E-LEARNING IN MATHEMATICS TEACHING

PAVEL HÍC, MILAN POKORNÝ

Department of Mathematics and Computer Science, Faculty of Education, Trnava University,
4 Priemyselná, P. O. Box 9, 918 43 Trnava, Slovak Republic
e-mail: phic@truni.sk, mpokorny@truni.sk

Abstract: HÍC, P. – POKORNÝ, M.: *E-Learning in Mathematics Teaching*. Induktívne a deduktívne prístupy v matematike, 2005, pp. 131 – 134.

The paper deals with the utilization of modern information and communication technologies in the preparation of future teachers at both primary and secondary schools. We describe the e-learning course which we developed and which can be effectively used in the teaching of chosen parts of the graph theory. The course, which can be used both on-line and off-line, deals with the Tarry's algorithm and its two applications, the Tremaux' algorithm and the algorithm of Edmonds and Johnson. It contains not only the theoretical part, but also a lot of concrete problems which enable students to verify the degree of mastering the objectives. In the end we present our experience by using the course in teaching.

Key Words: E-learning, Graph Theory, Tarry's algorithm.

Introduction

The huge development of modern information and communication technologies has also influenced methods of teaching. Since the Internet has become available for all university students, universities try to change the traditional methods of education and adapt them to new conditions. E-learning has become more and more popular both among students and universities. Students do not have to be present at every lesson anymore, they can sit at home and study via the Internet.

E-learning provides many advantages to both students and universities. Students can study whenever and wherever they want, they are not limited by a certain timetable. Moreover, they can skip some parts or study them in more detail. Courses also contain a lot of exercises and tests which give students accurate feedback about their progress. The majority of courses contain a lot of pictures, sounds, and videos, which make the courses more attractive. Thus a teaching process becomes more efficient, because it stimulates more senses. Universities usually appreciate a great deal of information provided by learning management systems. They can check and monitor the study activities of their students, as well as their progress. What is more, universities do not have so many buildings and classrooms dedicated to lectures. However, there are also many problems connected to e-learning. Universities have to invest a great deal of money to buy or hire learning management systems and to prepare suitable courses. They have to train their teachers to change the traditional way of teaching, as well as to be able to work with LMS. They also should enable their students to use computers in special classrooms for 24 hours a day. As for students, they also have some problems. In Slovakia, they still do not have equal opportunities to use computers and the Internet at home. The new form of study requires additional abilities and skills, especially the ability to work with the Internet. Some students are not prepared for such a high level of independence. We do not understand some students who try to print the contents of e-learning courses to be able to read it from paper.

E-learning at the Faculty of Education

The Faculty of Education decided to start distance learning in 2001. We had a chance to try the LMS EKP^{TM} for a year and we had two courses prepared. Our experience resulted in buying the LMS in 2003. We also bought several professional courses, for example ECDL courses, and started to prepare our own courses. It is impossible to demand our teachers to create the whole course, including its technical realisation. That is why after our teachers have prepared the content of a course, we have its technical realisation done by a professional company.

The LMS we bought is fully localised into the Slovak language and provides us a lot of information about our students. It records the number of entrances of a particular student, his time spent by learning, his results of the tests and a lot of other important data. The LMS is not dependent on any web browser and keeps AICC and SCORM standards, which enables us to use courses made by other institutions. It also protects personal data about students. The system is user-friendly both to students and teachers and enables them to interact in different ways, using internal email, discussion groups, or sharing files. The system also supports various ways of output.

The Course *Graph Algorithms at Schools*

In 2004, Department of Mathematics and Computer Science developed our first mathematical course, which is called *Graph Algorithms at Schools*. The course deals with three different problems from the graph theory, which are linked to the Tarry's algorithm and its two modifications, Tremaux' algorithm and the algorithm of Edmonds and Johnson. These problems are closely connected to real life, because they represent problems such as an exploration of a labyrinth and drawing an image with one move only. The course also shows the importance of algorithmic thinking in real situations. The course is really user-friendly and a user always knows what he can do. It can be interesting not only for our students, but also for primary and secondary teachers of mathematics.

The course consists of three parts. In the first part, the students are taught how to transform a map of a labyrinth into a graph, the principles of Tarry's algorithm and its realisation using five different colours, and how to use the algorithm to explore a labyrinth. This part also explains the disadvantages of the algorithm known as *Turn Right*. The second part deals with finding a way between two given places in the labyrinth. The students master the principles of Tremaux' algorithm and its application in real situations, as well as major differences between Tarry's and Tremaux' algorithms. The last part is dedicated to algorithm of Edmonds and Johnson, which can be used for finding an Eulerian trail of a graph. Students learn how to use the algorithm to draw a given picture with one move only. They are also taught the necessary and sufficient condition for drawing that picture.

The structure of all parts is similar. Each part contains an introduction, targets, key words, information about what students should already know and what they will be taught. The main part contains the explanation of the theory with a lot of pictures and a great deal of tasks which provide students with feedback. Each part also contains several videos with certain problems which students have to solve.

