3rd World Conference on Learning, Teaching and Educational Leadership – WCLTA 2012

Measuring and Evaluation in Machine Science and Design Education, based upon Diagnostic Research

Antoaneta Dobreva a *, Valentina Haralanova b

a Ruse University, Studentska st. 8, Ruse 7017, Bulgaria  
b Ruse University, Studentska st. 8, Ruse 7017, Bulgaria

Abstract

The interests and expectations of the students at Ruse University, Bulgaria in the area of Machine Science and Design are important for the lecturers delivering those subjects. The problem statement is connected with the identification of the challenges for academic staff. The purpose of the study is to improve the quality of education by analyzing the students’ assessment of the study process. Empirical and theoretical methods are used during the research. A method of inquiry based upon online assessment and a diagnostic method are introduced. The results are processed automatically. The results obtained are summarized and critically analyzed.

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Keywords: Machine Science and Design, Online assessment, Diagnostic method, Improvement of education quality

1. Introduction

The interests, needs and expectations of the students Ruse University, Bulgaria in the subject area of Machine Science and Design are very important for the lecturers delivering the relevant subjects and also for the improvement of the quality of the study process in the higher education system.

Training in Machine Science and Design is characterized by its special features and challenges. The reasons for this specificity are the interdisciplinary character of the knowledge obtained, the subjectivity of the spatiality imagination involved and the innovative thinking of the students.

During the last few years in Bulgaria, considerable reforms have taken place in the area of higher education, imposed at one and the same time by European requirements and national policies. Two challenges - the reduction in the number of lectures and tutorials for some subject and courses, and the abrupt decrease in the number of students due to the demographic reality in Bulgaria - are especially important for academic staff in view of their ambition to achieve high quality in students’ education and training.

Ruse University in Bulgaria follows the standards and the instructions for ensuring the quality of training in the Higher education European higher education. A system for quality control has been established. The system is on

* Corresponding Author: Antoaneta Dobreva, Tel.: +359-887-746-311
E-mail address: adobreva@uni-ruse.bg
the fact that students are the main consumers of the educational services offered by Ruse University. There are traditions and good practices at Ruse University in terms of requesting feedback from the students concerning their evaluation of the quality of the education they receive through the use of questionnaires. This has turned out to be an effective instrument for quality control of educational process. The authors take into consideration that in order to achieve visible results, those good practices have to be implemented on every possible level of the university structure.

According to research team, permanent communication with the students and obtaining their opinion about the lectures and tutorials delivered by staff is the best possible approach for obtaining a diagnostic evaluation of the lecturers’ work. The purpose of the study is to improve the quality of education and training through analyzing the students’ assessment of the study process. In addition, it is to obtain the opinion and vision of both academic staff and students with regard to future learning trends, and their expectations with regard to University institution.

2. Description of the research

The background of the study is the experience of Bulgarian and other European authors in the thematic area. During the creation of the questionnaires, the authors applied information based upon the experience at Ruse University and the good practices of other European universities.

Dobreva, Wasowicz, and Dobrev (2009) analyze the challenges by organizing and implementing student mobility through the European program, Erasmus. They recognize the importance of this program as an element in the integration of the Bulgarian higher education into the European academic institutional structure, and the improvement in the quality of the study process. The application of interactive methods in the training associated with Machine Science and Design subjects has been discussed by Dobrev, Georgieva, Rusinova and Dobreva (2009). A psychological and sociological investigation of the students’ opinion of the quality of education at Ruse University has been implemented. Ruse University has stated its mission as a higher education institution: to disseminate knowledge, to implement fundamental and applied scientific research, and to introduce innovations in industry (www.uni-ruse.bg). Through those activities, Ruse University contributes to the development of highly qualified young professionals. Therefore, it supports the sustainable development of the local region and of the Bulgarian economy. These priorities are reflected in the mission of the University according to the material approved by the Academic Council of Ruse University on 08.03.1994 which was subsequently upgraded on 13.05.2008 (Pencheva & Beloev, 2009).

By creating the questionnaires and formulating the questions, the authors have set themselves the task of examining the extent to which the teaching and research activities that staff and students are engaged in contribute to the execution of the University mission. Questionnaires containing 7 items were created. Their contents take into consideration with the specificity of the education in Design and Machine Science educational process (Haralanova & Khoshaba, 2012). Based upon the above-mentioned references, new questionnaires were created by the team. Each of the questions involved were written in both Bulgarian and English. The statements were as follows:
Statement 1: The delivered lectures and/or tutorials are interesting and motivating.
Statement 2: Succession between the knowledge acquired at Secondary school and University, and the new knowledge, gained in the framework of the subject, is ensured.
Statement 3: The study material is delivered in an understandable way.
Statement 4: Contemporary means for visualization are provided: posters, graphics, laboratory test machines, 3D computer models, animation, etc.
Statement 5: The lectures, tutorials and consultations are mutually connected.
Statement 6: The study course creates practical skills.
Statement 7: The lectures, tutorials and consultations ensure sufficient fundamentals for the successful finalization of the subject.

Table 1 shows the connection between the seven statements of the questionnaire with the strategic goals, cited as part of the mission of Ruse University.

<table>
<thead>
<tr>
<th>Strategic goals / Number of Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
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<tbody>
<tr>
<td>High quality of education &amp; research</td>
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<td>x</td>
<td>x</td>
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<td>Development of theoretical knowledge</td>
<td>x</td>
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<td>x</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<td>Application of National &amp; International Experience</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Ensuring professional competitiveness on the part of the future University graduates</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Elaboration of University system flexible to make it flexible to social conditions</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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</tr>
</tbody>
</table>

Table 1 shows the connection between the seven statements of the questionnaires with the strategic goals, cited from the mission statement of Ruse University.

