

**IMPROVING THE METHODOLOGICAL SYSTEM OF THE CASE STUDY  
TECHNOLOGY BASED ON A COMPETENCY-BASED APPROACH IN  
MATHEMATICS EDUCATION**

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**Annotation:** This article highlights the theoretical and practical aspects of improving the methodological system of the Case Study technology based on a competency-based approach in the process of mathematics education. The research develops systematic mechanisms aimed at enhancing students' mathematical thinking, reflective analysis, and logical reasoning skills.

**Keywords:** Case- study, competence, methodological system, mathematical environment, reflection, analytical thinking, quality of education.

**Introduction.** In the modern era, the education system is aimed at developing human capital, fostering students' independent thinking, analytical approach, and competencies in solving real-life problems. In contemporary mathematics education, the main focus is not only on providing theoretical knowledge but also on developing practical thinking, creativity, and the ability to find solutions in problem situations. This process is directly related to the transition to a competency-based model of education. Therefore, among the methods that activate the learning process and are oriented toward the learner's personality, the Case Study technology occupies a special place. In mathematics, integrating this technology with a competency-based approach serves not only to strengthen students' knowledge but also to develop their abilities to apply it in real situations, conduct logical analysis, and make decisions in problem-based contexts. The Case Study (situational analysis) technology in the pedagogical process involves analyzing a real or hypothetical situation, developing possible solutions, and making informed decisions. This method helps students cultivate critical and systematic thinking, creative problem-solving skills, teamwork, and communication competencies. Its main principles are problem orientation, active participation, reflection, and the integration of theory with practice.

Case Study technology, as such an approach, enables students to analyze real-life or professional problems, apply mathematical models to solve them, and justify and evaluate their results. At the same time, adapting and improving this technology within the context of mathematics education represents a pressing and significant direction of modern scientific research.

**Analysis of Literature on the Research Topic.** At present, within the system of continuous education, numerous studies have been conducted by scholars from our country and the Commonwealth of Independent States on the methodology of using the Case Study technology in teaching different disciplines. In particular, such researchers as I.A. Yuldoshev, U.M. Bakhodirova, A.Sh. Rashidov, Sh.F. Turaev, E.V. Egorova, N.V. Dudareva, and T.A. Unegova have carried out scientific research in this field. In addition, issues related to the methodology of teaching subjects such as mathematical analysis, differential equations, algebra, and number theory, as well as the formation of students' competencies in these disciplines, have been studied by D. Makhmudova, E.O. Sharipov, R.M. Aslanov, Yu.N. Bibikov, I.S. Novikova, N.V. Sycheva, and L.P. Kuzmina.

However, in these studies, the problem of improving the methodological system of the Case Study technology based on a competency-based approach in higher education institutions has not been sufficiently addressed. Therefore, developing effective methods for organizing the forms of teaching based on the improvement of the Case Study technology's competency-oriented methodological system is of great scientific and practical importance in the modern educational context.

**Research Methodology.** The main purpose of this research is to improve the methodological system of the Case Study technology based on a competency-based approach in the context of mathematics education, to develop a mechanism for its effective implementation in higher education, and to foster students' mathematical thinking, analytical, and reflective abilities.

The object of the research is the process of teaching mathematics in higher education institutions and the practical application of the Case Study technology within this process. The subject of the research is the process of improving the methodological system of the Case Study technology in mathematics education based on a competency-based approach, its didactic structure, methodological mechanisms, and the determination of its practical effectiveness.

In order to apply the competency-based approach effectively in teaching mathematical disciplines, the existing Case Study system requires a number of updates, including:

problem situations have not been sufficiently systematized from the perspective of mathematical modeling;

assessment tools are mainly aimed at reproducing knowledge rather than applying it;

reflection, analytical thinking, and creative approaches are not adequately encouraged.

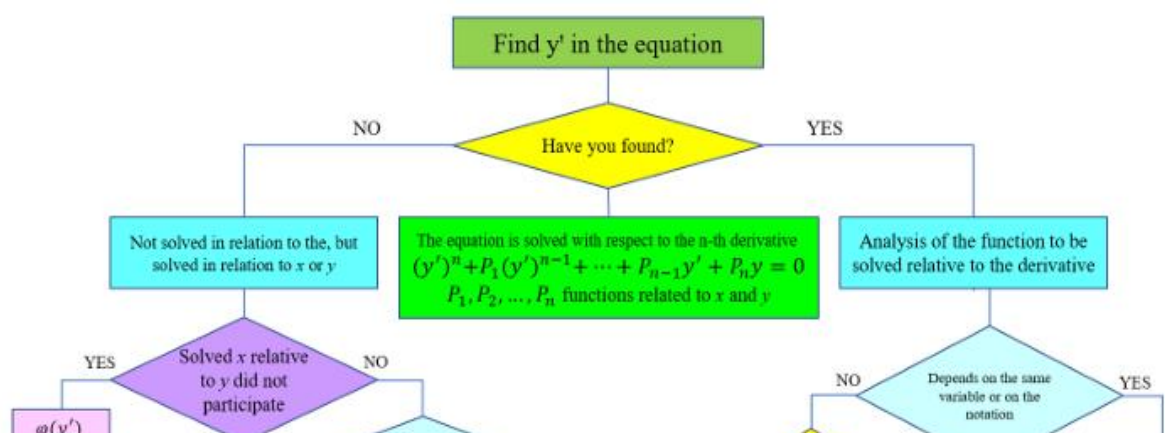
Therefore, the process of improving the methodological system has identified competency-based assessment criteria and the use of interactive tools as key directions.

