A PRACTICAL APPLICATION OF THE SYSTEM OF ASSESMENT MAINTENANCE OF THE QALITY OF EDUCATION IN SUBJECT „FUNDAMENTALS OF ENGINEERING DESIGN"

Baltova Lyudmila
Technical University
Sofia
Bulgaria

ABSRACT
This article presents the organization of education in the subject "Fundamentals of engineering design" in the Department of Fundamentals and techniques for design, the Faculty of Mechanical Engineering at the Technical University of Sofia. The program for training the students in the subject is discussed, the means for assessment of the acquired knowledge, including usage of the System of assessment and maintenance of the quality of education (SAMQE) are presented, the possible risks during the training and after graduation are identified, and measures for reducing the impact of these risks are implemented.

Keywords: education, engineering design, quality of education, identification of risk

1. INTRODUCTION

The Department of Fundamentals and Techniques for Design, the Faculty of Mechanical Engineering at the Technical University of Sofia has developed a program of exercises and control work to train students in the First Course at the subject "Fundamentals of Engineering Design" part I and part II (FED I, II).

2. SOME OF TASKS ARE: [7]

2.1. Design of electronic device

At a specified principle electrical scheme design PCB (Printed Circuit Board) and is made principled electrical scheme PCB graphic original design drawing, an assembly drawing, a list of components. The box is designed for fixing and protecting the PCB;

2.2. "Heuristics

A set of management objects to find original ideas which are the solution of the problem: "to change the external appearance, to add an additional feature or suggest another realization of the technical function of the projected object" through Morphological analysis and synthesis, Focus on the subject, Negation of signs, Empathy, Total analogy, Synectica, Modification of an idea";

2.3. Engineering analysis of the device

According to specified to the drawings of General type according to the student versions are made different analyses of device.

2.3.1. Structural analysis - made sketches and drawings of the set details and description of the technology of their preparation;
2.3.2. Constructive analysis - there are graphic symbol and lettering in principle electrical scheme, engineering effects and the types necessary theoretical calculations and the details for which they apply, order of assembling, possible reasons for the failure of the product;
2.3.3. Functional-value analysis - depending on the inputs and outputs of the specified assembled unit (flows of material, energy or information) are determined major and basic functions. Determine the relative importance and relative costs for the realization of each function and is obtained function-value chart. Make analysis of the results and identify critical functions (with greater costs than the significance) and offers a constructive modification of the method of attachment or form of participating in the function parts in order to improve the quality and reducing its price of critical function and of the electrical device;
2.3.4. Dimensional analysis – determine the type of assemblies specified in the drawings of the General type and limit deviations of the dimensions of the parts involved in the assemblies presented graphically and making a choice of smoothly cylindrical compound;

2.4. Design of electrical compounds for volumetric installation
A specify principle schemes of electrical circuits by the student variant, scheme of the location of electrical devices in the car and Principal electrical scheme of devices the compounds be designed for volumetric installation and a written scheme of compounds designed to wire bundle and produce an assembly drawing, list of components.
For preparation of all course tasks are used AutoCAD, SolidWorks, CADStar, Word.
The evaluation of each student is formed as the sum of points obtained from tasks and tests.
In table 1 shows the number of points equivalent to the annual assessments:

Table 1. Number of points equivalent to the annual assessments

Number of points	Annual assessment
Less than 60	Fail 2
from 60 to 69	Satisfied 3
from 70 to 79	Good 4
from 80 to 89	Very good 5
More than 90	Excellent 6

Developed options for tests used at the end of each term to check the level of learning: make a drawing of detail of AutoCAD, drawn part forms of SolidWorks, worked out PCB-design of CADStar, written answers to theoretical questions on the subject of lectures, in one of the tests we used for System of Assessment and Maintenance of the Quality of Education (SAMQE).
"The purpose of SAMQE is to achieve quality education in professional fields of the University, corresponding with national and European standards for education.
The system answers the questions "what" and "how to do" to achieve a high quality; "who" and "how" to assess the quality; how to use the grade to stimulation its continuous improvement.
The legal basis is included as current national special laws, government requirements for education degrees, legislation of National Agency for Education and Accreditation and specific university requirement – decisions of academic institutions and specialized commissions on quality of education institutional and faculty level.
The tools for maintaining quality include methodological materials, sample questionnaires for polls sources of information on the quality documents in the application of the system of accumulation and transfer of credits (ECTS), means of electronic support of learning." [3]

