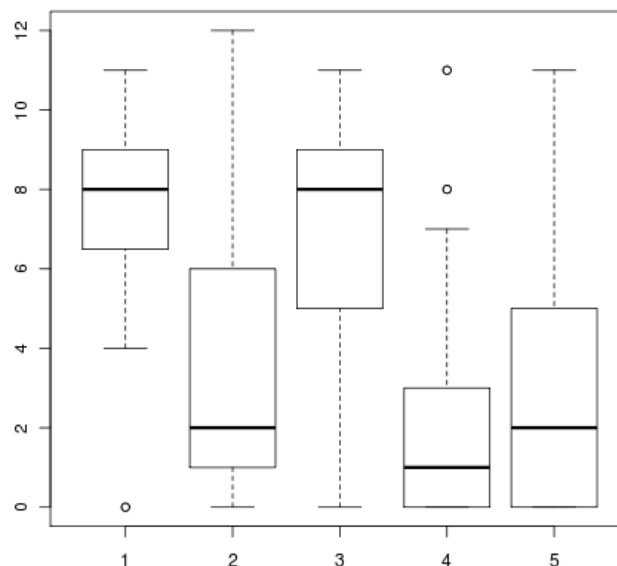
Figure 1: Results of the test 1. Diagrams correspond to groups 1TA (1), 2TA (2), 3TA (3), 4TA (4), 4TB (5)
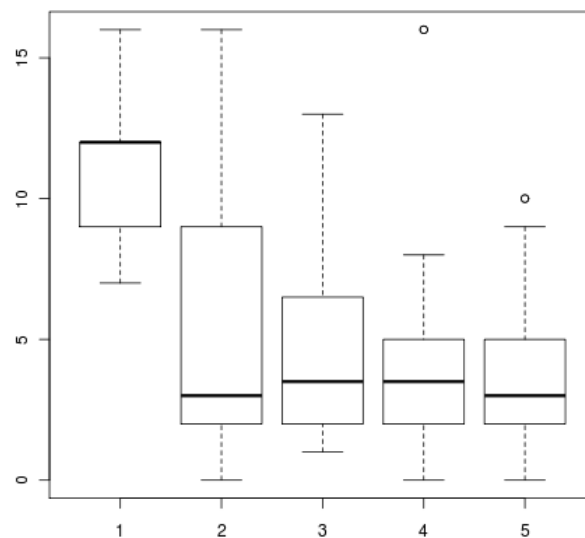
These can be explained in two ways: either the 2TA course materials were poorly prepared (and did not allow them to effectively consolidate the knowledge) or the group 3TA (using other platforms) has achieved outstanding results. The combination of the both factors is also possible. In fact – the course of the 2TA group has been implemented as beta course (pre-tested), while the 3TA course is the production one: implemented, tested and verified during the school teaching practice. This shows a very favourable course 1TA which is in alpha stage (skeletal course, unfinished and untested).

Providing a set of teaching materials on the website, poorly affects the fixation of the knowledge, which shows the results of the group 4TB. The absence of any support lead to the lack of skills (4TA). The achieved results are also the results of the students' abilities in mathematics, where in the teaching process there is the conversion of numbers between the numerical schemes. Therefore, the more difficult subject had to be examined, but run only during the UTK lessons. This task carries out test 2
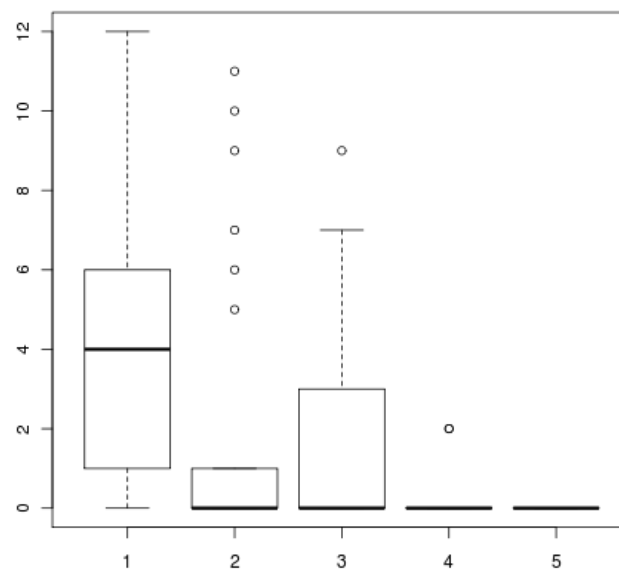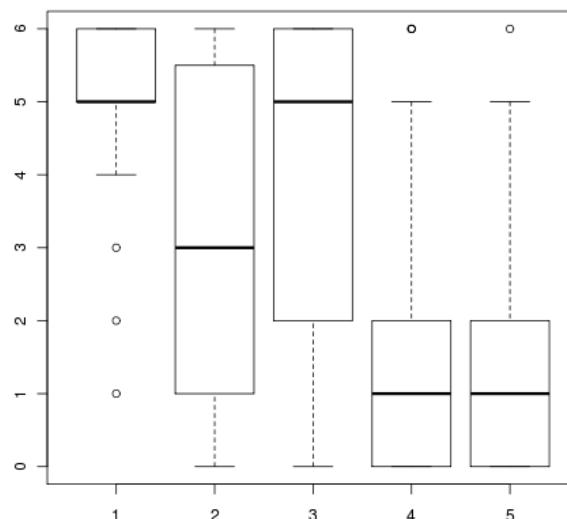
Figure 2: Results of the test 2. Diagrams correspond to groups 1TA (1), 2TA (2), 3TA (3), 4TA (4), 4TB (5)

The test 2 checked the ability to encode numbers in the sign modulus, one's complement and two's complement systems. The task of the test consisted solely on calculations. Results of students are generally weak, while in the 4TA and the 4TB groups is observed a complete lack coding skills. This result is an effect of the insufficient number of hours devoted to teaching the net fixation of the material (see medians). Against this background, preferably represent a group benefiting from the support e-learning, while comparing them with each other can be seen considerably important. The 3TA group compared with the group 1TA achieved worse results than in the test 1 - probable cause is the fact that the course 1TA put the emphasis on personalized learning, which contributes to better absorbing of the material. The group 2TA achieved very poor results, however, there appeared atypical observations - six students achieved significantly better marks than the rest of the ones. It is difficult to explain this phenomenon – these students are likely to be mathematically gifted people or the ones more interested in the issues of digital arithmetic, who devoted more time to solve tasks of this topic.

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Figure 3: Results of the test 3. Diagrams correspond to groups 1TA (1), 2TA (2), 3TA (3), 4TA (4), 4TB (5)

Test 3 checks the ability of logic gate recognition and knowledge of their truth tables. The tasks put here before the students were more mnemonic than practical. The groups 2TA, 3TA, 4TA, and 4TB have similar medians - with a surprising results of the 1TA group, which proves the validity of the strategy of teaching. It is worth noting that among the groups of e-Learning, the results of the 2TA and 3TA groups have positive skewness and the 1TA group negative skewness. Perhaps the individualized education influence affects the ability of students to memorize information. This requires further research.

Figure 4: Results of the test 4. Diagrams correspond to groups 1TA (1), 2TA (2), 3TA (3), 4TA (4), 4TB (5)

The test 4 controlled the understanding of the principles of multiplexers and demultiplexers. Students also had to know the internal structure of the digital circuit. There is a noticeable difference between the 4TA and the 4TB groups and groups of e-learning 1TA, 2TA and 3TA.
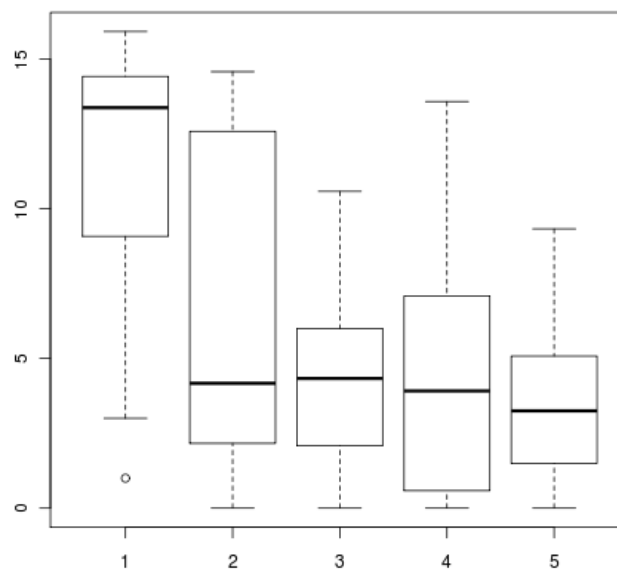
Figure 5: Results of the test 5. Diagrams correspond to groups 1TA (1), 2TA (2), 3TA (3), 4TA (4), 4TB (5)

The test 5 examined the ability to perform analysis of complex combinational digital circuits. The test included the circuit identification, understanding the principles of operation and ability to perform logical calculations. There is a noticeable difference in the results of the group 1TA and the results of other groups.

The test 4 results show some similarity to the results of the test 1 and the test 5 results to the results of test 3. According to the author, the type of the course influences the characteristics of the results. In terms of the students it can be assumed that the ability to perform calculations influences the understanding of digital circuits and the ability to remember the characteristics of goals: the ability to analyze patterns.

All tests show noticeably better performance of students belonging to the group 1TA, suggesting a high potential of the new methodology.

Conclusions

The test results lead to the following conclusions:
- use of educational courses on platforms Moodle or Claroline perpetuates knowledge of students, improving the test results after a longer time
- standard modules available on the Claroline platform are not sufficient to carry out an effective secondary education among the youth - it is necessary to develop a new training module that allows use of non-linear learning path
- the same provision of additional materials through a simple web page does not affect the outcome of education – the students need incentives to perform additional work and the ability to check their knowledge in the tests,
- introduction to courses with simple tools based on expert systems, allows for good consolidation of knowledge,
- fewer traditional teaching hours will not reduce the quality of teaching as far as it includes a new, effective teaching techniques.

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Recommendations

This work presents several approaches used to improve the effectiveness of teaching in secondary vocational school. The obvious direction for further action is to implement different teaching strategies. A real help in achieving this goal is the use of appropriate techniques and tools designed to extend the functionality of e-learning platforms.

One of the techniques described in the experiment, based on expert systems, gave a promising performance. As a further way of development of teaching modules can be suggested, for example, adapting to a student's intelligence. It is necessary to continue to work towards the application of artificial intelligence courses in school and to individualise teaching.

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Information and Communication Technologies and E-Learning in the Opinion of Teachers and Students of Secondary Schools in Poland

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Abstract: The changing market conditions related to the processes of globalization cause changes in human resource management. An employee wishing to retain their place of work must be flexible and capable of rapid adaptation of new technologies, especially information technology. Standard professional preparation, especially in the areas of advanced technology no longer enough, which forces the use of new techniques and technologies of teaching, especially in the sciences directly related to information technology. The case of learning throughout life has been noticed and appreciated by European institutions. Defined eight key competences that are needed by every man for self-fulfillment and personal development, for active citizenship and full social inclusion and employment. These include, inter alia, mathematical competence. Very accurately described it, Mogens Nisse. The idea of mathematical competence is in Polish and Czech standards, examination requirements. The article presents the results of the first stage of his doctoral thesis undertaken at the Faculty of Education, University of Ostrava on the development of mathematical competence in students of secondary schools using e-learning. Essential factors inspiring the creation and implementation of the research were: to develop techniques for creating e-learning courses through, inter alia, a system MOODLE CLMS), the desire to create the possibility of the emergence of a new type of educational materials and the results of surveys conducted among students and teachers of the Silesian province. I stage of research related to the results of two surveys sent to 500 students and 500 mathematics teachers of secondary schools in Poland within the province of Silesia. Studied knowledge of respondents about the use of modern ICT in education and e-learning. Developed a questionnaire consisting of 21 questions, grouped by type of information to provide. Initial questions provide general information about respondents, age, gender, indication of the type of school in which they work and learn for students. In addition, questions were addressed to teachers, inter alia, the seniority and the type of school completed. Another of the questions concerned the use of modern ICT technology - communication in education, in particular concerning the evaluation of their computer skills. Surveyed were asked to indicate the programs that they use in class or preparing for it. The last group of questions concerned, knowledge by teachers and students of e-learning and operate the system in Moodle. After analysis of the results found that Polish teachers of mathematics and students have insufficient knowledge of the use of modern information and communication technologies in education and e-learning. On the basis of survey data as a result there were specified milestones for research and their implementation.

Introduction

Velmi důležitým prvkem vývoje e-learningových systémů je úroveň informatických znalostí, využití informaticko-komunikačních technologií a počítače, a také názory ohledně podstaty e-learningu osob, na které se bude plánovaná činnost vztahovat. V případě středních škol jsou to učitelé, kteří tvoří didaktické dokumenty online a studenti, kteří je využívají.

Obecné informace o anketním výzkumu [1]

Hlavními činitely inspirujícími vznik a realizaci projektu byly: vývoj technologie tvoření e-learningových kurzů a touha autorky výzkumu věnovat se úsilí o vytvoření edukačních materiálů nového typu. V tomto období byly rovněž vytvořeny dvě ankety určené studentům a učitelům matematiky ve středních školách v Polsku na území slezského vojevodství: vztahující se na znalosti v oblasti využití moderních informačně-komunikačních technologií ve výuce a e-learningu.

Anketa pro učitele a studenty sestávala z 21 otázek. Byly rozděleny do skupin podle druhu informací, na které se vztahovaly:

- počateční otázky v anketě přinesly obecné informace o respondentech, věku, pohlaví, určení typu školy, ve které pracují a studují v případě studentů, pokud jde o učitele, byly tam dodatečně otázky mezi jinými ohledně délky pracovní praxe, stupeň profesního postupu, druh ukončené vysoké školy,
- další otázky se týkaly využití moderních informaticko-komunikačních technologií ve výuce, zejména otázky ohledně určení programů, které účastníci ankety využívají ve vyučovacích hodinách nebo k jejich přípravě,
- koncové otázky se týkaly znalosti e-learningu mezi učiteli a studenty a stupně jejich zájmu o prohloubení, rozšíření nebo nabytí znalostí a dovedností využití této technologie ve vyučovacím procesu a v učení.

Před zahájením hlavního anketního výzkumu byly provedeny jednak prostřednictvím Internetu, jednak osobně ankety mezi 120 učiteli a 130 studenty. S přihlédnutím k návrhům účastníků ankety byly opraveny nepřesné formulace týkající se anketních otázek, a anketa byla zároveň rozšířena o pět dalších otázek vztahujících se na obsluhu systému Moodle. Ve dnech 05-09 října 2009 byl proveden rozšířený anketní výzkum mezi učiteli matematiky ve slezském vojevodství. Celkově bylo prozkoumáno 500 osob. Výzkum byl proveden během informační konference na téma přípravy učitelů na novou povinnou formuli maturitní zkoušky z matematiky. V období 20 října – 20 ledna 2009 byla provedena analogická anketa mezi 500 studenty ve školách ve slezském vojevodství.

Otázky k informacím na téma zkoumaných osob.

Mezi anketovanými učiteli tvořily nejpočetnější skupinu ženy. Většina zkoumaných osob jsou absolventi univerzit a pedagogických vysokých škol, pracující v gymnáziích a odborných středních školách s pracovní praxi 11-15 let.

 Studenti podrobení anketě jsou osoby studující hlavně na gymnáziích ve věku 16-17 let.

Otázky k využití účastníky ankety moderních informaticko-komunikačních technologií ve výuce.

Polští učitelé a studenti posuzují vlastní dovednosti ohledně obsluhy počítače a počítačového softwaru dobře. Svoje informatické dovednosti zdokonalují na postgraduálních studiích a informatických školeních. Největšími překážkami, se kterými se učitelé setkávají při vyučování jsou: početnost tříd a nedostatek multimediálních pracoven.

Další otázky se týkaly využití počítačových programů a didaktických multimediálních programů během přípravy učitelů a studentů na hodinu matematiky. Obě dvě skupiny odpovídaly podobně, což znázorňuje níže uvedena tabulka:

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Tabulka 1: Počítačové programy, které využívají studenti a učitelé k přípravě na hodinu matematiky

Název programu	Klasifikace účastníků ankety
Textový editor (Microsoft Word, Writer(Open Office), ostatní	I místo
Microsoft Excel	II místo
Microsoft PowerPoint	III místo
Editor a nástroj HTML	IV místo
Nástroje k obsluze databází	V místo
Ostatní programy a aplikace	VI místo
Nepoužívám žádné počítačové programy	VII místo

Zdroj: vlastní výzkum

Tabulka 2: Didaktické multimediální programy, které využívají studenti a učitelé v hodinách matematiky

Název programu	Klasifikace účastníků ankety
Cabri	I místo
Grafická kalkulačka	II místo
Mathcad	III místo
Gran	IV místo
Ostatní programy	V místo

Zdroj: vlastní výzkum

Zkoumané program [2]:
- pomahají při podávání matematického obsahu;
- zpestřují proces výuky;
- prověřují úroveň znalostí a dovedností;
- působí, že student rozvijí svoje zájmy
- díky nim se matematické pojmy stávají jednodušší a snadněji pochopitelné;
- usnadňují provázení fixujících cvičení;
- vyrovnávají studijní šance studentů;
- nutí k intensivní práci ve vyučovací hodině.

Další otázky se týkaly využití Internetu účastníky ankety. Jak studenti, tak učitelé ho využívají většinou doma, a to 0 až 3 hodiny denně. Využívají Internet k vyhledávání potřebných údajů, informací z různých vědních oborů a ze života a ke komunikaci se známými.

Otázky týkající se znalostí e-learningu a obsluhy Moodle mezi respondenty.
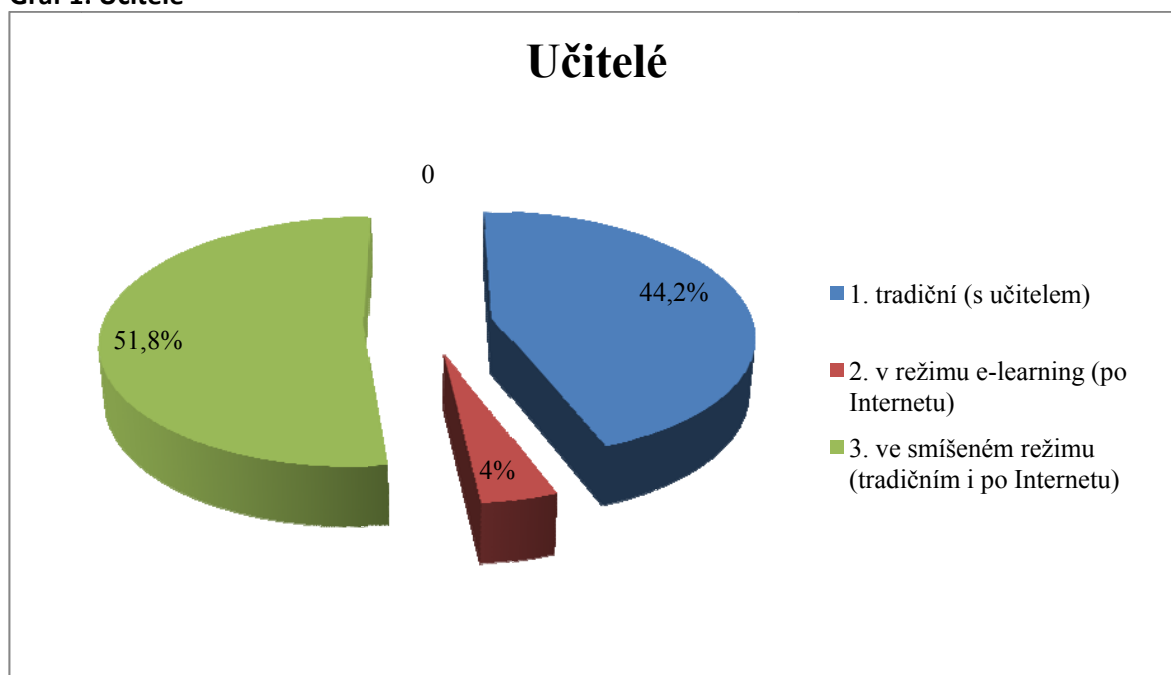
Poslední skupina otázek se týkala znalostí e-learningu a obsluhy platformy Moodle mezi učiteli a studenty. Jedna z otázek se týkala předností a překážek pramenících z výuky na dálku. Zde byli účastníci ankety rovněž zajedno. Ke kladům zařadili: individuální tempo výuky, možnost výuky na libovolném místě a v libovolném čase. Naopak mezi zápory vyjmenovali: nedostatek mobilizace k samostatnému učení a nedostatek dovednosti obsluhy počítače. 179 (35,8%) učitelů nedovede jednoznačně odpovědět, pokud jde o hodnocení zájmu o dálkovou výuku v Polsku, 105 (21%) se domnívá, že je velmi malý, 103 (20,6%) že je malý. Pokud se jedná o hodnocení studentů, největší skupina 160 (32%) se domnívá, že zájem je velmi malý, 140 (28%) že je malý a 100 (20%) že je průměrný. V další otázce měli účastníci ankety posoudit pro koho je e-learning nejlepším řešením. Měli možnost volby z několika odpovědí. Takto se představují výsledky:

Tabulka 3: E-learning je nejlepší řešení pro osoby:

Typy osob	Hodnocení učitelů	Hodnocení studentů
Osoby tělesně postižené	I místo	I místo
Osoby žijící v zahraničí	IV místo	V místo
Osoby pracující, které nemají čas dojíždět do školy	V místo	III místo
Osoby, které se učí v režimu denního studia	IX místo	X místo
Osoby, které studují dálkově	VII místo	VII místo
Osoby, které se učí v režimu večerního studia	VIII místo	VIII místo
Osoby často nemocné	II místo	II místo
Osoby, které se často účastní sportovních závodů	VI místo	VI místo
Osoby, které chtějí prohloubit a rozšířit své znalosti a dovednosti	III místo	IV místo
Osoby, které hodlají zahájit studium na vysoké škole	X místo	IX místo
Ostatní	XI místo	XI místo

Zdroj: vlastní výzkum

Pozorováním výsledků dospějeme k názoru, že respondenti odpovídali podobně. Největší skupina se domnívá že e-learning je nejlepším řešením pro osoby tělesně postižené a nemocné. Dále se objevily drobné neshody, učitelé se domnívali, že pro osoby, které si chtějí prohloubit a rozšířit své znalosti, a studenti naopak, že pro pracující osoby, které nemají čas dojíždět do školy. Pak byli účastníci ankety tázaní, jakým způsobem by se učili raději. Odpovědi znázorňují následující grafy:

Graf 1: Učitelé

Zdroj: vlastní výzkum

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Graf 2: Studenti
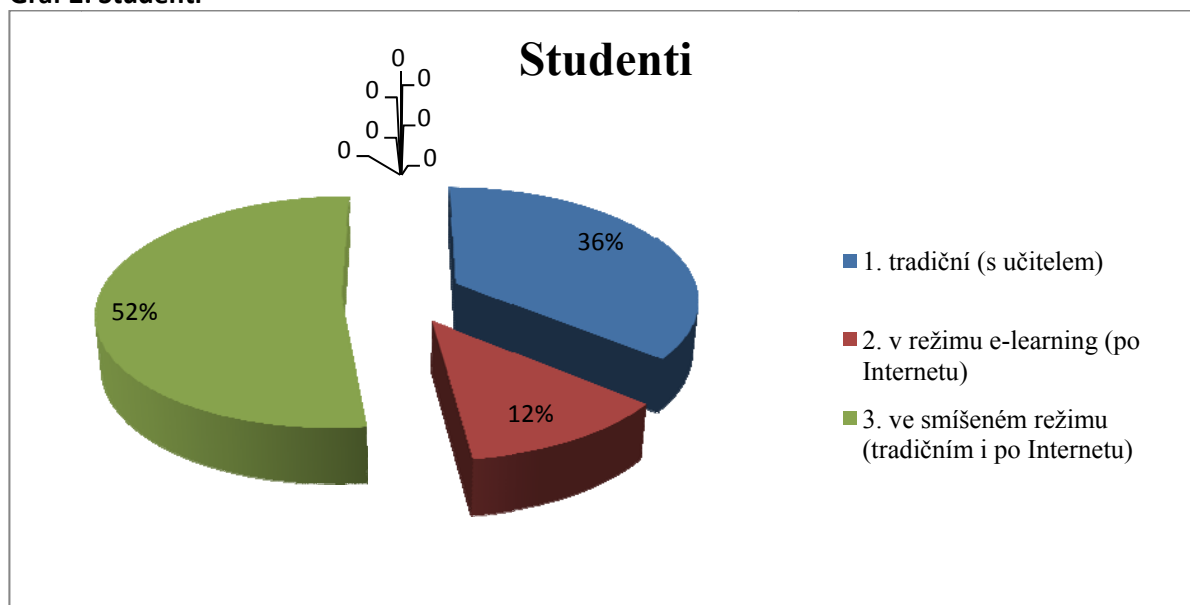
Zdroj: vlastní výzkum

Téměř 260 (52%) učitelů a studentů preferuje smíšený styl výuky tzn. tradičně i prostřednictvím Internetu. Odlišnosti se objevují při výběru ostatních stylů. Při srovnání obou skupin větší počet studentů než učitelů se raději učí v režimu e-learning po Internetu, a naopak menší počet studentů než učitelů upřednostňuje tradiční výuku s učitelem. 143 (28,6%) učitelů tvrdí, že zná obsluhu platformy Moodle, avšak pouze 27 (5,4%) ji využívá ve své práci k výuce. Tito učitelé využívají va své práci většinou následující prvky: úkol, workshop, quiz, vyučovací hodina, forum, anketa. Většina učitelů 380 (76%) by se chtěla účastnit kurzů, školení v oblasti obsluhy platformy Moodle.

