# SURVEY OF MARITIME STUDENT SATISFACTION: A CASE STUDY ON THE INTERNATIONAL STUDENT SURVEY TO IDENTIFY THE SATISFACTION OF STUDENTS IN MATHEMATICAL COURSES

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**Abstract.** This study presents the analyses of students' preferences, satisfaction and perception of learning mathematical subjects at higher education maritime institutions in Croatia, Latvia, Estonia and Poland. All these institutions participate as project partners in the MareMathics project. In order to evaluate the effectiveness of teaching and learning mathematics, a preliminary student survey was conducted in all project partner institutions. Two indicators were analyzed: exam success rate and learning outcomes achieved. The developed online questionnaire contained a number of questions about the teaching methods and tools used by lecturers. Students assessed the impact of different teaching methods, expressed their satisfaction with learning materials, their impact on the results achieved by them, and the overall course.

The analysis of the obtained data revealed that students faced difficulties in completing their tasks within subjects on mathematics and statistics. These research results lead to the conclusion that the used methods and tools of teaching mathematics and statistics, which are the essential influential factors on the overall satisfaction of students, are not effective and need to be modernized in the institutions under consideration. And this fact is crucial in the process of study and teaching of mathematical subjects as those subjects make up the base and necessary tools in learning other courses contained in the study program, especially in technical and engineering studies.

*Keywords:* higher maritime education institutions; STEM; learning difficulties; mathematics students learning habits

**Introduction**

Mathematical education constitutes undoubtedly a base for many STEM-related (science, technology, engineering, and mathematics) professions. Many studies reveal a shortage of professionals with the necessary skills to fill STEM-related vacancies. Despite the fact that demand for STEM-related professions is rapidly growing (Wilson 2010; Noonan 2017), the interest in STEM study programs is declining (Joyce 2014). Thus, the mismatch between demand and supply for qualified STEM-related professionals is evident. Recent studies (Shé et al. 2017) reveal that there is a clear need to change the approach in motivating young people to study mathematics and STEM subjects in general in order to fulfill industrial needs.

There are different strategies developed for universities for recruiting and retaining students in STEM study programs (Ruiz 2021) and improving mathematical education (Mardanova et al. 2020; Abdullayeva et al. 2019; Vedrenne-Gutiérrez et al. 2021; Wang 2019; Feuerstein et al. 2019; Nantschev et al. 2020; Alibishi 2018).

As the maritime industry plays a great role in the overall world economy, the professional occupation in the maritime sector constitutes a substantial part of all vacancies provided worldwide.

There are different methods developed to motivate and engage students to study specialty-specific courses in maritime education (Kunieda et al. 2017). However, students need strong background knowledge in mathematics and statistics in order to successfully pass maritime-related courses, as mathematics plays an essential role in maritime affairs (Stanivuk et al. 2017; Akakpo 2016).

The aims of this study are to:

(i) Describe the overall situation with courses on mathematics and statistics for maritime curricula

(ii) Reveal the main shortcoming in methods, resources, and tools used for teaching

(iii) Discuss the rate of students' success in mathematical exams, dropout rate, and the suggestions for eliminating reasons for students' low performance.

Methodology utilized in the study included surveys carried out during the summer semester, 2019/2020 academic year. There were two surveys performed:

(i) One aimed at teachers delivering courses in mathematics and/or statistics

(ii) Another aimed at students enrolled in maritime study programs.

Results obtained from of these surveys and derived conclusions were the first intellectual output in "Maremathics" an Erasmus+, KA2, Strategic Partnership project with the aim of supporting the creation and implementation of innovative practices in mathematics education for students of maritime studies across Europe. There are four Higher Education Institutes (HEIs) involved in the project: University of Split, Faculty of Maritime Studies, Croatia, Latvian Maritime Academy, Latvia, Tallinn University of Technology, Estonian Maritime Academy, Estonia,

The Polish Naval Academy Faculty of Mechanical-Electrical Engineering, Department of Mathematics and Physics, Poland. The surveys were carried out independently and simultaneously for each institution. Although questionnaires were identical for all universities participating in the surveys, some distinctions existed due to inconsistencies in the number of respondents. The results of the surveys were unified before analysis. Analyzed and compared results helped to answer the research questions.

**Methods**

The current study used data drawn from:

– Anonymous students' survey about quality, relevance and success of mathematical courses

– Survey aimed at lecturers of mathematical courses.

