MATHEMATICS TEACHING PROBLEMS AND ITS SOLUTION AT RIGA TECHNICAL UNIVERSITY

DZENITE Ilona (LV), VOLODKO Inta (LV)

Abstract. Mathematics is one of the basic subjects in all academic programs at Riga Technical University (RTU). At the same time it is one of the subjects which causes the most problems for many students. The main reasons are the students' insufficient knowledge of elementary mathematics, the students' disinterest and lack of motivation. In this article we present a description of a series of actions which are used in RTU for solving the above-mentioned problems.

Keywords: teaching of mathematics, elementary mathematics knowledge, motivation of students, e-learning

Mathematics Subject Classification: 97D60, 97D70, 97U50

1   Introduction

The Riga Technical University (RTU) is not only the oldest, but also the biggest Higher Education Institution in Latvia. There are more than 15 000 students studying in RTU this year. Its nine faculties have in total 137 academic programs of different levels.

Since all engineering sciences are based on mathematics, all RTU students study mathematics in the 1st year of their studies. However, higher mathematics studies are hampered by several factors such as: (i) The students' insufficient knowledge of elementary mathematics; (ii) The students' disinterest and lack of motivation. Let us consider each factor in detail.

2   The Students' Insufficient Knowledge of Elementary Mathematics

In order to check the knowledge level of elementary mathematics of newly accepted RTU students, every year, during the 1st tutorial on mathematics, the Professors of the Department of Engineering Mathematics give a small test for all the 1st year students. This test consists of 5 simple tasks involving: 1) operations with fractions, 2) calculation of a function value, 3) expression of a linear variable from a proportional equality, 4) basic properties of power functions, 5) basic properties of

logarithmic functions. Each correctly solved task is awarded 2 points. The test evaluation is given a positive result if the student is awarded 4 or more points. The points distribution in 2016/2017 academic year is shown in Fig. 1.
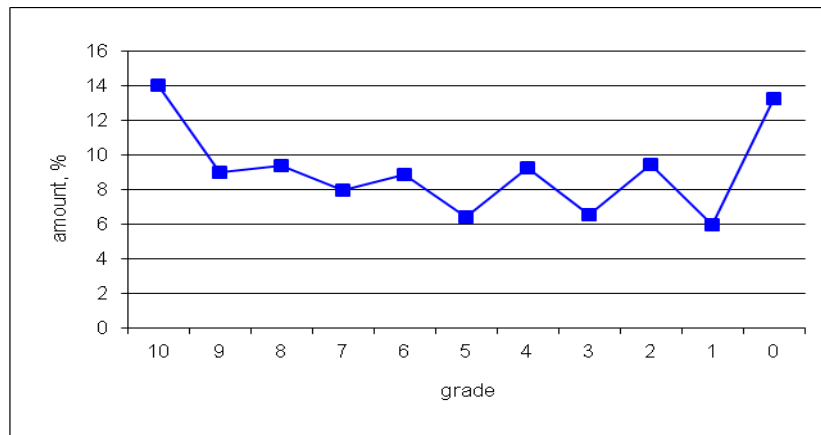

Fig. 1. The marks distribution for the elementary mathematics test in 2016/2017 a.y.

