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Hajiyeva Fatma
Lecturer
Nakhchivan State University, Nakhchivan, Azerbaijan
E-mail: fatmahaciyeva022@gmail.com
ORCID ID: https://orcid.org/0009-0003-6948-6889

Teaching Mathematics: modern approaches and methods

The article provides a detailed analysis of the implementation of new educational programs in Azerbaijani schools in recent years, the changes occurring in the reform process, the crucial role of teachers in the education system, and the measures taken to improve learning outcomes. Additionally, special attention is given to the fulfillment of the strategic goals and objectives set by the state. The article elaborates on the achievements and challenges in the field of education as a result of the implementation of new programs aimed at its development. Furthermore, the article examines the differences among students in personality-oriented education, the effective planning of the learning process, the diagnostic nature of assessment, its continuous implementation, and the identification of differences and difficulties in students' comprehension levels through this assessment. The importance of diagnostic assessment and continuous monitoring, while considering the aspects of education that require individual approaches, is emphasized as a key issue in the article. Among the main principles discussed are teacher training, professional development of teachers, and the application of individualized approaches to students. The necessity of professional development for teachers at all stages of education to enhance the quality of teaching is highlighted. Furthermore, particular attention is given to identifying key directions that can contribute to the advancement of the education system. The article underscores the importance of both local and international experiences for the continuous development of education. As a result, it is concluded that the role of teachers in the teaching process has been strengthened, the quality of education has improved, and the application of different approaches is expected to lead to more positive learning outcomes.

Keywords: *mathematics, strategy, integration, teacher training, technology, methodology, mathematics teaching.*

Introduction. In the Republic of Azerbaijan, it is stated in the national curriculum framework document of general education that in the teaching of Mathematics in secondary schools, students' essential mathematical knowledge, intellectual and logical development must be strengthened, and they should acquire the relevant skills suitable for their age level. Additionally, they should understand that the nature of many random events in life essentially has a probabilistic character. The application of the curriculum requires more creativity from primary school teachers. The determination of the lesson's goal is directly dependent on the standards. In traditional teaching, the goals of the lesson were abstract concepts such as "to teach," "to make students understand," or "to form". Now, the lesson goals consist of concrete actions such as "writing", "reading", "drawing", etc. If we pay attention, we can see that even in traditional lessons, the work and activity of the teacher were considered essential.

As it is evident, primary school teachers should know that in order to equip younger students with life skills, the activity level in the lesson process must be increased, and the teaching of Mathematics should be ensured at a high level.

After gaining independence, our country set important tasks for all sectors, including education. As the national leader Heydar Aliyev stated: "The main goal of reforms in the education system now is to align the Azerbaijani education system with the standards of the global education system".

The reforms in the education system also focused on the development of the Mathematics course and teacher training at all levels of education. The teaching methods of Mathematics led to the emergence of modern mathematical theories. The differentiation and unification of various mathematical theories reached a point where discussing a unified field of Mathematics became difficult. However, despite this, its unity has always been preserved. With the introduction of new teaching technologies, the teaching of Mathematics has become a complex process carried out by teachers (Mahmudov, 2015).

The teacher conveys the information obtained from various resources to the students by using new teaching technologies. The student, in turn, conveys the information gathered from sources such as textbooks, lesson materials, computers, etc., to the teacher.

At all levels of education, in order to solve the learning outcomes in accordance with modern requirements, the teacher must use new teaching methods based on the student's knowledge level (Mahmudov, 2015).

One of the main tasks of the methodology of teaching Mathematics is to form and develop cognitive activities that lead to innovations characteristic of the development of mathematical thinking. The problems faced by the subject of the methodology of teaching Mathematics can be conditionally divided into two categories: what to teach and how to teach. These problems are closely related to each other. As a result of the rapid development of science and technology in modern times, the teaching of new theories included in the school Mathematics curriculum requires new methods, and new methods in turn create the necessity for the emergence of new theories.

The methodology of teaching Mathematics lies at the intersection of Mathematics, Pedagogy, Psychology, Philosophy, and Logic, meaning that it combines these fields of science and is based on their interrelations when addressing the problems that arise.

The methodology of teaching Mathematics analyzes mathematical activities, and, relying on psychology and logic, it investigates the formation of students' cognitive activities and their development in all directions. Mathematics, as a science, cannot independently reflect the development of students' thinking abilities and cognitive development. This process is carried out by the methodology of teaching Mathematics. The selection of teaching material in the mathematics course requires a deep analysis of ideas, methods, and topics, as well as determining its place and application among the sciences.

The teaching methods of Mathematics are formed by implementing the teaching methods of pedagogy, the teaching methods of Mathematics, and didactic principles (Mahmudov, 2014).

