

to the discipline “Fluid Mechanics”. It has been introduced electronic scale in the model course of “Fluid Mechanics”, which is based on the given number of correct answers to the test questions and practical problems, showing the final score of the student. On that basis is made an analysis of obtained theoretical knowledges and practical skills of the students from the discipline “Fluid Mechanics” which appears as feedback for the teachers and give them an indication of what should be emphasized at organizing and presenting the theoretical and practical material in form of lectures and lab exercises.

Keywords: Mechanics of materials, Fluid Mechanics, e-learning, Moodle, marine engineers staff

1. Introduction

Specialized training of the marine engineering staff with engineering profile is provided by two main directions of the study disciplines. The first includes fundamental disciplines that give basic theoretical knowledges. The second direction includes profiling courses. The last one is characterized by their pure practical orientation. For their study, simulation complexes or high-cost computer simulators are needed.

The disciplines “Mechanics of materials” and “Fluid Mechanics” which are studied at the Department of Technical Mechanics at Nikola Vaptsarov Naval Academy have a theoretical character. To gain a good understanding of the theoretical knowledge get during the lecture course, many practical exercises are required, including solving problems and labs exercises. Due to the imposing tendency for decreasing of the total number of hours of the general engineering disciplines, this need is difficult to realize. On the other hand, another unfavorable trend is the decreasing level of students’ preparation to Mathematics and Physics with which they enter the school. At foreign students are adding something else – this is the language barrier. Even if their English language skills are excellent, studying theoretical disciplines such as “Mechanics of materials” and “Fluid Mechanics” involves many new technical terms in English that they learn for the first time. The combination of all this makes the “overcoming” of the theoretical part of the exam very difficult, and for some students even impossible. These disciplines are important as the theoretical foundations of the special training of ship mechanics, so they cannot be neglected and it has to be found a suitable approach the disciplines to be learned by the students. One of the steps taken in the Department of Technical Mechanics to solve the existing problems was to replace the traditional way of learning, and the check of theoretical knowledge to be replaced with online course including an electronic test. It was

developed on the basis of the Moodle distance e-learning platform, available through <http://moodle.naval-acad.bg/>.

2. Methods

The development of the course materials does not require the use of specialized software, which is often commercial or requires advanced computer skills and knowledge from the academic staff. The theoretical materials and exercises can be provided in PDF and HTML format. These formats are easily readable not only on a personal computer but also on mobile devices – smartphones and tablets. An additional advantage of PDF or HTML formats is their small volume. The formats allow them to be used in remote learning systems at low parameters communicational channels between trainer and trainees – if they are on a ship at sea or at a port outside of Bulgaria.

In the total of three electronic courses, students from the specialty “Marine Engineering” are included, bachelor’s degree. The first electronic course is “Mechanics of materials”. It includes 53 Bulgarian cadets and students. The second electronic course is in the same discipline but it is in English. It involves 26 foreign students. The third electronic course is about the discipline “Fluid Mechanics” including 40 Bulgarian cadets and students.

Electronic courses in Bulgarian for both disciplines include online learning resources: PDF lectures, exercise assignments, and exam test, [2], [3]. The exam test of “Mechanics of materials” includes 53 questions. The maximum time for solving is 1 hour and 30 minutes. The English language electronic course to the discipline “Mechanics of materials” only exam test. The exam test includes 26 questions and it is solved for a maximum of 45 minutes. The “Fluid Mechanics” exam test includes 40 questions and is solved for 45 minutes.

Using online based tests is not only a change in the form of the exam. This greatly changed the exam’s accents, which led to a change in the whole course. The online test examines the knowledge that concerns the production of different theoretical models, the hypotheses made, the final results, as well as their practical application. The test includes following types of questions: Matching, Multiple choices - Fig. 1 and Calculated. Calculated questions are parameterized with different variables for each participant. Solving such problems checks whether the students has mastered the theory and can apply it practically. An example of this is shown in Fig. 2 question.

The **cast iron** cantilever beam, shown in figure, has **T- shaped** cross section.
Which one from two variants (**a or b**) is better (**compare the strenght**) ?

Select one:

- a. Variant a.
- b. Variant b.
- c. The both variants are equivalent.