As can be seen from Fig. 1, only 14 % of students have solved all tasks in the test, but 35 % of students have not solved even 2 of 5 given tasks. This tendency remains the same from year to year, so that 35-55 % of students newly accepted into the university do not have the appropriate level of knowledge of elementary mathematics to study higher mathematics successfully. Fig. 2 shows the number of students who have failed the elementary mathematics test during the last 9 years.
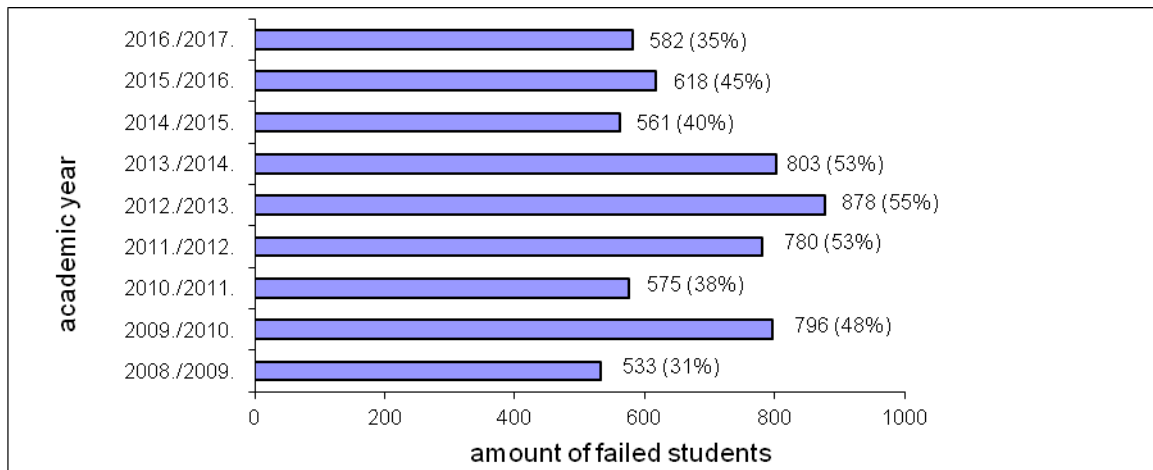

Fig. 2. The comparison of number of failed students during the last 9 years

From year to year the Professors of the Department of Engineering Mathematics have been searching for the solution to the problem: how to help weak students fill gaps in their knowledge of elementary mathematics so that they will be able to study the course of higher mathematics successfully. For this purpose:

1) Video lectures were created, freely available on the internet, in which the basics of elementary mathematics are explained in a simple and easily understandable form. The video lectures were made, processed and placed on the internet with technical support and assistance of colleagues from the RTU Information Technology Centre. There are 43 lectures available for students in

total. Each video lecture is short, lasting 5-18 minutes only, to ensure that students do not loose attention during the lecture. Thanks to these video lectures, students can repeat the elementary mathematics basics at the appropriate time, place and speed. These lectures are available not only for RTU students, but for everyone interested in the subject. The lectures can be used by schoolchildren both during their school studies and in preparation for university studies.

2) A free mathematical e-course based on MOOC (Massive Open Online Course) was created. The students of this course have access to lecture summaries, samples of task solutions with detailed explanations and self-assessment tests.

3) A new subject "Basic chapters of Elementary Mathematics" was created. At present this subject is taught only for part-time students, whilst for full-time students this subject is available as a subject of free choice. This subject lasts for 1 semester, 2 hours per week, and it helps students to learn elementary mathematics at a level which allows them to study higher mathematics successfully.

4) Starting from this academic year, for students who failed the elementary mathematics test, there are additional lectures on mathematics during the 1st semester.

3   The Students' Disinterest and Lack of Motivation

For many students mathematics seems not only difficult and complicated, but also redundant and unnecessary. The Professors of RTU Department of Engineering Mathematics try to solve this problem in the following two ways:

1) In order to make students interested in studying mathematics, Professors try to show them tasks that are connected with students' chosen specialization.

2) In order to motivate students to study during whole semester, the semester's final evaluation consists of not only the examination mark, but also of the work made during the semester, i.e. homework and classroom tests results. The semester's final mark is calculated by the formula $0{,}6*E+0{,}3*K+0{,}1*M$, where E is the exam mark, K is the average mark of all classroom tests, M is the average mark of all homework, under the condition that the exam was passed successfully.