Conclusion

1. Na základě provedeného výzkumu můžeme konstatovat, že se zavedení e-learningu jeví jako nutné.
2. Většina polských škol vlastní odpovídající hardware k provozování výuky tohoto druhu.
3. Pokud škola nechce instalovat vlastní platformu, může navázat spolupráci s jinou jednotkou, která vlastní server, za úplatu nebo bezplatně.
4. Objevuje se potřeba všestranné přípravy učitelů, mj. v oblasti: e-learningových kurzů, různorodých pracovních nástrojů na platformě a odpovídající metodické přípravy pro provozování výuky tohoto typu.

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Network Learning Activities Based on Collaboration

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Abstract: Collaborative learning occurs in situations when two or more people are engaged in learning activity that involves some kind of productive collaboration (e. g. working on group projects, joint problem solving, collaborative writing, debates/discussions, team competitions, role playing games). Every member of a learning group shares his/her knowledge, skills, experience, creative ideas, opinions, attitudes as well as motivation to fulfill the task successfully with his/her fellow learners. Individuals have to co-operate in pairs or groups to search for understanding and solutions. They often create a concrete artifact of their common learning (e. g. computer program, constructed model, presentation of project's results) in order to show it to others. This social interaction is considered to be one of the key concepts in modern constructivist and constructionist learning theories. In this paper, the classification of collaborative learning activities suitable for classroom environment is discussed. We focus on teacher coordinated, synchronous, problem solving and strategy planning class activities mediated by computers in network. We have been looking for such collaborative learning context, in which the benefit of face to face communication combines effectively with advantages provided by digital technology enhancement (multimedia, interactivity, immediate feedback, attractive scenario). As a result of this effort, an original online educational game was designed and implemented. The game was developed using Imagine Logo. The built-in network support included in this programming environment solves the problem of establishing the client-server connection, controlling the online communication and transmitting data via network through specialized classes. The paper presents features of the above-mentioned educational game and deals with some implementation details as well. The game is an open system so it can be customized to fit the needs of its potential users better (educational goal and rules of the game, nature and difficulty of tasks to be managed by players, time limit, number of competing teams). In conclusion, we sum up the findings acquired while realizing suggested network-based collaborative learning activity with students. These findings relate mainly to methodical and organizational aspects of computer supported collaborative learning (CSCL) activities: (1) collaboration stimulates students' motivation to learn and enhances their activity significantly, (2) digital technology helps to meet the educational goals of an collaborative learning activity in a more attractive and effective manner, (3) the educational goal of a network-based collaborative learning activity is a crucial attribute of its design.

Introduction

The European Commission has initiated a wide campaign named E-Skills Week to enhance ICT skills of people in European countries. Within the scope of this project, online IT Fitness Testing was organized in Slovakia in March 2010. The test was completed via internet by 55 380 voluntary respondents with average score of 39%. However, the evaluation of accompanying questionnaire concerning respondents' ICT using practices has become more interesting than the result of the test. In our estimation, the most surprising was the fact that 89% of respondents expressed that they participated in some social network on internet (eSkillsWeek, 2010). They also preferred Google, Wikipedia and internet forums as source of information to traditional sources like libraries, databases and educational portals. These findings indicate that needs to be a member of community, to share information, to collaborate with others are natural and spontaneous characteristics of people and computer networks provide especially convenient environment for their fulfilment.

Spontaneity of communication and collaboration on internet represents a phenomenon which makes educators face the challenge to innovate the educational process emphasizing the importance of students' personal competencies and application of personal forms of intelligence to problem solving or task completing. Gardner (1993) determines two forms of personal intelligence in his theory of multiple intelligences. Intrapersonal intelligence entails the capacity to understand ourselves, to appreciate our feelings, fears and motivations, and to be able to use information from our surroundings to regulate our lives. Interpersonal intelligence is concerned with the capacity to understand the intentions, motivations and desires of other people. It allows people to work effectively with others.

Collaborative learning is such form of learning that improves both intrapersonal and interpersonal forms of intelligence. Working on group projects, joint problem solving, debates, discussions, team competitions, role playing games are activities that stimulate learners to communicate, to understand others, to cooperate on achieving common aims, and to become themselves through others.

Classification of Collaborative Learning Activities

Collaborative learning is used as a term for a variety of approaches in education when people learn together, share their ideas, knowledge, experience, opinions in formal and informal exchanges, they cooperate in completing tasks and cope with challenges collectively.

Dillenbourg (1999) encounters various meanings of the term 'collaborative learning' from the point of three elements that determine collaborative activities:

- scales,
- types of learning,
- forms of interaction.

Scales

Different educational situations create conditions for collaborative activities with different scales: from 2 to 30 (or more) subjects, from 20 minutes to one year. For instance, working in pairs in a classroom for several minutes represents a situation of a small scale. At the opposite end of this scale, computer supported distance learning is a situation in which a group of 40 (or more) subjects follows a course over one year.

Different scales need different approaches to planning and researching collaborative activities. While psychology provides useful framework for analyzing cognitive processes in small groups, social psychology supplies methods for studying interactions in broader groups, and sociology helps us to survey the behaviour of subjects in larger study communities and its influence on learning.

Types of learning activity

Opinions differ in what type of learning activity is considered to be collaborative. From one point of view, learning is a social process in which *individuals learn together*, but there is no guarantee that new knowledge results from some kind of collaborative interaction. Dillenbourgh (1999) states the term 'collaborative learners' for this situation.

From another point of view, collaborative learning occurs in situation in which learners are *instructed to collaborate*, they follow a scenario in which they have to perform some kind of particular interaction at particular time. However, neither this situation implies that the peers take part in the collaborative activity evenly and that the interaction will occur.

To sum up, the main characteristics of collaborative learning activity is the high *probability* of getting new knowledge trough interaction with others. Each activity, e.g. following a course, solving a problem, working on project, playing a game, taking part in a competition, may be considered as collaborative if there are favourable conditions for forming productive interactions between learners.

Forms of Interaction

Collaborative learning activities differ in forms of interaction occurring during learning activity. We shall classify them according to following criteria:

- division of labour,
- degree of symmetry,
- goals,
- management of interaction.

The first criterion concerns the way and the degree of division of labour among partners collaborating on some work. Partners may divide the labour vertically into independent sub-tasks and then assemble the partial results into the final result. This approach is known as 'divide and conquer'. Another way of collaboration is 'joint effort' to complete some task when partners actually do the work together. Some kind of work division occurs in this case as well but it is less stable than division to independent sub-tasks, it may be changed continuously during collaborative activity. This approach is usually realized in case of small scales. Division also relates to the synchronicity of collaboration. While vertically divided activity enables asynchronous communication between partners, doing something together implies rather synchronous interaction.

The second criterion refers to the degree of symmetry. There are several ways to form groups and to design activities according to the symmetry of members' status in the group, and the symmetry of members' activities in the group. Asymmetry is usually caused by different level of knowledge and personal competencies.

In the next point of view, we classify interactions in collaborative activities in accordance with goals. Shared goals imply interaction based on cooperation, conflicting goals cause competition between peers.

Finally, we consider the management of interaction. Spontaneous informal collaboration usually happens without any coordination. Collaborative activities in the classroom are usually coordinated by teacher. In the following parts of this paper, we present advantages of computer-mediation in interactions between collaborating peers.

# Development of an Collaborative LEARNING Activity Mediated by Computer Network

As explained above, while developing *a classroom learning activity based on collaboration,* lots of important methodical and organizational aspects have to be taken into account. We recommend to start with answering these few questions:

1. What educational goals we wish to meet?
2. Why we want students to collaborate in pairs/groups?
3. What kind of active/passive collaboration is anticipated?
4. Is the suggested learning scenario attractive enough?
5. How to manage the collaboration process effectively?
6. How to evaluate the collaborative learning activity fairly and effectively?

In a traditional (non-ICT) classroom situation, teacher is usually the one, who coordinates and evaluates collaboration process of involved pairs/groups. Participating students are present at the same place, they can communicate face to face, discuss and work together using available sources and tools. We suggest to combine benefits of this direct social contact with advantages provided by digital technology (e. g. networked computers and educational software). We have been looking for *a classroom learning context*, where students would need to collaborate via *computer network*. But the need for such online collaboration must be natural and meaningful. As a result of the research effort, an online educational game was designed and implemented. We list some fundamental ideas embedded in the game reflecting questions from the previous paragraph:

1. In general, our online game is focused on fostering problem solving and strategy planning competences in students. The specific goal of the game depends on the input set of question/problems prepared by the administrator (e. g. teacher) before realizing the learning activity.
2. Groups of students (teams with 2-5 members) compete to win an online fight with simple rules (e. g. to construct the longest chain of fields within a common gridded playing area).
3. Team members have to collaborate actively to decide the next step and to answer questions (or solving problems) quickly and correctly. Different team members can focus on different tasks (e. g. one student chooses the best move according to the situation on the playing area, another students pay attention to the actual question/problem). Every single team collaborates with all opponent teams (in a passive way) as all competing teams share the same playing area.
4. Playing a dynamic game in order to be the best team of the class is likely to stimulate students' learning activity significantly.
5. When playing a multiplayer game, feedback for players should be immediate to keep the game status consistent with rules. Computers can facilitate this type of communication most effectively.
6. Rules of the game are objective (e. g. shape of the playing area, values of fields, number of attempts on a field, time limit for answering/solving the related question/problem). Results are evaluated automatically throughout the game.
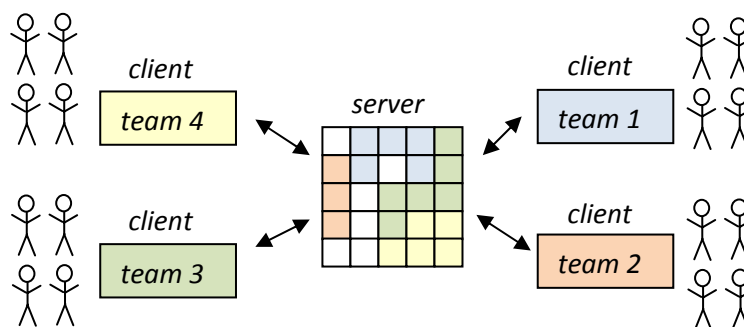
Figure 1: Collaboration within the online educational game

Design & Implementation Issues

The game was developed using Imagine Logo. The built-in network support included in this popular programming environment (objects of specialized classes) helps a programmer with establishing the client-server connection, controlling the online communication and transmitting data via network (Salanci, 2001).

The game has been designed as an open system so it could be customized to fit the needs of its potential users better. Time limit, number of competing teams and some other important technical details (e. g. IP address of the game server) can be specified by changing appropriate information in a configuration file. There are two variants of rules implemented for now (classical tic-tac-toe vs. building the longest continuous path). All fields on the playing area are the same weight, so the questions/problems can be distributed in a random manner. Question/problems must be defined in a multiple-choices format and are loaded from a text file when starting the server. They can include an

image when necessary. After a team's client requests for a free field, the game server sends one question/problem back.

Conclusion

Before developing the game introduced in this paper, we experienced a similar collaborative learning activity with 5 groups of adult learners (teachers from primary and secondary schools). Teams of 3-4 members were solving short mathematical problems assigned to the individual fields situated on a common map. The map with a treasure was saved and updated in an offline software environment. The answers of teams were collected by an admin of the game (lector). The lector had to type the data into the application and teams had to wait for the application's feedback. Although the collaborative learning activity was successful, the management of the game was too difficult and was slowing the competition down.

In our game, teams do not need to communicate with a teacher because the network application manages the whole process online and automatically. The game was tested with a group of university students (20 participants divided into 5 teams, content focused on computer graphics, 30 minute time limit). Students were active throughout the whole game and commented the activity as interesting and funny for them. To sum up our findings acquired while realizing suggested network-based collaborative learning activity in the classroom: (1) collaboration stimulates students' motivation to learn and enhances their activity significantly, (2) digital technology helps to meet the educational goals of a collaborative learning activity in a more attractive and effective manner, (3) the educational goal of a network-based collaborative learning activity is a crucial attribute of its design.

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Searching Eastwards

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Keywords: information resources, internet, teacher, education, lesson unit.

Abstract: A teacher who creates his/her own teaching materials often gets inpired with other teachers. Teacher searches not only for ready made materials, but also for ideas that could be modified for his/her purposes. After some time teacher starts searching beyond the sources in his/her mother tongue, usually in English. Nevertheless, our contribution is aimed at Russian sources. Firstly, we have searched the sources of the Russian State Library. It offers searching not only among books and articles, but also dissertations, and interlibrary lending services. General Federal Educational Portals (Базовые федеральные образовательные порталы) with its several links can be considered as the main informational signpost.The first of its links is the Federal Portal „The Russian Education" (Федеральный портал "Российское образование"). There we can find a catalogue of educational Internet resources. We can search according to the level of education, subject, kind of resource, and user. Federal Centre of Informational-educational Resources (Федеральный центр информационно-образовательных ресурсов) is an interesting portal offering six types of educational resources. They are divided according to the level to the comprehensive, secondary comprehensive, lower professional education, and upper professional education. These domains are further divided according to the subjects. The materials (teaching units/objects) are described (copyright, software, time assessment, target user, size etc.) Russian national portal for secondary education (Российский общеобразовательный портал) offers Internet resources of teaching texts, lesson units, and information on local educational portals. Portal of Informational Support of Comprehensive State Exam (Портал информационной поддержки единого государственного экзамена) provides the sample tasks for this exam.We also mention several specialised portals, such as Federal Educational Portal "Economy. Sociology. Management.", Federal Law Portal "Legal Russia", Social Humanities and Political Education portal, ICT in Education with developed searching for Internet resources. Russian Portal of Open Education (Российский портал открытого образования) offers more than 200 subjects of education. The visitors can animate the course work in two demo Moodle courses. The portal All-Russian Pupils´ Olympic Games (Всероссийская олимпиада школьников) provides organisational information and chosen sample tasks from previous years. From the point of view of our subject, the most interesting is the portal Network of Creative Teachers (Сеть творческих учителей). It offers ready made teaching projects, methodology, guidance for using ICT educational support, forums and assessments. A Window of Approach to Educational Resources. Electronic Library (Единое окно доступа к образовательным ресурсам. Электронная библиотека.) offers on-line teaching and methodology texts. Web pages of individual schools are none the less interesting sources. Some of them offer teaching materials. Searching eastwards provides very edifying comparison of Russian and Czech Internet education background. It offers methodology support as well as display of possible future shape of Czech educational portals.

Úvod

Učitel vytvářející vlastní výukové jednotky se snaží najít inspiraci i u jiných autorů. Hledá nejen hotové, použitelné výukové jednotky, ale i nápady, které by mohl modifikovat pro svou potřebu. Prvním zdrojem hledání bývá zcela logicky internet svého jazykového okruhu, autor projde dostupné vzdělávací portály, zhodnotí jejich přínosnost pro vlastní práci, pak pokračuje na webové stránky vzdělávacích institucí a osobní stránky některých kolegů.

Po určité době se začne obracet i ke zdrojům mimo původní jazykový okruh. Je běžné, že první možností bývá obracet se ke zdrojům v anglickém jazyce. Další hledání bývá závislé na autorově jazykové vybavenosti a jeho představě o stupni rozvoje problematiky v dané zemi.

Autorka práce si vytyčila cíl získání základní orientace v ruských výukových portálech a internetových stránkách. Její hlavní zájem se nachází v oblasti výukových jednotek pro výuku mateřského jazyka, občanské nauky a informatiky. Právě příbuznost obou jazyků je dalším důvodem, proč se jeví hledání v ruštině přínosněší než hledání výukových zdrojů pro výuku mateřského jazyka v angličtině.

Základní federální portály

Hlavním rozcestníkem informací mohou být stránky Základní federální vzdělávací portály *(Базовые федеральные образовательные порталы),* obsahující odkazy na další portály. Lze je nalézt na adrese: http://www.edu.ru/db/portal/sites/portal_page.htm. Poskytují přehled o logu, názvu a základních částech federálních ruských portálů věnovaných vzdělávání.

Obrázek 1: Ukázka internetové stránky základních federálních portálů

Federální portál „Ruské vzdělání"

Prvním z uváděných odkazů je Federální portál „Ruské vzdělávání" *(Федеральный портал „Российское образование*") na adrese http://www.edu.ru/. Z jeho obsahu můžeme zmínit část Pro maturanty a abiturienty s informacemi týkajícími se například dalších možností vzdělávání, jednotných výstupních zkoušek.

Zajímavější z našeho pohledu jsou Základní informační zdroje vzdělávání, které obsahují:
- **Národní projekt „Vzdělání"**(*Национальный проект „Образование"*).
- **Ruský portál všeobecného vzdělání** (Российский общеобразовательный портал). Nabízí mimo jiné i několik tematicky rozdělených kolekcí výukových objektů, najdeme je na adrese http://www.school.edu.ru/default.asp.
- **Jednotný katalog vzdělávacích internetových zdrojů** (*Единый каталог образовательных интернет-ресурсов*) se nachází na adrese http://window.edu.ru/window, poskytuje uspořádaný přehled o on-line učebních i metodických materiálech, třídí je podle stupně vzdělání,

předmětu, typu, hodnocení redakce a uživatelů. Stránky mají i druhý název Jedno okno přístupu ke vzdělávacím internetovým zdrojům.

- **Internetovou knihovnu celých textů učebních a učebně metodických materiálů** (*Полнотекстовая электронная библиотека учебных и учебно-методических материалов*). Opět se jedná o projekt Jedno okno přístupu k úplným textům učebních a učebně metodickým materiálům, je zde uplatněno podobné třídění jako u internetových zdrojů.
- **Katalog výukových zdrojů sítě Internet pro všeobecné (střední) vzdělání** (*Каталог образовательных ресурсов сети Интернет для общего (среднего) образования)* je publikací výsledků provedených výzkumů. Odráží stav v určitém období, přináší metodické materiály pro učitele a utříděný seznam nových zdrojů.
- **Knihy. CD/DVD. Audio/Video kazety. Vybavení i názorné pomůcky. Programové vybavení.** (*Книги. CD/DVD. Аудио/Видео кассеты. Оборудование и наглядные пособия. Программное обеспечение.)* jsou internetovým katalogem nabízejícím učiteli na jednom místě přehled informací o možných učebních pomůckách.
- **Jednotná kolekce digitálních vzdělávacích zdrojů** *(Единая коллекция цифровых образовательных ресурсов)* obsahující uspořádané odkazy na digitální zdroje. Systém je licenčně omezený pouze pro ruské uživatele, zahraniční zájemce je identifikován a zobrazí se mu pouze omluva.
- **Federální centrum informačně vzdělávacích zdrojů** *(Федеральный центр информационно-образовательных ресурсов)* je možné najít na adrese http://fcior.edu.ru/. Je výborným zdrojem inspirace pro vlastní tvorbu výukových objektů. Obsahuje otevřené modulární multimediální systémy pro vzdělávání tří typů informační (Ukázka na obrázku 2.), praktické a kontrolní (Ukázka na obrázku 3.). Jsou přístupné po instalaci OSM přehrávače do počítače uživatele. Kontrolní moduly zabezpečují i okamžitou zpětnou vazbu.
- **Všeruská olympiáda školáků** (*Всероссийская олимпиада школьников*), na adrese http://rusolymp.ru/. Poskytuje kromě organizačních informací i zadání některých kol olympiád z různých předmětů.
- **Všeruská internetová pedagogická rada** (*Всероссийский интернет-педсовет*), fórum ruských pedagogů, místo pro řešení společných profesionálních problémů.
- **Elektronické prostředky masové informace v oblasti vzdělávací tématiky** (*СМИ образовательной тематики*), rozcestník novin a časopisů týkajících se problematiky vzdělání na adrese http://www.edu.ru/db/portal/sites/ejornal/e_jornal.htm.
- **Nový standard všeobecného vzdělání** (*Новый стандарт общего образования*). Uvedená část portálu nemá zatím zpracovány materiály pro starší školáky, je tedy z pohledu učitele střední školy nezajímavá.
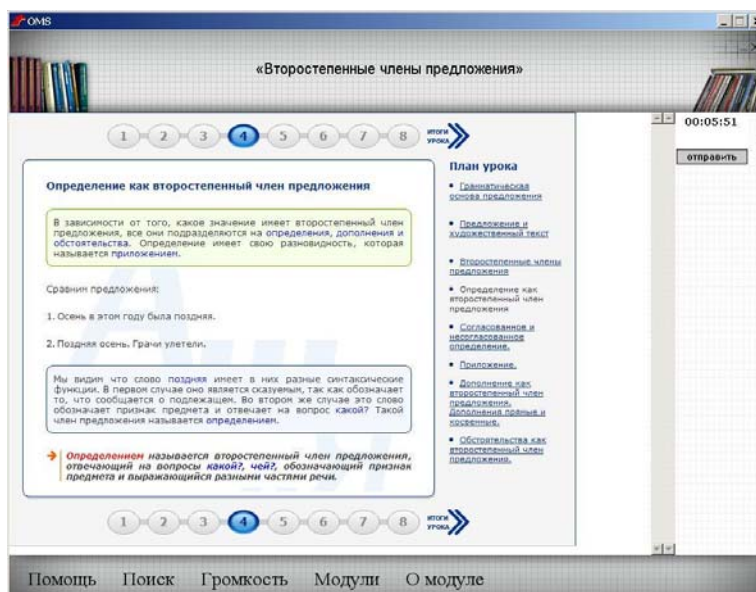
Obrázek 2: Ukázka internetové stránky modulárního multimediálního systému Vedlejší větné členy. Jedná se o informační typ výukového modulu, nachází se na Federálním centru informačně vzdělávacích zdrojů.
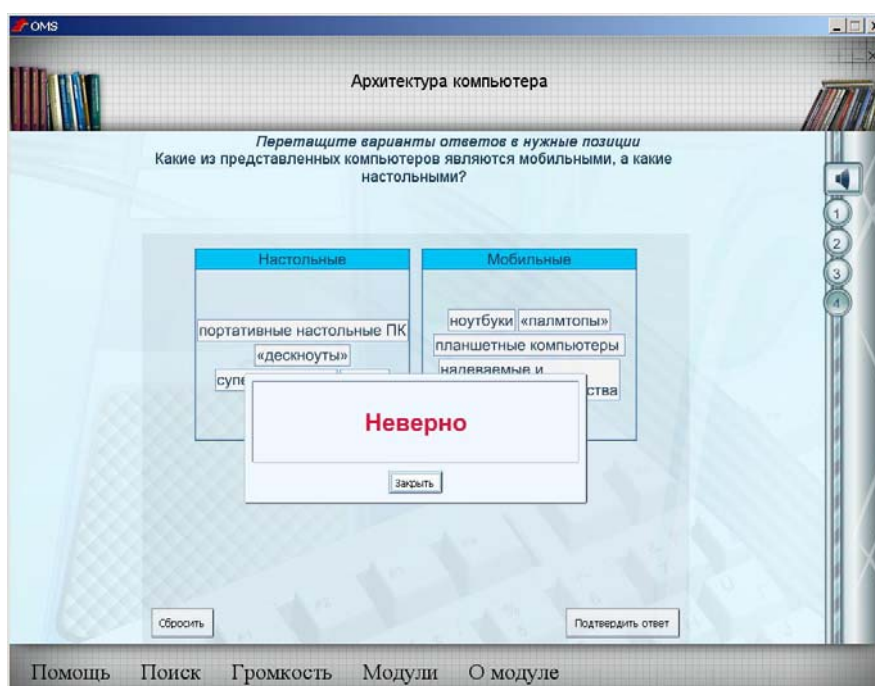
Obrázek 3: Ukázka internetové stránky modulárního multimediálního systému Architektura počítače. Jedná se o kontrolní typ výukového modulu se zpětnou vazbou, nachází se na Federálním centru informačně vzdělávacích zdrojů.

Ruský všeobecně vzdělávací portál

(*Российский общеобразовательный портал*). Uvedený jako druhý ze základních vzdělávacích portálů Ruska byl již popsán výše jako součást portálu Ruské vzdělání. Systém ruských vzdělávacích portálů je propojen na více místech navzájem, což sice zjednodušuje vyhledávání na počítači, ale hierarchii uspořádání činí méně přehlednou.

Portál Informační podpory jednotné státní zkoušky

Třetí z federálních portálů *(Официальный информационный портал единого государственного экзамена)* dostupný na adrese http://www.ege.edu.ru/ je pro učitele hledajícího inspiraci pro vlastní tvorbu výukových objektů zajímavý především zadáními zkoušek z jednotlivých předmětů.

