



Advantages Of Teaching Progressions Using Artificial Intelligence

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Abstract: This article is devoted to improving the process of teaching mathematical progressions through the use of artificial intelligence technologies. The study examines the essence of artificial intelligence, its role in the education system, and its integration with modern digital technologies. Particular attention is paid to the implementation of innovative approaches aimed at increasing the effectiveness of students' learning outcomes. The main part of the article analyzes effective methods of using artificial intelligence tools in teaching arithmetic and geometric progressions. In particular, it explores the capabilities of adaptive learning platforms that take into account students' individual characteristics, knowledge levels, and learning pace. It also highlights the possibilities of automating problem-solving processes, detecting and analyzing errors, and providing personalized recommendations.

Keywords: Artificial intelligence, mathematics education, progressions, arithmetic progression, geometric progression, digital education, adaptive learning, interactive methods, mathematical modeling, innovative technologies, learning effectiveness, digital competence, individualized approach, learning process, analytical thinking.

Introduction. The modern educational process is closely linked with rapidly developing digital technologies and strives to make the learning process more effective, interactive, and individualized. In this context, artificial intelligence (AI) is creating new opportunities in the field of education: it enables the assessment of students' knowledge levels, the adaptation of learning



materials, and the clear explanation of complex concepts. In particular, in teaching certain topics of mathematics, such as arithmetic and geometric progressions, artificial intelligence technologies can significantly improve the quality of instruction.

Mathematical progressions play an important role in developing students' logical thinking, analytical skills, and mathematical reasoning, and teaching them effectively and in depth is associated with various pedagogical challenges. Traditional methods are sometimes insufficient to meet individual learning needs. Therefore, adaptive platforms and automated analytical systems based on artificial intelligence are increasingly being used as innovative approaches in teaching mathematical progressions. One of the main problems encountered in today's educational process is the application of general teaching methods without taking into account differences in students' knowledge levels and learning speeds. As a result, some students face difficulties in mastering the material adequately, while others waste time on excessive exercises that demand unnecessary attention from the teacher. For this reason, the integration of AI technologies into the educational process makes it possible to provide an individualized approach to each student, systematically reinforce knowledge, and simplify complex concepts. This article is devoted to analyzing the role of artificial intelligence in the education system, the methods of teaching progressions using AI, and the effectiveness of such an approach. The purpose of the study is to identify ways to improve students' learning processes and enhance the quality of education through the application of AI technologies in teaching mathematics, particularly progressions. At the same time, the article also examines the potential of artificial intelligence in automating pedagogical processes, using resources efficiently, and the future prospects for further digitalization of education.

Literature Review. John McCarthy, Stuart Russell, and Peter Norvig developed the theoretical foundations of artificial intelligence and substantiated its role in the education system. According to them, artificial intelligence enables the individualization of the learning process, real-time analysis of students' knowledge levels, and the formation of personalized learning pathways. This approach helps take into account students' individual characteristics when studying topics such as progressions. [1]

M.Xashimxodjayeva and M. Rasuleva analyze the development of education in the context of digital transformation and emphasize that AI-based digital platforms increase the effectiveness of the learning process. They scientifically justify that, particularly in mathematics education, complex



concepts, including arithmetic and geometric progressions, can be explained more easily through interactive tools, visual models, and adaptive systems [2].

N. Raxmatullayeva, in her scientific works, examines issues of optimizing the educational process based on differential equations and mathematical modeling. The author emphasizes that learning progressions through AI tools by linking them to real-life processes significantly develops students' analytical thinking, logical reasoning, and problem-solving skills [3].

A.B. Suyarov and O.N. Yo'ldoshoval study the process of implementing modern pedagogical technologies and broadly highlight the role of artificial intelligence, AR/VR, and digital resources in education. According to them, teaching progressions with the help of AI allows for deeper understanding of the topic through visualization, simulation, and interactive exercises [4].

O. Mamarajabov and X. Asatullayeva analyze the principles of digital transformation and reveal the organizational, technological, and pedagogical aspects of introducing artificial intelligence into the education system. Their research shows that online platforms, adaptive tests, and automated assessment systems used in teaching progressions contribute to accurate evaluation and development of students' knowledge [5].

