COMPARATIVE STUDY OF TEACHING MATHEMATICS IN TWO UNIVERSITIES IN LATVIA

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ABSTRACT

The role of mathematical education in everyday life, professional activities, attitude towards the role of mathematical knowledge in the labour market is widely discussed in the literature. To improve the studies of mathematics according to the trends in society development, it is necessary to find out the mathematics teaching philosophy as well as to reflect views of the students on the issues of mathematics learning experience and mathematics teaching at university. The structure of mathematical study process for energy and electronics specialties at the RTU and LLU and the survey results, which was carried out at the Latvia University of Life Sciences and Technologies (LLU) and at the Riga Technical University (RTU), are analysed in this article. The questionnaire includes three diagnostic blocks: the role of mathematics in everyday life; in professional work / in relation to the labour market, and mathematics for the general development of a person. The total sample of the research included 887 cases. The results showed that the RTU students were more confident about their mathematical knowledge. They were ready to apply the acquired knowledge of mathematics in a new context and situation, while students of the LLU had more developed ability to use the acquired knowledge and apply in specific situations. A self-assessment method was used in the study; the results were based on respondents' opinion. Since this was a case study and it only reflects the views of the students who participated in the survey, the results did not provide generalizations, however, the study was conducted to identify problems, to carry out a more in-depth study of them and to search for solutions.

KEYWORDS

Mathematics, Mathematics Study Process Organization, Self-Assessment, Teaching Mathematics

1. INTRODUCTION

Human capital has become the cornerstone of economic and social well-being in the 21st century. In contemporary knowledge-intensive economies and societies, individual and societal progress is increasingly driven by technological advances. Prosperity requires nations to retain their competitive edge by developing and sustaining a skilled workforce, maintaining a globally competitive research base, and improving the dissemination of knowledge for the benefit of society at large. In this context, higher education represents a critical factor in innovation and human capital development and plays a central role in the success and sustainability of the knowledge economy (Dill and Van Vught, 2010).

In order to find out how the mathematical teaching guidelines and philosophy affect the skills and abilities of students to apply them comprehensively, from the spring of 2017 till June 2018 the researchers conducted a study in the 2 largest Latvian universities – the Latvia University of Life Sciences and Technologies (LLU) and the Riga Technical University (RTU). The questionnaire included three diagnostic blocks: the role of mathematics in everyday life; in professional work / in relation to the labour market and mathematics for the general development of a person. The study used a self-assessment method, therefore, the results were based on respondents' opinion. The results did not provide generalizations, however, the study was conducted to identify common problems, to carry out an in-depth study of them and to search for solutions.

Respondents were required to evaluate the indicated statements by expressing approval or rejection of the four-step *Likert* scale: *I fully agree*, *I agree*, *I disagree*, and *I completely disagree*.

The survey involved 887 respondents, and since the questionnaires were filled in sufficient quality, leaving no blank response windows, all evaluations have been taken into account in the calculations. As the specialties of the two universities differed significantly, in order to make the results to be maximally usable and equally assessable, in the study that is reflected in this article, one student group was selected and analysed from both universities: young people who study energy and electronics specialties from the RTU, and students of the energy specialties at the LLU.

2. MATERIALS AND METHODS

In order to maximally integrate mathematical knowledge and skills of young specialists into both routine problem solving and in professional circumstances, it was necessary to evaluate the basic guidelines and goals of the existing mathematics programs. The study had two parts: 1) to compare and study the aims of mathematics teaching in RTU and LLU; 2) to evaluate the competences acquired in RTU and LLU.

Questionnaires were sent to all students of LLU and RTU (both on-site and out-of-school) to assess students' competence in mathematics, not only by using database records of student achievements in higher mathematics, additional sections in higher mathematics in energy and electronics specialties, but also to understand to what extent applicants use their acquired skills to prepare for the labour market. The activity of respondents depending on the university has been shown in Table 1.