Federální vzdělávací portál „ Ekonomika. Sociologie. Management.“

Čtvrtý z federálních portálů (*Федеральный образовательный портал "Экономика. Социология. Менеджмент."*) zahajuje skupinu oborově zaměřených portálů. Najdeme jej na adrese http://www.ecsocman.edu.ru/. Opět na něm lze najít materiály podporující výuku. Nalezneme zde přehled literatury, článků, disertačních prácí, glosář, dále přehled internetových programů a internetových konferencí.

Federální právní portál „Právní Rusko"

Pátý federální portál *(Федеральный правовой портал "Юридическая Россия")* zaměřený na oblast práva, lze vyhledat na: http://www.law.edu.ru/. Pro inspiraci zde lze najít několik učebně metodických komplexů a přehled internetových zdrojů.

Sociálně humanitní a politické vzdělávání

Portál *(Социально-гуманитарное и политологическое образование)* věnovaný filozofii, sociologii, politologii, historii, pedagogice, státní správě a mezinárodním vztahům je sice plný informací, ale podle mínění autorky je mnohem méně zajímavý z hlediska inspirace pro tvorbu vlastních výukových objektů. Najdeme jej na adrese: http://www.humanities.edu.ru/index.html.

Informační a komunikační technologie

(Информационно-коммуникационные технологии в образовании). Portál nabízí velmi zajímavou část vyhledávání internetových zdrojů. To je možné podle předmětu, úrovně vzdělávání, typu zdroje a uživatele. Najdeme jej na http://www.ict.edu.ru/.

Ruský portál otevřeného vzdělávání

(Российский портал открытого образования) Nabízí na http://www.openet.edu.ru/ možnost distančního vzdělávání ve více jak 200 disciplínách. Návštěvníkům je dána možnost představit si způsob práce v kursech na příkladech dvou demo kurzů v prostředí Moodle.
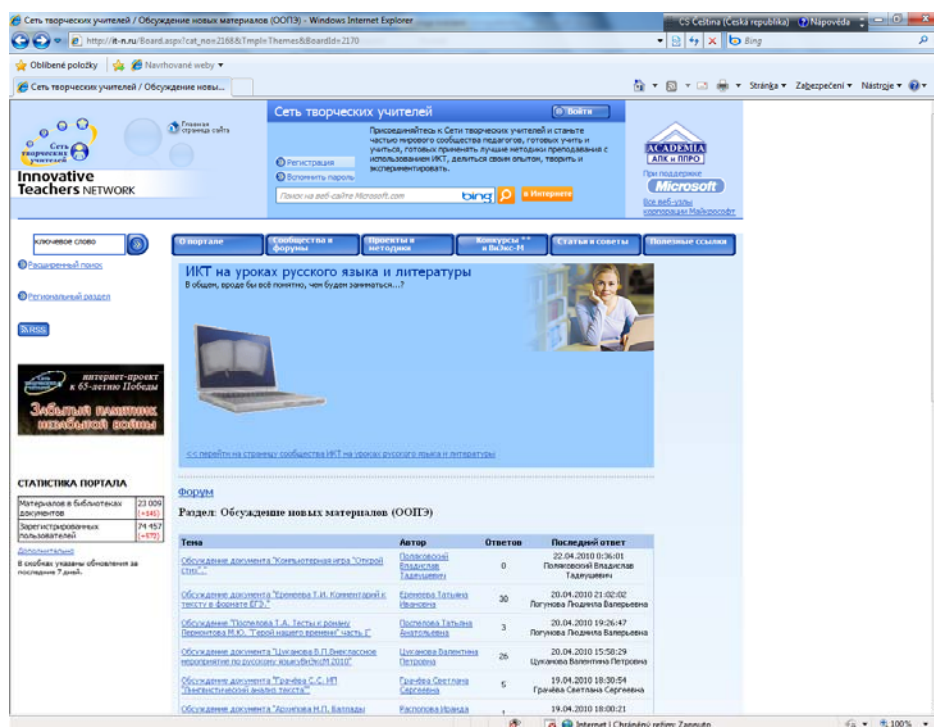
Další zajímavé portály

Síť tvůrčích učitelů

Z pohledu naší problematiky je nejzajímavějším portálem *(Сеть творческих учителей)* na adrese: http://it-n.ru/. Spolu s hotovými výukovými projekty nabízí i metodiky, vedení při využívání ICT podpory výuky, tematická fóra, posuzování výukových jednotek kolegy.

Obrázek 4: Ukázka internetové stránky s diskusemi pedagogů nad novými materiály.

Posledním neméně zajímavým zdrojem mohou být výsledky vyhledávání na stránkách některých škol, kde jsou nabízeny některé výukové materiály. To je však již poměrně časově náročná činnost, přesto zajímavá a přínosná.

Závěr

Hledání na východě bylo velmi zajímavé. Učitelé zde řeší velmi podobné problémy, jaké řeší i u nás. Mají výborné nebo i obyčejné nápady, ze kterých se lze pro vlastní tvorbu výukových objektů poučit jak v kladném, tak i v záporném smyslu slova.

Hledání na východě autorce přineslo i mnohá překvapivá zjištění. Prvním z nich je očividný fakt masivní státní podpory poskytované vzdělání s pomocí počítače, internetu, multimédií ze strany ruské vlády a státu. Systém vzdělávacích portálů je rozsáhlý, pokrývá téměř všechny oblasti vzdělání a výchovy. Mimo zmiňované federální portály existují ještě i republikové a oblastní. Učitelé mezi sebou soutěží, vzájemně si pomáhají, otevřeně řeší své problémy v diskusích, které jsou přístupné nejen pro žáky a rodiče, ale i pro kohokoli z celého světa. Většina materiálů je zcela neomezena licenčně, jsou dostupné metodiky, přehledy publikací, učebních pomůcek, programů.

Uvedené portály navíc žijí. Neustále se mění a doplňuje jejich obsah. Autorka tyto změny sleduje průběžně po dobu šesti měsíců a je překvapována jejich dynamikou.

Nelze si tedy neklást otázky o příčinách takových rozdílů. Jistě nemalou roli zde hraje centralizovaná státní – zřejmě i finanční – podpora.

Dalším důležitým důvodem mohou být i velké vzdálenosti a rozlehlost země. Je jistě jednodušší diskutovat pomocí internetu, nežli odjíždět tisíce kilometrů na konference.

Lze si jen přát, aby podobného stavu bylo v pokud možno blízké budoucnosti dosaženo i u nás.

Poďakovanie

Application of Computerized Test Technologies for Quality of Knowledge Diagnostics

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Abstract: The article presents the experience in developing and application of a test system allowing to diagnose the assessment of learners' knowledge through its monitoring during the set period of study. Among the recent educational technologies the computerised technologies of knowledge assessment and quality of knowledge take an important place. Effective components of the above technologies are computerised test systems featuring a high level of processing promptness and technological effectiveness of assessment. The important advantage of the computerised test systems lies in the opportunity to use them as an instrumental means of monitoring and diagnostics of the academic process. Under the author's guidance there has been developed a computerised test system allowing to diagnose the current state of the academic process through its monitoring results.. The system lets the user assess the current level of students' knowledge, present the testing results in a wide range of forms and statistical samples. Another important advantage of the system is the opportunity to automatically determine the components of testing materials content which were the most difficult to complete. Analysis of such information provides reasons to change the academic process in a certain discipline. A set of programmes functions in the OS Windows and is available for use as a networking option. The system provides the opportunity to create test assignments databases by a user without any programming skills; the opportunity to automatically compile test assignments using the test assignments databases in various disciplines;   the   opportunity   to manage the procedure of testing from the working place of a lecturer; the opportunity to control each student's completing progress in a real time; the opportunity to automatically present the results of a testing in various aspects in respect to analytical goals. System has the function to diagnose the quality of academic process as it allows to summarise and analyse the results of testing received by students in the set sections of the study material (syllabus in whole, separate part of a syllabus, separate themes). Structurally the system consists of the following parts for preparation and editing of electronic test assignments; preparation of documentation accompanying testing; administration of testing and control of its procedure (working place of a lecturer); organization of a test procedure (working place of a test); statistical processing of test results. Test system was trialed when students knowledge assessment in general physics had been monitored. Results testify to the opportunity of its wider use including the systems of distant learning.

Introduction

Quite often in university education quality management systems (QMS) methods of self assessment based on questioning of the subjects of education themselves prevail. Meanwhile more informative and objective are procedures of knowledge assessment monitoring being the technological basis for diagnostics of quality education. Results of pedagogical diagnostics can be used to efficiently improve and optimally plan an educational process.

Necessary stages in creation of knowledge assessment monitoring and diagnostics system are:

- analysis of contents of an educational process; structuring of contents of academic disciplines, introduction of the system of core material to be learned within each unit, section, theme, module of a discipline;
- development of requirements applied to learners when completing each component of contents of an academic discipline;

- selection of assessment materials (AM), determining the learner's level of completion for each core unit of contents;
- development and selection of computer software enabling monitoring and diagnostics of knowledge assessment.

Quality of diagnostic procedures is dependent on accuracy of criteria met by system under diagnostic. In pedagogical diagnostics – on quality of requirements applied to learners' knowledge, skills and abilities and on quality of assessment materials used for monitoring, the format and contents of which are determined by concrete tasks of monitoring and diagnostics.

- As long as technologies of monitoring and diagnostics allow to create the substantial basis for an objective assessment of learners' knowledge, they must become a key component in the university quality management systems.

Effective functioning of a quality management system is considerably dependent on quality of software and methodological means used in the monitoring procedure. The above means applied for monitoring of knowledge assessment must provide:

- opportunity to diagnose quality of assimilation of set contents components of an academic disciplines (diagnostic function);
- opportunity to receive comparative data as to the level of students' training within the set statistical groups (separate groups of students, years of study, faculties) (control function);
- opportunity to use them as a didactic means in teaching academic disciplines (educating function).

The above possibilities can be realised by the computer system "Inspector", developed by us (V.V. Kadakin, K.N. Nishchev at all, 2001). This set of programmes allows to carry out monitoring of quality of education at all levels consistent with the structure of education management system in the university. It includes the following analytical levels of information generalisation:

1. academic staff level;
2. chair level;
3. institute level.

Interaction of given levels is ensured by adjusting assessment criteria for quality of academic process to technology of collection, processing and analysis of the information. Technological basis for monitoring carried out with the use of the given system are presented by procedures of computerised testing of learners' knowledge.

«Inspector»' advantage in comparison with analogues features orientation on diagnostics of contents of quality of academic process. Basic material for carrying diagnostic research presents automatically created detailed reports on testing results of learners over the given set of contents components of an academic discipline. System based on computer testing allows to automatically select test assignments following the level of completion of corresponding contents of an academic discipline. Moreover protocol of a test session results contains information on the number of each answer (including wrong ones) chosen by a learner that makes it possible to analyse typical mistakes of learners. Results gained through analysis of the above information can be used for current improvement of an academic process in terms of its quality.

System "Inspector" has the following structural units:

1. unit of tests preparation (editing);
2. unit of testing and control over its procedure;
3. unit of collection and statistical analysis of test data.

A set of programmes functions in the OS Windows and is available for use as a networking option.

The system allows to:

1. create (edit) computerised test assignments by means of an import of fragments from Microsoft Office applications with the use of standard clipboard and graphic files of various types.
2. to automatically compile test assignments with the set structure using the test assignments databases in various disciplines.
3. to manage the procedure of testing from the working place of a lecturer an to control each student's completing progress in the real time.
4. to compile electronic databases of results received from all test sessions including detailed answer protocols.
5. to automatically present the results of a testing in various aspects dependent on analytical goals.

Results of all test sessions are kept in current and basic electronic journals databases and can be exported to the general databases. Producing of reports at each level of monitoring is carried out by the system of statistical processing and analysis of the monitored data. Format of reports is determined by the level and tasks of monitoring and is dependent on the detalisation degree of information required by an expert. Using the computer system an expert can receive various rating lists of testees where students are distributed on the basis of general amount of grades, results of completed test assignments and so on. Along with rating lists the above information can be presented in the form of charts and diagrams.

To export the information from the lower (chair, institute) to upper level (department of academic studies, rectorate) there is a special subsystem under development which will be integrated into the information and analysis system of the university management.

A key component of the computerised pedagogical monitoring system is presented by statistical processing of testees' results. Similar to monitoring diagnostic and control functions statistical processing of test results is carried out in two scenarios. In the first one it is carried out to analyse information on learners' assimilation degree regarding the contents components of an academic discipline (monitoring of contents of an academic process). In the second one the statistical processing of data is carried out to compare the absolute results of control testing among various groups of students (monitoring of academic achievement)

The subject of statistical processing in the first case is the body of data on test results in separate units of contents of an academic discipline (structural components of testing). The results of the statistical processing in this case are:

1. distribution of test results among the students of a set group in units of academic process contents (themes, sections (modules) of academic disciplines;
2. statistical data reflecting the dynamics of test results in chosen units of academic process contents (themes, sections (modules));
3. comparative statistical data on test results among various groups of students in set units of academic process content;
4. statistical data characterising the degree of results correlation in set groups of students in various units of academic process contents.

In the second case the results of the statistical processing of information are:

1. absolute results of control testing among a certain group of students, represented in the form of a rating table, charts or diagrams;
2. absolute and relative results of testing of a concrete student received as a result of an automatic search in the databases;
3. comparative statistical data on results of control testing in various groups of students
4. comparative statistical data on results dynamics of control testing in various groups of students and specialities;

5. statistical data characterising the correlation degree of test results in various groups of students in set contents components of an academic process.

The system offers the following mechanism of data collection and generalisation in the monitoring of the university education quality. The teaching staff level of monitoring compiles databases containing analysis results from current test sessions. The chair level compiles databases containing summarised results of monitoring as to the academic process conducted by a university lecturer. The faculty level compiles databases containing summarised results of monitoring as to the quality of an academic process among chairs. Faculty databases are the basis for compiling databases of the university education quality.

Research conducted on all levels of pedagogical monitoring offers recommendation as to the improvement and optimisation of an academic process. Monitoring results gained at the teaching staff level are used to conduct current correction of an academic process in a discipline or organisation of an individual work with the students. Monitoring results gained at the chair level are used to provide recommendations on improvement of an academic process in certain disciplines. Monitoring results gained at the faculty level are used to conduct a comparative analysis of quality of an academic process among chairs as well as recommendations on improvement of organisation of an academic process. Results of the pedagogical monitoring available in summarised university databases are the substantial basis for assessing quality of university education in general and its academic structural units.

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Remote Teaching as Information Search Skills' Education Means for Senior Pupils

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Keywords: information search skills, nonintegrated content task, internal integrated content task, inter-subject content task.

Abstract: In the informational – creative society a person has to study nearly all his life, to absorb the knowledge created somewhere else in the world, to use it, to create new knowledge and to pass it to others. These processes are determined by the development of technologies and the variety of sources. The two kinds of long-existed information sources (printed and verbal) were supplied by a new kind of information sources – electronic information sources: electronic course books, databases, teaching material on electronic media, and others. When the variety of information and its sources is increasing, other information management skills are necessary – to select the necessary knowledge, to systemize, to analyze and to spread it. In the second half of the XX century it was enough to find one or several printed sources of necessary information in order to solve a problem, and nowadays – to select one suitable source from a number of printed and electronic sources. To do this, new skills are necessary – information skills. They start forming in a comprehensive school. The structure of information skills is complicated. They are made of information search, understanding adaptation, and spread skills. This article only analyzes the skills of information search. Considering the new possibilities of teaching, the article discusses a scientific problem of how from an educological point of view senior pupils information search skills' are being influenced by remote teaching as well as physics tasks of different integrality level. The conducted quantitative research shows that traditional and new technologies are combined in educational practice of secondary schools. The article analyzes information search skills of senior pupils (final classes XI – XII). The first stage of information search is the planning of information search. The survey allowed distinguishing the following steps of information search planning: the content analysis of the assigned task, the prediction of possible information sources (electronic or printed). The second stage of information search is work with information sources. The article analyzes how senior pupils plan information search, what information sources they use, how often open code distant teaching program Moodle is used. What is more, the article analyzes whether and how the first and the second stages of information search are influenced by the content of the assigned task. In the research according to the content type the assigned tasks are grouped as follows: nonintegrated content, internal integrated content, and inter-subject content.

Technological and Educational Factors Determining Information Search Skills of Senior Pupils

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Abstract: The article deals with educational and technological factors, which determine senior pupils' (XI – XII formers') information search skills. The conducted quantitative research shows that when respondents (senior pupils) search for educational information, they use internet-electronic information search systems most often. When planning information search, students should raise questions, which stimulate the meaningfulness of studying. Fast information search tempo on the Internet sources limits pupils' reflexive planning skills, does not stimulate deeper insights into the task content or alternative search of information sources. Educational processes influence the formation of information search skills. The format of the assigned tasks content determines the planning of information search. Interdisciplinary tasks encourage pupils to plan information search, to see into the task content better, and to reflect the studying. Non-integrated tasks limit the planning of information search. They stimulate mechanic, fast search of information in the internet-electronic information search system.

Introduction

In an informational-creative society, a person has to study practically all his life, to absorb the knowledge created somewhere else in the world, to use it, create new knowing and pass it on to others. These processes are determined by technological development and the variety of information sources. A new kind of information sources – electronic information sources – has supplemented the two information sources (printed and verbal), which have existed for a long time. These are electronic textbooks, virtual learning environments, databases, teaching material on electronic media and other.

The application of information and communication technologies replaces informational skills, especially those of information search. Traditional information search method, when constant information is searched for in a small number of primary sources, is replaced by a modern information search method – the current information is searched for on virtual environments: virtual libraries, electronic databases. Information search is a unit of actions, methods and procedures, which are used to get information about something from the stored data. In order to find the necessary information, we have to think over an action plan, to create an optimal search strategy, and critically assess the information found (Doyle, 1999; Buschman, 2009).

Information search skills are a component of informational skills. In informatics, the concept of informational skills is used to describe work with computer and applied programs, as well as programming. These are informational technological skills. In librarianship, the term of informational skills is used to describe information finding, storing, systemizing and generalization.

Many foreign authors (Campbell, 2010; Hayden 2004; Kim, Jung, & Lee, 2008; Pinto, Cordon, & Diaz, 2010) analyzed information search skills. Since informational skills are relatively new phenomenon, there is not much of their research in the works of a country's educologists. The country's educologists' (Gedviliene & Vaiciuniene, 2006; Vaiciuniene & Gedviliene, 2008) research about students' informational skills confirm the findings of foreign authors' (Probert, 2009; Shapiro & Hughes, 1996) research. It was found, that the country's students lack independence when choosing information sources and determining the sources' priorities. The formation of informational skills is a permanent process, which begins in a comprehensive school. Therefore, educological insights about the formation assumptions of informational skills in a comprehensive school are topical.

Information search skills are an important component of the knowing how to study competence. This attitude is supported not only by educologists' research, but also by education documents (A Memorandum on Lifelong Learning (2001); Life-lasting studying assurance strategy (2008); Conceptual Framework of the National Information Society Development of Lithuania (2001)). They emphasize that those who are studying have to learn to plan the studying time, to foresee studying sources, adapt to changes and use the plenty of information. By managing time and information efficiently, people should be able to organize their studying (European Parliament Council recommendation about general life-lasting studying abilities, 2006). When a person manages the knowing how to study, he not only knows how the information is managed in a library, in a computer memory, but he is also able to reflect the information management processes: how he searches, stores, treats the information and how he is able to use it.

Regarding the above-mentioned topicalities, the scientific problem is formulated with a question: how do information and communication technologies determine senior pupils' (XI – XII formers') information search skills, and how do educational processes determine the change of these skills? The purpose of study is to reveal senior pupils' attitude towards the educational and technological factors, which determine the formation of the information search skills.

Study objectives:

1. To analyze pupils' attitude towards the role of educational factor (bibliographic and reflexive parameters) for the information search.
2. To highlight the role of interdisciplinary physics tasks for the information search skills.
3. To reveal the senior pupils' attitude towards technological factors, which determine the change of the information search skills.

Research Methodology

Pedagogical-psychological Preconditions

When analyzing the factors, which determine senior pupils' information search skills, the attitudes of fundamental cognitive learning theory and R. Marzano's (2000) new taxonomy of education aims were referred to.

Cognitive studying theory is based upon the information treatment model, used by the cognitive psychology. According to it, active meta-cognitive and cognitive activity processes are encouraged during the information search: planning, assessment of alternative decisions, metacognition. The cognition process of each studying person is individual and distinctive. In cognitive attitude, teaching is effective when the activity is actively affected and reflected (Ainley, Arthur, Macklin & Rigby, 2003). These attitudes are reflected in R. Marzano's aim taxonomy as well. It emphasizes personality's role in the study process and highlights the metacognitive skills of a studying person (setting the aims of activity, organization of individual activity, self-control, and reflexion).

Research Instruments

In order to reveal the senior pupils' (XI-XII forms) attitude towards educational and technological factors, which determine the information search skills, the following study methods were applied: scientific literature analysis, questionnaires, comparative analysis of the results.

Questionnaire is a quantitative survey therefore the study sample, its reliability, and representativeness is important there. The set of senior pupils (XI-XII formers) is finite. The general set consists of N=26447 (Lithuanian education figures, 2007) senior pupils, who study in comprehensive schools and gymnasiums. It was found (Calculated according to the equation: n = $\dfrac{1}{\Delta^2 + \dfrac{1}{N}}$, where n – selection

value, Δ – error value (0.05), N – General unit value), that the study sample, which consists of n=394 respondents is reliable. The sample size is outlined by 95% reliability, which is considered as sufficient in qualitative social surveys.

Questionnaire respondents were selected using the cluster sample. 5 study clusters were distinguished in the study (the biggest districts of Lithuania) – Vilnius, Kaunas, Panevezys, Klaipeda and Siauliai districts. The sample is stratified, since the general set was grouped at the beginning, and then random selection was applied in each group. Since the pupils from comprehensive schools and gymnasiums of the cities and districts took place in the survey, it is possible to claim that this study represents and reflects the general situation in Lithuania. It means that the study has representative sample, because it reflects the proportions of possible values of the surveyed features in the population.

The study questionnaire was projected regarding the information treatment stages: search, selection, fixation, storing, creation, presentation and use. This article analyses the results of just one diagnostic block – information search. Ordinal scale was used for the measurement of the surveyed features.

The quantitative study date was processed using the descriptive statistics. The replies' percentage rate was calculated, χ2 (chi square) was applied to assess the statistic significance of the attitudes' difference. The statistic error probability $p \leq 0.05$ was chosen. The critical limit of the statistic error probability p shows what size limit of the statistic solutions error is. Statistic solutions, which do not satisfy this condition $p \leq 0.05$ are treated as invalid. That is, no bigger than 5% solution error limit was set. Besides, statistic criterion t was used to assess the difference of relative rate. Statistic package SPSS was used for the statistic treatment of the study data. A qualitative survey supplemented the quantitative one. Content analysis of the questionnaire responses was carried out.

Results of Research

Educational Factors, Which Determine the Information Search Skills

Methodological attitude, that the first information search stage is planning, was followed during the study. Information search planning can be analyzed using two attitudes: bibliographic and reflexive. The following bibliographic information search parameters are distinguished: information source language, information source newness (not older than 10 years), information source type (book, magazine, and scientific article), and information source format (printed, electronic).

Reflexive attitude towards the information search planning is related to the internal reaction of a student. Information search planning may be analyzed according to R. Marzano's (2000) taxonomy of the education aims, the basis of which is topographic personality model ego component. According to R. Marzano, the personality ego determines whether metacognitive thinking system, which foresees the information search aims and strategies, is activated. Before starting to search for the information, a student should foresee the aims of the information search, to think over what he knows about the topic, and assess, how the new information relates to the previous knowledge and awareness. In other words, it is important to answer the following questions when planning the information search: is it completely new information? Does the new information supplement what is already known? Doesn't it contradict to the previous awareness?

When analyzing respondents' attitude towards the reflexive planning, it was found that less than a half of the respondents plan the information search reflexively. It should be stated, that the surveyed senior pupils differently assess various information source search criteria (table 1). The survey data shows, that, when planning their information search, a bit more than a half of the respondents (according to the assessment rank very often 51.2%) raise the question, whether the information source searched corresponds to the learning objectives.

It was found, that a bit more than a third of the respondents never apply reflexive planning when searching for new information (table 1). Only a fifth of the surveyed senior pupils very often raise the following questions when planning the information search: what is my experience and what do I need to find? Which study sources best correspond to the studying style? Will the new information be useful for the development of personal competences?

Table 1. Reflexive planning: senior pupils' attitudes' percentage rates

Information source search parameter	Assessment rating		
	Very often	Often	Never
Source's correspondence to the study aims	51.1	17.4	31.5
Source's information relation to personal experience	25.6	39.3	35.1
Source's role for the development of disciplinary competences	19.1	43.3	37.6
Source's correspondence to the studying style	20.0	40.8	39.2

Reflexive planning is important psychologically. It is claimed, that a person's memory has selective character. It means, that the information, which is meaningful for the student, which meets his interests and needs, gets into the long-term memory. It means, reflective information search planning should lightweight the assimilation of new material.