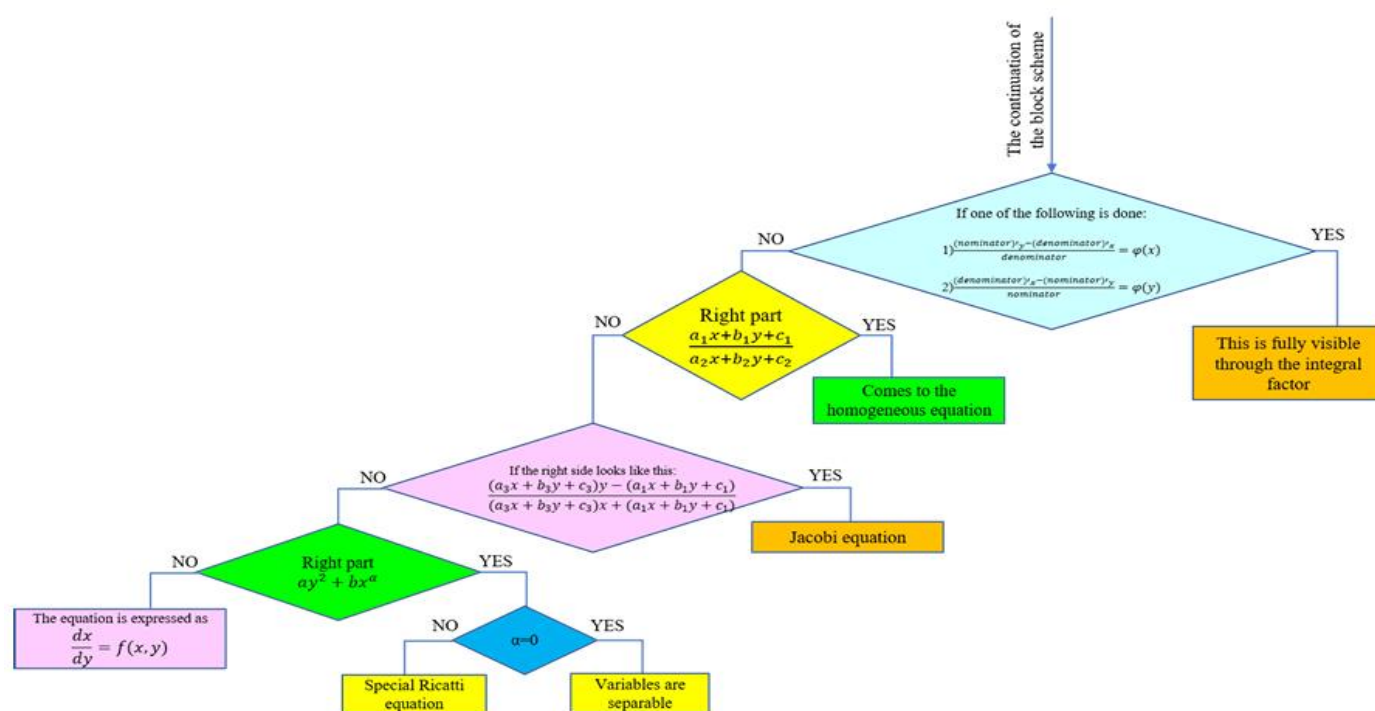
To demonstrate the practical effectiveness of the developed methodological system, the article presents examples of Case Studies used in the mathematics teaching process. These examples are selected based on situations that activate interaction between teacher and student, require the analysis of problematic situations, and stimulate students' creative and analytical thinking.

Example Case: *During an examination, students make mistakes in identifying the type of a differential equation.*

To address this issue, the following algorithm is proposed (see Figure 1):

**Figure 1.**





stages:

1. Diagnostic stage (preliminary analysis) — aimed at assessing students' initial level of mathematical competency and analytical thinking skills;
2. Experimental stage (teaching based on the improved system) — focused on implementing and testing the competency-oriented Case Study methodology.

To evaluate the effectiveness of the experiment, the data were analyzed using the Chi-square ( $\chi^2$ ) criterion, one of the mathematical-statistical analysis methods. The results showed that the effectiveness level of the applied methodological system reached 10.5% improvement compared to the traditional teaching approach.

This result indicates that the Case Study technology, when structured within a competency-based methodological system, not only increases the depth of students' understanding of mathematical concepts but also enhances their independent reasoning, analytical thinking, and reflective problem-solving abilities. Furthermore, students demonstrated greater engagement and

responsibility in the learning process, while instructors noted improved motivation and interactivity during lessons.

In summary, the experimental analysis confirms that the integration of Case Study technology with a competency-based approach significantly improves the overall quality of mathematics education, making it more practical, analytical, and student-centered.

**Conclusion and Recommendations.** The results of the conducted scientific research show that improving the Case Study technology in mathematics education on the basis of a competency-based approach not only activates the learning process but also serves as an effective tool for developing students' deep mathematical thinking, analytical abilities, and reflective reasoning skills.

Mathematics, by its very nature, requires mastery of theoretical concepts, logical proofs, and analytical reasoning. Therefore, the implementation of Case Study technology in this subject helps to strengthen the chain of theory practice reflection in students' cognitive development. The methodological system developed during the research demonstrated that students' not only academic knowledge but also competency readiness, creative thinking, and decision-making skills improved significantly.

In the lessons organized through Case Study technology, students apply mathematical models to real-life processes — such as economic growth, environmental issues, differential equations, optimization problems, and statistical analysis — thereby reinforcing and contextualizing their theoretical understanding. This approach makes theoretical knowledge more meaningful and practical, strengthens interdisciplinary integration, and forms a learner-centered teaching model that prioritizes active engagement and reflection.

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