

DEVELOPING LOGICAL THINKING USING PROBLEM STUDY TECHNOLOGIES IN MATHEMATICS LESSONS

Egambergan Madrakhimovich Khudoynazarov
Ma'mun University

Abstract: This article covers the theoretical and methodological foundations of using problem-based educational technologies in teaching mathematics in the primary education system. Problem-based learning is considered an important tool for developing students' skills in independent thinking, logical reasoning, and a creative approach. It also substantiates the role of methods and techniques that serve to increase the effectiveness of problem-based learning technologies, including problem-based questions, heuristic conversations, small group work, and interactive methods.

Keywords: problem-based learning, mathematics teaching methodology, primary education, problem situation, logical thinking, heuristic method

Introduction

In the context of today's globalization and digital transformation, the requirements for the education system are changing radically. Especially at the primary education stage, the formation of students' skills not only to acquire knowledge but also to think independently, analyze problems, and solve them is becoming a priority task. From this perspective, there is a growing need to abandon the traditional reproductive approach to teaching mathematics and to apply innovative pedagogical technologies, particularly problem-based learning technologies.

Mathematics, by its very nature, requires logical thinking, analysis, and the ability to make correct decisions in problem situations. However, practice shows that in many educational processes, students participate as passive subjects receiving ready-made knowledge. This hinders the adequate development of their creative and critical thinking skills. Problem-based learning technologies turn the student into an active subject, encouraging them to search, ask questions, and find independent solutions.

In the process of problem-based learning, the teacher acts not as an educator, but as a guide and organizer. During the lesson, artificial or real problem situations are created, and students acquire new knowledge in the process of solving these situations. Such an approach serves to form not only knowledge but also competencies in students. In particular, skills such as logical thinking, problem-solving, analysis, and finding solutions are developed.

From the perspective of modern pedagogy, problem-based learning technologies are being recognized as one of the crucial factors in increasing educational efficiency. In particular, the use of these technologies in teaching mathematics in primary grades increases students' interest in knowledge, engages them in active learning activities, and ensures the strength of acquired knowledge.

The issue of using problem-based learning technologies in teaching mathematics is considered one of the important directions of modern pedagogy. Because in today's education system, it is more important to teach students to independently search for knowledge, analyze it, understand the problem, and find a solution than to give them ready-made knowledge. It is in

this regard that problem-based learning technology manifests as a didactic approach that yields effective results in the system of primary and general secondary education, especially in mathematics lessons.

The theoretical essence of problem-based learning lies in the fact that in the educational process, the student is faced with a cognitive task that they cannot solve immediately using their existing knowledge, imagination, and practical experience. As a result, an intellectual difficulty arises in the student, i.e., a “problem situation.” The need to overcome this situation prompts the student to think, search, review existing knowledge, and acquire new knowledge and methods. Consequently, problem-based learning is not the acquisition of knowledge in a ready-made form, but rather the process of acquiring knowledge through research.

In pedagogical theory, problem-based learning is interpreted as a type of education that serves to develop students’ cognitive activity. In this technology, the primary focus is on the student’s cognitive activity. The student participates not only as a listener or performer but also as an active subject who observes, analyzes, compares, generalizes, and draws conclusions. It is precisely the presence of concepts such as number, operation, equality, inequality, form, measure, logical connection, and regularities in the content of mathematics that creates broad opportunities for problem-based learning.

The theoretical foundations of problem-based educational technology are inextricably linked to the theory of cognition, the activity approach, the concept of developmental education, and the competency-based approach. According to the theory of knowledge, a person acquires new knowledge in the process of understanding and resolving contradictions. Problem-based learning introduces this natural cognitive mechanism into the educational process. For a student, new knowledge is formed not as ready-made information from the outside, but as a product of their own mental activity. Therefore, such knowledge is relatively solid, conscious, and suitable for practical application.

From the perspective of the activity approach, the student acquires knowledge through active action. In problem-based learning, the student understands the question, analyzes the situation, makes assumptions, compares various solution options, identifies errors, and reaches a final conclusion. This process develops his intellectual potential. In mathematics classes, activities such as solving problems, finding patterns, determining connections between shapes, and performing logical tasks help effectively implement this approach.

Problem-based learning also occupies a special place in the theory of developmental education. This is because the main goal of developmental education is not only to equip the student with knowledge but also to develop their mental operations. In the process of problem-based learning, mental operations such as analysis, synthesis, comparison, generalization, abstraction, and concretization are actively used. This fully corresponds to the internal nature of mathematics. The reason is that mathematics is not only a science of calculation but also a science that forms a culture of thinking.

The competency-based approach is one of the methodological foundations of problem-based learning. In modern education, it is not so much a student’s ability to remember knowledge as their ability to apply it in practical situations. Through problem-based learning technology, the student not only learns a mathematical rule or formula but also learns to apply it in real or conventional situations. This, along with subject-specific competencies, also forms core

competencies such as communication, information management, independent thinking, and collaborative work.