Fig. 1 Matching and Multiple choice question.

Calculate the shear force in bolts from bolt connection if the force $F = 13 \text{ kN}$. Precision **0,01**.

Fig. 2 Calculated question.

When creating the questions, the drawings are plotted while adhering to the machine drawing rendering rules. Several of them include 3D images created with Autodesk Inventor. A similar question is shown in Fig. 3, where the test interface with navigation panel is also visible.

The change in way of conducting the exam to the discipline “Mechanics of materials” also leads to the change of the course itself – the theoretical part is reduced, referring to theoretical conclusions with all their completeness and complex mathematical transformations for the students, as well as some details of lesser practical value. Learning content is reduced by removing some topics from the classical course in the discipline. An emphasis has been

placed on the understanding of the final results and, above all, on results' practical application. A further accent focus the students' attention on the important examples of the future ship

Съпротивление на материалите

Начална страница ► Курсове ► факултет "Инженерен" ► Катедра "Механика" ► Съпрогат ► Въпросник, задания, тестове
9.01.2017 11253 ; 13.01.2017 11252; 19.0... ► Преглед

Навигация в теста

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

Приключване на опита...
Започване нов преглед

Въпрос 6
Все още не е даден отговор
От максимално 1,00
▼ Отбелязване на въпроса
⚙ Редактиране на въпрос

Определете минималния **диаметър** (в mm с точност **0,1**) на конзол схемата, ако $M_{yc} = 190 \text{ Nm}$. Допустимото напрежение $[\tau] = 60 \text{ MPa}$.

Отговор:

engineer, where the obtained results find application – stresses and internal forces in ship's hull, machines and mechanisms, as well as individual machine elements, problems related to temperature stresses, mounting inaccuracies, technological processes, repairs.

Fig. 3 Computational issue from the discipline “Mechanics of materials” with test interface and navigation panel.

The ultimate goal of both “Mechanics of materials” and “Fluid Mechanics” electronic test is to be developed into a complete online course on two disciplines including a forum for communication with students, questionnaires for exams and control papers, presentations, guidebooks, useful links on the Internet, teaching materials, assignments – everything needed to prepare the students for the disciplines.

3. Results analysis

When performing the analysis of the obtained results by the students' final examinations, the following specific features for the individual electronic courses should be taken into account:

- Different learning resources in the three courses – lectures and exercises provided in electronic format;
- Different examination tests – questions, number of questions, time to solve;
- A different number of students enrolled in the courses.

Table 1 shows the obtained statistical data during solving of the examination tests in the three courses, [1], [4]. Figure 4, Fig. 5 and Fig. 6 show the polygons of the frequency distribution of the final examination results in the three disciplines.

Table 1

	<i>Score</i>			<i>Time</i>		
	Mechanics of materials	Mechanics of materials (foreign students)	Fluid Mechanics	Mechanics of materials	Mechanics of materials (foreign students)	Fluid Mechanics
Mean	29,616666 67	11,016842 11	24,955882 35	1:08:36	0:32:53	0:38:56
Mean (% of maximum)	55,88%	42,37%	62,39%	76,22%	73,07%	86,52%
Standard Error	0,6970885 81	0,9460580 12	0,6989831 06	0:01:47	0:01:59	0:01:27
Median	30,195	13,12	25,35	1:12:00	0:33:48	0:42:55
Mode	30,22	14,82	21	1:18:00	0:45:00	0:45:00
Standard Deviation	6,1565196 5	4,1237712 68	4,0757368 68	0:15:47	0:08:37	0:08:26
Sample Variance	37,902734 2	17,005489 47	16,611631 02	0,0001200 21	3,58139E- 05	3,42755E- 05
Kurtosis	0,5659112 75	- 1,1790143 94	- 1,0052919 12	- 0,3764184 24	- 0,0143325 5	0,7069519 51
Skewness	- 0,6726809 72	- 0,6671906 57	- 0,1949939 11	- 0,6679603 77	- 0,3295445 88	- 1,4285035 35
Range	27,92	11,97	15	0:59:10	0:31:49	0:27:04
Maximum value	53	26	40	1:30:00	0:45:00	0:45:00
Minimum	11,85	3,45	17	0:30:50	0:13:11	0:17:57
Maximum	39,77	15,42	32	1:30:00	0:45:00	0:45:01

