

Improving Knowledge of Elementary Mathematics – the Way to Better Studying of Higher Mathematics

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Abstract: Higher Mathematics is one of core subjects in engineering sciences and at the same time it is one of the stumbling blocks in the first year of studies for many students. The main problem is insufficient level of student knowledge in Elementary Mathematics. In order to overcome this problem the Department of Engineering Mathematics have prepared short video lectures which are available online for free and compensative courses before first semester. The paper covers educational data analysis and our teaching experience.

Keywords: Teaching Mathematics, student knowledge in Elementary Mathematics.

Introduction

Riga Technical University (RTU) is the only technical university in Latvia, as well as, the oldest technical university in the Baltic States, where nowadays studies over 15000 students. The goal of the university is to prepare highly qualified, responsible and creative specialists in the engineer-technical fields. Mathematical knowledge and skills are the ground of all engineer-technical specialties that is why all students of RTU must acquire Higher Mathematics. As statistics of university shows, Higher Mathematics is also one of the biggest stumbling blocks for the first year students. It has several reasons, but one of the main – insufficient level of knowledge in Elementary Mathematics.

Description of existing situation

As entering exam in universities of Latvia is long cancelled, the enrolment in RTU is by the results of centralized exams in school (CE). CE works are evaluated in percentage - from 0 % to 100 %. Unfortunately, there are students that are accepted in RTU whose CE results in Mathematics are below 30 %, and even below 20 %. In Figure 1 is the amount of students that were accepted in RTU in 2014 according to their CE results (Birzniece, 2014, 5459-5463).

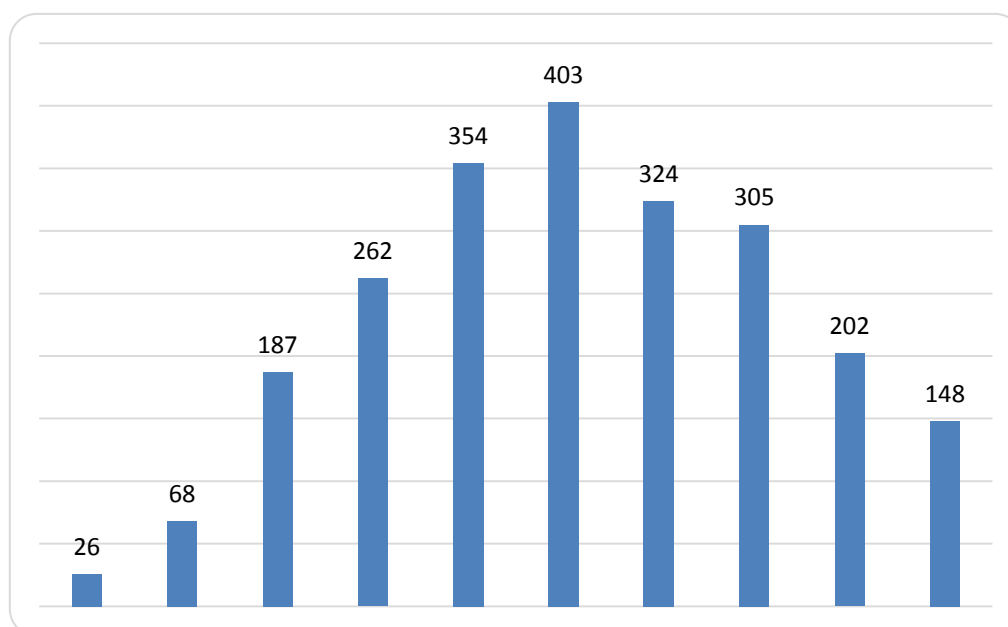


Figure 1. Amount of accepted students in RTU according to their CE results in 2014.

Regardless of the CE results, lecturers of the RTU Department of Engineering Mathematics, starting the new academic year, themselves evaluate the level of knowledge of Elementary Mathematics of their future students. On first lecture of Mathematics, first year students are given tests, which consist of 5 simple tasks: operations with shares, variable expression of the linear relationship, value calculation of algebraic function and basic properties of the logarithmic function. Each task is evaluated with 2 points. The work is considered failed if the evaluation is under grade 4. Average mark this academic year in the test of elementary mathematics is only 4.5. Grade division in 2014 is seen in Figure 2 and amount of failed in the last 6 study years – Figure 3.

