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I. L. Lebedeva, L. O. Norik

Irina.Lebedeva@hneu.net, Larisa.Norik@hneu.net

Simon Kuznets Kharkiv National University of Economics, Kharkiv

A MAPPING STUDY ON BUILDING MATHEMATICAL COMPETENCIES OF ECONOMIC STUDENTS

The modern educational policy of Ukraine provides that the priority for the development of education is its compliance with international standards, the integration of the national education system in the European educational space. This applies to all levels of education, from primary to higher education, including postgraduate diplomas and degree awards. In this regard, the general task of higher education institutions is the implementation of a competency-based approach in the training of professionals which would be competitive not only nationwide, but also in the globalized labor market. In competency-based education, the emphasis is on what graduates know and can do, rather than what is included in the curriculum.

The conceptual learning model provides for such a structure of competencies: knowledge, abilities, and skills (which are developed in the learning process) and social role, self-image, traits, and motives (which are foundation). But these characteristics are only the basis (the lower levels) of the conceptual model of learning, which is customarily represented as a pyramid. The upper levels of this pyramid are competencies and demonstration. Standard criteria already exist for assessing the level of knowledge, skills, and abilities, whereas the degree of development of each of competencies needs to be evaluated. In the USA, for example, several organizations deal with these problems. So, the Lumina Foundation for Education were developed standards for what bachelor's, and master's degrees should know and be able to do along five dimensions [1]: applied learning, intellectual skills, specialized knowledge, broad general knowledge, civic learning. The Degree Qualifications Profile has already been developed for disciplines such as physics, chemistry, biology, education, history, etc. Specialists in the field of economics and management also need such approach that would allow us to evaluate the quality of acquired competencies.

In developed countries, STEM technology [2; 3] has become increasingly popular when the study of natural Sciences (which include the economy) involves the use of Technology, Engineering, and Mathematics. The importance of the formation of mathematical competence in the training of economists and managers is emphasized in a number of works [4; 5] etc. Focusing the learning process on the interdisciplinary integration of mathematics and economics allows us to bring the learning process closer to the students' future professional activity and to increase their motivation for learning and self-development. In addition, Project-Based Learning [3; 6] in the framework of STEM technology means not only the application of knowledge from related areas in the process of working on a project, but also the development of creative, critical thinking. Skills critical thinking allows people of 21st century to better understand complex information and helps them make the right decisions and solve problems in real-world applications. The agglomeration of modern learning technologies as a foundation stone of the educational process is presented in Fig. 1.

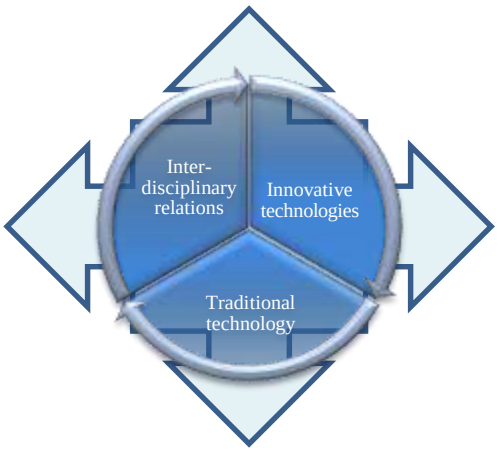

Fig. 1. **Agglomerate of modern learning technologies**

The purpose of this study is to analyze the structure of the mathematical training of economists and managers, its properties and its possible implementation in the framework of the competency-based approach pertaining to higher education. We are presenting a mapping study of scientific work of students that not only considers the results, but also indirectly reflects the activities activity related to the their finding. This is a review that seeks not so much results as linkages.

In our study, we proceeded from the concept that the formation of competencies requires the use of methods to enhance quality the learning process. Such innovation methods can be business games, trainings, performing own research under the guidance of a lecturer, etc. The most promising area of application of mathematical methods in economics is data analysis using mathematical models, statistical methods and software. The teaching of mathematical disciplines should be designed so that students not only gain knowledge which is included in the curriculum but also understand the need to apply mathematical methods to the study of patterns of real economic processes.