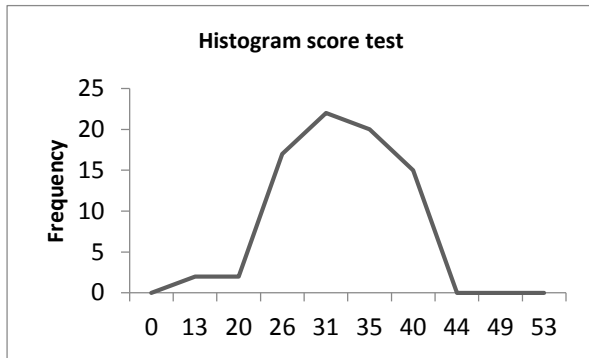


Fig. 4

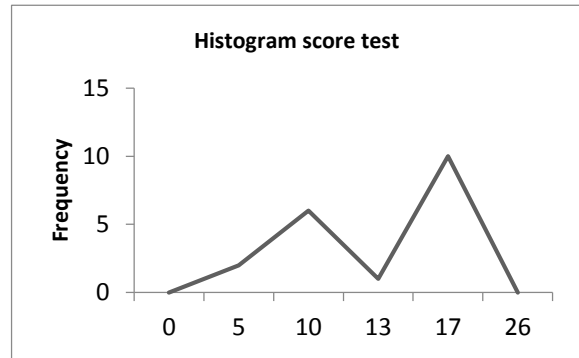


Fig. 5

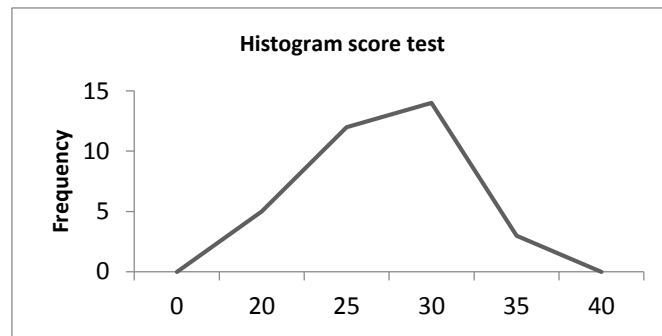


Fig. 6

Fig. 4, Fig. 5 and Fig. 6 polygons of the frequency distribution of the results of the finals exams in the three disciplines.

Analyzing the obtained results from the final examination tests, the following ascertainments can be made after the experiment has been completed:

- the average value of the results of Bulgarian students is over 50% of the maximum value;
- compared to the Bulgarian students, the results of the foreign students are below average;
- median and mode in all conducted investigations, except for results of the “Fluid Mechanics” final examination tests, are above average;
- in the results of the “Mechanics of material” final examination test, the frequency distribution is the closest to normal and kurtosis is positive (the polygon curve is pulled to the maximum value);
- asymmetry’s coefficients are negative for all tested parameters;
- in all conducted investigations, the asymmetry’s coefficient is negative i.e. the frequency distribution is left asymmetrical.

4. Conclusions

1. The use of online courses and test examination in an electronic version result in an average score for Bulgarian students exceeding 50% of the maximum score.
2. The use of an online version of the exam in the form of test reduces the subjective factor in knowledge control.
3. Use of pre-created online test in English reduces the influence of the language factor during the exam.
4. As a recommendation, it can be pointed out the development of teaching materials in electronic format in English and their addition to the distance learning system – Moodle.
5. An exemplary form of conducting the quiz – as current control after each of two main part of the “Fluid Mechanics” course can be a theoretical question and a calculated problem.

References

- [1] Колев Н., Приложна статистика. Част 1., УИ "Стопанство", 1993
- [2] Beer F.P., Mechanics of materials 6 ed., Mc Gray – Hill 2012
- [3] Hibbeler R.C., Mechanics of materials 8 ed., Prentice Hall 2011
- [4] Montgomery D., G. Runger. Applied Statistics and Probability for Engineers. John Wiley & Sons, Inc. ISBN 0-471-20454-4. 2002