

## INFLUENCE OF STUDENTS' SURVEYS ON TEACHING MATHEMATICAL SUBJECTS AT RIGA TECHNICAL UNIVERSITY

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**Abstract.** In a changing world, people's needs for education are also changing, so questions about improving the education system and the quality of education are particularly appropriate and important. Taking into account the changing educational needs of students and the fact that knowledge is becoming more universally accessible, we wanted to analyze our own learning processes and ask ourselves: "What is it that we want to provide as educators?" Students are directly interested in the quality of their studies. A confident and supportive approach to the 1st year students during math lessons is an important factor in raising the interest of students in mastering higher mathematics. This will assist students in developing their ability to solve engineering problems in the future. Student surveys are one of the most commonly used instruments in higher education institutions for collecting a reasonable student assessment of various indicators, characterizing both the quality of the studies and the lecturer's professional work. It is the potential of such surveys, which aim to improve Mathematical studies through knowing what students really think, and to gain an understanding what can help them to learn mathematics better, that prompted us, several Professors of Mathematics of the Department of Engineering Mathematics, to create our own survey with questions, which are specific to Mathematical subjects. The survey results are very informative. The structure of the survey invites students to extend their "yes"/ "no" answers with details, comments and opinions, and these are the most valuable results of the survey.

**Keywords:** students' surveys, mathematical subjects, higher education.

### **Introduction**

The most important task in the sphere of education could be described as satisfying the educational needs of society in general while meeting the particular educational needs of each student. In general, society needs to have people, who are suitably equipped to develop technologies, qualified to construct, ready to produce, to organize and to manage. These are people, who are able to prepare new generations, ensuring the continuing existence and development of humanity and society. On the other hand, students need to have a guaranteed profession and a level of knowledge sufficient for the realization of their abilities that will enable them to move upward in their chosen career for prestige, for wellbeing, for high income, etc.

It is clearly evident that nowadays education is becoming more widely available; therefore, the quality of higher education must be developed and improved to meet the needs of students and other beneficiaries of higher education [1]. In the conclusions of the EU Council 2011 about the modernization of higher education, the participating countries were invited to "promote the development of systematic effective strategies to ensure accessibility of education to minority groups and to intensify the efforts for reducing the indicators of higher education aborting, by improving the quality, the utility and attractiveness of the study courses, especially basing on those efforts on the acquisition of the existing student-oriented knowledge, and on support, advice and consultations provided to students accepted into higher education institutions" [2].

The main task of a higher education institution is the preparation of highly qualified specialists with high theoretical and practical skills in their chosen speciality and sphere, people who are capable as organizers of both work and other activities, and who are able to work in a team. Strategic planning and management in the field of improving the quality of education is impossible without using feedback from the consumer of the product - the future specialist, the present students. A higher educational institution, if it is unable to adapt at the level of the individual and of the social community, in terms of satisfying the needs and interests of various participants in education, and does not increase the value of educational services, is doomed to failure and will be supplanted by other educational institutions in the educational space.

### **Methodology**

One of the main products of a higher education institution is the knowledge acquired and mastered by students in the learning process. This knowledge must be confirmed by the test results,

exam results, producing projects together with any graduating qualified work, and not only be documented in the form of lecture notes. In the field of higher education, the system of intra-university quality control of education and the methodological bases for assessing the preparation level of graduates of higher education institutions are developing.

One of the mechanisms, which can be introduced to ensure the quality of education and studies, is the use of student surveys, which monitor the satisfaction of students with the organization and with the quality of the study process. Student surveys should be taken after both completing every study course and graduating the study program. This is the most straight forward way to transfer their suggestions or complaints to someone, who has the ability to change the study program together with its form or evaluation methods. Student surveys are not only a way to transfer complaints or suggestions to administration or professors, but also a tool that helps to distinguish that something needs to be improved – or visa versa – that the study program is very good and should continue along this path. Student surveys are another opportunity for every student to improve his/her own study process and make professors concentrate on student-centered principles, which take into consideration different needs, interests and wishes of every student, which makes the study process as suitable for everyone as possible.