In this study, as a method of improving the quality of education, we consider introducing students to writing scientific articles that summarize the results of their own research. The student chooses the topic of the article and research methods independently and independently collects statistics and processes them with the help of a software program.

We analyzed the students' articles, which were published in the journal "Youth Economic Bulletin KhNUE of S. Kuznets" [7]. The total number of articles was 5,402 articles, but only 1,524 articles contained one or another mathematical research. This amounts to slightly more than 28 % of the total number of articles. These articles were analyzed on the level of mathematical processing of research results in students' creative works and also on topics that excite students. Assessment of the level of use of mathematics was carried out on a 5-point scale. One point was assigned to the article in which statistical data were provided, but there were no calculations. Five points were assigned to the article in which the mathematical model of the process was built and the reliability of this model was analyzed. These studies were carried out separately for each year of study. The results of the distribution of scientific articles by these scores are shown in Fig. 2

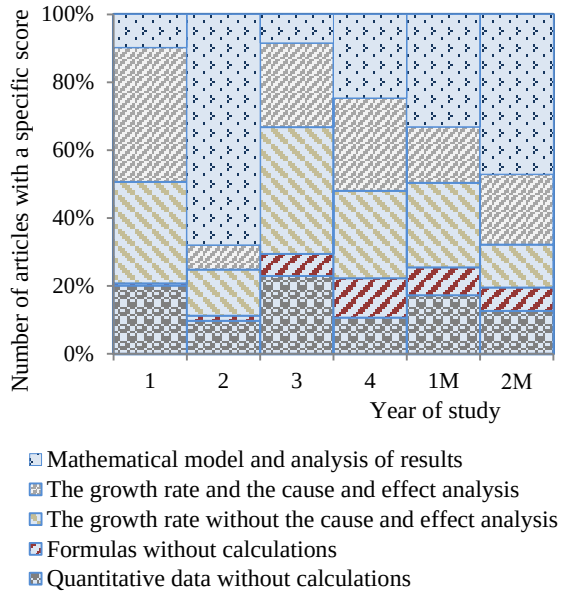

Fig. 2. **Distribution of scientific articles by the quality of mathematical data processing**

The analysis shows that most of the articles that were assigned the maximum score were written by students of the 2nd year of study (almost 65%). This is due to the fact that it is the 2nd year students who study such applied mathematical disciplines as econometrics and the operations research. Articles in which mathematical models are considered are practically absent among students of the 1st and 3rd year of study. Then their number begins to increase again. The level of use of the software corresponds to the volume of calculations. But it should be noted that some articles (about 15%) contain statistical data only as an illustration, and their quantitative analysis is not carried out. We estimated the range $[\bar{x}-\sigma;\ \bar{x}+\sigma]$ to which the average score $\bar{x}$ for using of mathematical methods belongs, taking into account the standard deviation σ (see Fig.3).

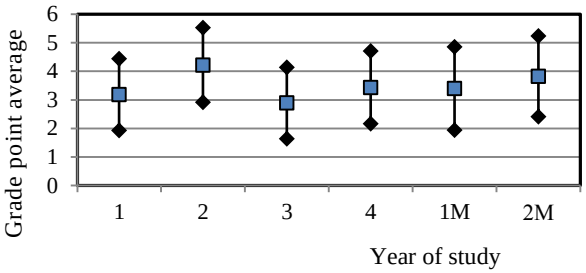

Fig. 3. **Distribution of the quality of mathematical data processing by year of study**

Last but not least, an analysis of the topics students choose for their research shows the following. Students of the 1st and 2nd courses choose more general social topics, which involve the consideration of any indicators in dynamics. 1M and 2M students (Masters) choose more specific topics that are directly related to the subjects they are studying.

Thus, the practical significance of the competency-based approach is to develop students' ability to use the mathematical apparatus in solving real economic problems. It is the use of innovative forms of training, the professional orientation of the disciplines of the mathematical cycle that is an effective means of eliminating the existing contradiction between the needs of society in qualified specialists and the current state of training students of economic specialties.

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