Table 1. Distribution of respondents depending on the university

		Absolute values	Percentage
University	LLU	244	28%
	RTU	643	72%
Total		**887**	

According to Table 1 the number of students at both universities might not seem proportional, but the sample size in each institution was logical since in 2016 14,997 applicants studied in the RTU, and 4353 in the LLU (which were 29% of the RTU students) In turn, emerging electronics and energy specialists constituted 26% of all respondents.

The future labour market cannot exist without comprehensive knowledge and competences in mathematics.

In 2000 a number of higher education institutions across Europe took part in the project “Tuning Educational structures in Europe” in which several competences were set as learning outcomes – instrumental, interpersonal and systemic. In many ways mathematical knowledge is ingrained in these competences (cognitive, methodological, technological etc. abilities). In 2006 the European Commission declared to strengthen key competences for personal fulfilment, development, and employability. They also included mathematical competence: 1. ability to solve everyday problems, using thinking patterns (logical or spatial), depicting/portraying (formulas, constructs, graphs, diagrams etc.); 2. ability to identify structure and links, repeatability and systematicity. In 2016 in the World Economic Forum “The Future of Employment” three out of ten main targets were directly connected to mathematical knowledge – solving complex problems, critical thinking and creativity.

Mathematical knowledge in the study process is crucial since: 1. the problem-solving in mathematical situations and the demonstration of relationships improves logical thinking, the ability to solve complex problems; 2. while studying comprehensive and complex solutions to mathematical problems, students develop systematic competences and critical thinking; 3. while working in a group on more complex non-routine tasks students develop their creativity.

When evaluating the teaching methods, basic principles and objectives of mathematical teaching in the RTU and LLU, it should be noted that they differed significantly, although the programs were similar. Therefore, it is important to take into account how differences in attitudes affect the knowledge acquired during the course of studies and the ability to apply them.

The study objectives in the LLU: to acquire mathematical knowledge and practical skills necessary for the study of future special courses. The study objectives in the RTU: to acquire basic knowledge in mathematics necessary for the successful mastering of specialty subjects;

The study results in the LLU: to develop students' logical thinking and application skills in relation to specialty subjects and their basic objects in order to provide students with the ability to analyse solutions for the most complex tasks. The study results in the RTU: to develop students' logical thinking and application skills in relation to specialty subjects and their basic objects in order to provide students with the ability to analyse solutions for the most complex tasks.

Assessing approaches for achieving these objectives, students of the equivalent specialty studies in mathematics – energetics and electronics – were selected.

The questionnaire analysis showed that the volume of RTU lectures in higher mathematics (within the framework of ECTS 13.5) was 80 hours, whereas in the LLU it was 72 hours; practical lessons were 96 hours and 72 hours respectively, as well as 40 hours of laboratory work in the LLU, which demonstrates that the LLU teaching process of mathematics emphasized practical tasks, solving various general tasks both in mind and using computer programs. In turn, the RTU worked more on theoretical material, presenting theories in classes and discussing with the students not only the basic elements of mathematics, but also their physical and economic core functions, and when the guidelines were set out and part of them were proved, the attention was paid to the use of practical skills applications in specific situations. In order to find out which of these approaches was more effective, students' answers to several questions related to mathematical competences, as well as some test results were studied and analysed.

At the beginning of the studies (September 2017), for maximizing the further work efficiency and adapting the forms of training for the particular study course, all students were invited to complete the preliminary knowledge test consisting of several simple examples in which students could demonstrate their basic knowledge and skills in mathematics

According to the preliminary test the assessment of 46% of RTU and 37% of LLU students' knowledge was insufficient, for 29% of RTU and 27% of LLU students – mediocre, but good and excellent only for 24% and 32% of the students. This could be due to the fact that after the end of study period, the break was 3 months, for college and technical schools` graduates – even one and a half years.

In order to help young people to understand the study material taught at the university, young people are offered optional (for those RTU students who have passed the test unsuccessfully – compulsory) subject "Additional chapters in elementary mathematics", during which it is possible to repeat forgotten concepts.