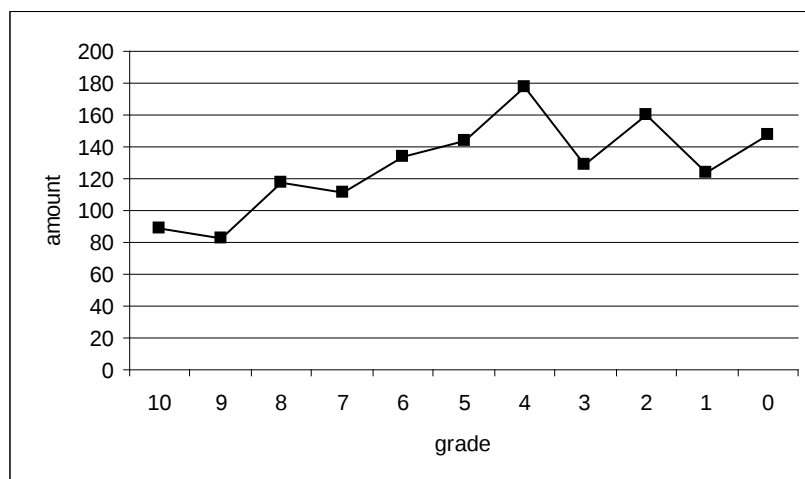


Figure 2. The division of grades in the test of Elementary Mathematics in 2014.

As it is seen from the Figure 2, in the last year the greatest maximum is on the grade 4, which is comparing good result, because, in the previous year it was 2, but one more year ago, it was 0.

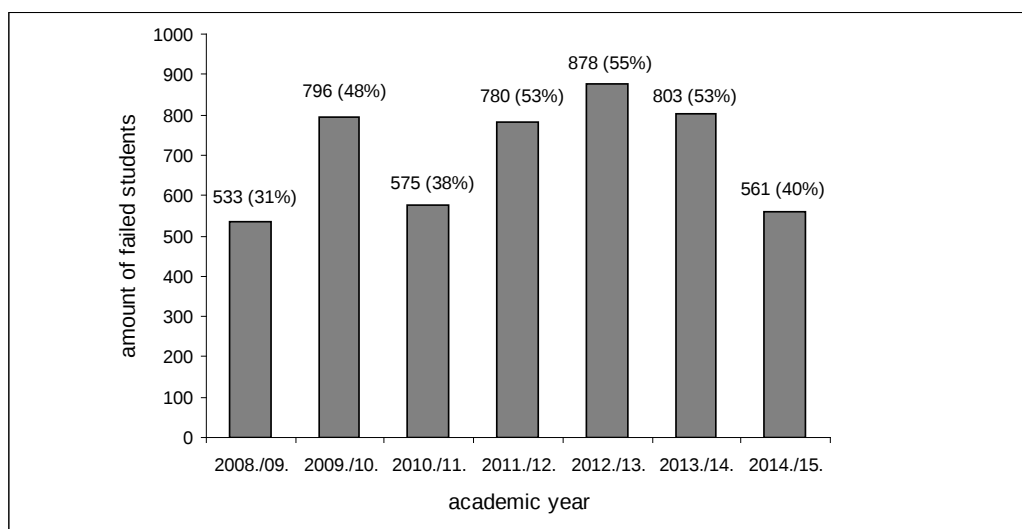


Figure 3. The amount of failed students in the test about Elementary Mathematics in the last six academic years.

Mathematics traditionally is considered one of the hardest subjects. Amount of students with low grades in Mathematics and dislike to acquire it is rising at the moment. Figure 3 shows that almost half of the students are not capable to solve even 2 of 5 assigned tasks. The results of the mathematics exam of the 1st semester show that these students are unable to acquire Higher Mathematics and successfully pass the exam.

