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**EFFECTIVENESS OF MEDICAL STUDENTS'
MATHEMATICAL COMPETENCE FORMATION THROUGHOUT
E-LEARNING PROCESS**

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Abstract. The article analyzes the mathematical competence structural components acquisition and development throughout the mathematics e-learning process, as e-learning role is also studied in terms of the medical university students' mathematical competence formation. Based on experimental data, the author made the scientific assessment of the mathematical competence main structural components at different stages of medical university mathematics e-learning process. The author shows that usage of modern information learning technologies in educational process can actively influence on the acquisition and development of mathematical competence basic structural components, promoting the formation of medical university students' willingness and abilities to solve theoretical and practical problems that are relevant to the professional activities of a modern medical profile specialist.

Keywords: e-learning; mathematical competence; model; high education; the main structural components.

The mathematical competence concept is considered from different points of view by modern researchers [1, 2]. To the author's opinion, the most accurate definition of mathematical competence is: an integral personal quality, readiness to study disciplines requiring mathematical base, ability to use mathematical knowledge in professional activity for various practical and theoretical problems solving [4]. In accordance with the definition,

mathematical competence is multi-component concept with multilevel structure. Its formation is the process of acquiring and developing various structural components. That is why; the development of mathematical competence model regarding its main structural components is the important problem of modern pedagogical science. To solve it, the author singled out the main (from his point of view) mathematical competence structural



components, namely: the readiness and ability in practical and theoretical problems to analysis and synthesis, to abstraction from the nonessential properties and objects and phenomena

characteristics, to generalization. A three-dimensional mathematical competence model representation is shown in Fig 1.

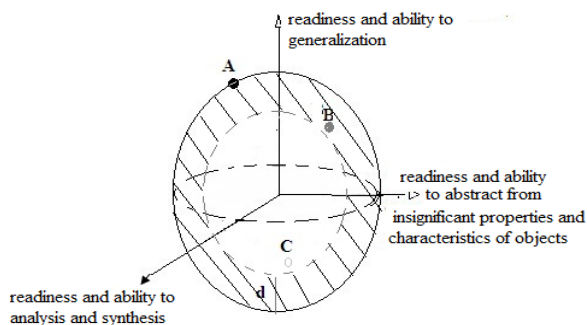


Figure 1. Three-dimensional representation of model of mathematical competence. Note: the area designated by shading on the sphere designates the level of mathematical competence of pupils conforming to requirements of the federal state educational standard.

Points of the sphere surface (for example, point A) in the coordinates of the mathematical competence basic structural components indicate the federal state educational standard mathematical competence level for medical university students. The goal of university educational process is to achieve the federal standard mathematical competence level. It should be noted that, sometimes, medical university students don't achieve the required mathematical competence level (shown on our model by point A) due to various reasons, ranging from low

students' motivation and lack of their self-organization, to insufficient educational and cognitive trainees' activity. In this case the mathematical competence components acquisition stops at the respectively low level (shown as point B inside the sphere in Figure 1). For this reason, there is a real need in educational tool that can increase the medical students' motivation, improve the university students' individual work organization and self-control function. To our opinion, e-learning can be considered as such effective



educational tool (instrument) at the modern conditions [3, 5, 6].

In this regard, the present research aim was defined as studying the e-learning role in mathematical competence basic structural components formation for medical students. The cognitive activity results of clinical psychology faculty students were chosen as an object of the study.

The research tasks are:

- to study clinical psychology faculty students mathematical competence level at the initial stage of mathematics e-learning;

- to analyze clinical psychology faculty students mathematical competence level at the final stage of mathematics e-learning.

Materials and methods.

The testing of 30 first-year and second-year clinical psychology students was carried out. First-year students were tested as the starters of mathematics e-learning. Second-year clinical psychology faculty students

were involved into mathematical e-learning testing after passing the mathematical course examination. The experiment was held in constant conditions for both groups of students: the research was held at 11 a.m. in the academic auditory. The research duration was about 50 minutes. The clinical psychology faculty students performed the testing independently without using any electronic devices. The testing was built on the basis of Atmhauer intelligence structure test including the scale of mathematical abilities determination and a questionnaire "Thinking type".

Table 1 represents first-year students' mathematical competence level at the mathematics e-learning initial stage. Medical students' basic structural components formation was esteemed, and the clinical psychology faculty students were distributed between four groups according to their mathematical competence level: high, medium, medium-low and low.



Table 1

The first-year students' mathematical competence level at the mathematics e-learning initial stage

| Level | Main structural components of mathematical competence | | |
|---------------|---|-------------------|---|
| | ability | | |
| | to analysis and synthesis | to generalization | to abstraction from objects' insignificant properties and characteristics |
| high | 7 % | 14 % | 0 % |
| average | 29 % | 29 % | 7 % |
| average - low | 29 % | 36 % | 43 % |
| low | 35 % | 21 % | 50 % |

As shown from Table 1, 7 % of the first-year examinees confidently coped with tasks, demonstrating high level of analytical abilities development. High level of abstract thinking development was not found among the students at mathematics e-learning initial stage. And 14 % of the first-year examinees showed highly developed abilities to identify significant relationships within the whole.

According to the test results, two-thirds of the first-year students confidently took a place in the group with an average and average -low level of ability to systematize objects or phenomena properties. Average and average -low levels of mathematical abilities for analysis and synthesis were demonstrated by 58 % of examinees. And exactly half of the first-year students were assigned to the group with average and average-low levels of

ability to translate information about real objects into symbols.

50 % of the first-year students got into a group with low level of abstract thinking development at the initial stage of mathematics e-learning. They had problems with abstract symbols and concepts operations. 21 % of examinees demonstrated difficulties in determining subject's common features by comparison, that was 2.4 times less than in previous group. About a third of the first-year students showed low level of analytical and synthetic abilities development.