Mathematics instruction examines the forms of logical reasoning and teaches the rules for drawing conclusions about specific ideas. Research has shown that mathematical theories with long histories sometimes reflect themselves in modern science as well. Every innovation in the field of Mathematics gradually influences the school Mathematics curriculum after many years. However, history shows that the goal is to renew, improve, and modernize school education. In the modern era, it is impossible to learn using old methods because it has been revealed that the method for studying current material is outdated and does not align with modern school education.

Learning mathematics in accordance with modern requirements, generalizing it, and teaching it in theoretical and practical directions is one of the aspects that reflects its development.

While mathematics education is modernized in countries around the world, studying the experience of foreign countries is of interest. Therefore, it is necessary to consider, analyze, and learn from the positive aspects of foreign experience in the development of materials and teaching methods for the Mathematics curriculum (Mahmudov, 2004).

The general objectives of education and upbringing include the role of Mathematics as a science in technology and production, the continuation of students' education in higher institutions, and the acquisition of knowledge, skills, and habits. Students should understand the scientific foundations of fields where mathematical methods are used in modern technology and production.

When teaching and education between teachers, students, and pupils are built on mutual respect at a high level, their overall success will be significantly greater (Mahmudov, 2014). This means that when students are treated with respect, care, and high expectations, the process becomes not only comprehensive but also reciprocal. It is necessary to work on developing positive qualities in students. This largely depends on the school administration and the teachers' attitude towards them.

The rapid changes and innovations in the education system demand a fundamental renewal of teacher training. This is one of the most important issues in the current period of societal development and reflects the constant need for the improvement of the education system in accordance with modern requirements. The future of our country depends on talented students and pupils. Therefore, our schools must train knowledgeable and skilled professionals. Teachers play a very important role in the development of skilled professionals (Akbarova, 2019).

Currently, new requirements are being set for teachers, and they must continuously study the innovations occurring in the curriculum, the development of electronic resources in the field of pedagogy, and other areas in order to align their duties with modern standards.

New teachers must be trained in pedagogy-oriented educational institutions, and the formation of the teaching profession must align with the demands of modernizing education.

As President Ilham Aliyev of the Republic of Azerbaijan has stated: "All work starts precisely from school; attention to education and care for teachers must always be present. All government agencies must listen to these recommendations and ensure their practical implementation' (Mahmudov, 2004).

The knowledge gained during initial teacher training at the bachelor's level must align with modern requirements, which greatly depends on the improvement of teaching outcomes and plays a crucial role in shaping the future teaching profession.

Textbooks and teaching materials should be prepared by a scientifically knowledgeable, competent, and professional teacher and should be continuously improved. Therefore, teachers must enhance their knowledge and adapt to modern requirements. Many of the issues highlighted emerge in the implementation of curricula and teaching plans. Without innovations and changes in teacher training, achieving successful outcomes is not possible. Therefore, teacher training in our country is carried out at a high level (Akbarova, 2019).

Reforms in the education system continue to develop, and the teacher, who is considered the driving force at the center of the teaching process, remains essential. The role of teachers is growing, and the demands for their professional qualities are increasing.

The education reform program approved in 1999 created an opportunity for profound changes in this field. In recent years, a number of state documents related to the development of education have been adopted: "**State Standards of Secondary Education in the Republic of Azerbaijan", "The General Education Concept in the Republic of Azerbaijan"** the state standards and curricula for general education have been approved, and the ways for the development of our education system have been defined. State education standards not only set requirements for students but also impose significant responsibilities on teachers (Iskanderov, 2008).

Every teacher must understand that content standards are divided into two categories: knowledge and activity. Knowledge itself is further divided into three categories: declarative (information-based knowledge, such as concepts, definitions, facts), procedural (knowledge related to the execution of activity procedures), and contextual (knowledge obtained through problem-solving methods). Activity, on the other hand, is divided into three taxonomies: cognitive, emotional, and psychomotor. All teachers must consider the declarative, procedural, and contextual nature of knowledge when applying state education standards. This is because, if a teacher constantly emphasizes declarative knowledge in the lesson, it will hinder the development and learning of the students. The teacher must know when to use the content standards related to procedural and contextual knowledge (Mahmudov, 2010).

One of the main conditions for improving the quality of the teaching process is how to organize students' activities. In other words, the teacher must be able to determine the levels of cognitive, emotional, and psychomotor taxonomies to achieve the correct result when training the teaching objectives based on the standards. In general, the teacher must love the children as friends and know that love is the best medicine in all matters. If we look at the lives of great scientists (Isaac Newton, Charles Darwin, Blaise Pascal, Albert Einstein, etc.), we see that most of them were students who, at school, were not different from the ones who were neglected by teachers. Later, these scientists worked on themselves and became great (Gojayeva, 2024).

