MATHEMATICS AND E-LEARNING

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Abstract

The project entitled "Popularization of Mathematics and Support for Transition of High School Graduates to Technical Higher Education Institutions" (short title: "Mathematics for Everybody with UEM", registration number: CZ.2.17/3.1.00/36239)are dealt with under a grant Operational Programme Prague Adaptability at the College of Economics and Management in Prague 5 and its outputs are applied to the Eliška Krásnohorská Grammar School in Prague 4 – Michle. The aim of the project is to provide high quality of mathematical education in interesting form, and mainly to increase the numeracy of current high school students, and to encourage high school students interested in studying at the technical universities and natural science in universities. In this article we review the assumptions on which we based the project. The following are the outputs of the project with an emphasis on elements of e -learning solutions of the project, especially in terms of video presentations and tests.

Key words: mathematics, e-learning, Mathematics for Everybody with UEM, video presentations, tests

JEL Code:C02, A22

Introduction

This paper continues and extends the article Coufal, Tobíšek (2014). Mathematics discussed in school is only a tiny part of a much larger area of activity that spans millennia and is performed by people all over the planet. Mathematics is really the basis of everything we encounter in everyday life – mobile phones, healthcare, and climate change – and this influence is growing ever faster. But most of the influence takes place invisibly or somehow "in the backstage," and it would be very easy to fall for a feeling that there is really no influence at all. We live in a world where it is increasingly difficult to find time to systematically read a long and complex argument or discussion.

Mathematics is generally said to be one of the unpopular school subjects. This argument can be supported by a number of surveys at the national and international level.

Some of the traditionally most respected studies are PISA and TIMSS surveys, which focus on numeracy of primary and secondary school pupils. Inclusion of the Czech Republic in international surveys in the field of measurement of learning outcomes allows for comparing the results Czech pupils with results of pupils from other countries. Both of these studies are in addition accompanied by an extensive questionnaire surveys that detect factors influencing the acquired knowledge and skills. Using these studies the professional and general public has the chance to explore new trends in the field of assessment of learning outcomes. Due to the fact that both surveys are repeated regularly, it is also possible to see how the level of knowledge and skills of Czech pupils is changing with regard to changes in the education system. Both surveys show that the current form of mathematics education is not adequately accepted by the students and there is hence the need to work on changing the approach to teaching mathematics at primary and secondary schools.

These reasons have led us to apply for the project "Popularization of Mathematics and Support for Transition of High School Graduates to Technical Higher Education Institutions" (short title: "Mathematics for Everybody with UEM", registration number: CZ.2.17/3.1.00/36239), which is being implemented in the framework of the Operational Programme – Prague Adaptability (hereinafter "OPPA")with financial support from the European Social Fund at two sites – the main center is the University of Economics and Management in Prague 5 (hereinafter "UEM"), the second implementation site is the oldest grammar school in Prague 4, the Eliška Krásnohorská Grammar School in Michle (hereinafter "GEKOM"). The outcomes are presented at a website Coufal, J., Tobíšek, J. (2015), with basic information about the project, research teams, and minilessons (video presentations). The lessons are organized into seven chapters, of which five chapters are almost completed, with chapter being supplemented continuously. The webpage also includes tests with automatic scoring, contacts (with the following e-mail address intended for any comments, complaints, suggestions for other examples and any other feedback: info@matematikavsem.cz), and links to project accounts on social networks (Twitter, Facebook, and YouTube).

1 The aim of the project

The aim of the project is to provide an interesting form of high-quality mathematics education to increase numeracy, especially of current high school students. A series of project activities produces rich project outputs including on-line application offering a set of mini lessons

provided through videos of easily understandable mathematical instructions, the topics being linked with innovation of the school subject that is being verified by direct teaching in secondary schools. The application is also useful for those interested in self-development or recovering the knowledge of mathematics focused on technical disciplines at universities.
Due to its comprehensive interactive implementation the project enables the target group of high school mathematics teachers to apply complex cross-curricular teaching methods, to follow the latest trends in technology, and thus to have a greater chance of winning the students for the study of the subject they had until recently feared. For students the project outcomes offer sophisticated and fun method of teaching allowing to understand mathematics as a tool for knowing the world, not as a set of formulas and theorems.

The strategic objective of the project is to encourage students' interest in mathematics and to enhance the quality of education in this field. Individual sub-goals are aimed at high school students and teachers.

Innovation of curriculum consist of draft concept, methodology, content and technology for an on-line application designed for the direct teaching of mathematics in secondary schools, which is also usable as a standalone educational tool. The aim of the project to provide a high-quality mathematics education in a fun way, thus popularizing the discipline of mathematics among high school students, and thus to support their transition to primarily technical higher education institutions, is being fulfilled through implementation of the main goal.