Although there are many different resources available for students and teachers to help support their learning or teaching, it is not clear what resources are the most used and preferable by students and teachers. Another focus of the research was to recognize the level of teachers and students satisfaction during the teaching and learning process. Therefore, the study was initiated to answer the following research questions:

(i) How do students and teachers view the methods and tools used in teaching math in a classroom?

(ii) What types of resources do students use and lecturers recommend for learning math?

(iii) Is there a difference in the method and tools used in different institutes?

(iv) Are teachers and students satisfied with the teaching and learning process?

This paper presents the results of surveys carried out on the teachers and students participating in the teaching or learning process in some of the courses of mathematics such as Mathematics 1, Mathematics 2, Statistics offered in bachelor study programs during 1st, 2nd or 3rd semester, and also some subjects related to mathematics such as Decision Support Systems, Dynamic Systems semesters, Fundamentals of Systems Reliability - offered in higher semesters (4th and 5th) at the University of Split, Faculty of Maritime Studies, Estonian MaritimeAcademy, Latvian Maritime Academy and Polish Naval Academy.

The study examined n=14 mathematics teachers and n = 340 students from all institutions. Data were collected during the summer semester, 2019/2020 academic year. The questioners were compiled using online survey tool Google Forms. Table 1 presents participating sample.

**Table 1.** Number of participants

| Institutions | Students | | Teachers | |
|---|---|---|---|---|
| | **Female** | **Male** | **Female** | **Male** |
| FoMS (nS=177) | 62 | 115 | 2 | 2 |
| EMA (nS=48) | 16 | 33 | 2 | 1 |
| LMA (nS=67) | 20 | 47 | 3 | 1 |
| PNA (nS=52) | 6 | 46 | 1 | 2 |
| Total (nS=345) | 30.1% | 69.9% | 57.1% | 42.9% |

\*\*\* FoMS – University of Split, Faculty of Maritime Studies, Croatia, LMA - Latvian Maritime Academy, Latvia, TalTech EMERA - Tallinn University of Technology, Estonian Maritime Academy, Estonia, PNA - The Polish Naval Academy Faculty of Mechanical-Electrical Engineering, Department of Mathematics and Physics, Poland

The answers were quantitatively and qualitatively analyzed by each HEI using statistical methods and the results were compared to determine whether there were differences in the responses between students/teachers who attended different institutes.

On this basis, similar conclusions were drawn and presented by individual universities.

The teacher questionnaire has 35 – 38 items. The number of questions in teachers' survey differs as PNA split up some general questions on more detailed ones. The items relate to tools and method applied by math lecturers and assistants in the classroom or for delivering materials and communication with students. The first part of the questionnaire: questions 1 – 4, involves the general data as gender, position to which the teachers are appointed, job seniority as a teacher in a high education institution, completion of a teacher education or training program. The second part, questions 5 – 11, concerns information about exams, recommended literature, ways of telling students the goals, learning outcomes, grading criteria, evaluation process and methods etc., ways of distributing material to students and the tools teachers use during their teaching. The main point which the survey tried to clarify was the general use of IT and whether it is used for teaching and communication with students. In that respect, the teachers were asked what type of IT they use in the communication process. Issues included in the fourth part related to the teaching quality: space and technical conditions for teaching, number of students aligned with the available capacity, cooperation with other teachers, special activities of students, using on-line tests, quizzes, solving real-life problems test. Our interest also included the teachers' assessment of students' performance and behavior, their prior knowledge sufficient for understanding the running content of teaching, their commitment to learning, the relationship between students and teachers and the teachers' satisfaction with the passing rates of the courses, constructive comments,

recommendations, proposals regarding improving the percentage of passing rate of the courses (questions 24 – 38).

The student survey identified the individual mathematical background of students, their perception of the importance of mathematical skills in their study and for a future job, use of methods and tools for learning and their perception of the teaching process. The survey consisted of 40 items. The first part – about 7-8 questions - explores the general data of the participants, their age, gender, nationality, their level of basic math knowledge, grade average from the high school and their attitudes toward the mathematical courses etc. Some statements (10 – 12) related to mathematical courses they have attended/passed during the study period, clearly defined assessment criteria and learning outcomes, their satisfaction and expectations, teaching methods regarding the mathematical courses, opinions about lectures, exercises, suitability and availability of the recommended literature. The questionnaire included also questions (4 – 5) on the teaching skills of lecturers/assistants in mathematics, statistics and the subjects related to them. Students were asked to express their satisfaction with resources and learning supports. Students were asked to recognize the organizational and teaching skills of their lecturers and assistants. Additionally, they were asked about their perception of math importance for their future job and for improving their skills and overall experience (8 – 9 items).