The quality of the teaching process and the regular monitoring of students' learning outcomes is especially important in the context of the renewal of educational content, the application of education standards, the normalization of lesson loads, the protection and strengthening of students' health, and the intensification of moral education issues. One of the main issues facing current teachers is the establishment of a monitoring and evaluation system in general education schools (Javadov, 2014).

In lessons, including Mathematics lessons, tasks that encourage independent activity form important skills in students, such as independent thinking and decision-making. The teacher's effort plays a central role in the formation of these skills. The well-roundedness of our teachers is especially important in the modern era. Otherwise, we cannot expect high achievements from our students. While implementing the pedagogical and psychological processes, it is also essential to consider individual characteristics along with general aspects. This approach is called differentiated teaching. Every subject has opportunities to be organized based on the differential approach. In the teaching process of Mathematics, one of the main subjects in general education, the most effective results come from a differentiated approach, which requires the teacher's competence. The teacher should focus on several aspects of differentiated teaching that allow the individualization of the teaching process. These aspects are as follows:

– The individual mathematical capabilities of learners;
– The individual characteristics of learners;
– The general and specific abilities of learners;
– The interests of learners (Akbarova, 2019).

Based on research and observations, it can be said that only a few students can master Mathematics at a high level. This is often related to students' fear of difficulty. Students with lower mathematical abilities are generally more inclined towards the Humanities. However, Mathematics is a part of general life skills and a subject of practical significance. Therefore, the teacher must work to make students realize the importance of

Mathematics and spark their interest in this subject. One of the key methods to achieve this is the differential approach. That is, it involves gradually developing the skills of "picking up a manageable stone and eventually lifting heavier stones". The differential approach in the teaching-learning-education triangle involves ensuring that students of various levels master the teaching material in accordance with their abilities and potential opportunities at different levels (Gojayeva, 2024).

The teacher can engage each student in working with teaching materials according to their abilities and interests, thus achieving the implementation of the teaching program. For this purpose, both the exercises in the textbook and additional exercises are selected according to the students' capabilities (Djafarova, 2024).

In Mathematics lessons, the teacher can group students in two ways. The first group includes students of different levels. The teacher assigns tasks according to each student's ability, ensuring that no student remains inactive in the class. Additionally, students with strong mathematical knowledge check the tasks of weaker students. This leads to leadership, division of labor, collaboration, care among students, as well as the process of imparting and reinforcing knowledge. The second group consists of students with the same or similar levels. In this group, the differentiated approach allows the delivery of knowledge and skills in various forms and variations to students who possess the same mathematical abilities and skills.

One of the most interesting examples of strategic conceptual documents that define teachers' professional competencies and the development of teacher training and post-graduate improvement systems can be found in the case of Bosnia and Herzegovina. In this country, a long-term project is being carried out to improve the teaching profession. The purpose of the project was to answer the question, "What kind of teachers should work to ensure the sustainable development of society in the 21st century?"

As a result, the project team created a broad framework of competencies and presented it to the public (Djafarova, 2024).

In our country, it is essential to note the necessity of changing the approaches to teacher preparation and professional development. Considering the unique circumstances and development characteristics of an independent country, a new concept of teacher professionalism must be reflected in normative documents that cover the teacher training process. The first step in realizing this is to identify the challenges teachers face in the curriculum and determine the reasons for these challenges (State Strategy for the Development of Education in the Republic of Azerbaijan, 2013).

Therefore, the use of modern teaching technologies in teacher preparation and the formation of the teaching profession is a current issue under the attention of the Ministry of Science and Education of the Republic of Azerbaijan.

Materials and methods. This study analyzes the development of the methodology for teaching Mathematics in Azerbaijan's general education system. The materials used in the research are mainly based on official documents related to educational reforms and curricula, as well as existing literature on modern teaching methods and the implementation of curricula.

The goal of the study is to investigate the impact of teacher training and professional development methods on the teaching of Mathematics. To achieve this, various approaches have been applied to assess the effectiveness of modern teaching methods and curricula. The research methodology combines both qualitative and quantitative approaches. The qualitative approach focuses on gathering information about teachers' teaching experiences, students' learning outcomes, and the diversity of teaching methods. The quantitative approach involves using tests and assessment tools to measure students' mathematical knowledge levels and conducting relevant statistical analyses.

The study also draws on theories from Pedagogy, Psychology, and Methodology, as well as best teaching practices and experiences from foreign countries. Theories related to teaching Mathematics, the application of modern teaching technologies, and the issue of students mastering teaching materials at different levels are also included in the research topic.