To summarize results, we simulated the mathematical competence initial level as a set of points within the sphere, coordinated according to the level of development of abilities to analyze and synthesize, generalize, abstract from nonessential objects and phenomena properties and characteris-



tics. It is important to note, the sphere surface points represent the mathematical competence level of educational

standard as the result of mathematics studying (Figure 2).

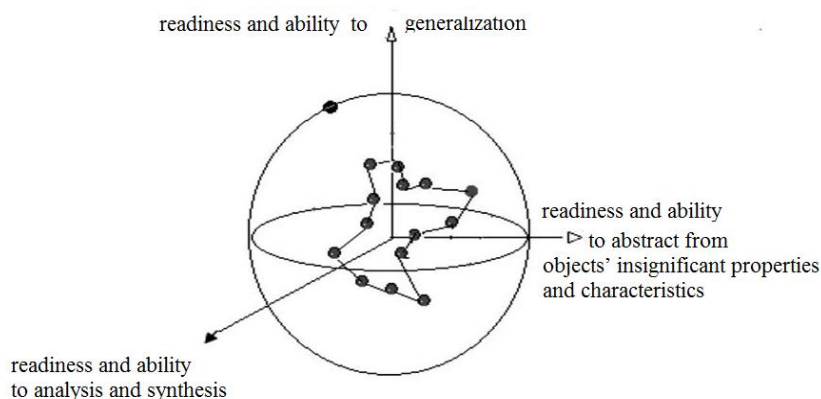


Figure 2. The first-year students' mathematical competence level at the mathematics e-learning initial stage.

Note: black points within the sphere designate the level of mathematical competence.

At the next stage of our research, first-year students began mathematics e-learning to acquire and develop mathematical competence basic structural components. To assess the e-learning effectiveness in the mathematical competence formation we test-

ed student's knowledge at the final stage of mathematics e-learning. The research results showed, that mathematics e-learning made it possible to increase the number of students with high level of abilities for analysis and synthesis from 7 % to 13 %. (Table 2).



Table 2

Medical students' mathematical competence level at the mathematics e-learning final stage

| Level | Main structural components of mathematical competence | | |
|---------------|---|---------------------------|---|
| | ability to analysis and synthesis | ability to generalization | ability to abstraction from objects' insignificant properties and characteristics |
| high | 13 % | 38 % | 0 % |
| average | 38 % | 31 % | 19 % |
| average - low | 44 % | 13 % | 50 % |
| low | 5 % | 18 % | 31 % |

The tendency of mathematical abilities development in e-learning process was found also in the component "readiness and ability to generalize". For this indicator, the most significant growth was observed. The fourth part of examinees joined the group with a high level of ability to mentally unite various objects, phenomena and concepts according to the most significant features.

At the e-learning final stage it was declined in the number of students, initially demonstrating a low level of mathematical skills development. The most significant progress was observed in the indicator "readiness and ability to analyze and synthesize". The number of examinees with difficulties in analytical activities has decreased from 35 % to 5 % in the mathematics e-learning process. Mathematics e-learning was effective in mathematical competence formation, particularly in

the development of such a component as "readiness and the ability to abstract from the non-essential objects and phenomena properties and characteristics." We noted a significant decrease in the number of students with a low level of ability to transfer information about real objects into symbols. Almost a fifth part of examinees got a higher level of abilities to carry out operations with abstract symbols and concepts. The number of students with low level of ability to manipulate symbols has decreased from 50 % to 31 %. Difficulties were mostly found in development of mathematical competence component "readiness and ability to generalize," although positive dynamics in ability formation was observed in the e-learning process. The number of students having problems in systemizing object and phenomena features was reduced from 21 % to 18 %. However, (from Ta-



ble. 2), progress was not as significant as for the other indicators. It should be noted that, decrease in the number of students with a low level of analytical and synthetic skills development, caused the expansion of the groups with average and average-low abilities for analysis and synthesis (from 58 % to 82 %). Mathematics e-learning allowed improving the mathematical

skills for the fourth part of examinees. At the same time, the number of students with average ability to determine the general features in a number of objects by comparison increased from 29 % to 31 %. The mathematical competence model shown in Fig. 3, demonstrates the real progress in each of the structural components at the final stage of e-learning process.

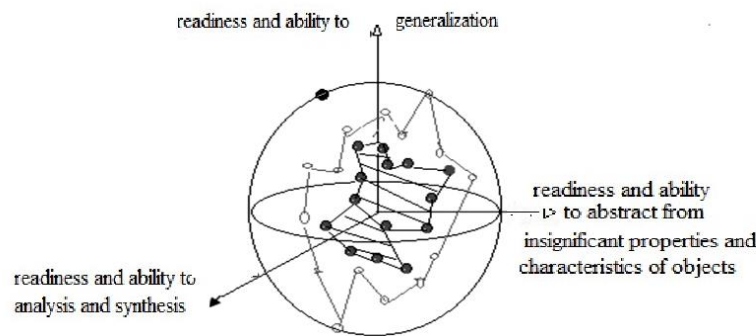


Figure 3. Mathematical competence model for clinical psychology faculty students' mathematical competence level at the mathematics e-learning final stage.

Note: black points within the sphere designate the level of mathematical competence at the mathematics e-learning initial stage, white points within the sphere designate the level of mathematical competence at the mathematics e-learning final stage

We think that the proposed model is useful in evaluating students' learning activity result. It can serve as an indicator of each structural components formation effectiveness and mathematical competence development. Model can be used as a measurement instrument of efficiency level for educational technologies. In our

study, all considered indicators are evidence of e-learning effectiveness in the mathematical competence formation. We hope, this fact will serve as a base for the further development of e-learning.



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