A significant part of student-centered education is the possibility that students may be able to influence their own study program, teaching methods and evaluation methods. In that way, students become partly responsible not only for what they learn themselves, but also for what they can receive from the professors and other educators during their studies.

The level of knowledge of mathematics received by students in schools throughout the country varies significantly. Newly accepted 1<sup>st</sup> year students are tested on their elementary mathematics skills, and also asked how they want to see mathematics lessons at university, what they like, or do not like, regarding the teaching of higher mathematics. Analysis of the test results allows professors to use the most appropriate methods of teaching mathematics in relation to weak and strong groups of students. A confident and supportive approach, especially to the 1<sup>st</sup> year students during math lessons, is an important factor in raising students' interest in mastering higher mathematics, and will assist in developing the ability of students to solve engineering problems in the future.

Since the 2007/2008 academic year, the Riga Technical University (RTU) is using a unified e-learning system, named ORTUS portal, which is based on the e-learning program MOODLE (Modular Object-Oriented Dynamic Learning Environment). Using ORTUS portal, the RTU Study Department conducts regular semiannual students' surveys about the quality of the content of every acquired subject and professors' work. The results of the survey are completely available to every professor regarding his/her study subject, also to the head of the structural unit of the professor, and upon request, to directors of the study programs, in which the professor is involved, as well as to representatives of the Student Parliament. It is clear that the questions in the existing RTU surveys have been of a general nature, with no clear reference to specific subjects and areas of study. RTU professors have regularly analyzed the results of these surveys and taken them into account in attempting to restructure study time in order that all the components relevant to the study process are used rationally, effectively and appropriately.

However, the existence of questions that have not been asked, particularly those questions specific to mathematical subjects, prompted us, several mathematics professors of the Department of Engineering Mathematics, to create our own survey. Three different surveys were created. One survey was offered in the 1<sup>st</sup> semester for those newly accepted students taking the basic Mathematics course and in the 1<sup>st</sup> year of their studies. These questions were designed to potentially benefit both the students and the professors. The questions were also aimed at helping us to understand what students expect from their studies; how they understand the study process, what they already liked, and what they think should be changed or improved. Another survey was offered at the same time for those 2<sup>nd</sup> year students taking the "Supplementary Mathematics" course, for both Latvian and foreign students. The survey contained some questions similar to the 1<sup>st</sup> year survey questions, but some of the questions were different. The answers to these questions gave us an understanding of the students' view of the study program and teaching methods, and if these views had changed since last year, as well as their progress in their studies at a higher education institution. In total, 317 students of the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Transport and Aeronautics, Faculty

of Power and Electrical Engineering were surveyed in the autumn semester of 2017. The questions and results of both surveys were presented, discussed and published at APLIMAT 2018 conference [3].

The 3<sup>rd</sup> survey was created recently and offered to the 1<sup>st</sup> year students in the 2<sup>nd</sup> semester of the 2017/2018 academic year. The need for a 3<sup>rd</sup> survey was highlighted by the answers we had received from the previous two surveys. The same groups of students (as in the 1<sup>st</sup> semester) of the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Transport and Aeronautics, Faculty of Power and Electrical Engineering were surveyed, 167 students in total. The survey sample for the 1<sup>st</sup> year students of the 2<sup>nd</sup> semester is presented below (see Fig. 1).