Students are not expected to read the content until they have learned it by heart, but to learn a small number of basic rules and to apply them in real problems. That is why every rule or explanation is immediately followed by a number of tasks. Since the course can be used in distance learning, students should always know what they have already mastered and what they have not. Unfortunately, we were not able to design those tasks as interactively as we wanted.

The main part of the course was made using Macromedia Authorware. Videos were made using Macromedia Robodemo and additional software made by Borland Delphi.

As follows from our experience, 24 hours is sufficient time for the majority of students to master the course, which is available on the web page http://elearning.truni.sk. To get permission to try the course, send a requirement to the authors. The course is made in Slovak.

Nowadays, the course is being used in preparation of future teachers of mathematics at our faculty. In the future, we intend to use it also in the preparation of future primary school teachers of children aged 6 to 10.

Teachers at our faculty have already prepared courses from other subjects (see [1], [4], and [5]). The authors of this paper are preparing the course *Binary relations* now.

Experiment

After we completed the course, we used it in real teaching process. First we used the course for 10 students of our faculty, who had chosen an optional subject *The Graph Theory*. The main parts of the subject were explained by a teacher. Then our students practised their knowledge, using our course which contained a number of tasks. Since we were satisfied with their results, we decided to use the course for more students. Moreover, we decided to use the course in distance learning, it means without any explanation from a teacher.

Later, we had an opportunity to use the course for students of the Faculty of Materials Science and Technology, Slovak University of Technology in Bratislava. We chose those students because we knew that they had no problems with modern technologies and the Internet. The course was a part of the subject *Discrete Mathematics*, which consisted of different parts of the graph theory. Tarry's algorithm and its applications formed about 20 per cent of the subject. These chapters were taught using our course. Each student was given a login and password, so we were able to monitor their activity. Some of them were really surprised when they were told how much time they had studied. The rest of the subject was taught using the classical method.

The exam also consisted of two parts. Each student could reach 100 points, from which 20 points were given for tasks connected to the content of our course. The average score for this part of the test was 16.2, which means 81 per cent. The average score for the whole test was only 64.5 per cent. The results of the test are depicted in graph 1. We can also notice that there is some correlation between the results of the classical and e-learning part of the test (correlation coefficient is 0.43).
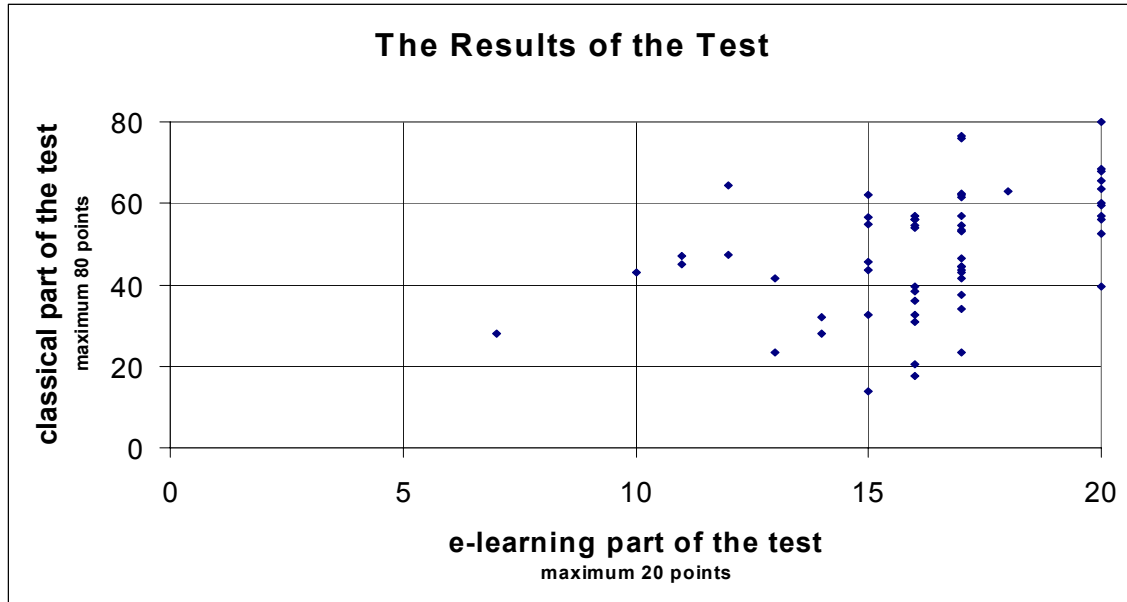
Graph 1

We do not claim that the course is more efficient than a teacher. It was not our goal to compare the classical form of learning with distance learning and so we did not do it. We just wanted to verify

whether students are capable of using a new, independent form of study. The results of the test proved that if the course is designed well, it can be successfully used in the teaching process at universities.

Conclusion

Although our faculty has only started to implement modern information and communication technologies into teaching, we think that their implementation is necessary for all modern universities. Therefore we decided to design more courses from the field of mathematics and other subjects.

We do not intend to replace teachers with e-learning courses, we want to find the proper combination of classical and modern teaching methods. We would like to enable our students to choose the best method of study and provide them with as many forms of additional material as possible.

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