As the semester results show, this formula motivates those students who have a weak knowledge of mathematics, but who are diligent and work during the whole semester.
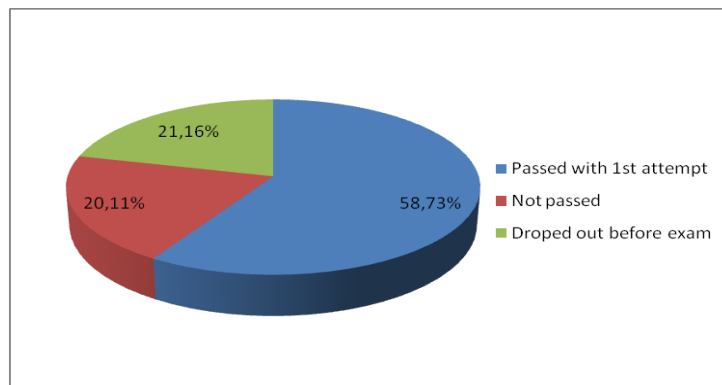

Fig. 3. The number of students that passed and failed in the 1st semester exam on mathematics

The following data was taken within only one RTU Faculty, the Faculty of Computer Science and Information Technology. In the faculty there are 443 students in their 1st year of studies. Summarizing the results of the 1st semester mathematics exam of 2015/2016 a.y., the following data was obtained (see Fig. 3). Slightly more than a half (58.73 %) of the 1st year students have passed the exam from the 1st attempt, 21.16 % of students dropped out before the 1st session. For the remaining 20.11 % of students who failed the exam, there is the possibility to retake and pass the exam before the next semester.

Fig. 4 shows the influence of the above mentioned formula on final results of students which passed the exam successfully. For most of them (73.87 %) the semester final mark is not changed, as those students showed the same knowledge as they did during the semester. For 16.22 % of students, the work during the semester helped them to increase the semester final mark by 1, while for the final 9.91% of students, who ignored the work during the semester, they have obtained a lower semester final mark than their exam mark.
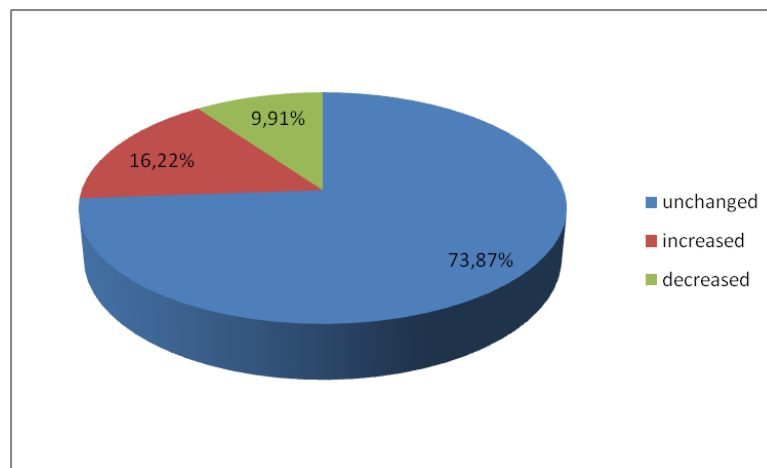

Fig. 4. The change of the semester final evaluation due to the application of the formula

4   E-learning Course – an Assistant for Students and Teachers

A good assistant for studies both for students and Professors is the portal ORTUS, created in 2007 by the staff of RTU Department of Information technology. Every year the portal is updated and improved. In ORTUS students can find all the necessary information they need for their studies. One part of ORTUS is dedicated to E-learning, which is based on the program MOODLE (Modular Object-Oriented Dynamic Learning Environment). In the E-learning section students have access to all subjects included in their chosen academic program.

In the E-environment of Mathematics subjects students can find the Professors' academic plans, timetable, the requirements for obtaining a successful assessment, summaries of lectures, samples of task solutions, homework tasks, tasks for self-study and self-assessment and aptitude tests. Here the Professors may inform students about upcoming tests, consultations and exams, as well as post the students' results after tests.