During the application of methodological approaches, the activities of teachers in the teaching process, their professional development levels, and the outcomes of students have been examined. One of the main methods in this research is the application of a differentiated approach in teaching Mathematics, the development of training strategies for students at different levels, and operations related to the implementation of this approach. To improve the effectiveness of the methodology, statistical analyses have also been used to evaluate teachers' teaching activities and analyze students' learning outcomes.

As a result, this research aims to assess how methodological changes in teacher training impact the quality of education and provide suggestions for applying new approaches in the teaching process.

The results of this research are significant in terms of improving the teaching process of Mathematics in Azerbaijan's general education system. The information and recommendations obtained in the study can provide practical benefits in several key areas:

1. Professional development of teachers: the research findings can contribute to the more effective design of professional development programs for Mathematics teachers. Recommendations are made for organizing individual and collective training sessions, seminars, and working groups to enhance teacher training and teaching skills.

2. Application of effective teaching methods: recommendations are provided for the use of modern pedagogical approaches in mathematics lessons. In particular, the application of the differentiated approach, the development of teaching strategies tailored to students' individual needs, and the use of interactive methods will contribute to improving the quality of teaching.

3. Improvement of student achievement: the research findings encourage the application of new approaches to make the teaching of Mathematics easier and more effective. Specific methods and teaching resources are proposed to increase students' mathematical knowledge levels and enhance their problem-solving skills.

4. Curriculum enhancement: recommendations are provided for updating the curriculum and integrating modern teaching models based on international practices. This can contribute to raising education standards and enhancing the global competitiveness of the Azerbaijani education system.

5. Integration of educational technologies: the research findings may encourage more effective use of digital resources and innovative teaching technologies in mathematics education. Virtual laboratories, interactive Mathematical platforms, and other technological solutions can help increase students' interest in the learning process.

These results will not only ensure more effective teaching of Mathematics in the general education system but also assist in achieving higher outcomes for both teachers and students.

Conclusions. In modern times, new demands continue to be placed on teachers. Teachers must organize their pedagogical activities based on modern educational standards and innovative approaches. To this end, teachers must continually track and adopt new developments in curriculum updates, pedagogical theories, the use of electronic resources, and other contemporary educational trends. The application of modern pedagogical approaches is necessary to elevate the teacher's professional training level and establish a more effective teaching process.

The formation of teachers should occur in higher education institutions with a pedagogical focus, and their preparation should fully comply with the demands of the education system's modernization. Educational reforms are dynamically ongoing, and the role of the teacher, as the leading force in the teaching process, is rising. As a result, the demands for teachers' professional qualities are increasing, and their approaches to pedagogical activities should be enriched with more modern and innovative methods.

For this reason, effective use of modern pedagogical technologies that meet the demands of the present time should be implemented in teacher training, and interactive methods and digital resources should be widely used to improve the quality of the teaching process.

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Викладання математики: сучасні підходи та методи

Гаджієва Фатма
викладач
Нахічеванського державного університету, Нахічевань, Азербайджан

У статті детально аналізуються впровадження нових навчальних програм у школах Азербайджану останніми роками, зміни, що відбулися в процесі реформ, ключова роль учителів у системі освіти та заходи, що проводяться для підвищення результатів навчання. Особлива увага приділяється питанням виконання стратегічних цілей та завдань, визначених державою. У статті детально пояснюються досягнення та труднощі, що виникли внаслідок впровадження нових програм розвитку освіти. Крім того, у статті розглядаються питання, пов'язані з індивідуальними відмінностями учнів у особистісно орієнтованому навчанні, ефективним плануванням навчального процесу, діагностичним характером оцінювання та його безперервністю, а також визначенням різниць та труднощів у рівні засвоєння учнів через цей процес оцінювання. Діагностичне оцінювання навчання та безперервний моніторинг з урахуванням аспектів, що потребують індивідуального підходу в освіті, підвищення функціональної ролі вчителів у навчальному процесі визначені як важливе питання. Основні принципи статті включають підготовку вчителів у навчальному процесі, професійний розвиток вчителів та застосування індивідуальних підходів до учнів. Підкреслено необхідність професійного вдосконалення вчителів на всіх етапах освіти для підвищення якості навчання. Крім того, увага приділяється визначенню важливих напрямів, які можуть сприяти розвитку системи освіти. Стаття підкреслює важливість як місцевого, так і міжнародного досвіду для сталого розвитку освіти. В результаті роль учителів у навчальному процесі була посилена, якість освіти підвищена, і зроблено висновок, що застосування різних підходів дасть більш позитивні результати навчання.

Ключові слова: *математика, стратегія, інтеграція, підготовка вчителів, технологія, методика, викладання математики.*

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