Distance Education with E-learning Support in Project Center for Innovative Education

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Abstract
The authors decided to devote this article to the project called Center for innovative education (ESF 2010-2012), which they participate on by solving it. The project is implemented at the Faculty of Natural Sciences (FPV), Constantine the Philosopher University (UKF) in Nitra and has two specific objectives. Main objective of this project is to upgrade the education at the FPV UKF in Nitra, adaptation to the needs of academia by improving quality and human resources skills development. The strategic objective of the project is related to the global objective of operational program through their specific objectives and activities that specifically contribute to increase the quality of the key responsibilities of project participants. The authors have a several positions in this project. One of the author’s tasks is to develop educational materials and their subsequent implementation into the LMS Moodle system. To the attractiveness of materials contributes not only the support of multimedia such as videos, support programs, applications that students can run during a study, but also the LMS Moodle that supports course personalization for student. We expect that such adapted materials should have a direct impact on students’ knowledge, thanks to which thus acquired knowledge should be longer-lasting. This step should cause an increase of student proficiency. The authors of this article further describe the structure of selected courses and their work.

Keywords

Introduction
The main objective of the project A-Center is the upgrade of education process at the FPV UKF in Nitra, its adaptation to the needs of knowledge society by improving the quality of human resources and development of their competencies. Strategic aim of the project is related to the main objective of the Operational Programme, through its specific objectives and activities that specifically contribute to increase the quality of the key responsibilities of project participants. The authors have more than one position in this project. One of them is to develop educational materials for the courses Discrete mathematics and Numerical mathematics and Optimization and then to implement these materials into the LMS Moodle system. The materials are divided into the individual lessons, which serve as support for teaching not only to teachers, but are primarily designed for students education, whether full-time or part-time study. The task of these materials is to get closer, impress and to drag students into the teaching process. We tried to make the courses attractive for students...
by using multimedia such as interactive animations, applications, supporting programs that complementary the courses for a better imagination and thus allow improved memorizing knowledge. This type of presentations was created for the course Numerical mathematics and Optimization and they were used in teaching process. The results of the use of these presentations are described in the last chapter. The project theoretical background and selected e-learning courses we introduce in other chapters of this article.

A-Center FPV UKF in Nitra – Innovative Education Centre

The project Center for innovative education has two specific objectives. The first one is the development of new forms of education with an emphasis on virtual learning. The second objective is innovation and creation of educational activities for target groups of academia on the FPV UKF in Nitra.

Information and Communication Technologies (ICT) Virtual

Project developing of virtual learning facility concept which is appropriate for implementation of distance method of study program Applied Informatics with e-learning support. Objective of this activity follows-up on the legitimate activity: Wider use of information technologies and new forms of education especially in the external study (virtual universities, distance learning, etc.). The specific objective is to increase the efficiency of Applied Informatics study, through the development of modern virtual learning facility. The activity is aimed at improving the quality and attractiveness of the content as well as formal aspect of courses and materials, taking into account the possibility of their use in distance form of education.

The objective of this activity should be closer specified as follows:

- design and implement the concept of virtual learning facility,
- specify the methodology of distance learning with e-learning support,
- specify the forms and activities suitable for efficient and high quality exchange of requested information in distance education,
- Implement the proposed approach to the study program Applied Informatics,
- prepare materials for the accreditation of study program Applied Informatics (distance method with e-learning support).

The specific objective is to increase the efficiency of Applied Informatics study, through the development of modern virtual learning facility. The activity is aimed at improving the quality and attractiveness of content as well as formal aspects of e-materials and e-courses, taking into account the possibility of their use in distance education methods. The target group for this activity are university teachers of FPV UKF in Nitra.

The purpose of this activity is to transform the established practices in the development of electronic materials into usable forms for distance learning organization. Output of the activity will be transformed courses for individual subjects of study program Applied Informatics eligible for accreditation of distance education. In addition to courses will be created the methodology of such courses, which can be applied to other faculty educational programs, respectively the University programs. The LMS Moodle environment will be used during implementation, which does not exclude use of the general methodology in other environments. (Aktivity projektu, 2011)
Creation methodology of the e-learning courses in science education