Students very widely use the above-mentioned portal. The following data is taken from the mathematics e-course of only one RTU Faculty, the Faculty of Computer Science and Information

Technology. Fig. 5 and 6 present the number of students who visited the E-course in the 1st and 2nd semesters, respectively.
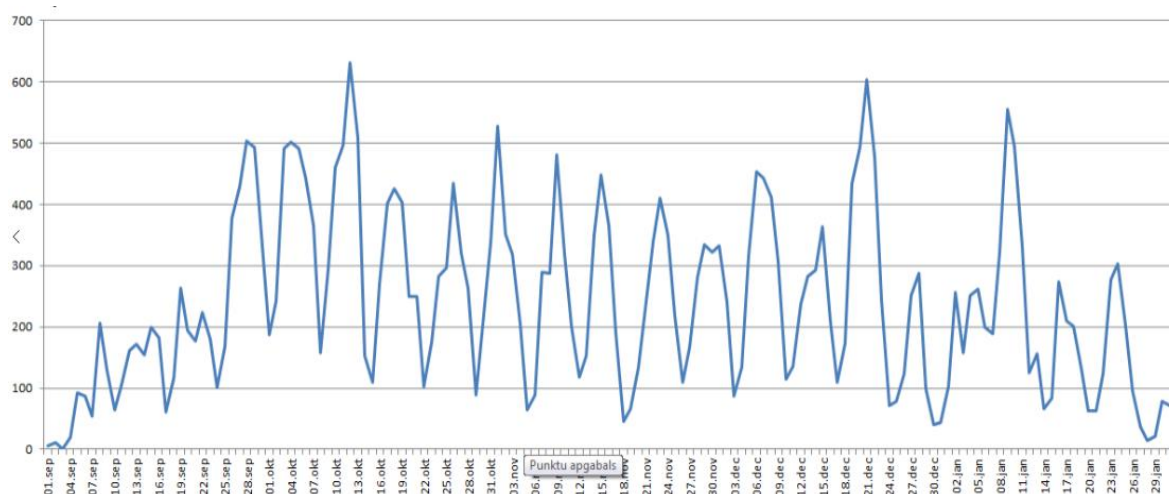

Fig. 5. The number of students' visits to E-course in the 1st semester

In the 1st semester the distribution of visits is quite smooth, except that there are less visits in the beginning and at the end of the semester. That can be explained very easily: in the beginning of the semester the 1st year students are not used to working with ORTUS materials, but by the end of semester most of students have already passed the exam. In the 2nd semester the situation is different: the ORTUS materials are used less during the semester, but the use of it increases during the examination period. The top use of ORTUS materials is on the day before the exam, and the second jump of it is on the day before the exam re-take.
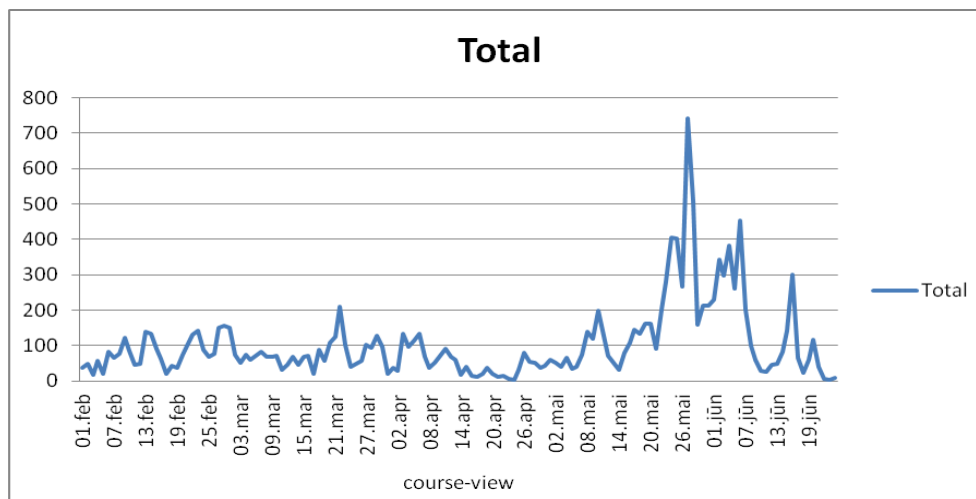