Moreover, the survey offered the opportunity that the respondents provide comments and suggestions for improvement of overall math teaching and learning environment (5 – 6 questions).

This study was carried out during the global COVID pandemic and locks across the world. Therefore it was difficult to get an expected number of responses – for at least 50 responses of students for every university.

This caused the following outcomes:

(i) the number of participants is still not significant for an adequate statistical estimate

(ii) some results are not comparable between institutions

(iii) some data are missing.

### Results

In this section, the relevant data regarding the background of the students who responded to the surveys are presented. After that, we present the findings regarding the resources, students' and lecturers' views on the teaching and learning methods. Finally, we will report the student overall satisfaction with math courses and their view on the course's contributions.

### Student Background

In this section, we will outline the relevant data regarding the background of the students who responded to the questioners. The background categories are shown in Table 2.

**Table 2.** Student Background

| Student background categories | Overall | FoMS | EMA | LMA | PNA |
|---|---|---|---|---|---|
| Student status (% of overall respondents in that category) | | | | | |
| FULL-TIME | 93.3% | 76.8% | 98% | 100% | 96.2% |
| PART-TIME | 6.7% | 23.2% | 0 | 0 | 3.8% |
| Matriculation exam or mathematics final exam in highschool | | | | | |
| % of overall respondents in that category | 99% | 98% | 98% | 100% | 100% |
| Score | 39.5% good | 37.5% sufficient | 29% sufficient | 42% very good | 39.5% good |
| Students' rating of their previous mathematical knowledge | | | | | |
| Grade (1 − 5) | 3.026 (good) | 3.1 | 3.5 | | 3.6 |
| Teacher's assessment of student's prior knowledge | | | | | |
| Grade (1 − 5) | 2.55 | 1.2 | 3 | 3 | 3 |

Different levels of student preparation create problems in the work of teachers who noticed that the overall mathematics knowledge of high school students is decreasing in the last few years.

Some serious knowledge is missing which can be one of the reasons for the low passing rate on the math exams. Comparing average mathematics grade from high school, student's pre-knowledge is evaluated. Results from the survey reflect that most respondents have average pre-knowledge.

Examples of results are presented on Figure 1.

**Learning resources**

Students and teachers gave a number of responses in relation to the questions on resources. Helpful resources used for mathematics are reported.

All teachers inform students about the goals, learning outcomes, grading criteria and evaluation methods before starting the math course. More than 60% of students/respondents agreed that assessment criteria are clearly defined.

**Literature**

As literature for the students, teachers most often recommend lecture notes produced by themselves. Often textbooks from other universities, teaching materials and learning resources published on the Internet are recommended. Figure 2 shows the percentage of teachers who selected each of the resource types. Some teachers selected more than one resource. The teachers were more inclined to recommend resources that they had developed themselves and provided via the Internet or e-learning platform (13 teachers)
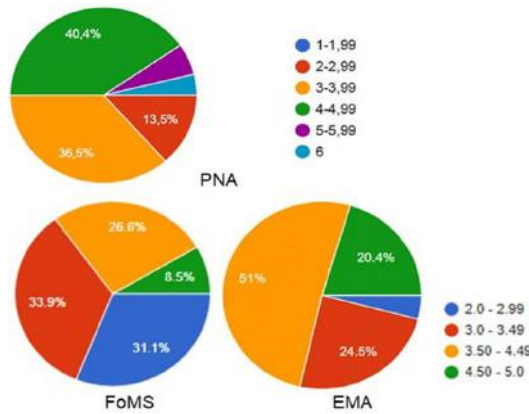
**Figure 1.** Average mathematics grade in high school

rather than freely available online resources (8 teachers). It can be explained by the fact that own material provides a focus for students.