If we take the statistics about students whose results in the centralized school exam is lower than 50 %, the situation is worse. The following data is taken from only one particular faculty, the Faculty of

Civil Engineering, about the last two academic years. This faculty in comparison to other faculties is in the middle level: the amount of accepted students with low knowledge of the elementary mathematics is no bigger or smaller. From Figure 4 we can see that division is almost equivalent: 38 % of these students passed the exam, 30 % failed it, 32 % did not come to the exam at all. Of course, the higher the level in CE, the bigger the amount of the students that passed the exam.

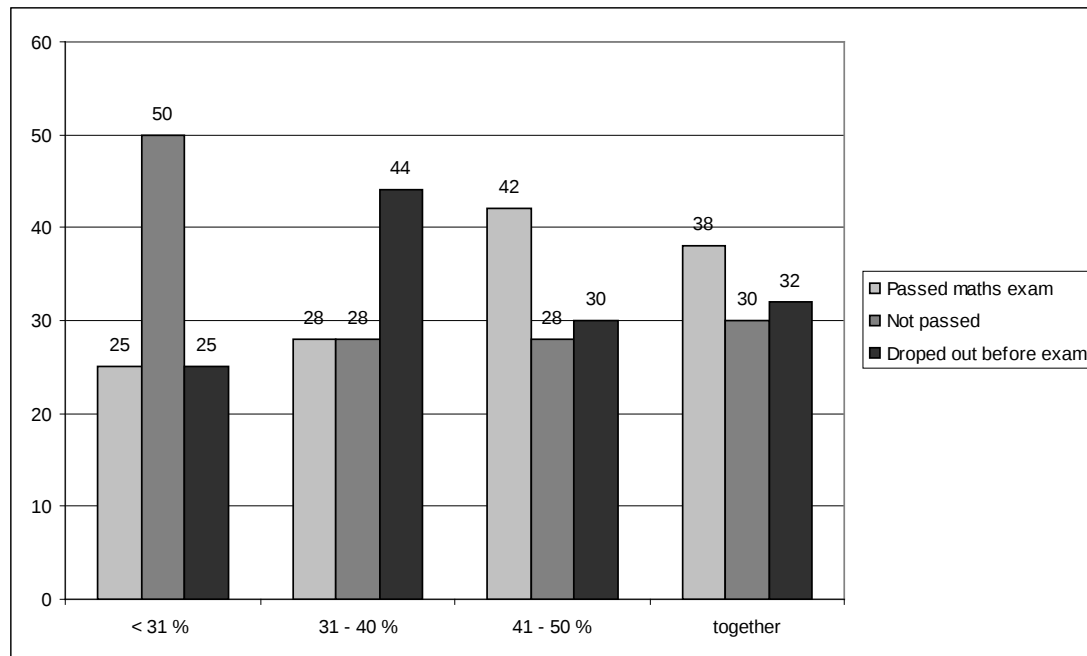


Figure 4. Summary of the results in the exam of mathematics in semester 1 (in percentage) for students of the Faculty of Civil Engineering, whose level of CE is lower than 50%.

The situation in whole RTU is also quite unpromising.

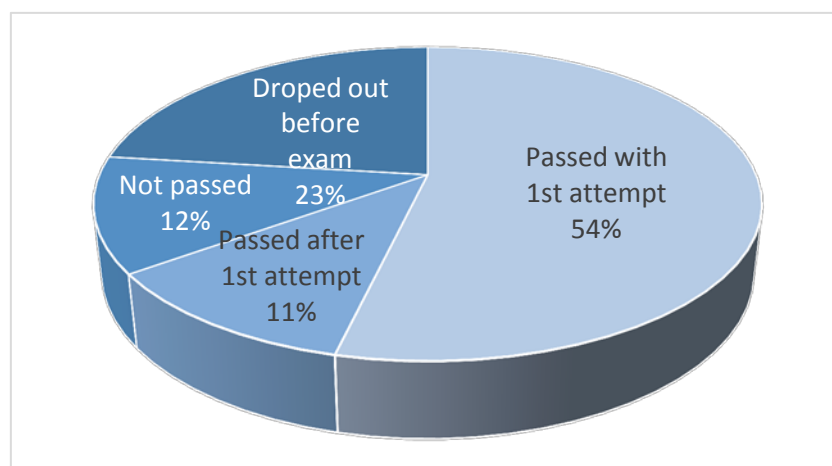


Figure 5. Results of the mathematics exam of the 1st semester in RTU.