The objective of this activity is proposal of single methodology for creation of e-learning courses to the development of lifelong learning programs for teachers in science, mathematics and informatics. The target group of the activity are university teachers of FPV UKF in Nitra, PhD students of FPV UKF in Nitra and post PhD students of FPV UKF in Nitra. Setup of target group will be implemented in several stages. In the first stage it should acquire the skills to work with ICT and in the next stages of preparation it will go on to gain knowledge and skills needed for use of ICT directly in the educational process. Achievement of these competencies, knowledge and skills of the target group is objective for preparation and development of current - modern virtual learning facility. (Aktivity projektu, 2011)

E-learning in academic environment

The activity’s aim is to intensify the activities of the Centre for e-learning in lifelong learning on FPV UKF in Nitra (CEV FPV UKF in Nitra) – creation of e-learning courses in LMS Moodle, professional guidance and tutoring for university teachers at UKF in creation of e-learning courses and e-materials to the improvement of computer-aided education. (Aktivity projektu, 2011)

The spirit of science

This activity aims to innovation of the teaching of natural sciences, particularly physics, through examination of selected natural phenomena using digital tools and methods. The specific objective is to develop and realize an experimental tasks in a virtual laboratory. (Aktivity projektu, 2011)

Author’s role in the project

The authors have several positions in this project. Among other things, the role of authors is to develop educational materials for specified study subjects, their methodological processing and subsequent implementation of these materials into the LMS Moodle, which is now already an integral part of education at the UKF in Nitra. The role of these materials is closer approach, engage the attention and draw students into the teaching process. To the higher attractiveness of materials contributes support not only of multimedia aspects such as videos, support programs, presentations, applications that students can run during the study, but also the LMS Moodle that supports personalization of courses for students.

E-learning has become an increasingly popular learning approach in universities due to the rapid growth of web-based technologies. E-learning implementation at universities is a long-lasting and complicated process. This process has to overcome a wide range of internal and external factors influencing e-learning effectiveness and content quality resulting in stakeholders’ satisfaction and acceptance of web-based learning. (Drlík, Skalka, 2011) Needs of society in field of education are nowadays based on higher level of quality and quantity comparing to the past. The number of applicants for the study is rising from year to year. How is it possible to find an optimal solution of this problem? As a both practical and logical solution seems to be exploiting of new teaching forms with application of new information and communication technologies. (Turčáni, Fojtík, Polák, 2010)
Characteristics and content of the courses

The course Numerical Mathematics and Optimization

Subject Numerical mathematics and optimization is being taught in the Bachelor’s degree program in Applied Science program in Teaching academical subjects - informatics. Subject is one of the compulsory courses in both study programs and it is also a part of the state exams. The goal is to become familiar with the basic methods of numerical mathematics and optimization, and their algorithm and understanding their nature. Knowing their programming to implement and apply to specific tasks in practice.

Content of the subject are Numerical Mathematic and Optimization methods. In numerical mathematics are taught parts as direct and interactive methods for solving simultaneous linear equations - the method of backward substitution, Gaussian elimination method, Jacobi and Gauss-Seidel method, an algorithm for solving systems of nonlinear equations. Furthermore, students will learn to solve nonlinear equations numerically with Newton's method, bisection method and the method of simple iterations. Using the relative differences, differences ahead and cubic spline, students learn how to count interpolation polynomial coefficients. Next chapter is devoted to the numerical calculation of derivatives and approximate computation of certain integrals of rectangular, trapezoidal and Simpson's rule. End of first half of semester consists of methods for numerical computation of differential equations - Euler's method, Predictor-corrector and Runge-Kutta methods.

The second half of the semester works with basic methods of optimization. In the introduction, attention is paid on the least squares method of discrete and continuous case. From non-linear programming and single parametrical methods are taught: Fibonacci method, method of golden section and Newton's method. Multi parametrical methods are represented by the gradient method, the method of the largest descent, penalty function and the method of Lagrange multipliers. As a part of linear programming will be mentioned simplex method, linear programming task. All these methods are lectured with a detailed derivation of algorithms, which are programmed by students on exercises in MATLAB.

The examination of this subject consists of two parts. In the first part the students solve practical examples with help of customised programs developed in the exercises. If they are successful, they proceed to the second part of the examination in which they are examined by theoretical knowledge.

The course Discrete Mathematics 1

Subject Discrete Mathematics 1 is a compulsory subject in the Bachelor’s study program in Applied Informatics in Teaching of academic subjects - informatics in daily and external form of study. Subject is one of the compulsory courses in both study programs and is a part of the state exams.