<p>For 1<sup>st</sup> year students of the 2<sup>nd</sup> semester study subject „Mathematics II”</p> <p style="text-align: center;"><b>SURVEY</b>  <b>“Students’ opinion and suggestions for improving lessons on Mathematics”</b></p> <p>1) Have YOU FAILED the EXAM for the 1<sup>st</sup> semester subject “Mathematics I”?</p> <p style="margin-left: 20px;">____ YES;      ____ NO.</p> <p>2) Has YOUR ATTITUDE changed regarding ways to learn, complete and pass the subject “Mathematics”?</p> <p style="margin-left: 20px;">____ YES, ( at present, I _____ );      ____ NO.</p> <p>3) In YOUR opinion, does the division of the semester final exam into MIDTERM EXAMS facilitate passing exams on mathematical subjects?</p> <p style="margin-left: 20px;">____ YES, ( since _____ );      ____ NO, ( since _____ );      ____ NOT important, it should be the choice of the lecturer.</p> <p>4) In YOUR opinion, should the NUMBER of LECTURES and TUTORIALS on Mathematics be increased?</p> <p style="margin-left: 20px;">____ YES, it definitely must be increased, since the number of solved tasks on each topic is not enough;      ____ YES, it would be good;      ____ NO, the present number of lessons is enough.</p> <p>5) In YOUR opinion, are HOME WORK ASSIGNMENTS needed?</p> <p style="margin-left: 20px;">____ YES, since it helps students master the material and be better prepared for the tests;      ____ YES, to increase the semester final grade, since it contributes 10 % to the semester’s final mark on mathematical subjects in the RTU;      ____ YES, but MANDATORY home work is needed (this means that without having a positive evaluation of work made at home, students are not allowed to come and take the exam);      ____ NO, it is not needed, if it does not influence the final grade of the semester.</p> <p>6) In YOUR opinion, are classroom written CONTROL TESTS on Mathematics needed?</p> <p style="margin-left: 20px;">____ YES, since it helps students master the material and be better prepared for the exams;      ____ YES, to increase the semester final grade, since it contributes 40 % to the semester’s final mark on mathematical subjects in the RTU;      ____ YES, but MANDATORY control tests are needed (this means that without having a positive evaluation of all classroom tests, students are not allowed to come and take the exam);      ____ NO, it is not needed, if it does not influence the final grade of the semester.</p> <p>7) Do YOU know that the EVALUATION FORMULA of all Mathematical subjects in the RTU is a result of the Students’ Parliament initiative and, this academic year, the RTU Rector’s order, according to which the final exam mark cannot exceed 50 % of the final grade for any RTU subject?</p> <p style="margin-left: 20px;">____ YES, I have known about this since the 1<sup>st</sup> semester;      ____ NO, I have learned it now.</p> <p>8) Do YOU know that the STUDENTS’ PARLIAMENT is an organisation, which can change students’ experience at University (for example, it can make proposals about study subjects’ evaluation criteria, about volume and content of study subjects, and about its proper place in the study programme. Finally, it can fight for the introduction of these proposals into the study process)?</p> <p style="margin-left: 20px;">____ YES, I heard about it and believe it will be useful;      ____ YES, I heard about it, but I do not believe it will be useful;      ____ NO, I did not hear about it, but I believe it could be useful;      ____ NO, I did not hear about it and I do not believe it would be useful;      ____ OTHER _____.</p> <p>9) Are YOU READY to contact the Student’s Parliament with study proposals and problems?</p> <p style="margin-left: 20px;">____ YES, definitely, I will contact it and try to improve the situation, if I feel there is a need;      ____ YES, maybe I will contact it;      ____ NO, I definitely will do nothing;      ____ OTHER _____.</p> <p>10) Do YOU have any other SUGGESTIONS?</p> <p style="margin-left: 20px;">____ YES, these are _____      ____ NO, I do not have.</p> <p style="text-align: center;"><b>THANK YOU FOR THE RESPONSE! YOUR OPINION IS VERY IMPORTANT!</b></p>
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Fig. 1. Survey questions for 1<sup>st</sup> year of 2<sup>nd</sup> semester students

## Results and discussions

One can see that the survey questions give us an understanding of the changes in the students' thinking, and in their attitude towards the study process, after half a year of experience at university and after passing first exams and many different tests.

