

## IMPROVEMENT OF TEACHING METHODOLOGY OF MATHEMATICS FOR STUDENTS AND PUPILS USING THE MOOC PLATFORM

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**Abstract.** Regarding the improvement of the teaching methodology of mathematics for students using the MOOC platform – this subject is topical, because the methodology of teaching largely determines the quality of learning. The aim of this article is to explore the opportunities how to improve the teaching methodology of mathematics and promote active studies of mathematics, based on the students' motivation. The author's created and rehearsed material in an open online site platform mooc.rtu.lv that helps students and pupils understand basic mathematical questions and prepare for mathematics tests gives support for acquiring mathematics independently. MOOC (*Massive Open Online Course*) allows unlimited amounts of participants and open access to the net. We assume that most people who are interested in technologies have a good knowledge of MOOC's basic principles and, possibly, have been involved in educational projects that use MOOC. While technologies develop, the change of distance learning courses into online educational courses seems to be a logical step. This is why there has been a rapid spread of this technology since 2011 used by millions of users.

**Keywords:** learning motivation, video lectures, higher education, basic knowledge of mathematics, MOOC.

### Introduction

Engineers are highly appreciated and in demand in the labor market, which is why qualitative education in the professional field has an important role in the future of the country. Experience shows that it is easier to study engineering if there is a good basic knowledge in the science related subjects. Furthermore, successful acquisition of science related subjects in university is possible only if students have a good base of basic mathematics.

As experience shows, many students admitted to the Riga Technical University (RTU) do not have knowledge of basic mathematics to a good enough level to successfully study higher mathematics and other sciences related and technical subjects. In the first lecture at the university, during the test of the students' knowledge of basic mathematics, it was concluded that almost half of the students cannot solve even two out of five simple tasks. As mentioned before, the tests include five simple tasks: operations with fractions, calculation of a function value, expression of a linear variable from equality, basic properties of power functions and logarithmic functions. For each correctly solved task the students were awarded 2 points. The test is passed successfully if the student gets at least 4 points.

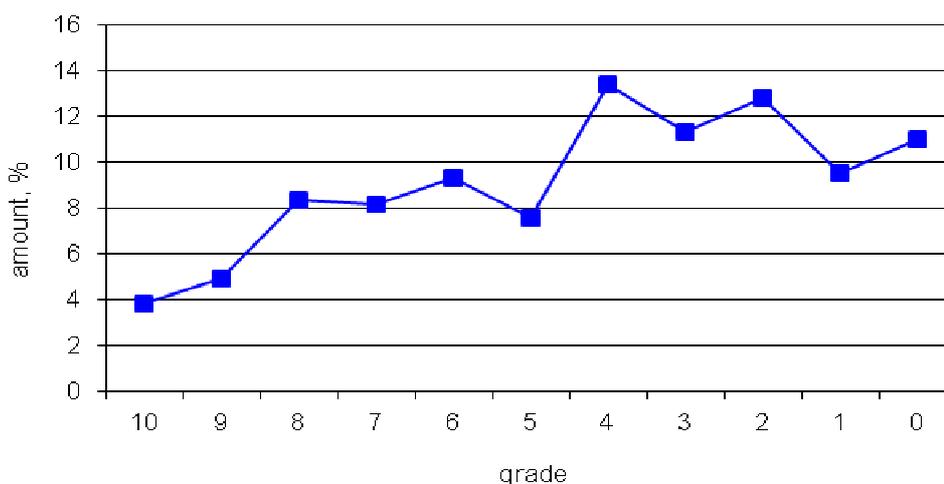


Fig. 1. Mark division of basic knowledge of mathematics test in 2015/2016 academic year

Figure 1 shows the mark division in a percentage of the students who started studies in the RTU this (2015/2016) academic year. Data were gathered evaluating the tests of basic knowledge of mathematics of 1387 students.

Comparing the tests for the last 8 years (Figure 2) we can see that there has been little improvement in the last two years. Thus, the results are not good enough as all students admitted in the Technical University must be one hundred percent able to pass such a test.