LLU and RTU researchers, having conducted a student survey, in which students evaluate their knowledge themselves, discovered that students were sufficiently self-critical and understood that good skills in mathematics are necessary to become a high-end specialist in electronics or energy. The results of the tests and student self-assessment were equivalent. Despite the low evaluation of mathematical knowledge, 78% of students said they were ready and willing to devote more time to math, either working independently or consulting with instructors, or in groups, creating "maths fan clubs" which RTU Electronics and Mobile Communication specialty students have been organizing for several years.

A university should create such study environment that would interest students in active participation during the study process, in developing creative tasks at home, not being afraid to enter into disputes and discuss problems and obstacles with educators. When students feel more comfortable they develop their judgment, ability to detect problems, analyse and develop rational scenarios for solutions. It is important to create positivism rather than fear – a positive attitude towards learning and work motivates for better results, including in mathematics studies. In order to create or improve this environment, it is necessary to find out the attitude and assessment of the students. Students were asked: "Please express your opinion on teaching mathematics at a university" from several aspects.

The students` answers were not unambiguous and they thoughts were changing. For example, 56% of RTU and 77% of LLU students emphasized that mathematics classes at university are formal and boring, but in response to the next question, 75% of RTU and 76% of LLU students claimed that the same training had been interesting and meaningful. Such results indicate that individual responses were influenced by several factors that require more precise data analysis; for instance, one of the topics to be learned was more simple whereas another was harder (students remember last lesson the best), how many lectures respondents had listened to, whether they had only attended lectures or only practical classes, maybe they periodically went to both classes, if students had attended special consultations provided by instructors. Having summed up all these factors and discussed problems with students, one can conclude that students who had understood the

mathematical connexions in high school and were also doing their best at the institution of higher education, did not experience difficulties in learning mathematics and being able to subsequently use it in the acquisition of professional study subjects. Whereas those students that had rather poor maths knowledge at the beginning of their studies at university (initial test results – 0-3), but were diligent at participating in all classes, consultations and different activities provided by educators, successfully overcame their difficulties when the objectives were clearly given. The electronics students of RTU who had insufficient maths assessment in the beginning of the studies, but attended 100% of lectures and consultations had a positive growth of average grade in mathematics during the study year.

When comparing the answers of the applicants from both universities, it was clear that the differences were not significant, and the RTU students' assessment of the study process and their acquired knowledge only slightly exceeded the results of the LLU. For example, 82% of RTU and 81% of LLU students admitted that the knowledge acquired in the higher education institution in mathematics helped them to understand other subjects.

3. CONCLUSION

The investigation of the multilateral learning process, both from the scope and quality of the inquiry, and from the attitude and skills of students and teachers, allowed the researchers to understand the opportunities for intellectual growth and cognitive development as well as their role in the learning process.

The study conducted the comparison of the results of the higher mathematics study process in 2 largest universities of Latvia – RTU and LLU, and the following conclusions were made:

- the results of the initial tests demonstrated that in the 2017/18 academic year the results of the energy students of the LLU were slightly higher than those of RTU electronics students;
- 45% of RTU electronics students fully acknowledged that the acquired knowledge in mathematics helped them to understand other subjects and solve various problem tasks and develop scenarios for their solution, while 37% of them agreed with the statement; in LLU the numbers accordingly were 51% and 30%;
- both universities had a mathematics support system for students – preparatory courses, course of elementary mathematics repetition, internet/ e-resources, additional consultations, etc.
- RTU students were confident about their mathematical knowledge. One of the reasons for this situation might be that the purpose of RTU mathematics courses is more specific, but in LLU it is more broad and includes seven mathematical competences;
- RTU students were ready to apply the acquired knowledge of mathematics in a new context and situation, while students of the LLU had more developed ability to use the acquired knowledge and apply in specific situations of life.

The **self-evaluation method** was mostly used in the research, thus the results were based on the opinion of the respondents, and therefore the results cannot be generalized, but they can be used to identify problems and to explore them further.

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