Figure 5 shows the results of the mathematics exam of the 1st semester in RTU in the previous academic year (Birzniece, 2014, 5459-5463). As it is seen from the Figure, only 54 % of the students pass it with the first attempt, 11 % pass it after several attempts, 12 % do not pass it at all. But, the greatest worry is about 23 % of students who do not take the exam at all. Those are the students that decide to leave RTU before the first session, mostly because of these three reasons: 1) students have entered several universities and choose on the university, not RTU; 2) do not like studies, are not interested; 3) studies are too difficult and they are left before the session. Save these 23 % of students are almost impossible, but, we can try to save at least part of those 12 %, who try to pass the exam.

For several years we have been searching the solution to this problem: how, as far as possible, help these students?

Searches for solution of the problem

The greatest problem is not connected to the fact that pupil (student) cannot acquire mathematical knowledge or skills, but to the fact that he or she does not want to acquire them. To avoid academic failure, universities have to make studies of Mathematics more attractive, as well as, improve those insufficient knowledge that student has not acquired at school. For this purpose Department of Engineering Mathematics in cooperation with RTU Study Department:

- organized intensive Mathematics course before the beginning of the academic year;
- in cooperation with RTU Department of Information Technology created a course of video lectures;
- worked out new study subject „Basic parts of Elementary Mathematics”.

We will tell about each activity.

Intensive courses of Mathematics

In August, 2014, RTU Study Department organized and Department of Engineering Mathematics led a week long free courses of Mathematics. Offer to attend these courses were sent out to 200 students, whose CE evaluation in Mathematics was below 30 %. Though, as it was mentioned before, a great part of students do not want to acquire Mathematics, so, only 48 students responded to the offer, but, in reality, even less students attended them regularly – only 28.

After the survey these courses were valuable to them, though, the test of elementary knowledge of Mathematics successfully passed only 8 of the participating students of the course. We can conclude that a week long courses are undoubtedly useful, but not enough for revision of all topics of school Mathematics.

Video lectures

Experience shows that it is much easier to study if you have gathered good basic knowledge in sciences. The main problem for students is the great amount of revision material, that is why, it is necessary to successfully organize both use of visual consumables, and positive interpersonal atmosphere, that would result the cognitive greed and willingness to get results in students. To ease the process of revision for students, a great attention is paid to the use of visual materials. That is why in the spring of 2014, by suggestion of Study Vice-Rector of RTU, lecturers of Department of Engineering Mathematics created a course of video lectures of Elementary Mathematics, which consists of 43 5-18 minutes long video lectures. Technically filming the video lectures, treatment and downloading them in the INTERNET provided colleagues from RTU Department of Information Technology. Lectures are available in YOUTUBE by the address in bibliography (RTU Mācības, 2015).

Statistics show that in total these video lectures have been watched more than 3000 times, the most in the beginning of September. Very much possible that increased interest about them was exactly after the test of Elementary Mathematics.

Mentioned study videos not only allow students to revise the topics of school Mathematics, but also they help secondary school pupils to prepare for studies at university. During the preparation of these lectures, practical testing of these methodological materials was carried out, paying special attention to improvement of methodology of mathematical acquisition.

Study subject „Basic parts of Elementary Mathematics”

Another way to revise the topics of Elementary Mathematics for RTU students is to choose the subject „Basic parts of Elementary Mathematics”. It is a 2 KP subject, supposed for students having problems with Elementary Mathematics. For now it is taught only to part time students, a lot of whom have

finished secondary school several years ago. Experience shows that it is easier for students to acquire the course of Higher Mathematics after finishing this course.

Results and discussion

Adult learning nowadays gradually becomes a lifestyle. Analyzing statistical data of employment and their correlations with educational level in European countries, we receive confirmation that a wholesome realized studying throughout life secures fruitful action in Professional and social fields of the personality. As the role of Mathematics increase not only in scientific– research work, but also in study work, working with different computer programs, great attention in study programs of Mathematics in universities must be paid to the quality of studies of Mathematics.