It was found, that senior pupils most often consider, how information sources correspond to the studying aims, when qualitatively assessing their attitude towards the reflexive planning (table 1). This regularity was tested in a quantitative way, applying statistic criterion t – statistic significance of the respondents' attitudes' (about reflexive planning parameters) relative ratio difference was calculated (table 2). It was found, that, in all comparison cases, the relative rate difference is statistically important.

Table 2. Assessment of the reflexive planning parameters: statistic significance of the senior pupils' attitudes' difference

Comparative reflexive planning parameters	t	α
Study aims – personal experience	2.11	$p < 0.05$
Study aims – development of disciplinary competences	3.67	$p < 0.01$
Study aims – studying style	3.13	$p < 0.01$

Senior pupils' attitude towards bibliographic planning when carrying out the information source search was analyzed (table 3). During the study, the above-mentioned bibliographic planning parameters were distinguished: information source language (Lithuanian, English, Russian, German, Polish); information source newness; information source type (book, magazine), information source form (electronic, printed).

Table 3. Assessment of the bibliographic planning: senior pupils' attitudes' percentage rate

Information source search parameter	Assessment rating		
	Very often	Often	Never
Information source language	64.2	25.2	10.6
Information source newness	59.1	29.6	11.3
Information source type	20.9	35.5	43.6
Information source form - electronic	82.7	0.0	17.3
Information source form - printed	17.3	0.0	82.7

The research data shows, that from 55.2% to 70.1% of the surveyed perform the bibliographic planning (according to the rating vey often), except for one parameter – information source type. Only a fourth (24.5%) of the surveyed indicated that they regard the source type (book, magazine, etc.) when planning information search. Most of the surveyed (according to the rating very often 82.7%) give priority to electronic information sources, when they plan information search. Only 17.3% of the respondents give priority to the printed sources of information when planning information search.

A more detailed study on information search according to the language showed that respondents, when planning information search, give priority to the sources in the native language – 78.4%, in English – 50.0%, other languages – only a small percentage of respondents.

The assessment of reflexive (table1) and bibliographic (table 2) information search planning parameters shows, that senior pupils perform bibliographic information search planning rather than reflexive. $\chi 2$ (chi square) criterion (table 4) was applied to assess the statistic significance of attitudes' difference. The statistic data shows, that in most comparison cases statistically significant difference among the respondents' attitude towards the reflexive and bibliographic planning parameters was established.

Table 4. The assessment of reflexive and bibliographic planning parameters: statistic significance of senior pupils' attitude difference (The table provides statistic error probability *p* values.)

Planning parameters	Attitude to the study aims	Attitude to personal experience	Attitude to disciplinary competences	Attitude to the studying manner
Attitude to the source language	0.514	0.025*	0.014*	0.017*
Attitude to the source newness	0.615	0.027*	0.021*	0.018*
Attitude to the source type	0.022*	0.721	0.355	0.241
Attitude to the source form (electronic)	0.029*	0.015*	0.000**	0.000**

Both reflexive and bibliographic planning requires time input. However, students tend to find the necessary information fast. Answering the questionnaire's close question about the speed of the information search, most of the respondents indicated, that it is important for them to find the necessary information as fast as possible. An open question supplemented the close one, answering which the respondents had to explain, what helps them find the necessary information fast. Qualitative content analysis of the open questions helped to find, that the respondents' opinions can be grouped into three categories: "Internet", "Knowing the sources" and "Quick thinking". Most respondents think that they manage to find information quickly because they know how to use the Internet ("<…> Internet is full of search programs", "<…> I firstly use Google search and then go to various internet sites to find paper works…"). Absolute rate of the propositions is 177. In the category "Knowing the source", the respondents think that they know what they are searching for, therefore they find the necessary information quickly ("<…> I know where to search", "I search in the right sources", "…I know the literature, where I need to search"). Absolute rate of the propositions is 102. In the category "Quick thinking", the pupils think that they find the necessary information fast due to their quick thinking ("<…> I can think quickly", "I am able to concentrate quickly"…). Absolute rate of the propositions is 15.

We think that such high self-assessment of the information search speed may be determined by an imprecise understanding of the information search concept. If we understand that information search is technical search for information using electronic information search systems, we may get an impression that information search skills are simple; therefore, it is easy to master them.

We also analyzed whether the task format has influence on the information search planning. Since all the respondents studied physics, they got a question related to studying physics. The respondents had to indicate whether the task content format influenced the information search planning. According to the content format, the tasks were grouped as follows: non-integrated task of one chapter of physics, internal integrated task of one branch of physics (optics, thermodynamics, etc.), integrated tasks of two subjects (physics-mathematics), integrated task of natural sciences content (physics, biology, chemistry). It was found that the task integrity has influence on the information search planning (table 5). A bigger percentage of the respondents indicated that tasks of interdisciplinary content stimulate the information search planning.

Table 5. The role of task integrity for the information search planning: senior pupil's attitudes' percentage ratings

Form of the task content	Task content coverage	Information search planning ratings			
		Very often	Often	Sel dom	Never
Non-integrated	One chapter of physics	15.5	36.4	38.5	9.5
Internal integrated	One branch of physics	13.7	36.0	42.7	7.7
Interdisciplinary	Physics - Mathematics	14.8	41.8	39.7	3.7
Interdisciplinary	Physics–Biology-Chemistry	10.7	44.8	39.4	5.1

In order to confirm the qualitative finding about the task content integrity role for the information search planning, mathematic statistics was applied. In order to assess the rating difference of the information search planning, when performing various integrity tasks, statistic χ2 (chi square) criterion was applied (table 6).

Table 6. The role of task integrity for the information search planning: senior pupils' attitudes' difference statistic significance (The table provides statistic error probability *p* values.)

Form of the task content	Non-integrated	Internal integrated	Interdisciplinary- Mathematics	Interdisciplinary– Natural sciences
Non-integrated	x	0.000	0.000	0.001
Internal integrated	0.000	x	0.012	0.011
Interdisciplinary- Mathematics	0.000	0.012	x	0.001
Interdisciplinary–Natural sciences	0.001	0.001	0.011	x

The statistic data shows that, in most comparison cases, statistically significant difference among the information search planning ratings, when performing non-integrated and various level integrity tasks, was found. Meanwhile information search planning ratings, when performing interdisciplinary-mathematics and interdisciplinary-natural sciences tasks, in all comparison cases are statistically insignificant.

The research data shows that integrated tasks stimulate the information search planning. The information search planning is stimulated by the following factors: when performing interdisciplinary tasks, it is necessary to foresee the relations among the analyzed phenomena and objects, to be able to transfer the study material from one subject context to the context of another subject. Therefore, a student has to reflect his knowledge and experience of a subject and too foresee more sources of information. These activities stimulate metacognitive processes and reflexive planning.

Technological Factors, Which Determine Information Search

Information search planning is followed by the second information search stage – work with information sources. Educational insights of the planning stage showed that senior pupils often plan information search in electronic information sources. These insights are confirmed by other research data about the use of information sources (table 7). It was found that 92.8% of the respondents (according to the assessment rating very often and often) search for the study information on the Internet. Schoolbooks are in the second place according to the importance of the information sources. 71.1% of the respondents indicated that they use schoolbooks often and very often. Statistic significance of the rating difference of the internet and schoolbooks use in the study process was calculated. It was

found, that it is statistically significant (χ^2 =24,33; df =8; p= 0,041). Although the difference between the internet and schoolbooks use ratings is statistically significant, we cannot deny the significance of the printed textbooks. More than two thirds (71.1%) of the respondents use textbooks in the study process.

Table 7. The use of information sources: senior pupils' attitudes' percentage ratings

Information sources	Very often	Often	Seldom	Never
Verbal	17.8	47.6	28.4	6.3
Books	23.1	43.8	29.8	3.4
Magazines	13.9	32.2	47.1	6.7
Schoolbooks	31.7	39.4	24.5	4.3
Scientific articles	14.9	26.4	49.0	9.6
Internet	72.6	20.2	5.8	1.4
CD, DVD	13.0	26.9	43.8	16.3
The media	16.3	38.9	37.5	7.2

We analyzed how pupils use other electronic information sources. provided in the form of various media (CDs, DVDs). It was found that senior pupils seldom (43.8%) or never (16.3%) use these electronic information sources. It means that more than a half of the respondents do not use them. After the comparison of the use ratings (very often and often) of the Internet and other electronic sources, it was found that the Internet, as the source of study information, is used by three times bigger percentage of the respondents. The difference is statistically significant (χ^2 =47,21; df =8; p= 0,001). Comparing the use of printed schoolbooks and other electronic media according to the rating very often and often, it was found that twice bigger number of the respondents use schoolbooks. The difference of among the use ratings of the above-mentioned sources is also statistically significant (χ^2 =18,14; df =8; p= 0,021).

Conclusions

Information search planning is an important component of informational skills. When planning information search, bibliographic and especially reflexive planning, which stimulates meaningful studying, is important. When planning information search, students should raise questions, which stimulate the meaningfulness of studying. Fast information search tempo on the Internet sources limits pupils' reflexive planning skills, does not stimulate deeper insights into the task content or alternative search of information sources.

Educational processes influence the formation of the information search skills. The form of tasks, assigned for students, determines the information search planning. Interdisciplinary tasks stimulate students to plan information search, to see into the task content deeper, and to reflect the studying. Non-integrated tasks limit the information search planning. They stimulate mechanic, fast information search on the internet-electronic information search systems, however they limit meaningful studying.

Technological variety of information sources determines pupils' information search skills. Senior pupils, when searching for study material, mostly use the study resources, which are found on the Internet. Printed schoolbooks remain an important information source for the respondents. They are less popular than the Internet, however more important than other electronic media (CDs, DVDs). The use of printed schoolbooks and electronic sources reveals the tune of traditional and new teaching technologies, confirms that new electronic technologies do not deny the printed old ones, and reflects the alternation of the information search skills.

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Psychological and Pedagogical Challenges in B-Learning

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Abstract: In this article we attempt to present a review of the chain of thought and research studies which led from traditional, institutionalized education, through distance education and e-learning to the newest ideas of b-learning and complementary learning. Each stage presented its creators with certain difficulties, highlighted by research projects of which selected samples we discuss. In the case of complementary learning, the most recent development in distance education, aside from discussing the research results, we present the reader with an outlook on the problems not yet resolved, and awaiting scientific attention.

Historical Note – Distance Education

Distance learning isn't anything new. It dates back over 300 years. The forerunners of distance education were the Americans – the first press notice advertising a correspondence course based on the teachers sending training materials, exercises and written assignments to students, came out in 1700. The rapid development in technology, especially digital telecommunication, computers and satellite communication observed in the second half of XX century resulted in the advent of Multimedia, Internet and Interactive Television. All of them have increasing influence on the processes of learning and teaching. When in 1962 the first American telecommunications satellite (Telstar 1) was placed on the orbit, the era of tele- and video-conference teaching began. Through the 70s and 80s it remained the most often used form of delivering educational content over distances, particularly by academic centers. The real breakthrough and, at least until today, the peak of DE popularity came with the arrival of the Internet.

The applications of the newest achievements of information and communication technology in education in recent years are usually referred to under the umbrella term of e-learning. The rapidly growing popularity, amongst the practitioners and researchers of education alike, of a concept of delivering knowledge in a very energy- and cost-effective way is by no means surprising. If anything, it provides a knowledge delivering platform in an environment that comes to many students as a much more natural one than school or even university courses. It appeals especially to those to whom traditional education is not easily available (for either socioeconomic or simply geographical reasons), and it allows for a great deal of student independence. It is not without its flaws though.

Difficulties with Traditional Education

Traditional approach to education, or as we should rather put it, 'before distance learning' approach to education, saw the process of learning as happening in a controlled environment (school and its rules), steered by protocol (traditional didactics), addressed to a varying group of receivers (students and their individual dispositions). If the outcome of the education process can be predicted by a generic formula of [(system conditions) x (student dispositions)] (see: Krathwohl, 1993), than this meant that the results of practically any two students could not possibly be the same. Aiming for the standardization of system conditions (didactics) had to result in varying students' results simply because no two students had the same cognitive, affective (motivational) or psychomotorical dispositions for learning (Bloom, 1980).

In 1984, in an attempt to address this matter, Benjamin Bloom published "The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring". This paper reported the results of a study on what has come to be known as Bloom's 2 Sigma Problem, which shows an astonishing positive effect for the average student in conditions of one-to-one tutoring using Mastery Learning (Anderson, Krathwohl, 2001) techniques. Bloom realized one-to-one tutoring is impossible in most educational systems, and encouraged educators to study combinations of other alterable variables in the learning process that may approach the 2 sigma results. At the time of the article's publication only meager means of 'out of institution' education were available, directing the efforts of educators into designing the way of fusing traditional schooling with instructions that would be addressed to the whole group of students but would also appeal to each individual's dispositions. The resulting 'Taxonomy of educational objectives' (Bloom, 1984), listing the steps of student's progress from comprehension of the material through its application, than analysis, synthesis, evaluation and finally to actual knowledge, is until today considered the most comprehensive study explaining how and why learning experience is transferred into conscious knowledge.

E-Learning and the Difficulties It Brought About

The arrival of the Internet, and with it education delivered 'over the cable', brought many answers to the problems of 'traditional' education. Simply put, it allowed for one-to-one tutoring, so richly advertised by Bloom's followers, in a very comfortable way. It gave students freedom and it let them create their own learning environments.

The fact was that e-learning, while making it possible to maximize the individualism of the learning process, presented researchers from both the field of pedagogy and psychology with an array of questions and difficulties. In psychology, they were mainly focused on the issues of attention guiding (Jamet et al., 2008) and cognitive load experienced by the students (Moreno, Mayer, 1999) while pedagogy addressed more systemic matters of student support, help-seeking and the whole structure and didactics of e-learning (Tanaś, 2007).

In the area of attention guiding, an article by Jamet, Gavota and Quaireau (2008) reports and discusses the findings of a study on how various types of attention guiding means affect retention and transfer. Two types of often used attention guiding techniques were tested in the study, sequential vs static presentation (parts of a picture either 'popped' on the screen in a sequence to illustrate the spoken – recorded – presentation, or the picture was present as a whole during the presentation) and salient vs non-salient presentation (parts of picture either colored red when spoken and than turned gray about or remained gray during the whole presentation). This allowed for a 2 x 2 matrix to be formed for the purposes of statistical analysis. The results of the study indicated that while salience (highlighting of the objects) indeed has significant effect on the understanding and retention of the material, sequentiality's impact is not clear – in some tasks it seemed important, in others the order in which parts of the picture were presented was irrelevant. This was explained by the authors by the presence of the spoken explanation (the study measured the effects of a computer-delivered lecture) – which was said to eliminate the need to guide attention chronologically with visual clues by guiding it with spoken clues. Another interesting finding of the study was that no effect for transfer tasks (applying the newly gained knowledge to new situations) was observed for either salience or sequentiality, although there is data available that indicates quite the opposite (Craig et al., 2002) – an interesting hypothesis that attention guiding might indirectly (negatively) influence comprehension remains to be tested.

Another study, comparing the effects of interactive and non-interactive pictures on the efficiency of learning, was reported by Rasch and Schnotz (2009). Groups of students were assigned a text to learn, in four groups coupled by interactive and non-interactive pictures that illustrated the text, in the fifth group the text contained no pictures at all. The results were rather baffling, as they indicated that adding pictures to the text was neither beneficial nor harmful to learning – the students' interactions with the texts were different based on what pictures were used, but the outcome of learning remained the same. Moreover, pictures proved to be harmful to the efficiency of learning. The results of the study

contradicted both the well-established multimedia principle (that multimedia means more effective, Mayer, 2001) and the redundancy rule (Sweller, 1999) and the ensuing discussion only served to highlight how tricky and unclear the ground is for practical planning of teaching materials.

A study into how the freedom of choice in shaping the learning environment affects the effects of learning was presented by Segers and Verhoeven (2009). In the study of a group of children assigned to either complete webQuests (closed search of the Internet) or do a free-search (Google, Wiki) the authors tested their hypothesis that cued research would lead to better learning results. Indeed, after filtering out individual conditions (generic linguistic and specific writing skills, but also information processing influenced learning gains), the authors proved webQuests to be more effective, albeit only for boys.

The aspect in information processing (dealing with information overflow), cast aside in the previous study as 'individual disposition', and therefore not related to the structural research conducted, was made the key point of an extensive study reported by Ledzinska (2009). The study on a very large group of students showed that information processing, or coping with information overflow in broader terms, is a crucial factor for how information is processed, retained, used – the importance of information processing grows even more as increasing amounts of information are produced and delivered 'into' the society, and with it, into the schooling system. This is an aspect of learning so far overlooked by most researchers, who focused more on how e-learning conditions affect its effectiveness, not on how e-student conditions do that.

The evidence from those psychological studies, pointing towards the problem of students' inability to cope with actually being made responsible for the large part of their learning conditions – be is as a result of the inadequacy of the teaching techniques employed or the inadequacy of students' processing, is further supported by studies more pedagogical in their approach. Research into how students deal with this increased load of responsibility (and if they deal with it at all) was conducted by Mercier and Frederiksen (2007) proving that not only task-related, but even help-seeking behaviors in solving complicated tasks are a complex, strategic cognitive process which, to many, does not come naturally. An analysis into how science exhibition visitors acquire knowledge was presented by Knipfer et al. (2009). The authors suggest that while technology is a very effective tool for knowledge transfer in science museums, it mainly inhibits only one of the three pathways believed to partake in such transfer – namely museum-to-visitor path. On the other hand it makes the second path, visitor-to-visitor, much harder to become activated. This in turn means that while technology allows for the knowledge acquisition, it might negatively impact (Walter, 1996) the interactions that lead to knowledge comprehension. This directly corresponds with the view (eg. Katra, 1995) that for an event (experience or chunk of knowledge) to gain significance, that event needs not only to be 'lived through', but also reflected upon, and than spoken about to others (interaction).

B-Learning as an Answer and Its Key Problems

A growing number of research reports and meta-analysis led many scientists involved in e-learning (Mc Cullough et al., 2006, Tanaś, 2004, Gajda et al., 2002) to believe that the sudden shift in control over the learning process, although beneficial from Bloom's theory's perspective (as it allows the student to compensate for possible cognitive, affective (motivational) or psychomotorical deficiencies by changing the structural conditions of learning) also created a number of specific difficulties, coming from what was originally considered the upside of the whole idea – the lack of rigid rules, the lack of controlling teacher, the lack of conditions forced upon the students. E-learners, in many cases, are simply neither ready nor even aware of their lack of readiness to take control over how, what and when they learn.

The concept of b-learning originates from the above conclusion (Graham, 2005, Young, 2002). It is a concept in which the distance learning's benefits are combined (blended, hence the name) with the advantages of direct teacher-student interaction. Its initial aim was to put together the techniques employed in e-learning and those employed in traditional education, requiring the presence of a teacher. Very soon however many authors (e.g. Osguthorpe, Graham, 2003) concluded that a simple combination of those would not address the difficulties of regular e-learning. Instead, a proposition to redefine the

role of a teacher in b-learning (and possibly the role of a teacher in general) was made (Ward, La Branche, 2003). In the light of this proposition, the name b-learning becomes a little misleading.

Complementary learning, as many authors now call it, is a concept in which the teacher assumes a two-fold role. In relation to the teaching material delivered via the now (at the risk of sounding paradoxical) 'traditional' e-learning, the teacher becomes a guide, leading the student through the material, assisting in organizing it, finding learning tactics and fusing the newly acquired information with the existing body of knowledge. This directly addresses the psychological-level troubles students have with information overflow and the inability to organize it presented by Ledzinska (2006). In relation to general experience of information overflow, its availability on one hand and uncertainly of their source and value on the other, as well as to address the difficulties with self-motivation, self-control and the need of a student to create their own learning conditions, the teacher becomes a coach. That coach's role is defined, in opposition to the traditional teacher's role of a source of information (in a broader view, a source of judgment and values too), as that of a trainer of the ability to deal with information coming from elsewhere, to self-motivate and to control one's progress.

Helping students to cope with psychological consequences of information stress (extensive study by Ledzinska, 2009): disorientation, inability to integrate the acquired information into the already existing body of knowledge, the feeling of possessing only outdated (and therefore useless) information, being unable to tell important knowledge from the trivial one and the negative emotions stemming from all those – also adds to the possible tasks of such a 'redefined' teacher.

The forefront of pedagogical and psychological innovation in distance learning, having resolved most of the difficulties connected with e-learning, now faces yet another kind of problems. Those problems are strictly tied to the changes in the role of a teacher that need to happen in order for complementary learning to be successful. From the psychological perspective, addressing the consequences of informational stress alone presents teachers with a number of problems, and it is closely followed by the need to stimulate interest and motivation of a student. On the pedagogical level, the most easily apparent difficulty is that the didactics of 'teaching how to learn in the modern world' are next to non-existent, although attempts to rectify that are being made (Morbitzer, 1997). Another often raised problem is that of the teacher ethos, defining the profession as something rather opposing what complementary learning proposes (Morbitzer, 2007, Michke, Stanislawska, 2006).

B-learning, and especially its enhanced version, complementary learning, seems to be the cutting edge of today's distance education. However, while providing solution to a lot of difficulties of more traditional approaches, they at the same time force upon their followers rather dramatic changes in what we grew to consider 'normal' teacher behavior. What the 'new' teacher behavior should be, and in fact what the 'new' teaching content should be, is far from established. A number of (so far) loosely related research projects touch on the subjects very closely related to the idea of fusing the traditional and the ultra-modern teaching. The need for the development of a whole new educational theory seems to be presenting itself, especially in the face of the fact that distance learning technology keeps developing rapidly, leaving little time for systemic reflection. Developing such theory might turn out to be the most challenging tasks for educational psychologists and pedagogues alike in the nearest years.

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E-Learning and the Relevance of Digital Competencies of Teachers

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Abstract: This paper presents a historical development of distance learning and a comparison with e-learning. The advantages and disadvantages of e-learning and distance learning are discussed. Since the preparation of e-material is a demanding and time-consuming task, the article also includes a discussion about preparing study material and the characteristics of good e-materials. Quality preparation of e-materials requires qualified teachers who master, beside the manufacture of e-materials, also the use of ICT. These skills have been added to the list of teacher competencies in the last decade. We call them digital skills. The paper presents the Moodle Educational Portal, which is one of the most popular open source learning systems in the field of education. Moodle is a Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). In the conclusion, the vision of integrating e-learning into the study process at the higher education is described. This vertical connection of the entire education within the same field of expertise is very important for all three levels of users.

Introduction

Over the past twenty years, the transformation of a relatively simple computer network used by a few researchers into a global Internet, involving hundreds of millions of people and generating a new economic order, took government, business and education, by surprise.

If the Internet is changing everything, will the Internet also have the power to change universities? Organisations do not change automatically. Organisational development requires proactive human intervention.

At the University of Maribor, the implementation of e-learning is in a very active phase but the actual utilisation of e-learning depends on each individual faculty. Faculties providing programmes for student teachers must pay special attention to the implementation of information and communication technology (ICT) in their study process. Education of teachers is namely the starting point in the knowledge transfer vertical (see Diagram 1).

Digital Competencies of Teachers

Due to the necessity of using the computer in the modern educational process, teachers no longer need only conventional competencies but also knowledge and competencies of using the computer in class. Teachers decide whether to enrich their classes with (ICT) and numerous factors influence the teacher's decision whether to use the computer in class. Preparing teachers to use the computer in class already during the teacher training programme, possibilities of accessing computers and the equipment available to students play a major role.

An ICT is a competency that has been added to the list of competencies in the last decade. Faculties providing programmes for student teachers are those that transfer knowledge and competencies to teachers.

Teachers, who have concluded their studies ten or more years ago, therefore did not acquire the required competencies during their study. For these teachers, corresponding training has been organised

that has however not been provided separately according to individual subject areas. Another factor that is strongly related to the use of ICT in education is the field of teaching. Due to the specific differences of individual subject areas, the use of ICT strongly differs among teachers of different subjects.

