ASSESSING THE EFFICIENCY OF TEACHING MATHEMATICS IN THE E-LEARNING ENVIRONMENT

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Abstract

The article deals with the issues related to the assessment of the efficiency and the quality of mathematical training of university students in conditions of electronic educational environment. It gives the definition of the quality of mathematical training of students. The article considers the ideas of competency-based, taxonomic, and qualimetric approaches for measuring learning outcomes. It describes the criteria and algorithm for assessing the efficiency of teaching Mathematics in conditions of e-learning environment.

Keywords: mathematical training, electronic educational environment, teaching Mathematics, Federal State Educational Standard of Higher Education (FSES HE), quality of teaching, student.

1. INTRODUCTION

The problem of improving the mathematical training of students in the system of higher education is becoming more and more important and requires deep scientific understanding (Toktarova, Fedorova, 2017). Up-to-date Federal State Educational Standards of Higher Education suggest a qualitative change in the organization of training in all its types and forms, including in the conditions of electronic educational environment.

The quality of education is a fundamental criterion for the efficiency of the educational process in both traditional and innovative learning environment. At the same time, it seems to be fair to determine the assessment of the quality of education as a teaching system that contributes to obtaining information about the learning outcomes in the form of knowledge, skills, personal qualities and abilities acquired by students during this process (Zhigalev, 2007).

In particular, *the quality of mathematical training of students* is understood as a certain level of achieving the goals of learning mathematics and the degree of compliance of the process and the result of mathematical training of students with personal expectations and needs of society in accordance with the parameters (Polonsky, 2016):

– Maturity of internal motivation to obtain and use mathematical educational information (availability of tools in the electronic educational environment to create student's needs and aspirations for learning and applying mathematical knowledge in professional activities);

– Volume, completeness and consistency of mathematical knowledge and skills (mathematical knowledge, skills and abilities should be presented in the electronic educational environment not in the form of scattered concepts and facts, but as a set of interrelated elements);

– Ability of students to individual search and processing of mathematical educational information (deep acquisition of mathematical knowledge is achieved only by individual analysis of new and complete information).

2. METHODOLOGICAL APPROACHES TO THE ASSESSMENT OF TEACHING MATHEMATICS

When shifting during the process of teaching mathematics to the electronic educational environment, to ensure high quality of training is becoming extremely important. Undoubtedly, the most important aspect of assessing the quality of education is the choice of assessment methods to measure learning outcomes at different stages, taking into account competency-based, taxonomic and qualimetric approaches.

The competency-based approach is based on the multidimensional and multi-structural characteristics of the quality of students' training, is focused on the formation level of competencies defined in the FSES HE. The assessment of learning outcomes in terms of competencies determines what a student should know, be able to do, understand, and have skills upon completion of training. For this purpose special databases of evaluation tasks are created. To have a more complete picture, there are developed competency passports consisting of a list of competencies that must be formed during studies from the first year to graduation. At the same time, to improve training efficiency it is necessary to establish the student's achievements at each stage of monitoring the level of formation of his competencies, data collection and analysis at the quantitative and qualitative levels. In relation to teaching mathematics, the requirements of modern educational standards also include a list of students' competencies formed during the process of mathematical training.

The next approach, which should be taken into account along with the competency-based one is *taxonomic* which allows to determine the levels of educational goals and learning outcomes, to structure the system of evaluating tasks. All taxonomic descriptions that determine training efficiency and quality are characterized by a gradual complication of cognitive activity of students. For example, B. Bloom (1967) describes the levels of training or successive cognitive categories and the degree of information acquisition. This taxonomy is presented in a structured form accessible for practical application; it is convenient for assessing the quality of teaching mathematics in the conditions of electronic educational environment. With a focus on the process of mastering mathematical knowledge the taxonomy will include the following levels: knowledge, understanding, application, analysis, synthesis, and evaluation. At each of the six designated levels the student performs certain activities in accordance with the specific requirements for assessing the efficiency and productivity learning mathematics.

The qualimetric approach is aimed at improving the objectivity of assessing the level of students' knowledge; it allows conducting statistical analysis of the results achieved and adjusting the learning process. In accordance with it, the assessment is based on the qualimetric methodology (direction connected with quantitative description of the quality of subjects or processes), where the goals and the learning outcomes (including the level of formation of competencies) are presented in measurable values. Each indicator characterizing the level of competency formation is given a numerical value. The results are measured by points, scaled, and analyzed by means of statistical and mathematical analysis.

Undoubtedly, all the presented approaches will be convenient in assessing the efficiency and quality of electronic training of mathematics in the conditions of electronic educational environment, but for a more complete result it is necessary to use a set of different approaches, complementing them with methods appropriate for e-learning goals.