In our department we apply SAMQE as the control system of the level of acquired knowledge through tests which are development teachers. From a methodological point of view, essential in the process of training the student to quickly choose the correct answers.
The tests cover subjects than are taught during the semester in tasks. The questions contain graphic and/or descriptive sections and four answers only one of them is correct.
On figure 1 shows the way in which it is organized introduction to a question from an appropriate test of the teachers, and figure 2 shows how it looks the same question of the same test, which is decided by the student.

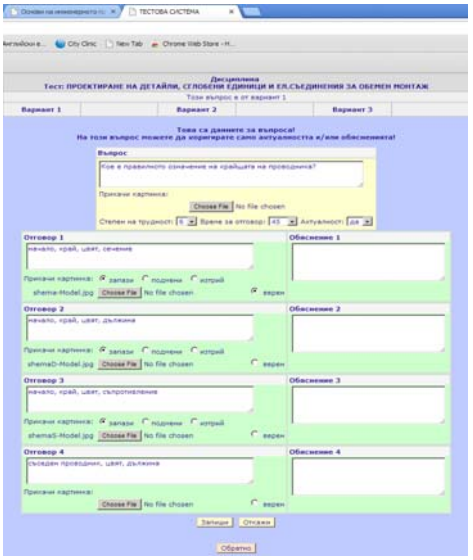

Figure 1. Organizing of the introduction to the questions of the tests by the teachers

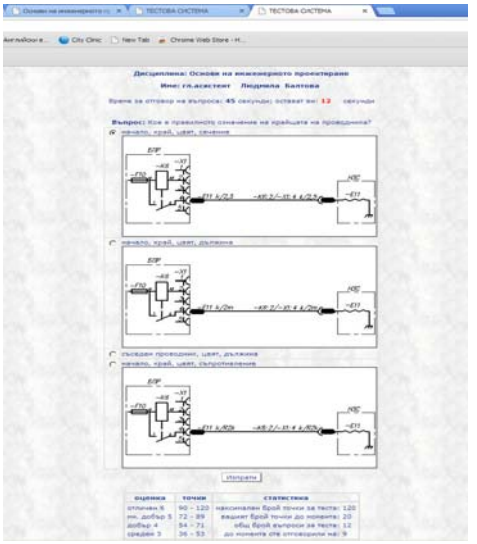

Figure 2. Organizing of solving to the questions of the tests by the students

The purpose of the training by tests is the students to enrich their knowledge, because they are able to make learning tests in convenient time, they searching answers to specific question in lectures, guide and textbook. Every student receives points for each correct answer, in the end the system shows the final grade depending on the ratio between correct and incorrect answers.
In conducting laboratory exercises and tests at the end of each semester students apply the knowledge gained from lectures and preliminary individual training.
On the table 2 shows the data on the basis of which analysis was made of the distribution of test results.

Table 2. Statistics

Statistics	FED part I	FED part II
Total number of students	446	414
Total number of student groups	35	31
Number of student groups of Faculty of Electronic Engineering and Technologies	10	9
Number of student groups of Faculty of Telecommunications	13	11
Number of student groups of Faculty of Computer Systems and Control	12	11

The difference in the number of students between the two semesters is due to failure of some of them for different reasons.
In figure 3 shows the distribution of results (points) test at the end of each of semester for the academic year 2011-2012, the summation of which are component of the final assessment of each student.
In table 3 shows specific values of the test results.

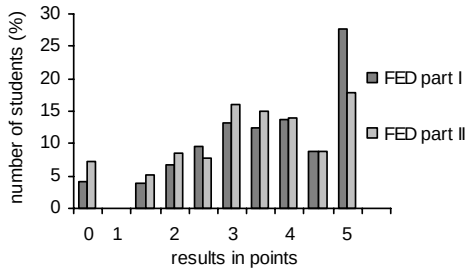

Figure 3. Distribution of test results

Table 3. Distribution of test results

points	% - "Fundamentals of Engineering Design" part I	% - "Fundamentals of Engineering Design" part II
0	4.26	7.25
1	0	0
1.5	3.81	5.07
2	6.73	8.45
2.5	9.64	7.73
3	13.23	15.94
3.5	12.33	14.98
4	13.68	14.01
4.5	8.74	8.69
5	27.58	17.87