Faculty providing programmes for student teachers

Transfer of knowledge and competencies from professors to

Educational institution

Transfer of knowledge and competencies from teachers to pupils

Pupils

Teachers acquire competencies for the use of ICT

Teachers use the acquired competencies for the use of ICT in the teaching process
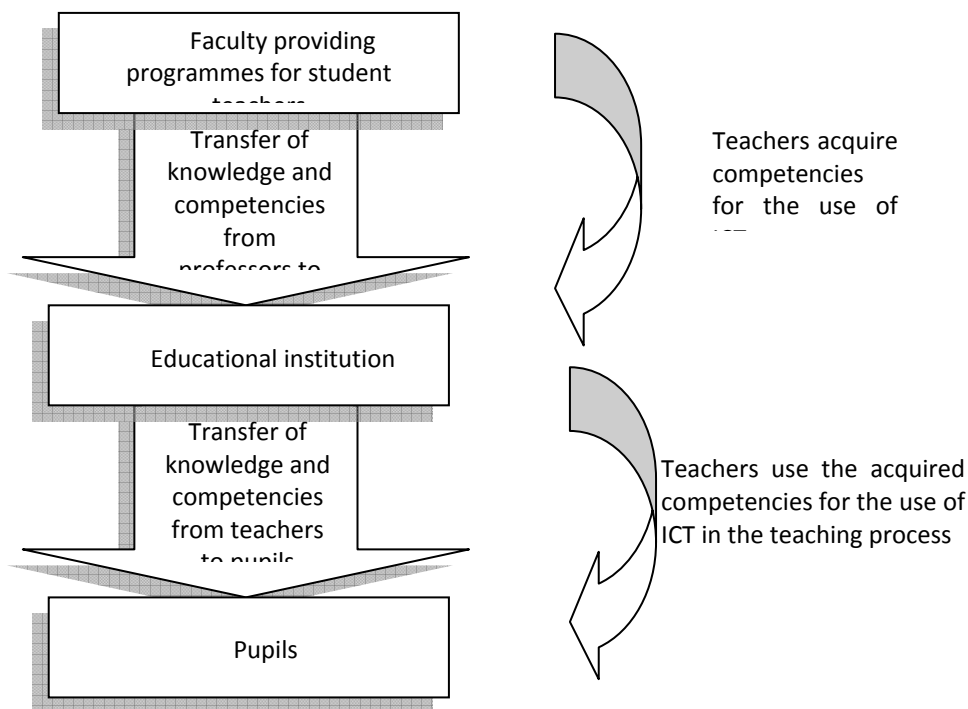
Diagram 1: Knowledge transfer vertical

Defining Distance Learning and E-Learning

As explained by Valentine (Valentine, 2002), the term distance learning is not new, but it has been around for well over 100 years. One of the earlier forms of distance learning was done through correspondence courses. In the middle of the past century technology changed and so has the definition of distance learning. Today, as stated by the author, the Internet and compressed video have taken distance learning in new directions.

Distance learning is defined as a form of education where the educator (professor) and participant (student) of the learning process are separated by space and time. The student receives the learning material that he uses to primarily prepare for the exams independently.

Taylor (Taylor, 2001) divided distance learning into 5 generations. The model of distance learning is shown in Table 1.

Table 1: Models of distance learning according to Taylor.

	Distance learning
The first generation; The Correspondence Model	*Print material*
The second generation; The Multimedia Model	*Print material, Audiotapes, Videotapes, Computer-based learning, Interactive video (disk and tape)*

The third generation; The Telelearning Model	*Audio teleconferencing, Videoconferencing, Audiographic communication, Broadcast TV/radio and audio teleconferencing*	
The fourth generation; The Flexible Model	*Interactive multimedia online, Internet-based access to www resources, Computer-mediated communication, ICT*	E-learning
The fifth generation; The Intelligent Flexible Learning Model	*Interactive multimedia online, Internet-based access to www resources, Computer-mediated communication using automated response systems*	

E-learning began after the year 2000 with the use of the Internet and ICT or in the fourth generation of e-learning according to Taylor. Today's generation of e-learning might be called the sixth generation that apart from interactive multimedia, Internet-based access to www resources and computer-mediated communication using automated response systems includes also a combination of real and virtual elements.

According to Tallent-Runnels et al. (Tallent-Runnels et al., 2006) e-learning is „any learning that is electronically mediated or facilitated by transactions software".

The generic term e-learning means the complete information support of the educational process that can be treated from different viewpoints (Dinevski, 2006):

- the information and technological viewpoint (ICT, software environment, different media);
- the organisational viewpoint (organisation of the learning process, distribution of study material, administrating the process, human resources management, support for statistical analyses);
- the didactic viewpoint (new methods and processes of teaching and learning, use of technologies for didactical purposes, new forms of constructing and methods of administering knowledge and information), and
- the professional viewpoint (development of e-learning as a special field).

Advantages and Disadvantages of Distance Learning and E-Learning Compared with Traditional Learning Process

Guri-Rosenblit (Guri-Rosenblit, 2005) stated three distinctive differences between distance education and e-learning. These relate to remoteness and proximity between the learner and teacher in the study process, relevant target populations, and cost considerations. The author explained that distance education as provided by the large distance teaching universities and e-learning are based on two different teaching/learning paradigms. While the industrial model of distance education is based on teaching large numbers of students by a handful of professors, most of whom do not communicate with the students at all, efficient e-learning encourages direct interaction between a small number of students and expert teacher/s. Distance education is aimed at students who are located in dispersed places and are physically distant from their teachers and the teaching institution, whereas e-learning can be easily utilized by both distant and on-campus students, and even more effectively by the latter. Distance education at university level in the last thirty years has prided itself for providing economies of scale as compared to campus universities, while well designed e-learning environments tend to cost even more than comparable face to-face encounters.

From the stated comparison, it is possible to perceive some advantages and disadvantages of distance learning and e-learning compared with traditional learning process. In sum, the greatest strength of distance learning is that it can be used anywhere (school, faculty, job, etc.) at any time (in the morning, in the afternoon, etc.), depending on the participant's wishes, needs and interests. It can include a large number of students, while at the same time saving time and money. On the other hand, efficient e-learning encourages direct interaction between a small number of students and teacher/s. "E-learning requires great maturity and discipline compared to traditional learning. It demands that learners interact

and collaborate which is not always the case in traditional learning. This type of learning can result in a deeper understanding and is usually preferred by adult learners" (Desai, Hart, Richards, 2008). In addition, the e-material is more attractive including elements of interactivity and much of the ICT can be used to enrich lectures and face-to-face tutorials. Despite its growing popularity, e-learning does have some weaknesses. The greatest one is the relatively high costs. As pointed out before, effective e-learning frequently costs more than conventional learning.

One characteristic of distance learning is that the learner and teacher are separated not only by space but also by time. This also means deficient direct relationship between teacher and the learner, which undoubtedly means an impaired face to face and social interaction (Desai, Hart, Richards, 2008). Especially with younger learners, a disadvantage of distance learning is evident in the lack of group social influence and the educational component. At the same time, distance learning primarily enables the acquisition of verbal knowledge and less that of skills and practical knowledge.

Study Material for E-Learning

The significance of e-learning material (e-material) lies in enabling the students a quality independent learning and self-evaluation of the acquired knowledge. The preparation of e-material is a demanding and time-consuming task.

In planning e-material, the anticipated learning objectives that are the basis for the extent of the subject matter and the choice of the assessment of knowledge are of vital importance. In addition to the subject matter, which is divided according to units and activities, e-material must include all the principal information - usually provided in the initial chapter (Dinevski, 2006):

- Brief summary; The chapter's learning objectives;
- Table of the chapter's contents;
- Anticipated time of study; Link to another subject matter (unit) or subject matters (units);
- Note on previous knowledge;

When talking about good e-material, we need to stress four aspects which determine the quality of the e-material (Dinevski, 2006).

The first one is Professional content.

The second one is Educational and didactic design of the material in the traditional sense. In its educational and didactic design, the e-learning material does not substantially differ from the conventional print material. The material needs to be designed following the same principles. This means that: the learning objectives must be clearly defined, the content must be divided into complete chapters or study units, with regard to content and didactics, the chapters or study units need to be designed so as to enable independent learning. The study material is divided into successive study units that all need to display the following fundamental structure: beginning, gist and conclusion.

The third aspect which determines the quality of the e-material is the Educational and didactic structure with regard to its electronic design. Compared to printed textbooks, the interactive and multimedia-supported e-material also has all the advantages provided by information and communication technology: audio recordings, video recordings, computer animations, simulations, etc., study navigation and different interactive aspects enabling simple and fast feedback to the student regarding his or her progress. The authors of e-material are met with different additional recommendations on what the e-material should include. Planning a user interface is a demanding task and its quality is of key importance for the success of the e-material. The standards relate to the relation between the user and the e-material and include:

- Orientation: does it provide fast and quality orientation during use (learning) – where in the material or on the learning path are we?
- Possibility of tracking: the possibility of tracking the student's progress (progress of the user of e-material) is assessed.

- Navigation: does the structure of the material enable the student a quality navigation (forward, back, out, back again to the same position, etc.) and to save the current situation and return to it?
- Additional navigational/organisational services: can the student add bookmarks, dictionaries; can he or she easily move on to other (related) study units and go back, etc.?
- Work support (help, online mentor, search engine, wizards, dictionaries, etc.)

The last aspect which determines the quality of the e-material is Technological implementation of e-material. The quality of the e-material is determined also by the technical implementation and compatibility focusing on those elements of e-material relating to the quality of the elaboration, installation, decompressing and uninstalling in different systems and environments:

- Availability of the study material (online, temporal availability, etc.).
- Installation/preparation for use: is the installation simple and fast enough? Automatic but controlled installation of additional objects (plug-in).
- Registration: is it simple and fast enough (web interface, etc.)?
- Program/environment/startup, using the e-material: is it fast and precise, does it enable saving settings and last position (when we last exited the material)?
- Uninstalling/end of use: is it fast and complete and does not require professional help?
- Interoperability: Is the object compatible with other objects and the complete system?

The Moodle Educational Portal

Moodle is one of the most popular free open source learning systems in the field of education. It is intended for all planning a longer e-learning process that will include people with rather well developed computer skills.

Moodle is alive and developing since 1999. It has been translated into more than 70 different languages. Moodle operates on different operating systems, from Windows, UNIX and Linux to Mac OS and also other operating systems supporting the PHP programming language.

Moodle has three user types: administrators, providers, and participants. The role of the administrators is to maintain the Moodle system and usually also the server running the portal. Moodle enables providers of e-learning to construct e-learning material. The providers monitor the activity of the participants, communicate with them and use e-material, while the participants use the prepared e-content set up by the provider.

What does Moodle offer the participants? It provides access to e-education, communication with providers and other participants in e-learning (through forums, chat rooms, blogs, etc.), it enables receiving exercises, seminar work and their submission to the provider of e-learning, etc. What does Moodle offer the providers of e-learning? Development of e-learning, construction and display of e-material; elaborating tests for checking knowledge; handing out exercises, homework, etc.; elaboration of a dictionary (professional terms used in e-learning); adding literature, links to other websites, adding audio and video recordings, etc.

The Vision of E-learning at the Department of Technical Education

In June 2007, the Ministry of Higher Education, Science and Technology adopted the Strategy for the Development of the Information Society in Slovenia through 2010. The strategy aims to facilitate effective use of information and communication technologies to boost the country's competitiveness and productivity and provide a balanced social and regional development and improve the quality of life of the society as a whole and of each individual. The strategy also covers the sphere of education and research which are the main activity of universities. At the University of Maribor (UM), the implementation of e-learning is in a very active phase but the actual utilisation of e-learning depends on each individual faculty.

Within the framework of the post doctoral project Analysis of the Higher Education Technical Didactics and Creating the Application Framework for Transferring Technical Knowledge project, Ploj Virtič and Pšunder (Ploj Virtič and Pšunder, 2009) in Slovenia conducted a research among teachers of Design and Technology (D&T), graduates of the Faculty of Natural Sciences and Mathematics (FNM). This research has shown that despite them not having sufficient knowledge regarding the use of modern tools for educational purposes; teachers are nevertheless inclined to the use of ICT. The finding that teachers support the use of the computer for educational purposes importantly influenced further activities related to the implementation of e-learning into the study process. The aim of this implementation is the setting up of an educational portal that not only provide e-learning to students but also enable a vertical connection among the technical education.

This vertical connection of the entire education within the same field of expertise is very important for all three levels of users. The teachers receive new knowledge and permanent education from the faculty, the students receive useful practice-oriented insight from the teachers and university professors receive feedback on the study process from the teachers which is essential information attributing to a higher quality of the study process. The educational portal thus directly and indirectly represents a means of communication for a higher quality of the study process.

E-learning at the Department of Technical Education on the FNM UM is implemented with the help of the Moodle open source system. E-material regarding individual courses will be elaborated mainly using the eXe software tool. The mentioned tools enable a broad range of learning activities and activities of providing study content, assessing knowledge, communication among users, etc.

This complex educational portal provides students:

- opportunities to access information and communication technologies;
- tools for student life: the routine use of information and communication technology in administrative dealings with students;
- tools for learning: using information and communication technologies in core educational processes;
- opportunities for students to learn about information and communication technologies and their implications in the student's area(s) of specialisation;
- the introduction of courses/specialisations in aspects of the e-world;
- the connection with teachers from their field of specialisation and the thus related exchange of useful information provided by practicing teachers.

Students are encouraged, and in many cases required, to communicate through various electronic discussion groups established for specific content areas as well as for informal social interaction. Fundamental to online pedagogy is the effective use of asynchronous CMC for ensuring effective interactivity, which is generally regarded as an essential feature of effective pedagogy. It is worth noting that there is a qualitative difference between a traditional on-campus tutorial (real-time verbal communication) and computer conferencing (asynchronous written communication) with the reflective and precise nature of the latter being very different from the spontaneous and less structured nature of oral discourse in either a face-to-face, video or audio teleconference context.

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Track 3 - Life Long Learning

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Towards the Reflection of Virtual Learning Environment

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Abstract: The paper deals with research activities run at the University of Hradec Kralove, Faculty of Education and Faculty of Informatics and Management, Czech Republic, which relate to information and communication technologies implemented in the process of instruction in various subjects. Particularly the role of a virtual learning environment (VLE) is mentioned and discussed, and information about core current projects is provided. The project work is understood to be a tool of VLE reflection, which is considered both from generally accepted points of view, and new approaches are also introduced.

Introduction

Currently, the implementation of information and communication technologies (ICT) into the process of instruction and forming a virtual learning environment are crucial aspects of developing educational projects, forms of education and designing e-learning products. These processes depend on the level of school technical equipment and computer literacy of students and teachers. It appears quite frequently that psychological, educational, didactic and didactic-technological aspects of preparation and running courses, evaluation of various virtual learning environments are the matter of research. Conferences, seminars and competitions are held focusing on e-learning, distance education, e-communities etc. Criteria of evaluation applied on e-learning courses in concrete virtual environments mainly focus on following features:

- Course content, i.e. how the educational objectives are defined, general course design, arrangement and originality, implementation of multimedia components, quality and adequacy of additional study materials.
- Ways of activating students, i.e. what tools are applied in communication, team work, application the knowledge in real life.
- Evaluation of planning and running activities according to the Syllabus and Calendar.
- Feedback provided via tests, self tests and scheduled assignments.

This "operating" and in the virtual learning environment pre-defined framework, conditioned by strict accepting algorithm procedures, forms a pragmatic position of courses, their successfulness, efficiency, accessibility, interconnection and succession to other sources. Forming educational co-operating e-communities is in a certain sense the result of designers, both of the virtual learning environment and single e-courses. The possibility to continuously update the course content, engage new participants and relate them to others, broaden the space and time available to study are considered to be contributive, as well as the number of course participants who can be educated at once, the open access to systematic education for handicapped students etc. On the other side, objections appear against the trend of ICT implementation to the process of instruction, resulting from neo-phobic approaches in general, from fears of technization, depersonalization, algorithmization,

undue rationalization, economization, and in a certain sense fears of a possible simplified approach to world, people and themselves. Technical scientist civilization considers the ICT an optimal tool for efficient and productive education towards the further development. The question, asked by philosophers, educators, psychologists, e-course designers and educants, is the question aiming at the content of education in differing world, and consequences of reducing the "being education" (i.e. education of man as the whole) to education for technocratic, bureaucratic civilization, for roles we play and have to play if we want to succeed (e.g. Palouš, 2009). Thanks to their potential the ICT and educational courses do not constrain the "being education", because they can substantially respect the necessity of setting student-oriented, teacher-oriented and content-oriented educational objectives. They can individualize the instruction from the point of pace, standard and non-standard educational offer. In the future the ICT do not have to be understood as a tool of technocratic dictate. ICT-based virtual learning environments can take into account value, emotional, ethic and aesthetic relations and consequences of cognitive contents, and thus contribute to personality development.

Authors contribute to the reflection of virtual learning environment by solving several research projects, e.g. "Interaction of real and virtual environment in early science education", "Evaluation of the modern technologies contributing towards forming and development university student competences", "A flexible model of the ICT supported educational process reflecting individual learning styles", and they have prepared a new project "Contexts of e-learning. Reflection of the Virtual (Learning) Environment in Education" dealing with other, not so commonly researched areas and approaches to e-learning contexts. The latest results of the projects are provided and discussed below. The field of e-learning is in the centre of pedagogical attention because of continuous search of new ways in education, and new strategies applying the information and communication technologies.

Project Work

The current society offers people new chances but at the same time requires new competences from them. In the last decade the lifelong professions were disappearing, and competences aimed at one profession have become useless and non-contributive. It is necessary to find, define and develop such competences which will be useful in most (still unknown) professions, which enable solving (still unknown) problems, prepare man to cope with fast changes in professional, private and social life. It is not a private matter, but it requires a kind and helpful social environment.

University of Hradec Kralove (UHK), led by the Faculty of Informatics and Management (FIM), belongs to active new competence providers, project applicants and supporters of project work. It has been offering the staff (both academic and administrative) courses towards developing required competences, mostly in the distance electronic way for a decade, and the whole process of ICT implementation is closely connected to project work. It started at the beginning of 1990s by using shared directories where study materials were presented. Step by step the importance of electronic mail increased for communication between students, and students and teachers, then other services followed - electronic administration of credits and examinations, displaying syllabi, timetables, entrance exams results, university websites were designed and e-magazine Telegraph published. Teacher's websites supporting instruction appeared, and in 1997 nearly 25% of teachers used them. Then the professional virtual learning environment Learning Space was bought, in 2001 it was replaced by WebCT. First distance on-line course was designed in 1998 within the Tempus Project MUDILT (Multimedia and Distance Learning for Teachers). Thanks to this project the first team was created which started to deal with this field actively. In 2000 within the Tempus Project PATTER (Public Administrators Training Towards EU) the ECDL (European Computer Driving Licence) course was the first one prepared in the electronic distance form, other courses follow. In 2001 the Institute of Further Education was established to offer the courses to public. Experience gained in designing and running these courses resulted in the OLIVA Project (On-LIne VýukA, on-line learning) targeting at university students. Consequently, that was why the process of training teachers in designing and running on-line courses started. New courses for university students appeared. First, in the field of Informatics, Economy and Management, then in foreign languages, Psychology, Ethics etc. Some of them were designed for distance education, others

supported present lessons. In January 2010 more than 170 courses are accessible in WebCT; 2,000 students of FIM use more than 10,000 chairs. Thus the WebCT implementation in the instructional process has become common standard, for both students and teachers. All WebCT users were trained in effective designing and teaching or studying, the newly interested have chance to gain this competence continuously. Training courses for teachers, future course tutors, are often run in the distance form where participants are in the position of students. It provides them important experience. Currently, having undergone the starting period of material and technical problems, the time came to deal with didactic aspects of ICT implementation into the instructional process. And what are the results?

- Are teachers able to apply suitable methods and forms of instruction, create and use appropriate didactic means which are offered by new technologies?
- Do students have higher level of knowledge if they attend lessons managed by ICT or run traditionally by teachers?
- Are the new didactic means (methods and forms supported by digital technologies) able to optimize the cognitive process of creating knowledge?

University of Hradec Kralove carried out several important project activities in co-operation with other Czech and international universities. In last five years the projects concentrated on interuniversity study based on virtual mobilities. Students can enroll at selected courses of any partner university and study the subject. The successful projects are e.g.:

- the RIUS Project (**R**un-up of **I**nter**U**niversity **S**tudy in selected universities in the Czech Republic, CZ.04.1.03/3.2.15.1/0067, https://www.uhk.cz/fim/projekty/1360) and
- the EVENE Project (**E**rasmus **V**irtual **E**conomics&Ma**n**agement Studi**e**s, 2005-3857/001-001, https://www.uhk.cz/fim/projekty/1740).
- The REKAP Project (**R**ozvoj **e**-learningových **k**ompetencí **a**kademických **p**racovníků, CZ.04.1.03/3.2.15.3/0406, https://www.uhk.cz/fim/projekty/2080) deals with ensuring the continual process of developing e-learning competences of academics at university.

Currently Running Projects

As mentioned above, information and communication technologies and e-learning have become standard for both the teachers and students, and researches proving the efficiency and users´ satisfaction are available (Bílek & Skalická, 2009); (Bílek, Poulová, & Šimonová, 2009). The team dealing with this field consists of academics of the Faculty of Education (M. Bílek) and Faculty of Informatics and Management (P. Poulová, I Šimonová) being supported by specialists from other branches. The three-year projects the team is working on are supported by the Czech Science Foundation (GA ČR). Projects intentionally are of similar structure, methodology and outcomes so that results could be easily generalized and recommendations provided to the wide range of users.

The project *"Possibilities and Limits of Real and Virtual Environment in Primary Science Education"* arose from today's situation when the Science teacher is expected to master not only his/her field and subject, but also have basic knowledge in Informatics and applied software. Progress in digital technologies and their applications in natural science and technical fields are rapid, so it cannot be expected teachers will minutely master most of the offered products. What is expected, it is general knowledge and orientation in principles, and paying more attention to perspective information systems according to the subject they teach. Focusing on new didactic means, both material and non-material, and their application into the process of instruction in a certain subject in theory and practice belongs to the field of didactics. It is not acceptable to define didactics as an intersection of a subject (branch) and didactics only, but it is necessary to discover wider relations and contexts. Currently, a new item has appeared connecting all field didactics – technology of education. This new stimulus should facilitate the implementation of latest technologies into the instruction. Simultaneously, it is possible to advocate that two sciences function each other as methodologies, mainly in situations when the science reflecting simpler fields of phenomena carries out the function of methodological tool towards the other science

which solves more complicated problems. When using this approach it is necessary to realize that apart from specific functions (originating from natural sciences), computers can also have another function, i.e. a didactic one. This results in the main objectives of the project which are as follows:

- Analysis of results in blended real and simulative experiment in natural science instruction abroad.
- Researching the effectiveness in application of selected simulative and animating experiments in primary chemical education by applying pedagogical research methods, especially direct and indirect observation, interview and pedagogical experiment.
- Researching the influence of preconcepts, individual learning styles and other pedagogical-psychological phenomena of effective learning on application of simulations and animations in primary Chemistry instruction.

This project is solved in three phases, starting from bibliographic search and concept activities. Results have been partly published in a monograph containing survey studies of authors participating in the project and other addressed national and international experts; it was published by the Faculty of Education, University of Hradec Kralove, in edition "Didactics of Science and Technical Subjects"; partly the research concept was specified according to the analysis results, i.e. preparation and choice of materials suitable for research activities (in the form of school chemical experiments and their simulations, including practice sheets) and tools for collecting data empirical research activities (Bílek et al., 2009).

The orientation of project "Evaluation of the modern technologies contributing towards forming and *development university student competences*" arose from the current state in the society (Poulová, 2005). Its changes are defined by generally acknowledged theses of fast development of ICT and their influence on the educational process, globalization of the world and the necessity of new key competences, availability of education and its influence on changes in lifestyle. The project aims at working up the theory of educational science on university level in the field of electronic education. Its main objectives are as follows:

- To find out the impact of different ways of the instructional process management on the quality and durability of students´ knowledge, i.e. research students´ results in the process of instruction managed by ICT, or by a real teacher.
- To evaluate the quality, meaningfulness, effectiveness and limits in the field of ICT implementation in the instructional process, present proposals to its optimum choice and extent.

The project started with the pedagogical experiment dealing with comparison of study results in the present and distance form of instruction. Students´ knowledge was tested before the process of instruction started by a didactic test evaluating the entrance level of knowledge (pretest), then when it finished (posttest), and after a three-month period. According to the collected data the project will result in recommendations towards improving the efficiency (quality) of the process of instruction run in both ways. The first phase resulted in a monograph of bibliography survey of authors-project solvers and other outstanding experts in this subject field (Šimonová, Poulová, & Šabatová, 2009). The second phase was and will be divided in two parts (12 months each) in which the experiment was and will be organized twice (in 2009 and 2010). Then results of both experiments will be compared and conclusions presented. The final period will be devoted to summarizing final results. The research group consists of students of University of Hradec Kralove, Faculty of Informatics and Management and Faculty of Education. Outcomes are expected in the field of educational science where appropriate proposals towards optimizing the process of instruction managed by LMS will be provided according to the gained results, and in the field of publishing activities where two monographs will be published.

Another related topic is mentioned in the project *"A flexible model of the ICT supported educational process reflecting individual learning styles"*. Teaching and learning styles play an important role in the instructional process (Lašek, 2006), (Mareš, 1998), especially if it is managed by a virtual learning environment, as they offer designers a wide range of tools which accommodate all learning styles, and

students can choose those activities which suit them best. In spite of this advantage, there exist several conflicting ideas concerning practical application of learning styles which should be taken into consideration, so teachers´ and students´ awareness of styles may help substantially (Felder, 2010).

The main project objectives are as follows:

- To adapt the Learning Combination Inventory (LCI) (Johnston, 1996) the conditions of Czech university education, and pilot it. Run an experiment to find out whether using such methods of instruction which reflect individual learning styles results in significantly higher level of students´ knowledge in comparison to the traditional, majority way of instruction.
- To evaluate the quality, meaningfulness, effectiveness and limits of ICT/LMS implementation in the instructional process, and present proposals to its optimal contribution and extent.