The questionnaire ends with an optional statement for the student. This is called a “Letter to the lecturer”. This last item is specific because it provides an option for the student to make some remarks and recommendation concerning the study material, the lecturer’s behavior, the literature sources, the availability of obligatory and optional textbooks, computer equipment, etc.

2.1. Target group of students participating in the research

The questionnaires were carried out with first year, second year and third year students, who study in a variety of engineering specialties and therefore are involved in different subjects in the area of Design and Machine Science. The responsible Department for all these subjects and courses is the Department of “Machine Science, Machine Elements and Engineering Graphics”.


These courses are indicated. This shows the percentage distribution in terms of student participation in these subjects.

2.2. Software specifics of the diagnostic research

The implemented research was carried out with the help of an online based questionnaire. The open-source software LimeSurvey was used for the realization of the presented E-questionnaire. The most up-to-date version of the software was downloaded and installed. This increased the security of the online activities associated with the software product, and increased the reliability of the presented research.
The software gave the option for a great variety of functions, which were necessary and useful for the requirements of the created questionnaire. These included an unlimited number of questions (the limitation depends only on the data base which is to be used); an unlimited number of participants, multi language options, anonymous and non-anonymous options, etc.

The questionnaire starts with the selection of a subject with regard to which the student will have his/hers opinion and recommendations. This selection is done using the drop down list of the subjects’ titles as shown in Figure 1.

The web-based system was installed on the University server with URL http://anketa.uni-ruse.bg/limesurvey/. The necessary database for the successful running of the system was also created.

The software options for assigning an opening and closing time for the implementation of the online questionnaire were used. After the deadline was over, the E-questionnaire was no longer accessible to the students. The administrators and the research team had access to the accumulated data.

The system gave the option for visualization of the results based upon the implemented E-questionnaire in a file, which can be considered as a record for each one of the participants. The visualization of the results was also done in HTML, PDF or Excel format. The research team was given permanent access to this information.

3. Analysis of the results

The results of the first statement are satisfactory. About 75% of the students evaluated the delivered lectures and tutorials as being useful and interesting. The other 25% did not have any opinion on that topic.

About 8% of the students, unfortunately, did not see the connection and the continuity between their preceding knowledge, acquired during their secondary and former higher education careers and the new knowledge obtained in the framework of the subjects under consideration.

Regarding statements 3, 4 and 5, there was one almost constant group of students (about 9%), who did not consider that the language of the lectures was easy to understand, that sufficient contemporary means and devices were used during the lecturers’ presentation, or that they were provided with the necessary consultation in extracurricular time.

A small group of students (9%) did not believe that the tutorials developed enough practical skills.

The questionnaire was presented several times online and in a paper version during the academic year 2011-2012. The results obtained were critically examined. The reliability of the presented test modules were analyzed and checked up through a repetition of the tests using a sample of 70 students after 4 weeks. The stability of the assessment was analyzed after giving an account of the results of the second test implementation. The reliability was determined through the correlation coefficient between both test research implementations:

\[
\rho = \frac{n \sum_{i=1}^{n} (x_{1i} - \bar{x}_{1}) (x_{2i} - \bar{x}_{2})}{\sqrt{n \sum_{i=1}^{n} (x_{1i} - \bar{x}_{1})^2 \sum_{i=1}^{n} (x_{2i} - \bar{x}_{2})^2}}
\]

The parameters which are used in the described equation are as follows: \(\rho\) is the correlation coefficient; \(n\) is the volume of extract; \(x_{1i}\) is the value of the result for the i-question from the first test implementation; \(x_{2i}\) is the value of the result for the i-question from the second implementation (i.e, from the re-test).

The high value of the correlation coefficient between the results from the first and the second implementation of the diagnostic research (\(\rho=0.91\)) is a guarantee of the considerable reliability of the questionnaire used.

4. Activities resulting from the diagnostic research

The research work, realized through the presented diagnostic research, supports the fulfillment of the goals and mission of Ruse University. The diagnostic research contributes to the main objective of the University which is to
develop the institution as a local and national educational and scientific center of excellence and to become an important part of the European educational and research scene.

The results obtained from the investigation were summarized and acted as the basis for discussion within the Department.

The students’ council was also given access to the results. The students can also participate by creating additional statements for the questionnaires.

The feedback received from the students is extremely useful. This feedback allows for the direct participation on the part of the students in the organization and management of the quality of the study process.

The data from the processed results are taken into consideration by the constitution and form part of discussion of the new study syllabi and curricula at department and faculty levels. The opinion and the vision of the students concerning their education are especially important for the development of new educational technologies.

The regular implementation of different kinds of questionnaires among the students is very good practice, and acts as an efficient instrument for improving the quality of higher education in accordance with European resolutions and with the quality control policy of Ruse University.

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The practical application of the process of receiving feedback from students concerning the quality of teaching leads to the following conclusions:
1. An increased interest on the part is observed;
2. The motivation of the lecturers with regard to improving the quality of the study process is increased;
3. The satisfaction of all representatives of the academic community - students, lecturers and academic management – is increased. Therefore, all stakeholders with regard to the evaluation of the quality of the study process are involved.

The overcoming of difficulties and some problems in the higher education system can only be realized through the collaboration and joint activities of all stakeholders in the European education space.

References


www.uni-ruse.bg