The central concept of problem-based learning is the problem situation. A problem situation is a situation in which a student faces an intellectual difficulty in which the existing knowledge is insufficient to fully solve the task. Such a situation leads the student to search based on internal needs. There are various forms of creating a problem situation in a mathematics lesson: problems with incomplete information, tasks with excessive information, examples with multiple solutions, analysis of contradictory statements, logical riddles, problems based on real-life situations, etc. It is important that the situation corresponds to the student's age characteristics, level of preparation, and cognitive capabilities.

In the theoretical structure of problem-based learning, components such as the problem question, the problem task, the problem task, and the problem statement are distinguished. A problem question, unlike a standard question, requires thinking rather than simple recall. For example, a question such as "Why can the number 12 be written as the same sum in two different ways?" encourages the student to conduct logical research. A problem task is a task that forces the student to find a new method. In the method of problem-based presentation, the teacher does not present the topic in a ready-made form, but poses a problem and demonstrates a way of thinking that leads to a solution.

In this technology, the role of the teacher also changes fundamentally. While the teacher is the primary source of information in a traditional lesson, in problem-based learning, they act as the organizer, manager, and motivator of cognitive activity. The teacher creates a problem situation, develops a system of questions, directs students toward research, supports their opinions, and provides assistance where necessary, but does not provide a ready-made solution immediately. This approach increases the student's independence and establishes a subject-subject relationship in the lesson.

The role of the student rises from a passive receiver to an active researcher. He observes, asks questions, guesses, tries to prove, finds mistakes, justifies his opinion, and comes to conclusions in collaboration with the group. It is this process that forms the logic, consistency, accuracy, and evidence that are important in mathematics lessons. In this sense, problem-based learning is not merely a method, but a didactic system that develops the student's culture of thinking.

The specifics of mathematics create a favorable pedagogical foundation for the application of problem-based learning technology. Firstly, mathematics is a science based on proof and logic, in which every rule, conclusion, and result has a specific basis. Second, mathematical problems can often be solved in different ways, which stimulates students' creative and flexible thinking. Thirdly, mathematics is inextricably linked to everyday life and manifests itself in practical activities such as measurement, comparison, planning, and calculation. Therefore, problem-based learning can be effectively organized by introducing real-life situations into the lesson.

Another theoretical basis for using problem-based educational technologies is the motivational factor. The problem situation arouses the reader's interest. He is more interested in solving a problem whose solution is unknown than in performing a simple exercise. Because human thinking has a natural need to eliminate uncertainty. The emergence of questions such as "Why?," "How?," "Is there another way?" in the student indicates the successful organization of

problem-based learning. It is precisely interest and internal aspiration that increase the effectiveness of learning.

Reflection is also an important theoretical component in the process of problem-based learning. The student analyzes how they solved the problem, which method they chose, where they made a mistake, and what else can be done. This approach develops metacognitive skills, meaning the student learns to observe their own thinking process. This is especially important in mathematics lessons, as the student must understand not only the result but also the solution process.

It should be noted that problem-based learning technologies are not applied uniformly at all stages of the lesson. Its effectiveness depends on the lesson goal, the content of the topic, the age and individual characteristics of the students, the level of preparation of the class, and the methodological skills of the teacher. It is advisable for problem situations in primary grades to be simple, visual, and enriched with game elements. In higher grades, more complex logical and theoretical problems can be applied. Consequently, problem-based learning technology, along with its universality, also requires flexibility.

In conclusion, the use of problem-based educational technologies in teaching mathematics is an important pedagogical requirement of the modern education system. This approach encourages students not only to master ready-made knowledge but also to think independently, analyze problem situations, and find optimal solutions. As a result, students acquire knowledge consciously and develop skills to apply it in practical activities.

Problem-based learning technologies enhance students' cognitive activity in mathematics lessons, making the lesson process interactive and rich in content. In particular, the use of problem-based questions, heuristic conversations, logical tasks, and group work methods fosters critical and creative thinking in students. This serves to develop logical thinking, which is the main goal of mathematics. Additionally, problem-based learning technologies increase the student's personal activity and place them at the center of the educational process. The teacher, on the other hand, acts not as an educator, but as a guide and organizer. Such a collaborative learning model fosters important competencies in students, such as independence, responsibility, and the ability to justify one's own opinion.

References

1. Tolipov U., Usmonboyeva M. Theory and Practice of Pedagogy. – Tashkent: Fan, 2012. – 320 p.
2. Yuldashev J., Usmanov S. Fundamentals of Pedagogical Technology. - Tashkent: O'qituvchi, 2004. – 104 p.
3. Ishmukhamedov R., Abdukodirov A. Innovative technologies in education. – Tashkent: Talant, 2008. – 180 p.
4. Karimov I.A. High spirituality is an invincible force. – Tashkent: Ma'naviyat, 2008. – 176 p.
5. Decree of the President of the Republic of Uzbekistan. A set of regulatory documents for the development of the education system. - Тошкент, 2020.
6. Polat E.S. New pedagogical and information technologies in the education system. – Moscow: Academy, 2005. – 272 p.

7. Jonassen D.H. Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environments. New York: Routledge, 2011. – 304 p.