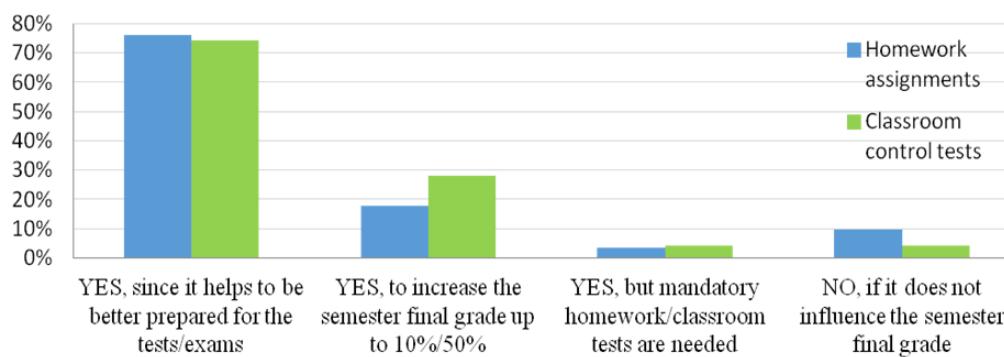
There is a significant difference between the motivation to study at a general secondary school and the motivation to study at an institution of higher education. As the authority of parents and the control of day-to-day teaching are diminished, the evaluation is less frequent, and therefore, as a result of a changing environment, a level of oversight is lost. The beginning of study at a university is only the first step in acquiring higher education, which a student may, or may not, follow through to completion. Even after their first semester it becomes very clear to the target-oriented student that the specific goal of their education determines the level of their individual involvement in the education process. If, for example, an individual student's desire is to achieve a prestigious profession or perhaps a highly paid job, then the education process needs to match the desired result for that student.

The survey results show that in the 2<sup>nd</sup> semester, almost 40 % of students changed their opinion about the importance of studying mathematics and the ways to study mathematics. They realised that they should learn to be consistent, rather than leave everything to the last moment, that they should attend all lessons and consultations, and independently read lectures notes and books. They should also learn solve many tasks, doing their homework at home, taking and passing all control tests successfully. After passing the 1<sup>st</sup> semester and its exams, students understood that they need to study much more intensely and consistently than they had during secondary school, if they want to get better results without stress.

The motivation for starting studies for 1st year RTU students is related to their interest in their chosen profession, and their desire to become a student. The study shows that students are aware of the importance of mathematics in university. However, student knowledge of mathematical subjects is primarily evaluated by mark, and this is the main and strongest motivation for them to learn. Thus, according to the survey results:

- most students (89 %) prefer to have the intermediate exams in facilitating their successful mastering of mathematics;
- more than half of the students (70 %) want to have more hours of mathematics per week;
- most students consider all kinds of individual verification work in mathematics to be highly desirable for successful study of the subject (see Fig.2.);

Homework assignments and classroom tests are necessary



**Fig. 2. Necessity for homework and classroom tests**

Students are not bored in math classes. When learning mathematics, students must understand that it is an active subject. Students need to be aware that professors take care of them as partners with the same goals and objectives. However, students need to make their own path and actively influence the study processes in the university. A good assistant to students, working for the interests of students, is the Students' Parliament.

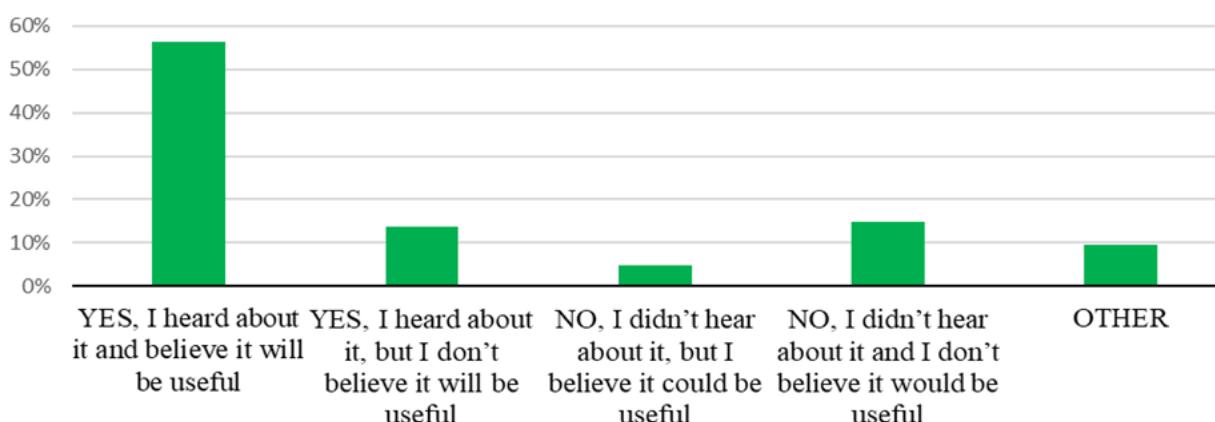
There is a particular innovation this year at the RTU. Starting from this 2017/2018 academic year, due to an initiative of the Students' Parliament and the RTU Rector's order, the final exam mark