A monograph dealing with the process of cognition and learning from the point of instruction (educational science), psychology, frequently used models defining student's learning styles, and tools provided by ICT towards accommodating student's needs will belong to the first outcomes. Then the process of determining students´ styles will run. According to the results students will be provided an electronic distance course offering a wide range of activities accommodating various learning styles. A newly designed electronic application will provide students the most appropriate activities according to student's individual learning style and monitor what materials they really use (Kulič, 1992). Finally another monograph will be published presenting the received results and recommendations, partial results will be continuously published on conferences and in journals. Students from all faculties of the University of Hradec Kralove will participate in the project. Their learning style will be determined by the adapted LCI in Czech language, their knowledge monitored by didactic tests evaluating the entrance and final levels of knowledge (pretest and posttest). According to the gained results appropriate proposals towards optimizing the instructional process in reference to individual learning styles will be provided. Partial project results will be published in journals and in conference proceedings.

Project Work in the Future

The project *"Contexts of e-learning. Reflection of the Virtual (Learning) Environment in Education"* will examine and evaluate a VLE from the point of philosophy, axiology and ethics. Psychological, educational, didactic and didactic-technological aspects of e-learning have been relatively frequently researched, while generally-epistemological, axiological and ethic relations usually have not frequently been a subject of reflection. If they are reflected, then it is done randomly only, or some authors apriori reject such a claim.

The above mentioned project team is led by Ilona Semrádová, Head of the Applied Linguistics Department, FIM, UHK.

The pre-defined framework of a virtual learning environment conditioned by strict accepting the algorithmized procedures forms a pragmatic position of courses, their successfulness, efficiency, accessibility, interconnection and succession to other sources. Currently, no complex concepts are available dealing with this field. Only isolated partial contributions appear which continue constructivist ideas in education, or mention e-learning cursorily, e.g. Liessmann, 2008.

The project main objectives are to identify and articulate philosophical, particularly axiological and ethic dimensions of e-learning; to set and define criteria of e-learning product evaluation which would taken into account contexts of using a virtual learning environment in education; to define the term of e-learning in the narrow and broad sense of the word; to set basic attributes of optimal educational practice from the philosophical point of view, while taking advantages and limits of e-learning into account; and last but not least to record basic trajectories, motivating incentives, experience of e-learning participants in different roles (teacher – tutor – course designer – student – administrator – technician – manager of the e-learning concept in the university institution).

Conclusions

Current orientation of university education, which is changing under the influence of latest technology development and new key competences, can be researched from various, different points of view. Education supported by ICT has been spreading because of growing popularity of digital technologies in general. Another reason is it enables easier and more complex realization of the instructional process, offers choice of place, time and pace for studying, allows an individual approach to students preferring various learning styles. These are the key values important for the effectiveness of the process. Material and technical requirements having been satisfied, strong attention must be paid to didactic aspects of the instructional process. To contribute to this process is the main objective of these projects.

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Continual Education of Teachers by the Means of Accredited Educational Program with E-Learning Support

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Keywords: educator, lifelong education, continual education, e-learning, lms moodle

Abstract: The following contribution deals with the continual education of Primary school teachers, particularly by the content of educational programme with an e-learning support created at the Department of Informatics at UKF in Nitra. The continual education Act as a part of whole-life education is effective from 1.november 2009. It solves a task of systematic process of acquiring knowledges, capabilities, skills on standard function of pedagogical and specialized activity or supplement of professional competences of pedagogical and specialized employees. These competences are necessary for completion qualified conditions of pedagogical and specialized employee. The educational continual programmes are based on acquiring the definite number of credits and also on support of carrier growth of teachers in contrast with previous educational activities in postgraduate education with achieving of certificate after graduation, which did not solve other carrier growth neither teachers compensation packages. After taking effect of continual education Act, many educational institutions started to create and offer programmes of various kinds. The selection and accreditation of each educational programme depend on new-coined accredited commission of Ministry of education of Slovakia. The hypothesis about subject fields of UKF which will be supported by positive judgement of educational content and following accreditation is noticeable. The programmes of informatic character will have more difficult position, because many public either private institution had been offering various courses and activities which were focused on acquiring computer skills by achieving of standard necessary for certificate ECDL. By the time this interest had declined. The Department of Informatics as a consequence of previously mentioned problem, decided to develop continual educational program which would increase basic computer knowledges of teachers. The concentration was focused mainly on those products which will support innovating teaching methods by using project teaching in daily practice of primary school teachers. The training activity Press enter accredited by the accredited commission by the end of the previous year. It is based on combined form of education with the e-learning support. It contains topics relating to the knowledges of orientation in virtual space and sphere of hardware and personal security and its extending. The attention is paid to children's safety using an internet space for various activities. The security knowledge or copyrights abusing have also connection with virtual space. One of the topics is also the creation of own web pages by normal way or with the help of models, patterns of various commercial or non-commercial institutions. Attractive and good quality presentation on own web site is not going without any knowledges from graphic sphere. The knowledges from multimedia are also closely connected with it. The knowledges of systems LMS sphere for teaching operation are the right orientation in scholarship market.

Úvod

Kontinuálne vzdelávanie svojim významom vypovedá, že ide o vzdelávanie pokračujúce, čiže postgraduálne. Predstavuje vzdelávanie určené skončeným učiteľom, ktorí zastávajú miesto pedagogického zamestnanca v školskom prostredí. Kontinuálne vzdelávanie sa zameriava na modernizáciu a inováciu každodenného vzdelávacieho procesu v základnom, strednom alebo aj vysokoškolskom prostredí. Tento novoprijatý zákon sa týka sa nielen ďalšieho vzdelávania pedagogických zamestnancov ale rieši aj otázku ich postavenia a ďalšieho kariérneho rastu.

Význam kontinuálneho vzdelávania

Kontinuálne vzdelávanie, podľa zákona, rieši otázku sústavného procesu nadobúdania ďalších spôsobilostí, vedomostí, zručností na štandardný výkon pedagogickej a odbornej činnosti alebo dopĺňania si profesijných kompetencií pedagogických zamestnancov a odborných zamestnancov. Tieto kompetencie sú potrebné na splnenie kvalifikačných predpokladov výkonu pedagogického alebo odborného zamestnanca. Kontinuálne vzdelávanie, tak ako hovorí zákon, predstavuje nadobúdanie vedomostí a zručnosti z pedagogiky, psychológie, aprobačných predmetov alebo zo študijných odborov, iných oblastí súvisiacich s výkonom pedagogickej činnosti alebo s výkonom odbornej činnosti (1).

Ako sa týka tento zákon vysokoškolských vzdelávacích inštitúcií? Akým spôsobom môžu vysoké školy prispieť k aplikácii tohto zákona do praxe základných a stredných škôl?

Uskutočňovanie kontinuálneho vzdelávania pripúšťa zákon vykonávať formou prezenčnou, dištančnou alebo kombináciou prezenčnej a dištančnej formy, čo nazývame aj blended learningom. Už samotný názov napovedá, že sa realizuje s podporou informačno – komunikačných technológií, ktoré sú už v súčasnosti prístupné a používané vo vzdelávacích ustanovizniach.

Druhy kontinuálneho vzdelávania definuje zákon nasledovne: aktualizačné vzdelávanie, inovačné vzdelávanie, špecializačné vzdelávanie, funkčné vzdelávanie, kvalifikačné vzdelávanie, vzdelávanie na doplnenie kvalifikačných predpokladov.

Všetky spomenuté druhy vzdelávania môže poskytovať iba vysoká škola alebo organizácia zriadená ministerstvom, na zabezpečenie alebo plnenie úloh v oblasti kontinuálneho vzdelávania.

Základné, stredné, stredné odborné školy, cirkev alebo iné právnické osoby nemajú zákonom dané vykonávať všetky druhy kontinuálneho vzdelávania, majú tieto práva obmedzené.

Podstatným znakom kontinuálneho vzdelávania, na rozdiel od predchádzajúcich druhov a foriem vzdelávania sa stala skutočnosť, že jeho úspešným absolvovaním získa účastník vzdelávania určitý počet stanovených kreditov. Získané kredity sa budú účastníkom napočítavať k získaniu plného počtu kreditov, potrebného k ich kariérnemu rastu. Kredity sa prideľujú nasledovne: za každých 5 hodín sa počíta jeden kredit za absolvovanie aktualizačného vzdelávania a inovačného vzdelávania, špecializačného a kvalifikačného vzdelávania. Kredity sa neprideľujú za adaptačné vzdelávanie, za prípravné atestačné vzdelávanie, funkčné a funkčné inovačné vzdelávanie, špecializačné a špecializačné inovačné vzdelávania na výkon činností triedneho učiteľa a uvádzajúceho pedagogického zamestnanca alebo odborného zamestnanca a kvalifikačného vzdelávania.

Povinnosťou školy a školského zariadenia, je poskytnúť priestor iniciatíve učiteľa aj umožnením prezentovania inovačných postupov svojej práce, medzi ktoré sa zaraďuje najmä autorstvo alebo spoluautorstvo schválených alebo odporúčaných učebných pomôcok vrátane počítačových programov, učebníc, učebných textov, metodických materiálov a pracovných zošitov, iné tvorivé aktivity súvisiace s výkonom pedagogickej praxe alebo výkonom odbornej činnosti, napríklad výsledky výskumu, patenty, vynálezy, odborno-preventívne programy, odborné články publikované v odbornej literatúre (1).

Na fakt o novoprijatých formách vzdelávania nezareagovali iba vysoké školy, ale najmä metodické centrá a ďalšie vzdelávacie inštitúcie, štátne aj neštátne, ktoré začali pripravovať rôzne typy vzdelávacích programov, určených pedagogickým zamestnancom v praxi. V mnohých prípadoch sa jedná o vzdelávacie projekty, finančne podporované Európskou úniou.

Katedra informatiky upriamila svoju pozornosť na tvorbu vzdelávacieho programu, ktorý samozrejme priamo vychádza z jej podstaty a úzko súvisí s informačno-komunikačnými technológiami. Pri tvorbe vzdelávacieho programu, tím odborných pracovníkov sledoval najmä cieľ, aby obsah vzdelávacej aktivity bol naplnený tak, že po jeho absolvovaní napomôže účastníkom inovovať, aktualizovať a modernizovať každodenný vzdelávací proces so značnou podporou IKT, či už na základných alebo stredných školách.

Motivujúcim prvkom by sa malo stať nielen získanie kreditov, ale rovnako dôležitým motivačným prvkom je zaujímavo a pútavo spracovaný vzdelávací e-learningový priestor, poskytnutý pre vzdelávanie v LMS Moodle. IKT by mali byť v súčasnosti už skutočne ďalšou pravou rukou dnešného pedagóga, bez ohľadu na vekové rozpätie.

Prieskum

Doposiaľ mnoho inštitúcií, ponúkalo rôzne kurzy a aktivity, ktoré boli zamerané najmä na získavanie primárnych počítačových zručností, vychádzajúcich z dosiahnutia štandardov, potrebných na získanie certifikátu ECDL. KI mala a má taktiež akreditáciu na získanie certifikátu ECDL a pripravovala účastníkov ECDL k úspešnému ukončeniu vzdelávania.

Postupom času však záujem zo strany verejnosti o tento druh vzdelávania ochabol. V prieskume nás preto zaujímalo, akými spôsobmi získali učitelia počítačové kompetencie. Predkladáme tieto zistené výsledky v grafickom znázornení:

Otázka č. 1:
Akou formou ste absolvovali vzdelávanie?
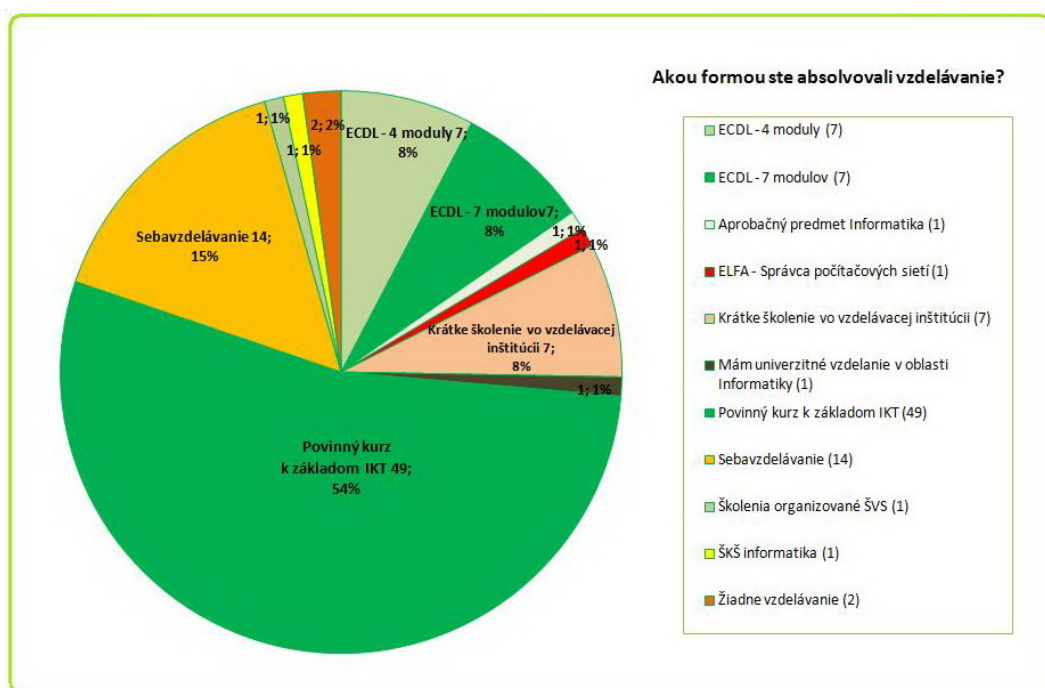
Odborní pracovníci Katedry informatiky majú už dlhoročne overené skúsenosti s prácou v prostredí e-learningového vzdelávacieho systému LMS Moodle. Tento systém väčšina pedagógov využíva na podporu dennej aj externej formy výučby s tým, že podpora e-learningu im dáva možnosť skvalitniť a zefektívniť vzdelávací proces z hľadiska času, priestoru, výhodnej komunikácie a ďalších podpôr, ktoré umožňuje LMS Moodle.

V minulom roku sa KI zaradila medzi katedry Fakulty prírodných vied UKF v Nitre do projektu „Od prezenčného k dištančnému vzdelávaniu". Zmyslom projektu bolo práve spracovanie tematických celkov alebo samostatných odborných tém tak, aby sa tieto mohli využívať ako e-learningová podpora vzdelávania pre všetkých pedagogických pracovníkov.

Vzdelávacia aktivita pod názvom „Potvrďme to Enterom s podtitulom Multimédiá v projektovom vyučovaní" bola tvorená v období návrhu a realizácie ešte pred prijatím zákona o kontinuálnom vzdelávaní.

Bola vypracovaná, ako vzdelávacia aktivita, bez možnosti prideľovania kreditov. Vychádzala zo zákona č. 567/2001 Z. z. o akreditácii vzdelávacích aktivít. V tomto duchu bola aj akreditovaná Akreditačnou komisiou Ministerstva školstva SR, v septembri 2009. Jej ukončením nezískajú účastníci vzdelávania kreditné hodnoty ale certifikát o absolvovaní.

Vzdelávacia aktivita v rámci celoživotného vzdelávania, bola spracovaná do 6 tematických celkov, logicky na seba nadväzujúcich:

1. Prvé kroky s IKT v internetovom priestore
   Bezpečne na internete
2. Učiteľ ako manažér vzdelávania
   E-learning a LMS Moodle
3. Počítačová grafika
4. Ako tvoriť jednoduché multimediálne aplikácie
   Autorský zákon
5. Vytvorme si webovú stránku
6. Príprava multimediálneho projektu pre podporu projektového vyučovania

Otázka č. 2:

Mali by ste záujem o vzdelávací program (kombinovanou formou) s nasledujúcimi tematickými celkami?
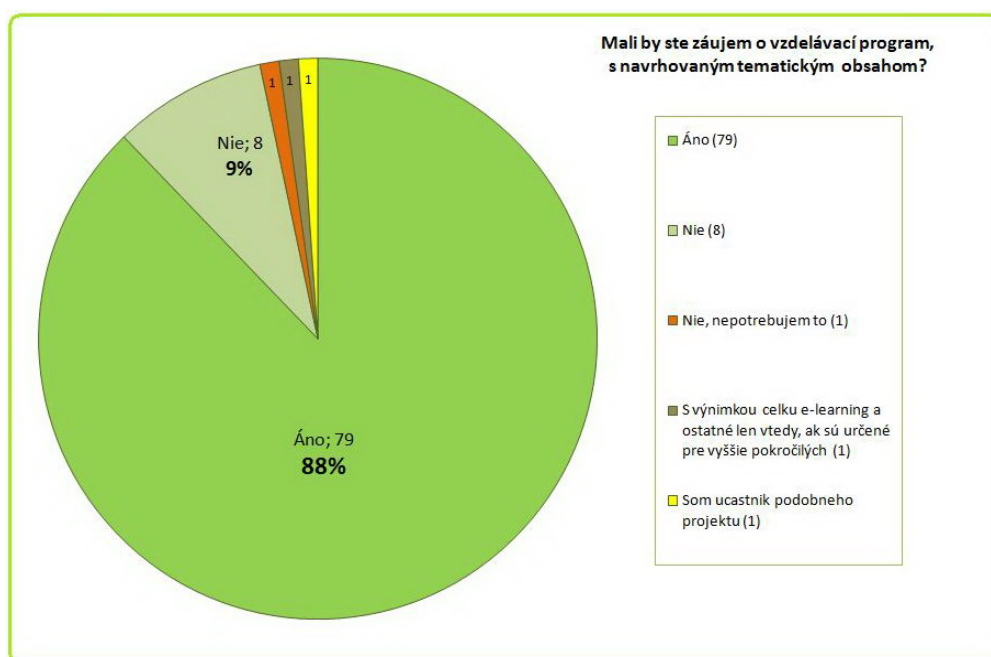
Otázka č. 3:

Boli by ste ochotní venovať tomuto vzdelávaciemu programu 2 semestre na vysokej škole, kombinovanou formou vzdelávania?
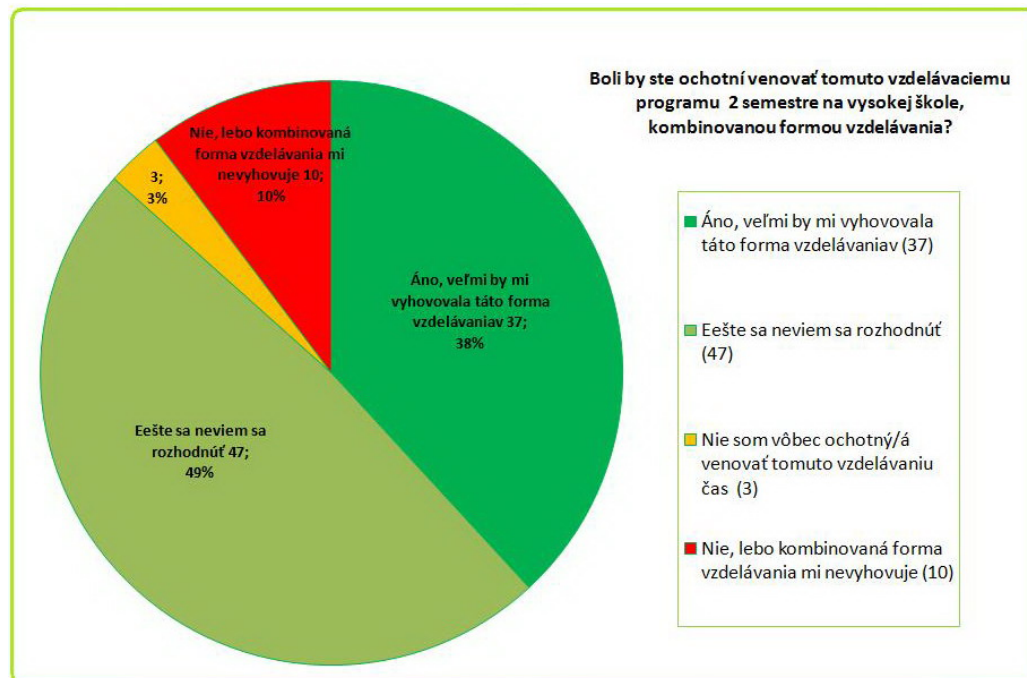
Záver

Pripravujeme sa a aj to očakávame, že po overení (ukončení) pilotného projektu vzdelávacej aktivity pedagogickými pracovníkmi UKF, budeme musieť realizovať určité úpravy a zmeny, podľa relevantných a korektných pripomienok absolventov. Až takto upravený vzdelávací progam predložíme opäť Akreditačnej komisii MŠ SR na akreditáciu.

Očakávame, že novoakreditovaným vzdelávacím programom obohatíme platformu štúdijných programov v oblasti celoživotného vzdelávania na UKF.

Veríme, že ak oslovíme pedagógov - učiteľov v praxi, budú mať záujem tento o druh aj formu kontinuálneho vzdelávania. Ak bude vzdelávací program úspešný, čomu veríme, prinesie mnoho pozitívneho jednak tvorcom – tútorom vzdelávania, ako aj samotným účastníkom.

Poďakovanie

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E-Learning in the Courses of Life Long Learning

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Abstract: Information and communication technologies (ICT) have become a very important part of our everyday lives. Thus the ICT skills have become an essential need for everyone who wants to benefit from innovation of today's world. On the face of it, we can say that ICT play an important role especially in education. ICT can help to transformation of learning environment – it enable new ways of teaching and learning, it helps to constitute a shift from a teacher-centred pedagogy to a student's active learning and has changed much more aspects of traditional pedagogy. E-learning encompasses all forms of Technology-Enhanced Learning or Web-based learning including computer based learning, computer based training and computer-supported collaborative learning. E-learning is usually suited to distance learning but can also be used in conjunction with face-to-face teaching (blended learning). In higher education we can see the increasing tendency to work in virtual learning environment or multiuser virtual environment in which all study processes are handled through a consistent user interface. Various forms of e-learning provide benefits especially in the case of life long learning students. It is convenience and flexibility to learners first of all which means that learners are not bound to a specific time or place to physically attend classes. The Department of ICT education of the Centre for Lifelong Education (Faculty of Education, Palacky University in Olomouc) provides for last 4 years the life long courses for teachers focused on the use of ICT in education of different subjects (English language, Czech language etc.). Our courses are focused on development of basic ICT skills and its creative use in classroom. To help our learners develop ICT skills also in the area of e-learning activities, the courses have been realized as a blended learning which means the part of face-to-face teaching and study in the Learning Management System Unifor. On the base of our experiences from the courses since 2006 we can note that the majority of teachers usually come with basic ICT skills (which mean the work with MS Office software, work in Internet network (mail, chat, internet sources searching) or work with an education software). They are less skilled in the area of work with interactive whiteboard or using Web 2.0 tools (mostly it is a passive work with "wiki" tools or multimedia storages as YouTube etc.). The majority of the learners are not able to work with ICT in a creative way which means that they have created their first online blog or the first published webpage in our seminars. Therefore we find it beneficial to teach our learners how to work with ICT actively to be able to use the virtual environment in their own communication with their pupils (by creating online education objects or online school magazine etc.). E-learning in LMS also enables our teachers to develop their ICT skills by the use it within the educational process and help them to better understand the digital educational object structure.

Introduction

"***When it comes to helping them learn how to be citizens in a democracy, media literacy education is central to 21st century civic education.*" (H. Rheingold, 2007).**

Nowadays we live in an increasingly digitalized culture – it has also an influence on many areas of everyday activities. Information and communication technologies (ICT) have recently become also a very important part of how people interact with each other. On the face of it, we can say that ICT play an important role especially in education. Computer Assisted Learning (CAL) nowadays represents one of significantly developing area, especially in the meaning of academic and further education. In connection with development of ICT itself and its superior hardware and software equipment, new ways of its use in education are emerging, particularly then in the area of e-learning.

E-learning in Education

E-learning, in its wider meaning, means classical teaching with the use of computer, in closer meaning denotes real virtual school (Fojtík, 2001). According to Sebera (Sebera, 2010), e-learning can be more simply defined as "any use of electronic, material and didactic means to effectively reach the teaching aim taking into account realisation particularly/not only by means of computer networks". On the basis of possible internet connection, there can be distinguished online and offline teaching as it is not necessary to be connected online. Online teaching can then take its course synchronically (real time) or asynchronically. Within the synchronic way of teaching can be used online tools for direct communication between the teacher and student (instant messaging, chat etc.). The most common communication tools of asynchronic teaching are email or discussion forums, in other cases is taken into account work with different data discs (CD, DVD, USB etc.).

Learning Management Systems (LMS) have become these days personalised virtual study environment in which student can find not only courses, tests, instructions how to study but can also participate in discussion forums to single topics or consult with peers or teachers some unclear parts of the content of the lesson in the same way like he was in the real class. To create such a "virtual class", meaning high quality on-line learning course, it is needed much more than just to transform teaching materials into electronic form and upload them to the internet network. It is important to create an environment which can, as much as possible, retrieve classical teaching instrument. For this purpose special applications are being developed and are based on high quality database support. There is a list of different products nowadays in which it is possible to create virtual learning environment (e.g. Microsoft Learning Gateway) or substantial amount of commercial LMS, e.g. WorkPlace Collaborative Learning or open source systems (e.g. Moodle, Sakai, Cybeo etc.) which connect possibilities of classical teaching with the help of texts, animations, audio and video materials with means of offline or online electronic communication.