Students were asked to evaluate their agreement with the proposed statements "The literature is appropriate and useful for exam/midterm preparation" and "The literature is available", on a scale from 1 to 5 (1 – strongly disagree; 5 – strongly agree). Figure 3 presents the results. These data were examined by HEI and no significant differences were found.
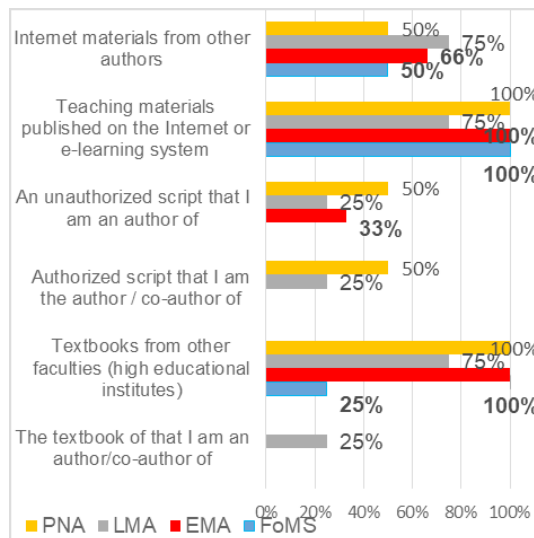


**Figure 2.** Literature recommended by teachers
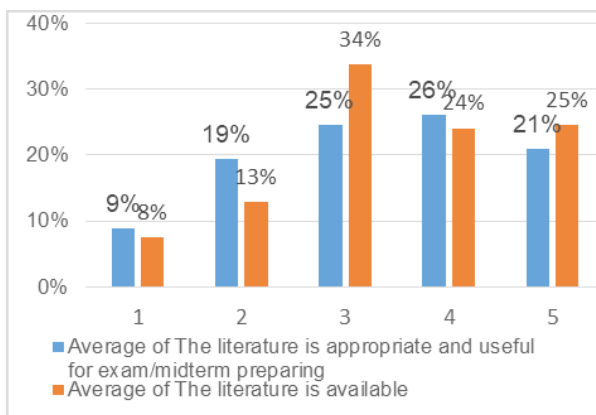
**Figure 3.** Student assessment of literature

**IT tools used by teachers**

Students were asked what type of IT their teachers use for teaching. As expected, blackboard and marker pen dominated. There was also a very high percentage for PowerPoint presentations. There was a relatively low use of video clips and animations and quizzes or on-line tests.
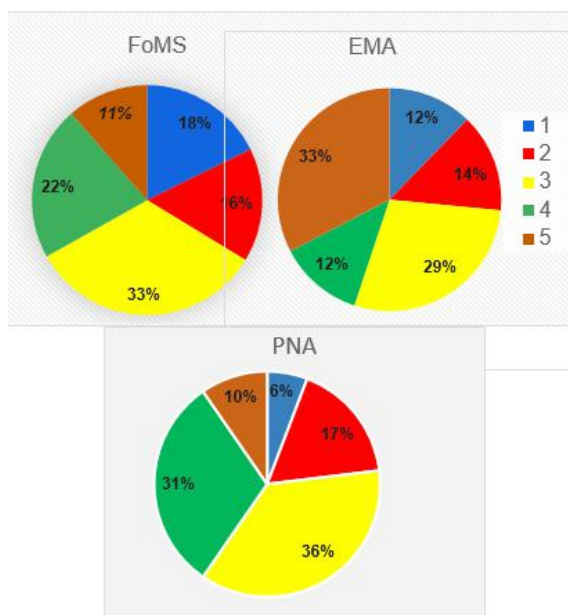


**Figure 4.** Students' rate on suitability and attractiveness of teaching methods

This answers were also examined by HEI and no significant differences were found.

Survey analysis revealed that teaching methods used by the teacher were not sufficiently suitable and interesting for students. For three institutions, Figure 4 shows students' agreement with the statements "*Teaching methods used in class are appropriate and interesting*", on a scale from 1 to 5 (1 – strongly disagree; 5 – strongly agree).

The majority of students labeled their satisfaction with label 3.

**Students' ways of learning**

Students were asked to list any resources they found helpful in learning mathematics, under the following headings: textbooks, shared handouts, own lecture notes, searching for additional information on websites and other (specify). Additionally, they were asked to evaluate the way of learning.