Another goal of the project is to enable high school teachers to apply, via the project outputs, in the teaching of mathematics cross-curricular teaching methods using the latest technological trends and solutions. In vocational education the implementation of the project will hence support the cooperation of teachers of mathematics with teachers of vocational subjects and also the development of cooperation of high school and university teaching staff.

By its content the project is aimed primarily at secondary school students and supporting their transition to higher education. The content is designed with regard to demands and topics of technical college disciplines. During the project implementation teaching in the innovated educational program will take place for eleven months at the high school, which is partner to the project.

The project is aimed at two target groups – high school students and high school teachers. With respect to the group of high school students we focus primarily on students in the second, third and fourth years of study, or on students in their final years before entering a college or work. These are mainly young people in full-time studies aged 16 – 19 years. Most

of them live with their parents, have no permanent job, and are only acquiring their first work experience through holiday and weekend jobs.

A high proportion of their free time is taken up using modern technology, and they are used to communicate with each other and with other people through technology. They follow the latest trends in technology and are able to easily navigate in them and use them. Easy access to technology and their understanding of it as a mundane part of life enables the high school students to use these tools not only for leisure but also for other activities (ex. studies or short-term employment opportunities).

The target group of high school teachers is composed of persons employed in education institutions, aged between twenty-five and sixty-five. The target group consists of people with higher education and in our project is represented by teachers focused on mathematics. High school teachers are directly involved in the project – as a group of teachers participating in the project team. However, we also expect their further involvement in the project – as a group of persons who are the main stakeholders for the dissemination of large-scale project outputs (participants of workshops, meetings, conferences, professional magazines and publications readers, etc.). In terms of the use of modern technology these are mostly people who can work with technology to a limited or low level. They may nevertheless be characterized as a group of people inclined to use modern technology.

It can thus be said that although they do not always use the state-of-the-art, they are sympathetic to these procedures and it is easy to motivate them to use of modern teaching methods and techniques. For motivation, however, this group must be properly acquainted with the meaning and usage procedures of new technology solutions, as well as with their benefits.

2 The project outputs

The principal outputs are video presentations, tests, manuals (Manual for Users of the Mathematics for Everybody with UEM Project, and Manual for Teachers Using the Mathematics for Everybody with UEM Project) and workshops for users and teachers, but manuals and workshops are not elements of e-learning. Project outputs and their sharing procedures are designed with the highest possible efficiency and rationalization of resources used. When creating the outcomes we used textbooks for mathematics from the technical universities (ex.Logan, 2006, Clark, Brechner, 2007) and results of research from Czech

universities (ex. Klůfa, 2012, Coufal, 2012, Klůfa, 2013, Coufal, 2013,Kaspříková, Klůfa, 2014, Coufal, 2014, Mošna, 2013).

The first of the progressive steps was in our case the basic outline of the entire course Mathematics for Everybody with UEM:

1. Introduction
2. Functions
3. Special Functions
4. Complex Numbers
5. Combinatorics
6. Series and Sequences
7. Probability

This outline has become the Ariadne's thread for creating the presentations, tests and manuals.

2.1 Video presentations

We have used experience with e-learning (Mošna, 2013, Klůfa, Kaspříková, 2012). Individual video presentations have been created in several steps:

a) We wrote the underlying text for the power point presentation using college mathematics textbooks Logan (2006), Clark, Brechner (2007).

b) Then we transposed the data into animated power point presentation (figs. 1 and 2 present the first two slides of chapter 2.03 Convex and Concave Functions – out of total seven).

c) As the next step we brought the power point presentation to life and provided it with speech, creating a video presentation.

d) The next step was technical check of the video presentation at UEM and its placement on both YouTube and the http://www.matematikavsem.cz/(Coufal, Tobíšek, 2015) webpage (section Mini lessons).

e) Further on the video presentation was checked by the GEKOM implementation team, and the video presentation was used in individual classes in mathematics courses.