E-learning in Multi-user Virtual Environment (MUVE)

To the area of new trends in e-learning can be assigned also the use of simulations in the real environment in virtual reality which works as a platform for interactive and collaborative teaching – MUVE. It is defined as virtual 2D or 3D environment presenting simulation of the real environment (Brdička, 1999). It shows the integration of up to date used forms of on-line communication and becomes a medium through which it is possible to create social interactions being very close to communication in the real world. Collaborative hypermedia environment, which is represented by MUVE, implements the majority of he above mentioned aspects of e-learning – they are object oriented systems in which communication proceeds in real time, e.g. through audio or video conference or in interaction through 3D graphic representations (avatars). In comparison to previous types of electronic communication (e-mail, text or video chat), which is used to communicate separately, communication in MUVE environment integrates all these types and increases the effect of the online communication. "User represented by avatar is located in particular virtual environment; his location is visible also for the other users which leads to arising of social presence." (Říha, 1999) User in MUVE can observe communication of other users, can move to chosen user in a second which helps to communicate in the very similar way like in the real environment. MUVE can be considered as constructive environment because it is not only the source of information but it is also dependent on the contact with other people which corresponds to contemporary didactic theories putting an emphasis on social aspect of education. MUVE eases reciprocal cooperation, helps physically remote users to work on collective projects because their work in real world would be difficult and financially expensive. In contrast to online education supports represented by LMS, web pages or blogs, MUVE enables students to simulate real situations in which they can learn how to work with objects and demonstrate the topics in virtual world; they can take part in actions and processes which would be inaccessible for them in real world (e.g. molecular structures production, airplane operating etc.). Teaching in MUVE takes part in virtual schools which are

supplied with classrooms (some of which are in buildings, some are in free areas or under sea water). Students in schools can move in a very similar way like in the real world – school can be entered, they can go through classes, go to library, sit to the table etc. Teachers can build special classes equipped exactly according to needs of their subjects. The teacher can be occurred in the classes in the form of avatar and by means of this communicate with his students (e.g. through text or voice form or by videoconference in his real appearance). Students can be given learning materials in the classroom as well as links to study. Students can exercise topics on particular objects and they can work together or on the basis of teacher's instructions. Teacher has a board in the classroom (e.g. in TappedIn environment) which works in the same way as real board – there can be written notes on it, can be erased and any user can read it. During the teaching in MUVE, it is possible to take a video record of the lesson or an activity – this function can be used for speech preparation to which the teacher wants to return in future. Students can create objects, go through virtual environment simulating different times or cultures, they can join the chat with authors or take part in concerts of their favourite music groups playing also in the real world. They can put into MUVE their own literary works or react to works of other users etc. The most extensive and best known 3D virtual world project in these days in is Second Life (SL) (http://www.secondlife.com) where are over 12 million users up to date. The possibility of connection people from all over the world, from different nations and social background enables laying out completely new types of communities and experience exchange goes much more easily than in the real environment. Many universities have already discovered these possibilities which are being offered to them by SL and create their virtual campuses, presentation rooms and held their educational courses. We can find here for example virtual classes of more than sixty American colleges, e.g. Oakland University, Ohio University etc. In the Czech virtual environment, some faculties of the Czech universities have introduced themselves – Ethnical faculty of University of Economics in Prague, Faculty of Education ZCU in Plzen, Faculty of social studies MU in Brno and Philosophical faculty UP in Olomouc.

E-learning in Additional Education of Pedagogical Employees (AEPE) at Faculty of Education in Olomouc

E-learning is more and more used for teaching methods within AEPR. Especially method of blended learning represents suitable platform for realisation of courses AEPE because it provides direct contact with the teacher to the members of the course and at the same time, they are not limited by physical space or by time aspects. Taking into account all the above mentioned advantages, we have also decided to use this form for the realisation of DVPP courses for lower and upper secondary school teachers at Faculty of Education, Palacky University in Olomouc. We have already started to use the method of blended learning in 2006 within the realisation of courses of State Information Politics in Education (SIPVZ) which were realised under the scope of Training Centre SIPVZ, purpose-built institution at Faculty of Education, Palacky University in Olomouc (see http://odborict.upol.cz). After the end of the government conception SIPVZ, the centre was transformed into ICT Department of Lifelong Education at Faculty of Education, Palacky University in Olomouc. Our courses are focused on development of basic ICT skills and their creative use in classroom. Nowadays are accredited (accreditation MŠMT, no. 11 388/2007-25-275) these courses: *Basic ICT course, Advanced ICT course, ICT in the Czech language and literature, ICT in English, ICT in German, ICT in mathematics, E-learning for teachers,*

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In 2010 the Department expanded the offer of its courses by getting the donation from ESP project (OP Education for Competitiveness, no. CZ.1.07/1.3.00/14.0011). Within this project called *ICT Course*

for Pedagogical Workers are prepared nine new courses: *ICT in English at primary school, ICT in English – basic course, ICT in English – advanced course, ICT in Czech language at primary school, ICT in media education, ICT sources of contemporary Czech literature, ICT for classical literature for children and adults, Modern presentation through interactive whiteboard, Dangerous communication techniques connected with ICT.*

Online lessons themselves at our department take part in Learning Management System UNIFOR. Every course has its own virtual class in which are integrated all communication channels (communication centre) needed for interaction between teachers and students and between students themselves as well. Together with basic teaching space (in which are integrated all multimedia distant texts, tasks and tests), there is also forum, e-mail communication, multi e-mail etc. The teacher has complex overview about all students, about continuous tasks observance and also data when a student is visible in the classroom.
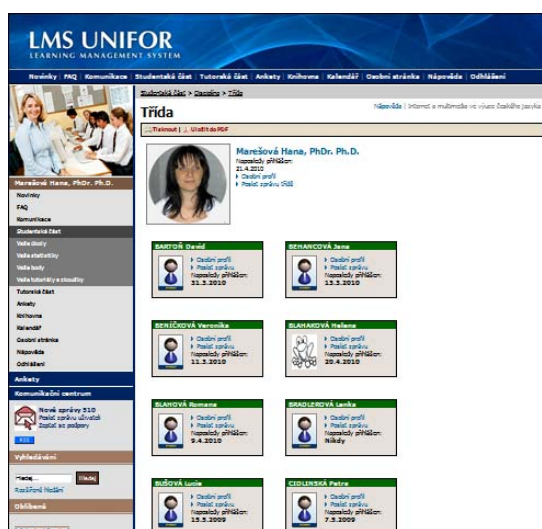
Picture 1. Example of virtual classroom in LMS UNIFOR.

On the base of our experiences from the courses since 2006, we can note that the majority of teachers usually come with basic ICT skills (which mean the work with MS Office software, work in Internet network (mail, chat, internet sources searching) or work with education software). They are less skilled in the area of work with interactive whiteboard, using Web 2.0 tools or working in Learning Management Systems. The majority of the learners are not able to work with ICT in a creative way which means that they have created their first online blog or the first published webpage in our courses. Therefore we find it beneficial to teach our learners how to work with ICT actively to be able to use the virtual environment in their own communication with their pupils (by creating online education objects or online school magazine etc.). E-learning in LMS also enables our teachers to develop their ICT skills by the use it within the educational process and help them to better understand the digital educational object structure. Learners were also included into communication in the MUVE – Second Life – in which they were supposed to cooperate together on given tasks. The possibility of virtual communication by individually created avatars and the movement in the virtual 3D environment has given them a new experience of connecting with other people and new possible ways of learning strategies. The positive experiences with Second Life at our university have also teachers and students at the Department of Applied Economics which use it as one of the newest methods of virtual teams building by team gaming of specially designed games (Kubátová, 2007).

Conclusion

ICT do not represent only source of information for education. They can also become an environment which has the new dimension – e-learning teaching is no more limited by the borders of physical space, students can study any time in any cultural or language environment without the need to move in real space. Individualised and interactive teaching in virtual reality forces user towards the active work within his own education and also to contact and cooperation with other people. All these aspects surely correspond with contemporary pedagogical theories.

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On Experience in the Delivery of E-Learning-Assisted Lifelong Learning

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Abstract: Distance learning, owing to such advantages as flexibility, ease of access, modular character, quality, cost-effectiveness, state-of-the-art technology, large audiences, social balance, global reach, the new role of the teacher, positive effect on the learner, has become a leading mode of tuition and instructional technology practically at all levels of the education system. It is difficult to imagine today any contemporary university or department without a website. Moreover, it is getting more and more common for universities and individual departments to operate distance learning platforms which implement various teaching, scientific and educational goals. This article examines various aspects of experience in the use of the distance learning platform of the Faculty of Ethnology and Sciences of Education (FESE) in Cieszyn (University of Silesia in Katowice) in teacher training and lifelong learning. Furthermore, the author discusses examples of good practice in comprehensive, systematic and effective use of the faculty distance learning platform, based on CLMS MOODLE system in order to: 1) provide pedagogical support for teaching programme courses, run in the full-time and part-time mode (hybrid learning), 2) assist teaching staff as well as graduate and post-graduate students in carrying out scientific research and pedagogical experiments, 3) train future and active teachers, post-graduate students, counsellors, teacher trainers, therapists, and others teachers in distance learning – to use e-learning in their own work and to act as tutors, 4) provide access to educational materials for students and other users; 5) foster international cooperation, in particular, through international projects.

Introduction

The global transformation from industrial to information society as well as social and economic changes taking place both in Poland and other European countries have necessitated reforms in many areas of government responsibility. In this respect, the priorities include reforming the education system which involved the implementation of modern educational technologies and modes of tuition.

Distance learning, due to such advantages as flexibility, ease of access, modular character, quality, cost-effectiveness, state-of-the-art technology, large audiences, social balance, global reach, the new role of the teacher, positive effect on the learner, has become a leading mode of tuition and instructional technology practically at all levels of the education system (Smyrnova-Trybulska, 2009).

Distance learning can cater to the needs of practically all categories of recipients and users of education services, starting from secondary school and university students wishing to continue improving their skills and acquiring more knowledge, through adult learners from all walks of life, especially teachers wishing to continue in-service training or to pursue lifelong training, and ending with the unemployed, disabled and all other people looking to improve their skills and knowledge (Smyrnova-Trybulska, 2009).

Reasons and Considerations for Lifelong Learning Supported by E-Learning

One of the most important educational challenges that is present practically in all European countries is the creation and development of a system of «education functional and effective during all life» (LLL - Life Long Learning), which is mentioned in the Bologna Declaration, to which Poland is a signatory.

Contemporary times, in which high technologies and knowledge societies play an important part, are marked by increased levels of activity in old age, accompanied by active efforts to keep knowledge up to date. Besides, social processes are taking place faster than before.

Simultaneously, there are now a rich variety of Information and Communication Technology (ICT) tools which can potentially be used in innovative ways to support learning, providing the opportunity for students to take control of, and personalise, their learning. Coupled with this there has been a fundamental shift in the nature of society; the world in which we live is dramatically different from that of our grandparents. As a result, the nature and purpose of education has changed; in part in response to the changing nature of society and in part given the changing perspective on what education in a modern context is for. (Gráinne, 2006)

Nowadays it would be hard to come across a higher education institution (faculty), school, kindergarten, vocational training institution, teacher training centre or other educational institution that does not maintain its own website. More and more educational institutions are launching distance learning systems or components thereof in response to the needs of both learners and teachers. The implementation of distance learning is being facilitated by increasing availability of information tools and means which, in turn, are being developed as a result of advances in information and communication technologies, and particularly web-based technologies. All of these developments have contributed to the emergence of multi-functional, quite reliable, user-friendly distance learning tools. (Smyrnova-Trybulska, 2009).

These include more advanced tools such as content learning management systems (CLMS's), including open source systems (MOODLE, Claroline, Dokeos, Atutor and other systems) supporting practically all phases of the learning process as well as content management systems CMS (e.g. Mambo, Joomla!, Drupal, Nuke PHP Apache), enabling users to quickly launch vertical portals such as educational portals, featuring various services, including those with return email links but requiring initial configuration and subsequent maintenance by an IT specialist. Solutions developed using Web 2.0 technology (Blogs, Forum, Wiki, Chat, WWW, RSS, CSS projects, open repositories of audio and video materials, and podcasting and other forms of social software etc.) are also available; they can be used by all users, including those without any special IT training. Web 2.0 is not a new worldwide web or the Internet; it is a new method for using the Internet's existing resources. Web 2.0 is the informal designation of Internet sites and services launched after 2001 which primarily rely on the content generated by users visiting the site or service. Web 2.0 was designed to facilitate interactive information sharing, to enable Internet users to use personalised web pages. Generally, websites have become more user-centred. It is hard to overestimate the importance of CLMS systems and Web 2.0. services in efforts aimed at achieving educational goals nowadays as the underlying principle of education is shifting towards personal-oriented education, focussing on the learner and on the development of the learner's mental faculties, creative abilities, personal qualities as well as the ability to think creatively and critically. The most popular and fast-developing MOODLE system, based on tenets of social constructionism and the concept of micro-worlds (enabling learners to explore course environments), implemented by Jean Piaget and Seymour Papert, has yet to realize its broad educational potential. Thanks to its open code and broad spectrum of resources offered, MOODLE can be flexibly developed, adapted and modified to meet the various needs of learners, teachers and educational institutions. (Smyrnova-Trybulska, 2009).

The Web 3.0. project, which is also fast-developing and promising technology, exemplifies the evolution of both the Internet and other tools and ideas towards the conversion of the present system for imparting knowledge into a broadly defined database model. The idea behind Web 3.0 is to convert

web page content into a format readable by various applications (including those that are not web browsers), systems utilizing artificial intelligence, semantic solutions as well as software capable of visualizing and processing data within a three-dimensional space. Pages developed using Web 3.0 will be able to identify the user's intentions based on the data transmission context. This will enable the user to retrieve necessary data more quickly and easily and use them to effectively achieve her/his educational goals. The Internet2 project, which is expanding globally with more and more universities joining in, offers such elements and services as a global digital library, open education program database, a virtual laboratory to carry out experiments in any science field, a service to transmit 3D images to remote sites (tele-immersion). These services and facilities have already undergone preliminary tests and will soon be made available to the global academic Internet community, offering new advanced educational tools and opportunities for use thereof (Smyrnova-Trybulska, 2009).

Learners are also changing; they enter education with very difference expectations from students in the past. They have grown up in a networked society, where the use of technologies is pervasive across all aspects of their lives. They are no longer passive recipients of knowledge, but active demanding 'customers' who expect and want an education tailored to their individual needs. Technology is not seen as an 'add on' luxury but a central tool for supporting all aspects of their study. These changes are very evident in the emergent findings from a current study of students' perceptions and use of technologies in the UK, USA, China, Australia, Poland, the Czech Republic, Slovakia, Ukraine, Russia, other countries, which consists of an online survey, a series of case studies, a distance courses and others e-learning forms, methods and tools. (Gráinne, 2006)

E-learning Platform in Teacher's Training and Lifelong Learning

This article examines various aspects of experience in the use of the distance learning platform of the Faculty of Ethnology and Sciences of Education in Cieszyn, University of Silesia in Katowice in teacher training and lifelong learning. Furthermore, the author discusses examples of good practice in comprehensive, systematic and effective use of the faculty distance learning platform, based on CLMS MOODLE system (Figure 1), in order to: 1) provide pedagogical support for teaching programme courses, run in the full-time and part-time mode (hybrid learning), 2) assist teaching staff as well as graduate and post-graduate students in carrying out scientific research and pedagogical experiments, 3) train future and active teachers, post-graduate students, counsellors, teacher trainers, therapists, and others teachers in distance learning – to use e-learning in their own work and to act as tutors, 4) provide access to educational materials for students and other users; 5) foster international cooperation, in particular, through the international project supported financially by International Visegrad Funds (IVF) "E-learning – as a Road to the Communication in a Multicultural Environment", implemented in collaboration with University of Ostrava (Czech Republic), Matej Bel University in Bańska Bystrica (Slovak Republic), which project has been successfully completed. One should also highlight the value and multipurpose character of the FESE distance learning platform in helping to identify right solutions for different educational, academic, and social problems as well lifelong learning issues that were difficult or impossible to solve in a conventional manner.

Expectations of Faculty of Ethnology and Sciences of Education in Cieszyn, University of Silesia in Katowice in successfully actual and future teacher's training and lifelong learning could be provided thanks to the platform of Content Learning Management System (CLMS), one of the most popular and quickly developing system is MOODLE. This system was chosen as a tool to the realization of becoming the defined plans of department reality and the future integration of local space into the European one, and worldwide computer-educational space. As the practice showed the system MOODLE did not fail the expectations of its users.

Distance Support of Programme Subjects, Provided in a Full-Time and Part-Time Mode (Hybrid Learning)

The general aims also include familiarization with media processing programmes: graphics processors, sound recorders, programme recording, video processing sequences, programmes-converters, etc. Among the aims is also familiarization with basic services available on the Internet and with CLMS MOODLE - the system supporting distance learning and developing distance education competences. The aim of practical classes is, first of all, to develop practical abilities of using computer equipment and to solve practical tasks with the help of utility programmes and the Internet.

The high value and relevance of the subject, and also its practical aspect on one hand, and the small number of hours envisaged in the curriculum on the other hand, have led to contradictions between ambitiously justified aims and objective problems with their implementation, connected first of all with the small number of hours. In such conditions, as real-life experience shows, active and systematic use of distance learning is a sufficient solution, adapted to the requirements formulated for the subject, and allowing to support all stages of teaching process: familiarization with new teaching material, formulating practical abilities, recording theoretical knowledge and practical abilities, casual and final check-up of the knowledge, evaluation.

Figure 1: Distance Learning Platform of The Faculty of Faculty of Ethnology and Sciences of Education (FESE) in Cieszyn (University of Silesia in Katowice) (http://el2.us.edu.pl/weinoe).

That is just the supporting system of distance learning MOODLE and a department platform http://moodle.weinoe.us.edu.pl based on it, which effectively handle performing all these tasks. In the framework of this IT subject students take part in distance courses "MS Word and its possibilities" ("We are getting acquainted with the word processor Word", "The word processor for advanced learners", "Analysis of data in the spreadsheet MS Excel", "Arrangement of multimedia presentations in the programme MS Power Point" ("We are making multimedia presentation in Power Point").

Also as an optional subject, students can take part in any computer course, for example: "Creating web-page on Front Page Express", "My first front page in HTML", "Basic WebDesing" ("Internet Technologies"); "Graphic in IrfanView", "Raster Graphics in Photoshop", "Vector Technology in CorelDraw" ("Computer graphics"), "Digital photography - we are making a multimedia album", "Creating animation in Macromedia Flash", "Film Development and Editing in Computer Programmes", "Sound Recording and Processing in Computer Programmes" ("Computer Science and Technology Information"), and others.

In this context it is worth mentioning the rules of the Bologna Process, which Poland joined a few years ago. One of these rules envisages that the number of hours of instruction on tertiary education programmes will change so that more time will be devoted to self-study than to traditional face-to-face classes. When this change materializes, it will be of crucial importance to provide means of two-way communication between the instructor and students and to ensure high teaching standards. Comprehensive and systematic implementation of distance learning methods, well-thought-out beforehand, can significantly contribute to the achievement of this goal.

E-learning courses are also actively used to support classes in various courses offered on post-graduate studies organized on WEiNoE, for example: Oligofrenopedagogy, Educational Therapy, Education of Family Life, Integrated Early School Education with Pre-school Education and others.

Taking into consideration the fact that post-graduate students mainly include active teachers, who pursue their post-graduate studies and at the same time work in their jobs and perform official duties, who have families and quite often commute to university a few dozen and even several hundred kilometres, enabling them to take part in distance learning is a good and flexible solution, allowing them to organize their own education process and to ensure high professional and teaching standards.

Use of the Platform in the Preparation of Future Teachers to Take Advantage of Distance Learning – to Use E-Learning in Own Profession and to Perform the Role of A Tutor

The platform also offers such as distance courses as "Distance learning" and "Developing distance courses in the MOODLE system", which are available free of charge to all those interested in obtaining tutor's competence: future and active teachers, post-graduate students, counsellors, teacher trainers, therapists, and others.

Simultaneously with the new concept of the development of educational system and standards of teacher preparation, every teacher should be a computer teacher, possessing the competence of distance learning. The implementation of these tasks should be ensured by institutions of higher education employing active and common remote controlled forms and teaching technology. The positive example in this context is the distance learning platform WEiNoE and its use in IT training for teachers while they attend the course called "Information Technology in the work of an assistant to a disabled person."(E.Smyrnova- Trybulska, 2009)

Effective Use of the Faculty Distance Learning Platform in Order to Foster International Cooperation

About Project "E-learning – as a Road to the Communication in a Multicultural Environment"

International project supported financially by International Visegrad Funds (IVF) "E-learning – as a Road to the Communication in a Multicultural Environment", implemented in collaboration with University of Ostrava (Czech Republic), Matej Bel University in Bańska Bystrica (Slovak Republic), which project has been successfully completed.

Description of aims achieved, fulfilling a set of objectives and expected contribution of the project

The aim of the project has been to address the problem of fostering close cooperation and strengthening relationships between the Czech Republic, Poland and Slovakia. In particular, the project was designed to promote regional cooperation among Visegrad countries through support for research and educational projects as well as through e-learning and LLL programmes, conferences, workshops, and the development of regional educational environments as well as training of teachers in the field of ICT and E-learning

The official languages of the project were Czech, Slovak, Polish and English. The international project "E-learning - as a Road to Communication in a Multicultural Environment" has successfully served the following purposes:

- Popularization of E-learning in academic environments and among students through the organization of the 2-days conference (19-20.10.2009) entitled: "Theoretical and Practical Aspects of Distance Learning" with 97 participants (academic staff, teachers, students and others), and the workshop "Distance Course Design Using CLMS MOODLE" (20.10.2009) with 35 participants (as above). The participants of these activities were from all above mentioned countries.

- Training prospective teachers to use distance teaching and to utilize e-learning in teaching and preparing them for the role of a tutor. Development of e-learning postgraduate programmes for teachers in ICT and other fields. These objectives were achieved through several actions, among the others, series of distance courses on the e-learning platforms of University of Silesia and University of Ostrava and above mentioned workshop and conference.

- Publication of proceedings of the conference entitled "Theoretical and Practical Aspects of Distance Learning", including publication in the Internet, with 26 articles devoted for different aspects of distance learning: 1) Theoretical and Methodical Aspects of Distance Learning; 2) Practical Aspects of Distance Learning with Successful Examples; 3)Development of Teachers' Computer Competences for Use in E-learning; 4)Multimedia and E-learning System in Distance Learning; 5) Psychological, Social and Legal Aspects of Distance Learning.

- This publication was designed as both instrument for popularization of the idea of e-learning and training and teaching materials.

- Publication of articles and papers on the project outcomes in academic journals and other hard copy and on-line periodicals as the method of e-learning and distance learning popularization.

Other Long-Term Objectives Successfully Supported by the Project

- Provision of access to educational materials to students, local communities and all those interested, including people with disabilities, people with limited financial resources, residents of small towns and remote areas, in furtherance of the European community goal of providing equal opportunity for all citizens in access to knowledge.

- Development of a working model of an information and educational environment intended to provide support for distance learning and teacher's education in Visegrad Group countries as well as further development of distance learning platforms actually operated by all project partners.

- Development of distance courses in pedagogy, ICT and other fields.

- Fostering close cooperation, strengthening relationships and promoting regional cooperation in the field of education, especially e-learning, between Czech Republic, Poland and Slovakia

Description of media coverage, outcomes (publications etc.) and other enclosed project's documentation http://weinoe.us.edu.pl/sites/weinoe.us.edu.pl/files/pliki/Public_Relations_1.pdf

Conclusion

At the same time it is worth mentioning that there is still large potential to be tapped and a wide spectrum of tasks and projects which will be implemented in the near or more distant future through the active use of the platform, in particular: international projects as well as support for many courses offered as part of post-graduate programmes and for self-study activities; support for all courses included in full-time and extramural programmes; support for the disabled and other activities. Another important consideration is the monitoring and evaluation of the effectiveness of the use of e-learning platforms. That is why in her article the author looks at preliminary results of an evaluation of the utilization of e-learning techniques and the faculty's platform for LLL purposes.

