

#### **THE ROLE OF INDEPENDENT LEARNING FOR THE DEVELOPMENT OF GENERAL CULTURAL COMPETENCES BY ENGINEERING UNDERGRADUATES WHEN STUDYING MATHEMATICS**

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**Keywords:** general cultural competences; independent learning; methodological support; pedagogical conditions of formation of general cultural competences; training manual.

**Abstract:** In this paper, we define pedagogical conditions for the formation of common cultural competences of engineering undergraduates, focus on the importance and the role of independent work of students, and describe the experience of organizing the independent work using the developed methodological support.

Currently, the system of higher education undergoes a dramatic change of paradigms. A few years ago university graduates were expected to master a profession that would get them into employment and make a career in the chosen field. Today, the requirements for bachelor graduates have changed. They are expected to develop competences for further self-education and professional adaptation. Therefore, bachelor training at university has to be adjusted to the new requirements and imply a shift in educational technology focusing on the development of students' creative abilities, formation of general cultural competences and professional qualities to meet the demands of the labor market in the economy of innovation.

University training of future engineers requires new innovative approaches to education aimed at meeting the quality evaluation criteria, organization of the

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educational process and its management. This idea is reflected in the content of the competence-based approach to national education. The number of competences a future engineer is expected to master is wide enough. The full list of competences is enumerated in the National Standard of Higher Education of the Third Generation. However, it is a big challenge for university teachers to select a set of basic characteristics of a future engineer out of this range of competences. On the one hand, they are based on professional knowledge, but on the other hand, they include the general cultural competences.

General cultural competences, being an invariant component, are transformed into learners' personal qualities, such as the ability to operate under specified conditions, attitude to work, readiness for independent and individual work, decision-making, self-esteem, willingness to acquire new knowledge, etc. All these qualities are formed at the initial stage of professional training through the study of mathematics. Mathematics teaches a man to think and to develop accuracy, clarity, and conciseness. The study of mathematics requires constant attention and the ability to concentrate; it helps to develop the ability to analyze mistakes, have a critical attitude to work, be honest and conscientious.

The task of formation of general cultural competences of technical university graduates must be addressed consistently and comprehensively throughout the whole process of training. We believe that at the initial stage of professional development the formation of professional skills of future engineers through the study of mathematics requires the following pedagogical conditions of the organization of the educational process:

- providing students with teaching and learning support, such training manuals, including samples of tasks for different levels, aimed at enhancing students' cognitive activity and satisfying their need for novelty and variety of exercises;

- ensuring active involvement of students in co-curricular activities, followed by self-evaluation and discussion of the results so as to identify strengths and weaknesses of their own work, and encourage self-development and raise learners' self-esteem;

- using active and interactive forms of learning (brain-storming, interactive games, etc.);

- creating favorable psychological environment by using teaching methods to meet the needs of students with regards to their age, personal qualities, psychological features, especially those of first-year students; a high level of personal self-development of teachers can systematically and purposefully strengthen the development of professional skills and important personal qualities of students;

- ensuring quality control of students' learning through a variety of forms and methods with clearly defined criteria.

Meeting the challenges of intensification and control of students' cognitive activity is based on the development of elements of self-education focusing on students' independent learning. These teaching conditions also serve as a qualitative indicator of independent learning as a form of organization of the educational process.

Given the specificity of the course "Mathematics" and new trends in the system of higher education, as well as the fact that independent work in the course occupies a large proportion of learning time allocated for its study (and, therefore, plays a major role in the formation of common cultural competences of specialists), the organization of independent work of students both in and out of the classroom becomes a predominant factor in the successful formation of the components of common cultural competences of future engineers.

Optimal organization of independent work in the course "Mathematics", which is the basic element of mathematical and natural-science disciplines, allows one to form common cultural competences of professionals and help them to acquire personal qualities through the study of professional cycle disciplines, as well as for the successful self-development within the selected area and adaptation in the society. The purpose of the proposed innovations in the organization of independent work in this case is the formation of students' understanding of mathematics as a foundation for further development of the scope of their professional activities on the basis of personality traits that determine the readiness of innovative specialists for professional work.

In the study, we selected the features of independent work required for successful study of the course "Mathematics" and its organization:

- students have access to teaching and learning materials developed for their independent work, aimed at the formation of common cultural competences of future engineers;
- independent work of students is based on extensive use of active and interactive forms of its organization;
- independent work of students is largely determined by the presence of various forms and methods of its control.

We consider the development of methodological support of educational process. The team of the Department of «Higher Mathematics» of Tambov State Technical University has published a series of tutorials [1 – 4], designed for self-development of Bachelor students; these tutorials include resources that allow for informed, creative and critical acquisition of the materials by the students. Each section of mathematics and each theme are accompanied by a description of their role and place in the general course of mathematics, natural sciences and in the cycles of general professional disciplines, as well as in the future professional work of engineers. We formulated learning objectives of each section, described the competences, which can be developed through the organized learning process, and compiled a list of questions and tasks for self-assessment.

The tutorials include a sufficient number of tasks of different level of complexity for independent work: the test tasks (Level A), standard tasks for independent work (Level B), tasks of increased complexity, applied problems and creative tasks (Level C). The series of published textbooks completely covers the course of Mathematics for Bachelors of Engineering.

The textbooks are designed in such a way as to provide enough support to the students for self-study and create favorable conditions by motivating learners for self-development, and "learning to learn" independently.

The independent work using these textbooks involves several stages such as self-study of the textbook sections, independent solution of the problems in accordance with the level, self-check using the answers sections. Students are expected to use guidelines for learners which are included in each of the textbooks. By working independently students become more organized and involved in the classroom activities. Collaborative work of students and their participation in extracurricular activities raises their motivation for learning.

Assessment of students' progress using different forms of control is very important. The Department "Higher Mathematics" of Tambov State Technical University has been using the rating system of evaluation of students' progress since the 2004. The new system requires developing and putting into practice the variability of forms of quality control.

The described requirements for pedagogical conditions to form common cultural competences of undergraduate engineering students are aimed at the development of personal qualities necessary for the formation of a competent Bachelor of Engineering.

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### **Роль самостоятельной работы студентов в процессе формирования общекультурных компетенций бакалавров инженерных направлений**

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**Ключевые слова:** методическое обеспечение; общекультурные компетенции; педагогические условия формирования общекультурных компетенций; самостоятельная работа; учебное пособие.

**Аннотация.** Сформулированы педагогические условия формирования общекультурных компетенций бакалавров инженерных специальностей, выделены характеристики самостоятельной работы студентов; дано описание опыта организации самостоятельной работы на основе разработанного методического обеспечения.

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