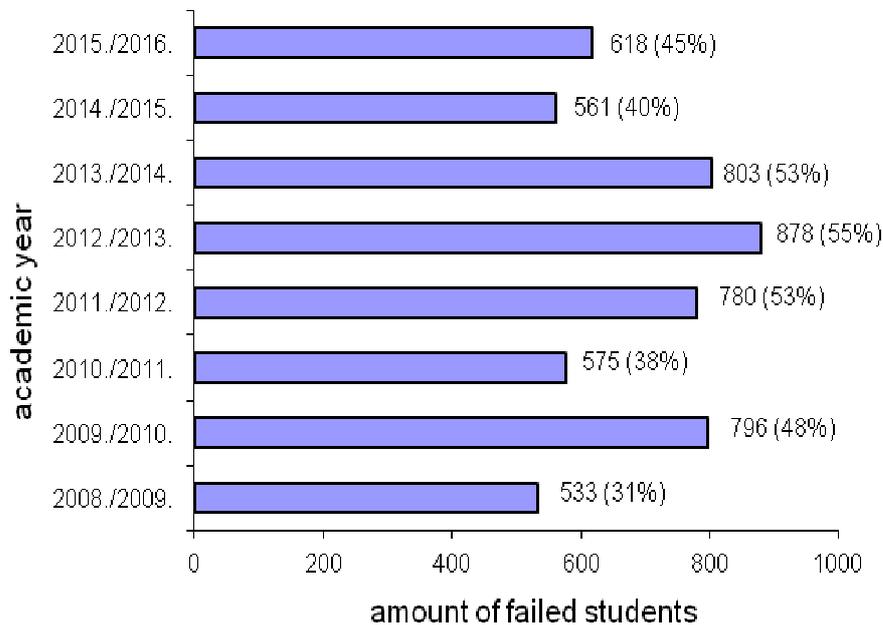


Fig. 2. Amount of “failed” students in basic knowledge of mathematics test in the last 8 years

For several years we have been searching the solution to this problem: how, as far as possible, help these students, who have an insufficient level of knowledge of Elementary Mathematics? How to motivate students to learn mathematics? Motivation has very close relation to the quality of the study process. The research works demonstrate that motivation in particular largely determines whether the study process will be successful or not. The students who have a clear goal of their professional career are better motivated than those who just study either because all are studying nowadays or they simply cannot find another occupation they would like to do [8].

### Materials and methods

To help students with poor knowledge of basic mathematics, the RTU carries out various activities:

- a course of video lectures in basic mathematics has been created and is freely available in YOUTUBE;
- intensive courses of basic mathematics were organized before the beginning of the academic year;
- a new subject has been created – “Basic Chapters of Elementary Mathematics”;
- starting from the next academic year, obligatory extra classes are planned in semester 1;
- a help course in basic mathematics was created in an open online site platform mooc.rtu.lv.
- in this paper we will have a closer look at the last mentioned activity.

In cooperation with infrastructure support of the RTU, the open online site mooc.rtu.lv was created in the autumn of 2015. At the moment a help course in basic mathematics is available on the site, which gives the students a chance to improve their knowledge by acquiring mathematics in a new, simple and effective way. Availability of learning materials all together, option of studying at any time, availability of learning aids, possibility to reinforce the particular subject with various visual study materials like video, audio etc., level of security, these are the main factors that motivate students for using e-studies environment [7].

There are six different topics from the teaching programs of basic mathematics in the help course; each of them is divided in three parts – theory, video materials and tests. To pass the course successfully, the user must pass all available tests (lowest acceptable evaluation is 4 out of possible 8

marks). Answers to every test question can be given only once, so the students must be careful and pay attention. The courses can be entered with a student's own ORTUS password. It is planned that soon there will be help courses available on the site in higher mathematics and physics.

There are available units of basic mathematics in the course that will be necessary for the students to successfully acquire higher mathematics. The aim is to provide interactive, up to date and available extra educational materials for students and pupils.

The topics of the help course in basic mathematics are

1. Arithmetic operations (addition, subtraction, multiplication, division) with fractions.
2. Algebraic expressions, their transformations. Simplification of algebraic expressions. Formulas of abbreviated multiplication.
3. Linear and quadratic equations, linear and quadratic inequalities.
4. Interval of function definition and function value. Simple function values. Even and odd functions. Ways of assignation of function. Graphs of basic functions.
5. Basic properties of powers.
6. Exponential equations and inequalities. Logarithmic equations and inequalities. Basic properties of logarithms, their usage for solving equations and inequalities.
7. Trigonometric functions. Signs of trigonometric functions. Basic trigonometric identities.

### Results and discussion

As the help course in Basic Mathematics is available for users only from January 14th, 2016, at the time of writing the publication (which is a month and a half from the date mentioned), there are 124 participants registered in the course, and all together they have looked at the course 1501 times.

As mentioned above, each topic consists of three types of materials: theory, tasks and tests. After completing the task and submitting the answer the correct answer with full explanations is given. Also, by giving a wrong answer in the test, the correct one is shown. Statistics of the course show that for now the biggest interest is in the tests. Figure 3 shows division of the views in percentage by types: more than  $\frac{3}{4}$  of all views – 75.93 % – are tests, whereas, theory and tasks have shown lower interest – accordingly 12.92 % and 11.5 % of views.

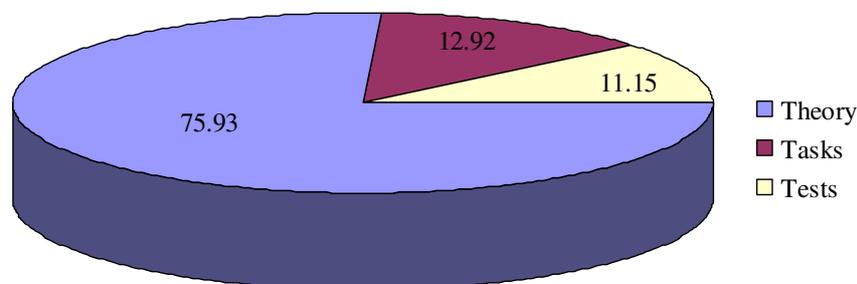


Fig. 3. Division of views of the help course of Elementary Mathematics in percentage by types

Statistics of the course by topics (Numeration of the topics corresponds with the one shown previously) are shown in Figure 4. It is visible in Figure 4 that the most viewed topic is arithmetic operations with fractions, and the least viewed is linear and quadratics equations, linear and quadratic inequalities.