3. SYSTEM OF CRITERIA FOR ASSESSING THE EFFICIENCY OF TEACHING MATHEMATICS IN ELECTRONIC EDUCATIONAL ENVIRONMENT

It is well known that the efficiency and quality of e-learning depends on the criteria used and the choice of assessment methods and approaches. An optimally thought-out system of criteria and requirements for the electronic educational environment allows guaranteeing design, development, and accumulation of high-quality educational content and tools as the basis for the implementation of an effective educational process using e-learning technologies (Toktarova, 2017).

The following target groups of criteria are used to assess the efficiency of teaching mathematics in the electronic educational environment of the Mari state University:

1) *Regulatory and organizational* (authorship of the course; expediency of studying the course in the electronic form (ability to achieve the objectives of the course); availability and access to the work program; presence of a matrix of competencies; availability of scheduling);

2) *Psychological and pedagogical*:

– *Content* (models of the courses and their instructional design; variety and completeness of the didactic material; availability of illustrative material; interactivity of the course content; information and functional completeness; assessment of achieving the learning objectives; development of system of evaluating and monitoring students' knowledge; availability of a system of methodological assistance; formulation of corrective instructions);

- *Subject content* (target orientation of mathematical material; applied orientation of teaching mathematics; presence of key tasks; variety of types of mathematical tasks; provision of computer mathematical modeling tools);

- *Technologies* (applied technologies of the course; technologies of educational material delivery; - technologies used for interacting of the subjects of training; completeness of the use of existing and new technological opportunities and resources);

- *Adaptation* (availability of input test to determine students' characteristics and needs, their initial level of preparedness; provision of a learning algorithm in accordance with the individual characteristics and preferences of a student; learning management; multi-level learning material; psychological comfort (focus on different types and styles of thinking); availability of didactic material and resources to people with disabilities);

3) *Software and hardware* (functionality of tools and resources of the environment to meet the requirements of learning technologies; provision of the educational process with the necessary software; duration of downloading the electronic didactic materials and working speed of resources; provision of a possibility of multi-media preparation and presentation of educational material; freedom of access to information resources; possibility of distant learning; availability of an adaptive course on the formation of information competency of students; compliance and support of domestic and international standards; availability of a mobile version of the content of the electronic educational environment; ease of course navigation; easy access to courses and services; user-friendly interface);

4) *Communicative* (variety and convenience of forms of pedagogical interaction of subjects of the educational process; structure and character of the dialogue; feedback with the teacher; support of students; possibility to perform group tasks);

5) *Personnel* (qualification of a teacher / tutor; level of proficiency of a teacher / tutor in information and communication technologies; degree of availability of teachers; availability of technical and methodological support services for training).

The algorithm for assessing the quality of teaching mathematics in the electronic educational environment assumes step-by-step execution of technological operations in order to ensure the unity of internal and external quality control of training:

Stage 1: selection and development of criteria and evaluation base:

– Forming the groups of quality indicators / criteria reflecting the peculiarity of teaching mathematics in the electronic educational environment by groups of normative and organizational, psychological and pedagogical, software and hardware, communicative, and personnel character;

– Selecting the evaluation indicators / criteria for each group, as well as approaches / methods of their measurement (it is possible to apply a set of approaches for a deeper analysis);

– Determining the significance of criteria or groups according to the purpose of assessment and the context of internal and external conditions;

Stage 2: design, development, and implementation of the electronic version of the questionnaires in the electronic educational environment (developing online test questionnaires with the choice of appropriate answers, with a user-friendly assessment mechanism and software implementation);

Stage 3: planning of control and assessment activities (determining the time and quantitative regulations, the terms for assessment, the placement for questionnaires and their provision, as a rule, at the end of the course, module / section, topic, etc.);

Stage 4: arrangement and implementation of activities to assess the quality of teaching mathematics in the conditions of the electronic educational environment (assessing; collecting measurement data resulted in specific values);

Stage 5: processing of the received information (calculating and analysing the results in accordance with the approaches to their measurement chosen at the first stage, determining the rating level for the measured values);

Stage 6: result in the form of a set of factors, the interpretation of which allows to make a conclusion about the quality of teaching mathematics and forecasting activities for further efficiency improvement.

4. CONCLUSION

Thus, achieving the quality of education is the most important task of every modern educational institution. One of the main directions of improving the quality of students' training is e-learning focused on students' active cognitive efforts in the electronic educational environment. The quality of electronic teaching of mathematics in the electronic educational environment depends on the quality of compliance with the regulatory and organizational, psychological and pedagogical, software and hardware, communication, and personnel requirements for the arranging of training. At the same time, the assessment of training quality should meet such universal principles as specificity (clear defining the criteria-based assessment, approaches to its measurement), integrity (ensuring the full volume of requirements for the learning outcomes), and efficiency (soundness of methodological and technological tools for obtaining evaluation information and performing the necessary calculations).

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