Subject content consists of completed and extended concepts forming the mathematical basis of informatics. Its task is to repeat and enhance the basic concepts of number theory, arithmetic, set theory and combinatorics, which have wide application in all areas of informatics. We deals more with divisibility of natural numbers and divisibility criterias, the transfer of whole and decimal numbers from one number system to another, matrix and their equivalent adjustment, vector spaces, the concept of sets, binary relations between sets and on the set, functions and combinatorial tasks. Discrete Mathematics 1 is a compulsory subject for first-year students of Applied Informatics, Computer modeling in science and Teaching of academical subjects for the combination with informatics. (Tomanová, Vozár, 2006)
Course content Discrete Mathematics 1 consists of the following thematic units: Introduction to propositional numbers, Boolean algebra, Relation divisibility and its properties, the smallest common divisor, smallest common multiple, Euclid algorithm, Diofant’s equation, divisibility criteria, the concept of sets, binary relation, showing as a special case of relation, Feasible and countless sets. Teaching itself takes the form of lectures and their related exercises.

**Structure of the courses**

Since this is a project in which participate all departments of FPV it was necessary to create a unified structure on the faculty, which is obligatory for all courses. This system was chosen because of the uniformity for students to become accustomed to a single structure, and thus more orientate themselves in e-learning courses with different content. There was a proposal of a structure not only throughout the course of individual lessons also given the task of the staff team from the Department of Computer Science, whose members are also the authors of this article. Other department then took over the structure.

Courses are divided into individual lessons, which serve as support for teaching not only for teachers, but are primarily intended for graduate students, whether full-time or part-time study. Lessons in the courses are chronologically divided, so their number depends on two aspects as the length of the semester as well as an aspect in which year the student is studying.

The agreed structure of the course is as follows (Fig.1):

**Introduction**
- Information Sheet,
- The recommended study literature,
- Conditions for successful completion of the subject,
- Glossary of terms,
- Discussion for the subject.

**Lesson**
- Short summary of lectures and exercises,
- Study material for lectures (book module),
- Study material for exercises (book module),
- The Forum,
- Test from actual lesson,
- More resources.
Final evaluation of the subject is in teacher’s competence. This means that it’s on his decision what form he uses to complete the course. Most used form to investigate students’ knowledge is a test or project.

When entering formulas into LMS Moodle ordinary characters are not always sufficient. Often, especially in professional texts are used various special characters. Inserting these special characters can be made by using the editor for insert equations Dragmath, which is directly implemented in the LMS Moodle. This editor has its advantages and disadvantages. The advantage is certainly rapidity at which characters are inserted into the text. Its disadvantage is the limited number of symbols and characters, which may have been insert this way. If a user needs a character that is not in the menu, he is forced to study the corresponding code in TeX, and then insert it. Such parts of the text, which represent formulas is therefore necessary to specifically identify, so LMS Moodle could to process them before displaying. (Drlík, 2011)

Because of high frequency of complicated mathematical formulas in textbooks for both mentioned subjects, respectively e-learning courses are by inserting formulas used equations as editor, as well as knowledge of TeX. To improve the output of TeX filter built in LMS Moodle it was more appropriate to set output not as the GIF format, but as the PNG format which are visually different.

**Support materials in the courses**

In Discrete Mathematics 1 and Numerical Mathematics and Optimization courses is possible that student determine the way of study. First option is with support of book module directly in LMS Moodle (online course). The second option is to download all the materials in PDF format (offline course). Online course offers support materials for student such as various applications (it is an interactive teaching applications, testing applications in which the student either before or at the end of the study verify their knowledge), PPT presentations, which are designed to further clarify discussed issues and thereby get closer to a student.
The lessons of the course Numerical Mathematics and optimization, whose content is aimed at optimizing are except agreed modules are also links to interactive multimedia presentations (Fig. 2). In one lesson can be included several presentations, because each one is designed for one optimization method. Since the curriculum is very difficult, presentations are given to support students imagination and so help them to better understanding of the curriculum and also contribute to better quality and more durable student’s knowledge. For creating of presentations we used a graphic editor based on vector graphics, e.g. Macromedia Flash MX. There are presentations created for each individual method and a teacher is free to use them while giving a lecture or at the seminars. The whole presentation emulates the form of the e-learning course. Each page of the presentation is divided into two parts. On the right, there is an algorithm written. The algorithm is supplemented by a multimedia part on the left where there is a derivational process described following a concrete example. The last page of a presentation contains an algorithm of the method chosen written in a quasi Delphi language. Students are obliged to program the algorithm at the seminars as well as to use the algorithm for solving of the optimality problems. (Vozár, 2007)