That is why it has been an actual question recently, how to motivate students to an active action, improve the understanding about the significance of Mathematics in everyday life and role of Mathematics in other scientific, social and personal developments. Can Mathematics become understandable? That depends on teaching Mathematics that includes several factors, the most important of which is a teacher in the process of teaching mathematics. That is why the aim is to choose teaching methods that are contributory to cognitive process, that develop both skills to study, and use the knowledge creatively. To provide teaching process suitable to nowadays, lecturers must use the newest teaching methods and technical teaching tools in their work. It requires „non-stop improvement, enlargement of basic knowledge and perfection of basic skills, non-stop development of them, education always and everywhere” (Šmite, 2004, 92).

Teaching materials of the studies is advisable to visualize as much as possible, giving opportunity to see the material both as a total, and in parts. Parallel to task solving example, grounds of theory and explanation must be given. Student, who combines studies with work and is able to attend only part of offered classes, wants to receive short and specific information, his or her attitude towards homework is negative, but he or she wants to receive the materials that are suitable for independent work – concise, understandable, with ready examples to solve the task. To create interest, lecturer must not only be knowledgeable, but must know how to organize lecture so that students are not bored, they do not lose attention. Nowadays pedagogy suggests that interaction between lecturer and student is the most important part that involves psychological and practical preparation for the action, realization of the action and evaluation. The professionalism of the lecturer is hidden in the ability to choose such teaching methods that rise activity in students and creates positive atmosphere during the learning process. During the process of changes in the education, the methods that are used by the lecturer have more significant role than study programs and workbooks, because newly worked out study program, workbook or study computer program does not promote the quality of education, if lecturer does not have the needed skills to use them.

To find out the opinion of students, there is a system for students' surveys created, where students evaluate the quality of every RTU study subject and the work of lecturer in the auditory. This information allows evaluating objectively teaching methods, study materials, lecturers and carrying out the necessary improvements

Information amount increases in every science field, that is why, university can no longer give all the necessary amount of knowledge, skills and abilities that will be required throughout the whole work life. The tasks that the new specialist will have to solve must be taken into account – finding workplace, ability to adapt in the workplace, make career independently, in the case of failure, the ability to change jobs. That is why an actual problem of pedagogical process is to optimize the relationship between the ready knowledge and student's own revelation, so that student from three possible roles – *consumer*, *observer*, and *participant* – would choose the last one (Kangro, 2006, 115-128). Those long-lasting and universal skills and abilities that would be useful in different life fields should be anticipated during the planning of the studies, and such qualities should be created in the new engineer that are characteristic to acquired profession and that help to be competitive in the labor market.

Conclusions

- Nowadays studies are characterized by the change of attitude both from the lecturer, and the students, both to the content of the studies, and study process. It requires lecturer's elasticity and effective ability to combine teaching methods, as well as, personal interest in acquisition of Mathematical skills of every student.
- Authors' created and tried out in practice video material helped students to understand separate mathematical questions, gave support for independent work in acquisition of Mathematics, helped prepare for Mathematics tests and as a result, promoted students' motivation for active acquisition of Mathematics.

Bibliography

1. Šmite A. (2004). Izglītības iestādes vadība I daļa. Pedagoģs. Organizācija. Pārmaiņas. (Management of educational institution Part 1. Pedagogue. Organization. Changes). Rīga, RaKa, Latvia. 256 lpp. (in Latvian)
2. Kangro I. (2006). Studentu matemātiskās domāšanas izpētes teorētiskie un praktiskie aspekti. (Theoretical and practical aspects of the research of students' mathematical thinking). LU PPI zinātniskie raksti: Vispārīgā didaktika un audzināšana. (Red.: prof. Dr. habil. paed. Irēna Žogla, vietniece prof. Dr. philol. Ilze Kangro) Rīga: Izglītības solī, Latvia, 115.–128. lpp. (in Latvian)
3. Birzniece I. (2014). Making Higher Mathematics Accessible: Experience from Riga Technical University. Proceedings of ICERI 2014 - 7th International Conference of Education, Research and Innovation, Spain, Seville, 17-19 November, 2014. Seville, pp. 5459-5463.
4. RTU mācības. [online] [02.02.2015.]. Available at http://www.youtube.com/results?search_query=rtu.emacibas.lv