The chart shows that during the second semester have increased the number of students (expressed in %) with an average evaluation by tests.
The number of students with 5 points less because they are excellent students who submit in time correct course tasks for which they receive maximum points, study regularly and this helps them to get high points of all tests that they do. Since the test was conducted last school week, some of them do not do, because they have received enough points for excellent evaluation, and this in turn increases the number of results with 0 points.
From the experience in recent years found that due to low activity and low interest of students, the results are unsatisfactory. Is made analysis and take measures to reduce those trends.

3. POTENTIAL RISKS IDENTIFIED DURING TRAINING

Identifying potential risks during training and after graduation leads to taking preventive action to minimize or eliminate (as much as possible) and the implementation of preventive action increases the quality of education, and this leads to increase the competitiveness of the our University.

3.1. Risk of loss of interest in the subject

To minimize this risk we developed tasks with themes related to the practice, otherwise the students losing motivation.
To manage to collect more points in the transmission of the course assignments and in solving test papers we are published on SAMQE "Most Frequently Asked Questions" and "Most Common Mistakes".

3.2. Risk of outdated of the information presented in the tasks

To minimize this risk every year we reissued the guide reflecting changes in the standards, design and technological documentation, indications on drawings and schematic design.

Constantly we updated techniques to enable students to work on the latest version of AutoCAD, SolidWorks, CADStar. Companies that have their distributors provide training version of their products to draw because we train their future customers;

3.3. Risk of incorrect terms of tasks

To minimize the risks before each semester we checked and eliminate errors found as in the tables of the assignments and in the drawings;

3.4. Risk of inaccuracies in the hardships of the tasks

To minimize this risk in tasks in a balance between the examples that students might encounter in practice and theoretical knowledge to get to realize them.

To be able to discuss among themselves the problems arising in course assignments two students are a team, but everyone makes its coursework. In transmission each of them answers a variety of questions, the answers to which determine the number of points placed by the teacher.

During the academic year students can ask questions of teacher, both in the lab and in the Student Hours.

3.5. Risk of incorrect orderly arrangement of tasks

To minimize this risk difficult tasks are in the middle of the semester, allowing students accrue more knowledge and skills, but in the end we left with the task of medium difficulty and more practical to remain sufficiently motivated;

3.6. Risk of incorrectness of deadlines for implementation of tasks

To minimize this risk the period for transmission of tasks are distributed so that the more difficult to have more time.

To stimulate systematic study we determined the sanction of reducing the number of points of each task that the student does not submit at preannounced period;

3.7. Risk of lack of motivation of teachers and student

"Incentives have moral and material expression.

Incentives for teachers are publishing the best teachers in the website of the faculty or university, published the rating of all teachers in the evaluation period, additional remunerations and other privileges by a decision of the Academic Council.

Incentives for students are publishing the names and CV of the best students in the university's website and assisting the academic units for proper implementation, recommendations for stipends from companies monetary rewards by a decision of the Academic Council." [1]

3.8. Risk of unsuccessful realization of the students in their specialty after graduation

This risk is assessed as very higher, because the training is not tied to requirements of the companies. Still in the process of establishing links between training and industry need.

To change this, Technical University-Sofia increasing popularity of traineeship programs by organizing Career Center. Twice a year invite companies which want to benefit from the knowledge and the desire of students to gain professional experience in a particular field. Sometimes students become Fellows of the companies in which they are training.

Besides traineeship programs a study on the economic needs of specific specialists and develop new curricula competitive specialties.

4. CONCLUSION

Presented a comparative analysis of the distribution of the results of tests made at the end of each semester on the subject "Fundamentals of Engineering Design".
Since the share of show good absorption of the necessary knowledge and skills in our subject is relatively low need search of new ways to motivate students to show better results.
For this purpose is appropriate placement test before the start of relevant exercise with which to test student's knowledge of every task. Students are admitted to exercise only at successful solving of the placement test. This will encourage regular learning and reduce the risk of lack of motivation of the students.
Identified the risks that can occur during education and shows the actions taken to increase motivation of student.

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