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# BASIC METHODS AND THEIR DIDACTIC PRINCIPLES IN TEACHING MATHEMATICS TO GENERAL SECONDARY SCHOOL STUDENTS

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**Abstract:** This article analyzes the main methods used in teaching mathematics in general secondary education schools and their didactic principles. The study highlights the primary didactic objectives of the teaching process, their formation, and their role within the structure of the lesson. The author considers the methodology of teaching mathematics as a bilateral process based on the interaction between teacher and student activities. The article examines the advantages of scientific research methods, heuristic approaches, problem-based learning, and methods applied within the framework of modern STEAM technology, as well as their role in developing students' creative thinking skills. Furthermore, the study broadly discusses instructional methods aimed at fostering independent thinking, analytical abilities, and conclusion-drawing skills alongside theoretical knowledge acquisition. According to the author, teaching through problem-based learning not only provides knowledge but also enables students to become active participants in the educational process. The article reveals the practical significance of methodological approaches in improving the effectiveness of mathematics education in general secondary schools.

**Keywords:** Mathematics education, Didactic principles, Teaching methods, Heuristic method, Problem-based learning, Scientific research methods, STEAM technology.

Main Didactic Objectives in Mathematics Lessons Each lesson is designed with various didactic objectives. Among them, one serves as the primary objective and is referred to as the main didactic objective of the lesson. The objective of each individual lesson determines the overall aim of the lesson system and, through this, reveals the content of the topic being taught to students. In one case, the objective may involve introducing students to new concepts; in another, it may focus on expanding and deepening previously introduced concepts. In a third case, the aim may be to develop specific skills and competencies, while in a fourth, it may involve assessing students' knowledge, skills, and competencies. Several of these objectives may be addressed within a single lesson. Reviewing previously covered material includes organizing earlier lessons into a new system and simultaneously assessing students' knowledge. The presentation of new material is always followed by practical exercises and activities.[1]

School practice has established a specific lesson structure, and most teachers who follow this system achieve effective results. Usually, at the beginning of the lesson, homework is checked or the previous topic is reviewed, followed by a question-and-answer session based on the previously studied material. After that, new material is presented, and in order to reinforce it, students are given exercises and problems to solve or are asked control questions. At the end of the lesson, homework assignments and methodological instructions are provided. In some cases, a lesson may be devoted to only one of these objectives. This single objective is called the main didactic objective of the lesson, while all other objectives are subordinated to it.[1]

In modern didactics, including the methodology of teaching mathematics, the problems related to teaching methods have been generally resolved and are characterized by the following two aspects:

A) Teaching (the activity of the teacher);
B) Learning (the conscious activity of students).

The teaching methods used in the school mathematics curriculum can be classified as follows.

1. Scientific research methods (observation, experimentation, comparison, analysis and synthesis, generalization, abstraction, concretization, and classification).
2. Teaching methods (heuristic method, programmed instruction method, problem-based learning method, lecture method, and discussion method).
3. Reasoning methods (induction, deduction, and analysis).

As is well known, the object of study in mathematics consists of the spatial forms of material objects and the quantitative relationships between them. In the process of determining these quantitative relationships among forms, mathematicians use scientific research methods as essential tools of investigation. The scientific methods used in mathematical research simultaneously serve as scientific inquiry methods in the teaching of mathematics as well. Below, we consider the methods applied within STEAM technology.[2]

Heuristic Teaching Method. The word heuristic means “I discover” or “I find” through question-and-answer interaction. Teaching through the heuristic method began to be widely applied in schools in the early nineteenth century. The American scientist George Pólya described the heuristic teaching method as follows: “The aim of heuristics is to search for methods and rules that lead to discoveries.” He recommended implementing the essence of the heuristic method according to the following sequential plan:

1. Understanding the statement of the problem;
2. Developing a plan for solving the problem;
3. Carrying out the plan;
4. Looking back (checking the obtained solution).

During the implementation of this plan, teachers seek answers to the following questions:

1. What is unknown in the problem?
2. What is known in the problem?
3. What conditions are given in the problem?
4. Have similar problems been solved before?
5. If similar problems have been solved, can those methods be used to solve the current problem?

Undoubtedly, the above plan structure contributes to the development of students’ creative thinking activities. However, this scheme cannot be considered the only way to develop students’ creative abilities.

Problem-Based Learning in Mathematics Lessons For every stage of social development, there exists a specific content and direction in the development of educational theory. In other words, in accordance with each stage of societal progress, the content of curricula, educational principles, and the forms and methods of organizing the teaching and learning process are appropriately designed and improved. As a result of conducted experiments and observations, general principles for activating students' cognitive activity and effectively utilizing their intellectual potential in the educational process have been developed. These principles include the following:

1. Developing a system of problem-based questions related to the topic being studied;
2. Teaching the lesson material through the discussion method based on the system of problem-based questions and revealing its essential meaning;
3. Assigning inquiry-based learning tasks grounded in problem-oriented questions.

When educational material is explained according to the above stages, students encounter facts and concepts that they cannot immediately comprehend. As a result, a problematic situation arises between the students and the material being studied. A problematic situation is defined as a specific type of interaction between the object being studied (theoretical material, examples, or problems) and the learning subject (the student).

Determining the role and significance of problematic situations, while taking into account the psychological and pedagogical laws of students' active thinking processes, forms the central idea of problem-based learning. A lesson process organized around the resolution of problematic situations is called problem-based learning. In problem-based learning, the teacher's role is to explain the content of particularly complex concepts when necessary and, at the same time, systematically create problematic situations between students and the material being studied. The teacher introduces students to facts, and as a result, students independently analyze these facts, draw conclusions, and make generalizations. The theoretical materials, exercises, and problems studied in the school mathematics curriculum can, according to their content, be divided into problem-based and non-problem-based types.

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