Fig. 6. The number of students' visits to E-course in the 2nd semester

The use of E-course facilitates studies and has the following benefits:

- Materials are available for students at any time and place they have internet access;
- Students may study at their own speed;

496

- Students have the opportunity to combine studies with work and more effectively manage their time;
- The use of technology stimulates studies and increases the students' interest;
- Professors have the opportunity to use information blocks of different types and sizes, not only texts, but also video lectures and interactive materials;
- Professors may reduce their workload, by substituting part of students' classroom and homework tests with online tests at the portal.

In our opinion, there is only one disadvantage: many students are not able study in the E-environment, they don't know how to work with work plans and course materials, and are not able to communicate with Professors.

The ORTUS portal has a feedback facility. Every semester through this portal, students take a survey, in which students express their thoughts about Professors and their teaching methods. Each Professor has access to the survey summary, which shows his/her assessment. This indicates any issues with the Professors' teaching, and gives them the opportunity to improve their working methods.

Modern youth are native users of computers and willingly use information technology. In order to make mathematics courses more attractive, the mathematical software MATHEMATICA and MATLAB were introduced. During the classes students learn how to use these packages to solve mathematical problems, similar to the tasks solved at tutorials, but with a higher degree of difficulty.

Despite all above mentioned actions, and taking into account that nowadays the amount of available information grows rapidly, university cannot give to students all necessary knowledge, skills and abilities that they will need in their later life. The student himself must be able to distinguish the important from the unimportant, and to learn how to optimize the relationship between knowledge and their own learning needs.

References

[1] ČERŅAJEVA, S., VOLODKO, I. Teaching Mathematics in Riga Technical University. *International Conference "Mathematical Competence Development in Higher Education Institutions*", Jelgava, 2012, Latvia, p. 21.

[2] DZENITE, I., VOLODKO, I. The use of the package „Mathematica" in teaching of mathematics in Riga Technical University. In *Proceedings of the International Conference on Engineering and Mathematics.* Bilbao, Spain, 2009, June 17–19, p. 75–79.

[3] VOLODKO, I., ROŠČINA, I. Использование портала ORTUS для обучения математике в Рижском Техническом университете. *Некоторые актуальные проблемы современной математики и математического образования. Материалы научной конференции „Герценовские чтения - 2012",* Санкт-Петербург, Библиотека Академии наук, 2012, April 16-21, p. 168–173, (Saint Petersburg, Russia, in Russian).

[4] VOLODKO, I., ROŠČINA, I. Использование пакета программ Mathematica9 при обучении математике в Рижском Техническом университете. *Труды международной*

научной конференции „Образование, наука и экономика в вузах и школах. Интеграция в международное образовательное пространство". Цахкадзор, Армения, 2014, March 24-29,p. 482–485, (Tsakhkadzor, Armenia, in Russian).

Current address

Ilona Dzenite, assistant professor
Department of Engineering Mathematics, Institute of Applied Mathematics,
Faculty of Computer Science and Information Technology, Riga Technical University
2 Daugavgrivas street, Riga, LV-1007, Latvia
Tel. number: (+371)67089527, e-mail: ilona.dzenite@rtu.lv

Inta Volodko, professor
Department of Engineering Mathematics, Institute of Applied Mathematics,
Faculty of Computer Science and Information Technology, Riga Technical University
2 Daugavgrivas street, Riga, LV-1007, Latvia
Tel. number: (+371)67089528, e-mail: inta.volodko@rtu.lv