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E-Learning Supported Lifelong Learning: Leonardo Da Vinci Projects Innoskills and Faster

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Keywords: innovation management, small and medium-size enterprises, rapidly growing businesses, web-based training materials and tools, leonardo da vinci programme

Abstract: The paper briefly summarizes information on two projects of the Leonardo da Vinci programme – transfer of innovation, in which the UWB participates as the project partner. The project InnoSkills focuses on the growth of competencies of the SME staff in innovation management. The training is supported by the learning platform http://www.innoskills.net. Its main elements are: Innovation Guide, consisting of consisting of 12 chapters focused on different issues of the innovation management; the guide is implemented as online e-learning modules supported by multimedia elements. Innovation Rooms offering access to selected web based tools enabling collaboration and knowledge sharing. Resource Library containing additional material, web links, documents and articles linked to the chapters of the Innovation Guide. Guide to informal and cooperative learning. The main target groups are SME managers, consultants, students and researchers. Project partners are Treviso Tecnologia (Italy, coordinator), LiNK MV and Pro-competence (Germany), E-Learning concepts Rietsch KEG (Austria), Parkurbis (Portugal) and Firenze Tecnologia (Italy) The project FASTER focuses on ambitious, rapidly growing, knowledge-intensive entrepreneurs and companies (gazelles). At the UWB, the main target groups are nascent entrepreneurs – master and Ph.D. students. Other possible users are starting companies looking for best practices, examples, possibilities of financing, business planning, etc. It is based on the ISTUD Entrepreneurship Programme adapted to partner countries on the basis of the regional analysis of entrepreneurial milieu and training needs in partner countries. The training materials and other tools will be available at the project website http://www.fasterentrepreneurs.eu/. FASTER project fosters the cooperation among key actors involved in entrepreneurship promotion such as organizations providing learning opportunities, incubators, Technology Transfer Offices and early stage investors. The cooperation among the above mentioned actors is crucial for the success and effectiveness of the training programme, because it will give the opportunity to the would-be entrepreneur to build a network able to support him in the starting phase. Project partners are The West Pomeranian Business School (Poland – coordinator), ISTUD Foundation and RTD Talos (Italy), INNOSTART (Hungary) and META Group (Cyprus). The full paper includes more detailed information on the objectives and outputs of both projects, references to additional information and examples of the use of project platforms.

Introduction

The University of West Bohemia is a partner in two Leonardo da Vinci – transfer of innovation projects. Both of them are now in their final phases and we would like to present here some of their deliverables (even if they are not yet complete). We hope you will find them useful in trainings of various target groups, from university students to managers of SMEs.

Project InnoSkills is focused mainly on enhancement of competencies of SME´s employees in the area of innovation management, project FASTER on the analysis of the regional entrepreneurial milieu and support of ambitious, knowledge-based, fast growing enterprises (gazelles).

Projekt InnoSkills

Project partners are Treviso Tecnologia (Italy, coordinator), LiNK MV and Pro-competence (Germany), E-Learning concepts Rietsch KEG (Austria), Parkurbis (Portugal) and Firenze Tecnologia (Italy)

Main output of InnoSkills (InnoSkills- Innovation Skills for SMEs, project LLP-LDV/TOI/08/IT/481 of the Leonardo da Vinci – transfer of innovation programme) [1, 2] is the Innovation Guide. Compared to its previous version, the guide was upgraded and transferred to other languages, among others in Czech (so that now it is available in 12 languages). The Guide is accessible at http://www.innosupport.net and is complemented by other elements for cooperative and informal learning: the resource library and innovation rooms.

Possibilities of the platform usage can be best illustrated by snapshots of web pages.

After you open the main page, we recommend to select the language and to view the tutorial that will guide you through the platform (see Fig. 1).
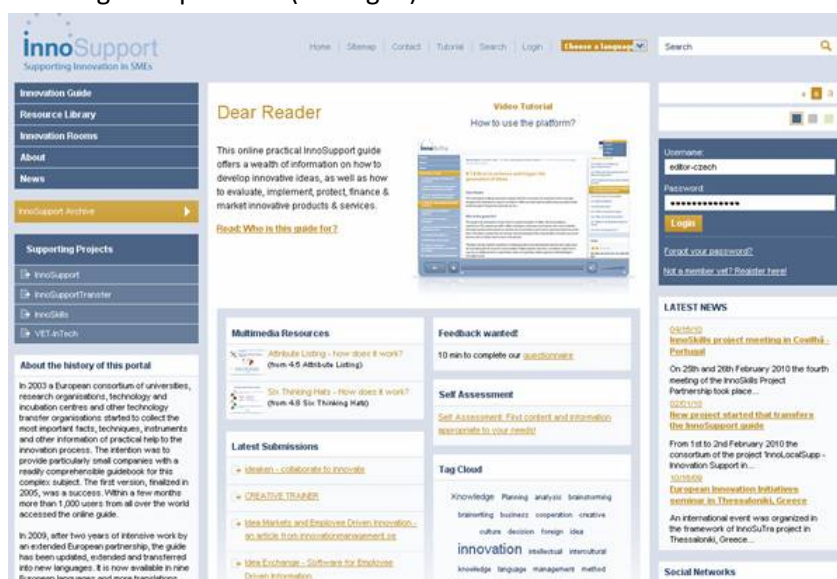
Fig. 1. Home page, introduction to the platform

When your first experience is satisfactory and you intend to come back, we recommend you to register as a new user. After verification of your identity you will be granted access rights allowing you to add your resources to the library and use other possibilities of cooperation offered by the platform. Next time, you can login using your user name and password.

Your next step may be entry to the Innovation Guide. You can start by completing the self-assessment questionnaire. If you answer the questions about you interests and knowledge of specific issues of innovation management, the system recommends you the most relevant components of the Guide.

The Guide consists of 39 modules grouped in 12 chapters. It is possible to download the modules in pdf format (not yet in Czech). However, some content (multimedia, tests ...) are available only in online version.
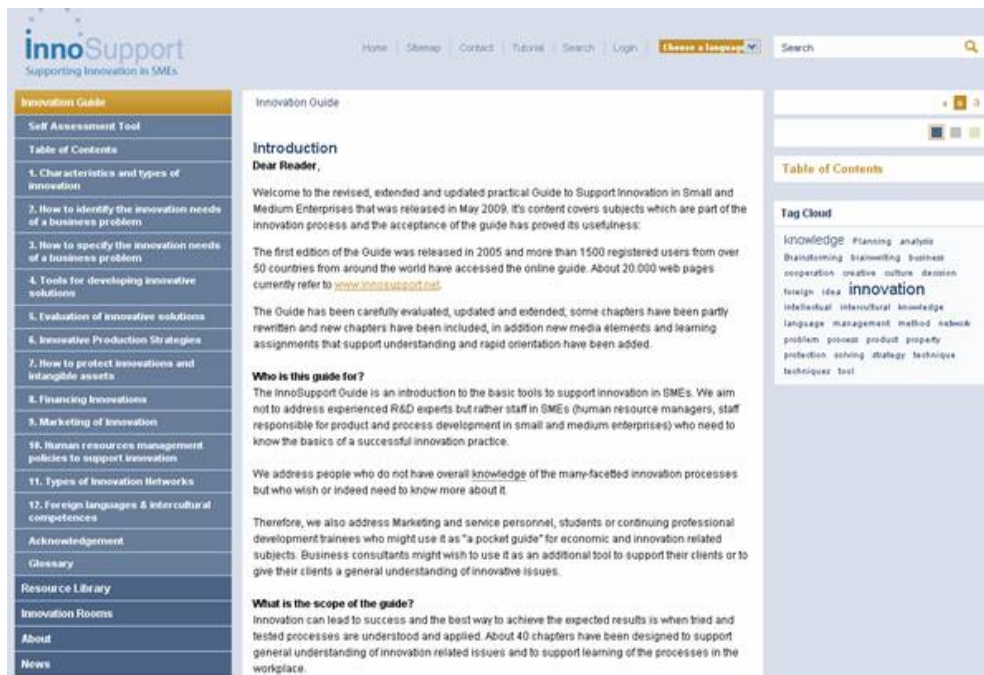
Fig. 2. Introductory page of the Innovation Guide

For the user's convenience the structure of the modules is uniform and orientation in the text is made easier by using icons (see Fig. 3).

Modules are enriched by user friendly multimedia elements (flash, short videos) and tests – see Fig. 4.

If you are the registered user and you have or know some interesting resources (your own document, web link, etc.) you would like to share with other users, you can upload it to the resource library and link it to some module of the Guide. After that, the users see the link to your resource when they open the corresponding module. The process of the resource insertion into the library is explained in the short tutorial.

Fig. 3. Typical module structure, icons used in the text

Fig. 4. Example of multimedia element

In innovation rooms you have access to selected tools supporting creativity, cooperation and knowledge sharing. In addition to specific tools and links to them, you will find here short guides to their efficient use and summaries of their benefits. Currently there are tools supporting the following activities:

- Brainstorming
- Mind mapping
- Collaborative text processing

- Whiteboards
- Online voting

And now we would like to wish you the pleasant experience with the platform and ask you to complete the questionnaire, in which you will share with us you experience. Do not be afraid to criticize - we appreciate you feedback that can help us to further improve the platform. The questionnaire is available at the home page, its completion is not too time demanding. Thank you for your response.

Project and Website Management

The project management was supported by the Team Organizer provided and administered by LinkMV. Its main component is the working space shared by all partners, each work package and meeting having its own directory for file storage.

The free open source Content Management Framework TYPO3 [5] provides a backend for management of the content and a frontend engine for website display.

The process of development of the Innovation Guide content consisted of several steps:

- translation of modules from English to target language (Czech) (MS Word – doc),
- development of multimedia elements (ppt, mp3, flash), their transformation and inclusion into the database,
- preparation of online templates (English) with links to multimedia elements,
- conversion of doc files to online content (TYPO3),
- final edit and conversion of doc to pdf files and their inclusion into the platform for downloading.

Projekt FASTER

Goal of the FASTER project (FASTER-Training for Fast Growing Entrepreneurs, project 2008-1-PL1-LEO05-02076 of the EU Leonardo da Vinci – transfer of innovation programme) [6, 7, 8] is sharing and development of efficient training methods and tools supporting ambitious potential entrepreneurs establishing knowledge-intensive fast growing companies (they are often known as "gazelles"). For such a company it is typical that within 3 years after its foundation it creates at least 20 new jobs.

Project partners are The West Pomeranian Business School (Poland – coordinator), ISTUD Foundation and RTD Talos (Italy), INNOSTART (Hungary) and META Group (Cyprus).

The deliverables of FASTER are:

- 4 analytical reports describing the entrepreneurship milieu in partner regions, needs and requirements on the training of entrepreneurs. The conclusions of these reports were used to design region dependent pilot training programmes. At the UWB, the main target groups are nascent entrepreneurs – master and Ph.D. students. Other possible users are starting companies looking for best practices, examples, possibilities of financing, business planning, etc.
- Training Toolkit containing 8 training units (see Fig. 6). Example of the training unit content is presented in Fig. 7)
- Guide for trainers with the following components:
  - Entrepreneurship matrix: traditional way to see the entrepreneurial process
  - International Entrepreneurship: A strategy map for addressing country context challenges
  - Districts and district firms: their evolution and future developments
  - Exercises and other active methods
  - Learning conditions
  - Learning styles, Questionnaire on the evaluation of learning styles
  - Training process
  - Evaluation of entrepreneurship programme: Swedish experience

- European university-based entrepreneurship training programmes: Best Practices

Both guides are based on the experience of ISTUD foundation [9] and were used in the train-the-trainers programme in Prague workshop in March 2010.

FASTER project fosters the cooperation among key actors involved in entrepreneurship promotion such as organizations providing learning opportunities, incubators, Technology Transfer Offices and early stage investors. The cooperation among the above mentioned actors is crucial for the success and effectiveness of the training programme, because it will give the opportunity to the would-be entrepreneur to build a network able to support him/her in the starting phase.

The project website [6] is used throughout the project as the repository of documents and shared workspace.

We invite you to join our community – register and we will start to deliver to you the project newsletter.

Fig. 6. Description of the FASTER Training Toolkit

Fig. 7. Example of the FASTER training unit „Innovation and R&D"

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Distance Learning at Comprehensive School of Lithuania: the Need Analysis

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Abstract: The vision of distance education in Lithuania is to secure affordable life-long learning based on the use of modern ICT for every citizen of Lithuania by expanding a distance teaching/learning network. (Development of Lithuanian Distance Learning Network.- Strategy, 2005). Distance Education (DE) in Lithuania is expanding quite rapidly. However until now it is more prevalent in universities. This is explained by a better technical base of universities (Matulionis, 2007). In 2009, a research on the need for distance learning services within the non-formal adult education framework showed that the distance learning opportunity would have the circle of its users in the given field of education as well (Vilkonis, Turskienė, 2009). A course of distance learning has also been prepared at one comprehensive school in Vilnius (Ozo school). It is used by children of emigrants who wish to continue their education in Lithuania. For example, in the academic year 2006-2007 there were 220 distance learning students from Lithuania, Norway, Ireland, England, Spain, Belgium, Georgia, the United States and Germany. The need for distance learning within a comprehensive education system has not been investigated in Lithuania so far although certain features and theoretical background suggests the existence of such a need. The research issue was expressed in the following questions: What is the current need for distance education services at a comprehensive school of Lithuania? What groups of students are interested in such an opportunity? Hence, the research was aimed at finding out the need for distance learning at a comprehensive school of Lithuania as well as target groups of students. The research was based on qualitative research methodology. The underlying technique employed in the research was a Delphi method expert survey. The research took place in October-December 2009. 12 experts participated in the research. Employees from the education system and other institutions were selected as experts due to the nature of their professional activities, available information and sufficient competence on answering questions related to the needs of the students and the school. The findings showed that the need for distance learning was stimulated by students and the school needs. In conclusion, the following groups of distance students can be distinguished: children undergoing treatment for a long time (at home, in hospitals, health centres), students living abroad, prisoners, athletes spending a large proportion of the school year at sports camps, gifted students, students with special needs or special learning needs, students unable to attend school or to train together with other students for various reasons (including pregnant schoolgirls), students repeating the course, immigrants, working adult students and extra students in preparation for the final examinations. Schools lacking one or another specialist are also interested in the distance learning opportunity. It is a matter of great relevance in rural areas and remote regions. Distant teaching could be referred to certain modules for several schools simultaneously.

Introduction

The rapid pace of modern knowledge society conditioned by the processes of developing modern information technologies and globalization leads to significant changes in education systems. Having joined the European Union, Lithuania as well as other European Union countries implements education in compliance with the Memorandum on Lifelong Learning adopted in Lisbon in 2002. Under the Memorandum on Lifelong Learning, Lithuania prepared the National Education Strategy for the period of 2003-2012. The Seimas of the Republic of Lithuania has approved the provisions whereby the three main objectives of educational development are formulated and the means for their implementation are provided. One of the said objectives is to develop an ongoing affordable and socially equitable education

system that would warrant lifelong learning. Most employed people in Lithuania aspiring to continue their studies have no opportunity to retreat from work and go to educational institutions. Therefore distance education programs and individual learning is the only way out for such persons.

The vision of distance education in Lithuania is to secure *affordable lifelong learning* based on the use of modern information and communication technologies for every citizen of Lithuania by expanding a distance teaching/learning network (Development of Lithuanian Distance Learning Network: Strategy, 2005). The programme for implementation of the National Education Strategy is targeted at further improvement of infrastructure and the development of new services adequate to the educational needs of modern society by 2012. The establishment of distance learning service centers in all elderships across the country shall be actualized by 2012.

The need for distance learning was revealed by researches carried out during the period of 2005-2009 (Matulionis, Rutkauskienė *et al.*, 2005, 2007; Vilkonis, Turskienė, 2009). It can be maintained that distance education is undergoing quite a rapid development in Lithuanian universities. It was found that the system of non-formal adult education was experiencing the need for distance learning services as well (Vilkonis, Turskienė, 2009). The question remains whether there is a need for distance learning services in Lithuanian comprehensive schools. A distance training course in all subjects for the 10th formers has been prepared by a single comprehensive school in the capital of the country (http://www.ozomokykla.eu/). According to the teachers of the given school, the course is convenient to children with special needs and to athletes. However, the capacities of one school are rather limited. The online discussions have shown that children, having gone abroad with their parents, are willing to continue their studies in the Lithuanian language.

According to L. Zajančkauskienė (2006), there are quite few manifestations of distance learning in Lithuanian comprehensive schools; only individual activists in promotion of this process can be observed. It was found that distance teaching/learning opportunities in comprehensive schools are poor, with teachers being unprepared in this context (Zajančiauskienė, 2006; Ivanauskienė, Tankelevičienė, 2006). Paterson *et al.* (2005) argues that Lithuania lacks distance education researches; there is no scheme enabling to evaluate the effectiveness of distance learning and the ability to meet the needs of target groups.

Hence the research problem can be expressed by the question whether there exists the need for distance teaching/learning services in Lithuanian comprehensive schools and what target groups it manifests itself in.

Research Methodology

The following two basic methods of research were employed: a Delphi method expert survey and secondary school upper grade students questioning. The expert survey took place during the period of October 2009 – January 2010 whereas the students questioning was carried out in January – February 2010. This article presents the findings of the expert survey.

A feedback was applied in the expert survey. The intervention with multiple repeated discussions was underlying the building of the consensus. The expert survey was conducted in three stages. In the first stage, the experts responded to the following five open-ended questions: 1) Is distance teaching/learning in the comprehensive school relevant today? 2) What are the factors prompting the need for distance teaching/learning in the comprehensive school? 3) What are the factors limiting the possibility of providing distance teaching/learning services in the comprehensive school? 4) What groups of comprehensive education students might be interested in distance learning? 5) What are the perspectives for providing distance teaching/learning services in the comprehensive school in the next five years?

In the second stage, following the generalization of the first research results, the second stage questionnaire which included all the first stage statements was delivered to the experts. A 1-to-3 rating scale where: Agree=1, Partly Agree=2, Disagree=3 was used for the assessment of each statement by the experts. The second stage results were analysed by calculating the index of popularity, subsequently all the statements being ranked according to their significance. In the third stage, the

second stage results were presented to the experts who were asked for a comment, a complement or an objection in relation to the results.

A sample of education professionals, knowledgeable of the situation in comprehensive schools and capable of giving a competent opinion, was selected for the expert survey. It involved professionals from the Education Development Centre under the Ministry of Education and Science of the Republic of Lithuania, specialists from municipal education departments and the children rights protection service, representatives of the Sports Department and two school principals – the members of the School Principals Association. A total of 12 experts were invited to participate in the survey but only 11 of them stayed in the survey until the end.

Research Results

The research has shown that the possibility of distance learning is a matter of relevance in the comprehensive school as well however for some groups of students rather than for all of them. In large, for those students who are unable to attend classes for a longer period of time for various reasons but are capable of learning individually, consulted by a teacher. Due to new information and communication technologies, more opportunities are emerging for learning indivisually without sticking to a certain place and time. As it can be seen from Table 1, the need for distance learning is primarily associated with students whose ability to participate in conventional classes on school premises for a longer or a shorter period is limited by health problems or congenital or acquired disabilities.

Table 1: Student Groups Interested in Distance Learning

	Target Groups	Target Group Description	Index of Popularity
1	Students undergoing treatment or disabled students	Students temporarily dropped out of the educational process (students unable to attend school because of health problems, i.e. students taught at home)	0,95
		Students undergoing treatment in sanatoriums	0,95
		Students undergoing treatment in hospitals	0,90
		Students with special needs and special education needs (they could be grouped in terms of learning difficulties, intellectual development, physical or mental disabilities, behavioural disorders or some other adversities, for example, students with autism spectrum disorders when a person cannot learn in a team)	0,75
2	Students learning in addition	Individually learning several subjects, preparing for examinations	0,90
		Students having chosen individual studies	0,90
		Gifted students	0,80
3	Students having gone abroad	Lithuanians and their children living abroad	0,85
		Students leaving Lithuania for a longer or a shorter period of time	0,70
4	Adult students	Students at youth and adult schools	0,65
5	Talented young sportsmen	Sportsmen spending much time at sports camps	0,60

The values of the index of popularity in the given group indicate an extremely high need for distance teaching/learning. Another target group consists of students attending classes regularly and distinguished by exceptional abilities and learning motivation. Distance learning would allow them to learn to a greater extent and at a higher rate than the average class, to gain more knowledge and to make better use of leisure time and individual learning opportunities. The third target group also involves students devoid of any health problems but unable to attend school because of a varied place of residence. These are students who have gone abroad with their parents in search for a job. A large part of such students wish to continue their studies in their mother tongue at a Lithuanian comprehensive school. The fourth target group comprises fit students as well however their

opportunities to attend conventional classes are limited. These are adult students working in Lithuania or in other countries. The fifth group are talented sportsmen spending a considerable time at sports camps far away from home and school. The possibility of distance teaching/learning, albeit through a facilitated curriculum, would prevent them from seriously lagging behind their peers.

Few students interested in the possibility of distance learning have not been separately ranked in the Table 1 as being less significant due to a lower index of popularity. These are young people serving their sentence in prison, pregnant schoolgirls and students attending on severely ill persons or disabled parents at home.

Further, the factors leading to considerations about the provision of distance teaching/ learning services within a comprehensive education system shall be analysed.

Table 2: Factors Influencing the Need for Distance Learning

	Factor Group	Factors	Index of Popularity
1	Endeavour to ensure access to learning and equal opportunities for all	Endeavour to facilitate learning for children with physical disabilities	0,95
		Endeavour to obviate a short-term withdrawal from studies because of a disease which does not interfere with learning	0,95
		Endeavour to ensure continuous learning during quarantine	0,85
		High employment of the teacher and students during the workday, raising the need for consultation	0,60
		Increasing number of students willing to deepen and broaden their knowledge in a subject	0,60
		High student activity and involvement in extra-curricular activities	0,40
2	Learning quality improvement	Increasing focus on students with special educational needs (in the broad sense)	0,60
		Endeavour to prevent students absent from school (both, with and without justified reasons) from lagging behind which could result in incomprehension of new learning material, lagging behind to a large extent and ultimately – dropping out of the education system	0,55
		Endeavour to ensure teaching/learning quality for want of specialist(s) at school	0,55
		Demand for changes and innovations	0,65
3	Increasing teacher competence	Increasing number of teachers using ICT in their work	0,90
4	Increasing resident mobility	A drastic increase in the international mobility of residents and, at the same time, of students	0,85
5	Technological development opportunities	Development of information and communication technologies and new opportunities	0,80
		Increasing number of personal computers in student families	0,80
		Expansion of public internet access	0,80
		Expansion of internet access in remote regions	0,75

In addition to the factors contributing to distance learning, certain factors limiting the possibility to provide distance learning services have been distinguished as well (Table 3).

Table 3: Factors Limiting Distance Teaching/Learning Opportunities

	Factor Group	Factors	Index of Popularity
1	Teacher competence and attitudes	Teachers' distrust of students and their individual learning, the desire to control	0,90
		Some teachers' lack of computer literacy	0,80
		Lack of knowledge on the contemporary distance learning opportunities	0,80
		Absence of comprehensive school teacher training	0,75
		Insufficient efforts of many teachers to adopt innovations	0,60
		Teachers' passivity	0,45
2	Technological barriers	Shortage of possibilities to access special distance teaching/ learning environments	0,80
		A computer is unavailable to some students	0,70
3	Lack of resources	Lack of time for the assignment and assessment of individual tasks	0,85
		Inflexible system of payment for work and labour accounting	0,85
		Lack of funds allocated for the payment of school work	0,85
		Deficiency of electronic database tasks under study subjects	0,80
		Lack of electronic textbooks and other teaching/learning tools	0,80

The largest and the most significant group of factors is related to teacher competence and attitudes. Teachers' distrust of student ability to study individually, the desire to control the learning process and to maintain a closer contact with the student in order to ensure regular communication are top rated. It is believed that independent learners require the supervision of teachers and parents which would be more difficult to ensure through distance learning. Experts also note that a computer and internet access are not available to all families. Teachers have a limited access to virtual distance teaching/learning environments. Electronic textbooks and electronic database tasks available to all teachers would come in handy too. This would save the time spent on the preparation of electronic learning materials. In this way, the value of time as deficient resource would be reduced. It is also emphasized that distance learning does not replace laboratory and other practical work. Attention is also drawn to negative effects of computer work on health.

Experts have a notion that distance teaching and learning in the Lithuanian comprehensive school is viable. The state shall assume an important role in the provision of both, the infrastructure and the schools with sufficient funding and material support. It is recommended to spread the experience of distance education among comprehensive schools and to ensure access to timely and competent advice by implementing distance learning services.

Conclusions

1. Distance learning has been and continues to be important to a part of students at comprehensive schools but currently the number of target groups is increasing.

2. Currently, distance learning is a matter of relevance to students deprived of the opportunity to attend conventional classes in a traditional school classroom. The following 4 main target groups can be distinguished: a) students with short- or long-term health problems undergoing treatment in hospitals, sanatoriums or at homes when health problems do not interfere with learning, also students with congenital or acquired disabilities who are taught at home; b) students having gone abroad with their families but willing to acquire general education in Lithuania; c) gifted and highly motivated students dissatisfied with the average educational level; d) sportsmen leaving for sports camps in other cities for a long time; e) adult students, some of them living and working abroad.

3. The need for the provision of distance education services in the comprehensive school is prompted by endeavours to guarantee all students equal access to general education and to improve teaching and learning quality. The need for distance learning is also increased by the growing mobility of Lithuanian residents and workforce in particular. The need for distance teaching and learning is based on evolving e-learning technologies, the growing competence of teachers and the improving access to the internet.

4. The provision of distance teaching and learning services is still hampered by a lack of resources, some teachers' negative attitudes towards innovations and competence deficiency.

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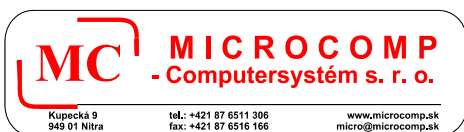*{vacekj,egerova}@kip.zcu.cz*

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