The main problems for the students appear with large amounts of revision materials; that is why it is important to successfully organize visual consumables and a positive atmosphere that will inspire a willingness to gain results in the students. To ease the revision process for the students, great attention is paid to using visual materials. Online courses can be a great facilitator of professional development, where everyone can choose their own learning speed. In MOOC course the learning material is given in a visual format to the maximum extent possible, and the students are given a chance to see the material both as a whole and in detail. Parallel to the tasks, theory grounds and explanations are given. Material is a help for the students who want to receive short and precise information, whose attitude towards homework is negative, but who want to receive learning materials that would be suitable for

independent work, succinctly, understandably and with tasks they can undertake. The data gathered in universities around the world show that a massive open online course or MOOC becomes more and more popular in the world, though there is a question at the moment on how to use it to improve the students' results, because also in universities around the world that offer these courses it has been concluded that they are successfully finished by only about one tenth of the students.

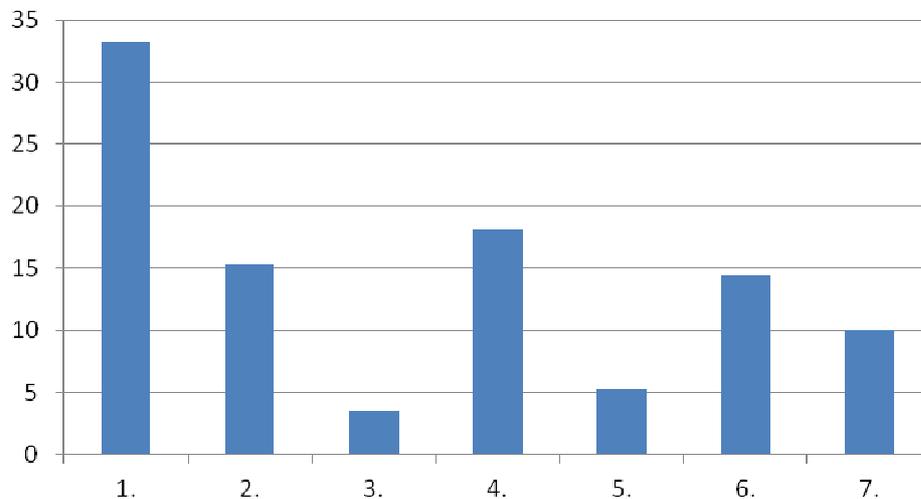


Fig. 4. Division of views of the help course of Elementary Mathematics in percentage by topics

The research shows that students' or pupils' participation in the course rapidly decreases during the first week, but later it decreases slowly and in an almost linear fashion [1]. Most commonly courses are finished by those who already have grounding in the particular subject and mostly pupils with average level of knowledge gain most from the courses [4]. To lower the risk of leaving the course, success of pupils must be regularly monitored, and those who have a risk of being discharged, must be given an instructor [5].

Lecturers from the University of Pennsylvania conducted research of who uses MOOC courses, and why they use MOOC courses. It appeared that mostly MOOC is used by young, well educated people who are employed. An interesting fact is that MOOC is more used by men than women. The main reported reasons for using MOOC: 1) learning while keeping a job; 2) satisfying curiosity.

Most authors, while acknowledging the benefits and good qualities of MOOC, acknowledge that MOOC does not guarantee high quality results for all participants. More than a half of people who successfully finish a MOOC course in secondary education already have secondary education grades [2]. MOOC has also not reached its potential in higher education. Since the very beginning these courses have faced a number of problems and questions about the reliability, quality, evaluation methods and learning results [3]. There are still disagreements between MOOC opponents and supporters. However, despite of all this, MOOC is becoming a new, significant mechanism for teaching, where thousands of students can take part at once.

## Conclusions

1. As motivation is aggregation of reasons that evokes and maintains active learning process of the mathematics studies, assistance of the students at structuring and planning of the learning process is necessary for their motivation.
2. The authors' created and rehearsed material can help pupils understand separate mathematical questions, give support for acquiring mathematics independently, help prepare for mathematics tests and as a result promote pupils' motivation for active acquisition of mathematics.
3. Pupils' learning motivation can be increased by using the developed material. This work is a great gain for a lecturer, because the preparation stage of a lecture is a very time-consuming process.
4. If critically viewed, then MOOC courses have not brought any revolution. Yes, world-class universities offer courses for free to any student that is by now the only significant difference from traditional full time or distance education. But pedagogical methods that are mainly used in these courses are not revolutionary – video lectures, tests with limited answers.

5. Pedagogical researches show that the most effective learning methods are those where students have many opportunities to get into discussions with a lecturer. Unfortunately, MOOC does not offer such opportunities.

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