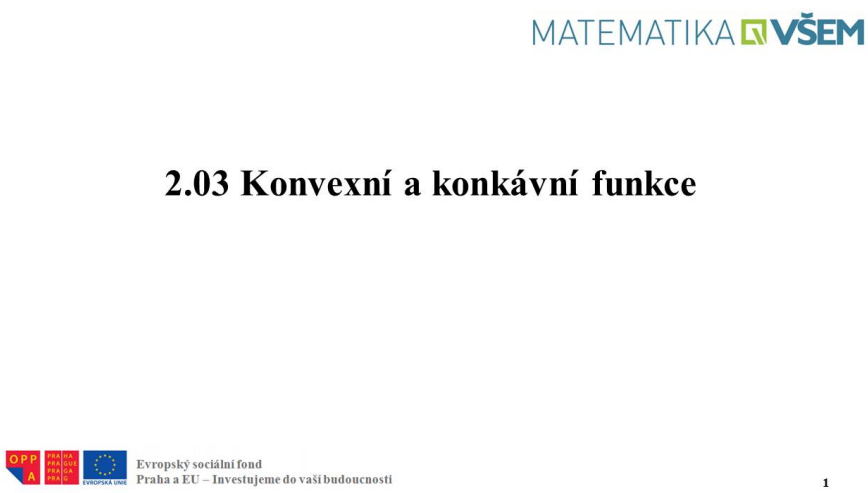
f) The final step is a definitive approval of the video presentation by both implementation teams.

2.2 Tests

The second most important item of the main menu provides the users with a system for testing and exercising their knowledge according to topics corresponding to individual chapters.

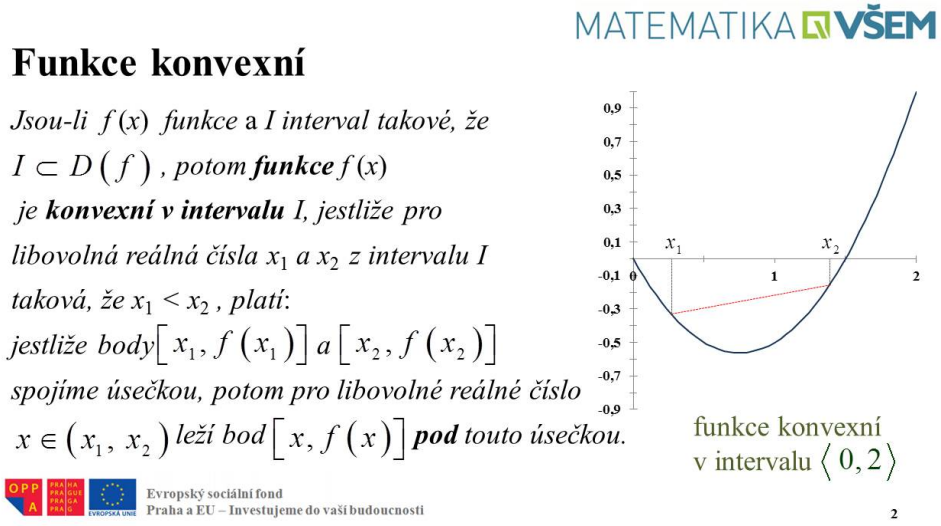
The "Knowledge Tests" option includes hyperlinks to 5 randomly selected problems from a pool of problems related to a given topic. With each problem 5 possible solutions are provided, again generated in random order, so if a user generates a set of problems from the same topic multiple times, the correct answer need not have the same label (order number) in the same task.

Fig. 1: The initial slide of chapter 2.03 Convex and Concave Functions



Source:our own

Fig. 2: The second slide of chapter 2.03 Convex and Concave Functions



Source:our own

At the beginning of the test the user must enter his/her email address to uniquely identify the test solver, then s/he gradually, problem by problem, marks the answers that s/he considers correct based on his/her calculations. Several of the answers offered can be marked as correct, and sometimes a "none of the offered options" option is also available. After marking the solution to the last problem the user selects the option "Send test and see the result." The system evaluates the accuracy of the responses and displays the results. At the beginning of the evaluation the overall rating in % is indicated as the arithmetic average score of all test questions. For example, if a user solves a single problem at 100 % and all the other four at 0 %, the resulting overall rating is 20 %. The evaluation of each problem involves the accuracy of responses for each of the options (no option picked means that the answer is incorrect). If there is more than one correct answer and the user only selects one, the final evaluation is adjusted proportionately.

Conclusion

In this paper we refer on results of the project "Popularization of Mathematics and Support for Transition of High School Graduates to Technical Higher Education Institutions" (registration number: CZ.2.17/3.1.00/36239).The aim of the project is to provide high quality of mathematical education in interesting form, and mainly to increase the numeracy of current high school students, and to encourage high school students interested in studying at the technical universities and natural science in universities. We believe that the popularization and dissemination of project outputs will increase the awareness of high school students and teachers of the development of mathematical skills using a preferred method, through a series of activities aimed at dissemination of project outcomes. We also believe that the outputs of this project will lead to expansion of inter-institutional cooperation between teachers of secondary schools and universities (and not only between UEM and GEKOM).

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