cannot exceed 50 % of the final grade for any RTU subject, and all RTU Professors are obliged to grade any study course for a student not only upon the student's final exam results, but also upon their work in the semester. Thus, for all Mathematical subjects in the RTU the "Evaluation Formula" was created by the head of the Institute of Mathematics of the RTU, which gives 50 % of the mark for the final exam, taken during the exam period; 40 % of the mark for tests and assignments, taken during the semester; 10 % of the mark for homework solved at home. Such an approach encourages students to learn steadily and deeply, so that the results rely on a student's knowledge, not on luck during the exam (see Fig. 2). This situation is appreciated both by diligent students and professors.

As the 2<sup>nd</sup> semester survey shows, more than half of the students (68 %) were not yet familiar with the order of the Rector to reduce the value of the examination mark among the overall indicators of student achievement in the semester in mathematics. Besides, only a little more than a half of the students (56 %) positively assess the role of the Students' Parliament regarding its place and potential in adjusting the learning process, taking into account the expressed wishes of the students. The other half of the students either did not know about the power of the Students' Parliament, or did not believe that it could be effective (see Fig. 3). But thanks to this survey, more students learned about the activity of the Students' Parliament, so that 66 % of the students answered that they would probably contact the Students' Parliament, if they encountered learning problems or had suggestions for improving the learning process. This is a very positive result arising from the survey, which may encourage students to be more active and take greater responsibility for the quality of their own study at the university.

"Students are directly interested in the quality of their studies" [4]. The learning path is precisely determined. Even though each student might complete their study path in different ways, each and every student has a significant role to play in the study process. So, it is our responsibility as educators to offer the best support for each and everyone of our students. In every area of study, the relevant subject information is selected by the lecturer, prepared and presented to the students. Therefore, one of the most important skills that must be learnt by students today, is the ability to orient oneself in the information environment.

### Students' Parliament is an organisation which can change students' experience at University



**Fig. 3. Role of Students' Parliament in RTU**

In order to ensure accurate monitoring of the quality of its education, a university needs to have in place a method of both receiving the necessary data, and how to apply the data to the education process. One of the data gathering methods used is the previously mentioned student surveys [5]. Ensuring the essential quality of education is a process that, in this case, is carried out by educators. Their responsibility is to check if the performance of the study program is of a high quality, as well as analyzing answers to remove imperfections and to make any necessary improvements. It is essential that at the end of the survey, students have the opportunity to write their own comments and suggestions about the study program of the subject, the teaching methods, and the professor's work.

Usually, this is the most interesting part of the survey results. Of course, the credibility of the survey depends on the number of students participating [6]. As the number of students participating in the survey we conducted at the RTU was large, and the students were chosen from different faculties, the results are quite credible.

## Conclusions

1. Students evaluate the knowledge and skills acquired in mathematics positively, as they are aware that this knowledge is necessary to continue their studies at the university.
2. Students like the principle of a variety of types of examination so that different types of tests are appreciated when assessing the students' knowledge, for example, intermediate exams.
3. Students are involved in decision making related to the study process, and in decision making related to the interests of students. Their proposed suggestions are analyzed, and their significance and utility are evaluated.

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