Figure 5 shows the percentage of students who selected each of the resource types, some students selected more than one resource. As shown in the figure,
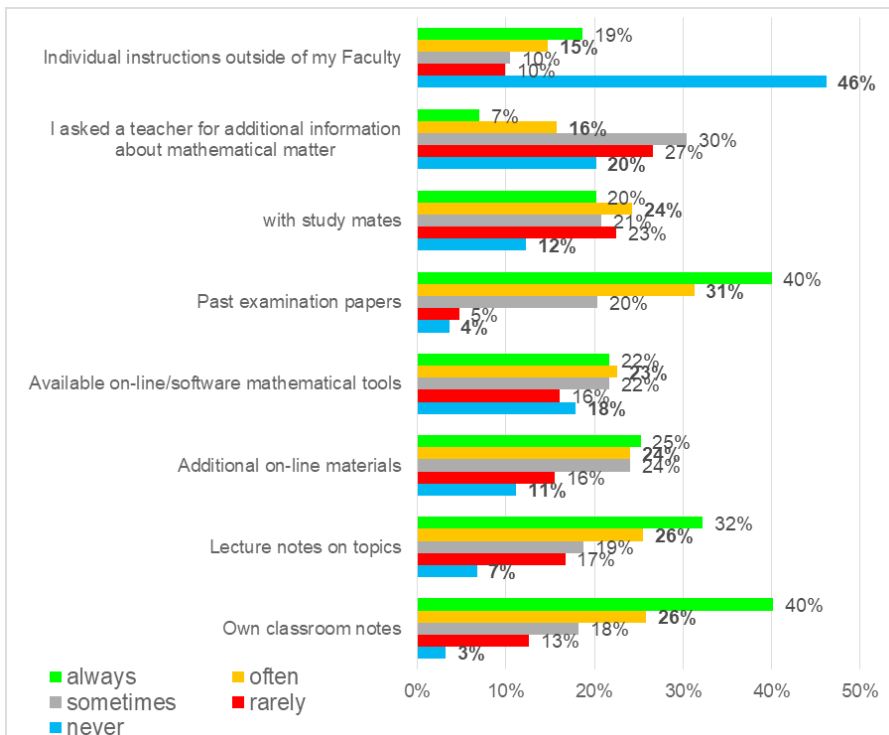


**Figure 5.** Students' ways of learning mathematics

students need a different way of learning. Although, students are brought up in the digital age less than 50% of them use software/tools available online. Over 60% of students used paper-based resources: own classroom notes or lecture notes on topics. Similarly, lecture notes and hardcopy materials were the resource most recommended by the teachers as being helpful. More than 30% of the students acknowledged that they need often or always instructions with private tutors. 20% of students didn't take advantage of regular consultations with their mathematics teacher. They underestimated teamwork with their study mates, as well.

**Student's satisfaction**

Students were required to rate their experience and satisfaction with math courses (on a scale of 1 to 5). Since students from different institutions have different courses, it was not appropriate to compare the results by course. Therefore, the average rate of all courses of three institutions is presented in Table 3. For Latvian Maritime Academy, students expressed their satisfaction through benefits gained (Figure 6).

**Table 3.** Student Satisfaction

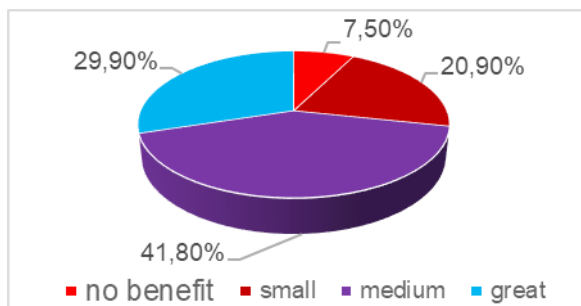|          | FoMS | EMA  | PNA  |
|----------|------|------|------|
| Avg rate | 2.78 | 3.46 | 3,42 |



**Figure 6.** LMA – Students' assessment of their benefit from lessons on average

**Course's contributions**

The contribution of mathematics to their future occupation is not clear to students and this may be one of the reasons they are not motivated. This result is expected since 70% of teachers never or rarely connect theory and practice by solving real-world problems. The following figure reflects student's perception of contributions of mathematics through two of five posted questions.
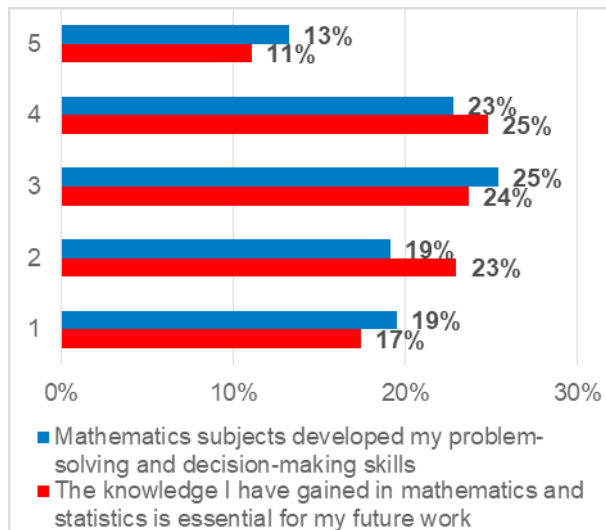
**Figure 7.** Students' perception of contributions of mathematics