Testing and verification of knowledge

In order to streamline the testing of students and also to meet the objectivity on practical part of the test we used the activity Test and created question categories according to the tasks type to which we have entered the examples. From these are randomly generated different questions (examples) for each of students, which are part of practical test. Because of the fact, that only one number is not always the correct answer on the question that represents function extreme, we were forced to use questions of such type, which allows the selection of multiple answers. When it happens, that answer is represented only by one number (extreme value), we have to test it, if the result falls within the specified allowable range of solutions for the task. After all question are answered, respectively all examples are solved and test is ended, students answers are automatically evaluated and students are immediately informed if they passed the written form of test. Based on this feedback, they know if they could enter second part of exam.
Statistical evaluation of the enquiry

In order to verify the implementation of presentations into teaching, we implemented a survey designed to assess the presentations. Respondents were Master students of Computer Science that is future teachers and they answered the questions from the questionnaire, from which we select the following three:

- **Question 1:** Lectures were supplemented by a lectured optimization methods presentation. As future teachers, do you think that the use of such a teaching aid makes sense?
- **Question 2:** Was your lesson more interesting by using these presentations?
- **Question 3:** Do you think you are able to understand the lectured curriculum without these presentations?

The questions No. 1 and No. 2 had a three-point scale rating and the question No. 3 had a five-point scale rating as indicated in Table 1.

<table>
<thead>
<tr>
<th>Three-point scale rating</th>
<th>Five-point scale rating</th>
<th>Label in chart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Strongly agree</td>
<td>1</td>
</tr>
<tr>
<td>I don’t know</td>
<td>Agree</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>Neither agree nor disagree</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Disagree</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>5</td>
</tr>
</tbody>
</table>

On the question 1, respondents had a choice of three answers: Yes - I do not know - No. The answer Yes marked the 78 respondents, representing 97%. The answer No marked no one and two respondents (3%) identified the answer I don’t know. According to the answers above, we can conclude that students clearly accepted the inclusion of presentations in the learning process. This confirms that the student accepted used teaching method. Graphical evaluation of the question is in Figure 3 and it is labelled q1.

![Figure 3](image-url)
For the Question 2 was used the same rating scale as in the previous question. The answer Yes marked the 67 respondents, the answer No marked 0 respondents and the answer I don’t know marked 13 respondents. According to these answers we can conclude that the use of classroom presentations attracted 84% of the students. Graphical evaluation of the question in Figure 3 is labelled q2.

Graphic representation of the answers to Question 3 can be seen in Figure 3 labelled q3. The most frequently occurring responses were Agree, Neither agree nor disagree and Disagree. Prevailing tendency to answer according to the median answer is Neither agree nor disagree. According to the answers to this question we have not received a clear answer whether students are able to understand the subject matter with or without a presentation. The decisive factor to answering was a self-assessment of the respondents rating their own knowledge, which obviously is not at all the same. We think that the most frequently occurring answer students selected because they could not assess how the use or non-use of presentations affected their approach to lecture curriculum.

Discussion

According to the answers to question 1, where 97% of the students marked Yes answer, we can state that the students clearly accepted the inclusion of presentations in the teaching process. This confirms that the students meet the used teaching method.

According to an analysis of responses to other questions we can express this conclusion: nearly half of the students considered the introduction of presentations to teaching process the interpretation as imaginative and almost a third of respondents find it easier to understand. More than 80% of respondents do not see in the introduction of presentation any disadvantages and for 84% of respondents was lesson more interesting by using created teaching aids.

In further work on the project the authors plan to implement a similar survey to evaluate the created electronic teaching aids for the course Discrete Mathematics 1.

Conclusion

The authors in the article further described the structure of the selected e-learning courses and creation of materials for courses in subjects Discrete Mathematics and Optimization and Discrete Mathematics 1. According to established e-learning courses with quality content and varied selection of different types of support materials we assume, to achieve our set objectives of the project A-Center and streamline education for students at FPV UKF in Nitra. We also expect that such adapted materials will have a direct impact on students’ knowledge, which should be longer-lasting and will result in increasing their expertise.

References