**Discussion**

The goal of the study was to analyze the overall situation with mathematics courses at maritime higher education institutions in Croatia, Latvia, Estonia, and Poland and to estimate the effectiveness of the methods, resources, and tools used for teaching mathematics and statistics. The students' preferences, satisfaction, and perception of learning mathematical subjects as well as the teacher's view of the teaching process and success of students in mathematics were studied by means of teachers' and students' surveys. Analyzing the results, it is clear that there are some shortcomings and dissatisfaction in the process of teaching and studying mathematical subjects which should be discussed in order to find ways to improve them.

Teachers in all partner institutions are unsatisfied with the students' results in mathematics exams and with students' basic knowledge gained at high school. As can be seen from the results of the survey, most students have average or low pre-knowledge in mathematics. Some serious errors persist even from the primary school level. It is very difficult for these students to understand and master the new study material. It is one of the main reasons why students do not pass exams successfully or leave their studies during the first year of study. On the other hand, different levels of students' initial knowledge in mathematics create problems for the teachers' work. Almost all universities of natural and technical sciences face these problems. One of the options for solving this problem can be the offering of an additional course in elementary mathematics for students with a low level of basic knowledge acquired in high school. These additional courses are already practiced in some institutions.

Besides, teachers critically assessed students' learning activities. They pointed out that students do not always work effectively during classes, possess a low motivation level to cope with their study load, and show no interest in lessons. This may be the second reason for the low exam pass rate. On the other hand, many students confirmed that attendance of classroom lectures and practical classes of mathematics considerably helped them in studying and preparing for their exams.

Useful resources used by students to study mathematics were also analyzed in the research. From the results of the survey, it can be seen that teachers more often recommend using lecture notes produced by themselves as literature; teaching materials published on the Internet or e-learning system; textbooks from other faculties (higher education institutes), and internet materials by other authors. Most students are satisfied with the availability of the recommended literature; however, there were also a lot of neutral answers (34%). The majority of students find literature appropriate and useful for exam preparation and only 28% of them have the opposite opinion. From the results of the survey, one can see that the majority of students often or always use past exams for learning, own classroom notes, and lecture notes on topics posted by teachers. They also use a variety of additional opportunities such as online materials and software mathematical tools that are available on the internet. Some students have also looked for help from other students or from private tutors. A very low percentage of students ask the teachers for help in learning.

The results of the survey also show that teachers in all institutions mostly use traditional methods and tools such as a whiteboard and marker pen, together with PowerPoint presentations in the teaching process. These methods still hold up but are not as attractive for nowadays students. Teachers rather rarely use IT tools such as web sites, online quizzes and tests, video clips, animations, and mathematical computer programs. Many students rated the methods used by teachers as inappropriate and uninteresting. Teachers also rarely connect theory and solving math tasks with real-world problems. Therefore, students do not understand that mathematics is not only theory, formulas, theorems, etc. but also the ability to solve real-life problems.

From the results of the survey, it follows that the importance of mathematics for their future profession and work is not clear for most students. This is one of the reasons why many students have low motivation and, as it was mentioned before, are not interested in learning mathematics. It should be noted that one of the reasons why teachers rarely demonstrate the use of mathematics to solve real-life problems and the connection of the studied topics of mathematics with the future profession of students is the insufficient number of hours for mathematics classes. Another reason is that the knowledge of first-year students is not enough for a full understanding of mathematical methods used for solving the majority of real-life problems. In addition, using

modern tools and IT, teachers should not forget that traditional methods of teaching are also good and students understand mathematical tasks better when a teacher solves practical problems and writes the solution step by step explaining the material.

### Conclusions

It can be inferred that there is a need to improve the teaching and learning process in maritime institutions under consideration. For this purpose

(i) Teachers should point out the importance of connecting the theory with solving problems from real life and show the application of mathematical formulas and methods to physics and other related technical and economic subjects, showing students why mathematics is important for their future job.

(ii) The modern IT methods should be used more widely for mathematics teaching.

(iii) Teachers should increase the level of student engagement, use internet resources and mathematical software more often.

All these activities should not cause a decrease in teaching effectiveness. Instead, they ought to support the learning process, raise the level of students' mathematical skills and motivate students to study topics related to mathematics and statistic.

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