M. Ahadova pays special attention to the development of teachers' digital competencies. The author substantiates the need to improve teachers' professional training for the effective use of artificial intelligence tools. In particular, it is emphasized that teachers can implement an individualized approach in teaching progressions using AI [6].

S. Xolbekova analyzes the integration of mathematics education and digital competencies in the context of an innovative economy. She scientifically demonstrates that teaching progressions using artificial intelligence contributes not only to mathematical literacy but also to the development of independent learning, critical thinking, and skills in working with digital technologies [7].

Main Part.

Advantages of Teaching Progressions Using Artificial Intelligence.

Today, the role of artificial intelligence technologies in the educational process is steadily increasing. With the help of specialized software tools and interactive platforms, students have the opportunity to learn mathematics, including the topic of progressions, much more effectively. Artificial intelligence is becoming an important tool in individualizing the learning process, identifying errors, increasing motivation, and ensuring a deep understanding of the subject by students. One of the most important advantages of artificial intelligence is its ability to provide a personalized approach. Each student has a different level of



knowledge, pace of understanding, and reaction to difficulties. In traditional classroom methods, it may be difficult to fully account for these differences. However, AI-based learning platforms make it possible to assess a student's knowledge and generate tasks tailored to their needs. For example, if a student quickly understands arithmetic progressions, they are given more complex problems; if difficulties arise, the platform provides additional explanations and visualizations. This approach helps students not only memorize knowledge but also understand it more deeply. In addition, artificial intelligence enables rapid analysis and error detection. The program immediately checks the problems solved by the student and points out mistakes. This process not only helps students understand and correct their errors but also prevents them from repeating the same mistakes in future tasks. As a result, students actively participate in their own learning process and strengthen their knowledge. The interactivity of artificial intelligence also increases students' motivation. Through software tools, progressions can be explained using graphs, diagrams, or animations. In this way, the topic becomes visually engaging, interesting, and easier to understand. This stimulates students' interest in working with the topic and increases their overall interest in mathematics.

Furthermore, artificial intelligence allows for providing students with an unlimited number of exercises and examples. This enables learners to study the topic comprehensively and solve problems of varying levels of difficulty. At the same time, it creates opportunities for instructors to effectively plan the educational process. Software tools provide statistical data on students' activity, performance levels, and errors, which helps instructors identify learners' needs and adapt the teaching process accordingly.

Another advantage of artificial intelligence - supporting a student's individual pace of development. Each learner studies at their own speed and rhythm, and artificial intelligence takes this rhythm into account. This approach not only strengthens the student's knowledge but also increases their self-confidence. In this way, students engage with mathematics without fear and work actively and independently. In general, teaching progressions with the help of artificial intelligence makes the educational process more effective, interactive, and personalized. This technology helps students understand the topic more quickly and deeply, while enabling teachers to improve the quality of instruction. At the same time, this approach creates a learning experience that is not only effective but also engaging and motivating for the future. Personalized education is one of the most effective directions of AI-assisted learning. Each student has different abilities, levels of knowledge, and learning speeds. AI analyzes



students' test results, the quality of completed tasks, classroom participation, the frequency of repeated mistakes, and other parameters. Based on this analysis, an individual learning pathway is developed for each student. For example, if a student quickly understands arithmetic progressions but struggles with geometric progressions, AI provides exercises and additional examples specifically in that area. In this way, the student learns at their own pace and knowledge gaps are reduced.

AI also provides materials tailored to students' interests. For example, if a student is interested in biology, mathematical problems can be explained through biological examples. This increases students' motivation and makes the learning process more engaging and meaningful. AI provides real-time feedback: as soon as a student makes a mistake, the system explains the cause of the error and shows how to correct it. This helps develop the student's independent working and self-learning skills. AI also plays an important role in assessing and analyzing the quality of education. It analyzes students' test results, homework, classroom participation, the speed of task completion, and their errors, identifies weaknesses, and provides pedagogical recommendations. At the same time, AI ensures fairness in the assessment process, as results are based solely on student performance, eliminating subjective human factors. This is especially important when analyzing overall results across large classes or schools. In general, artificial intelligence personalizes the learning process, makes it continuous and interactive, simplifies the pedagogical process, and improves the quality of education. In this way, AI helps fully unlock each student's potential, increase motivation, and maximize the effectiveness of learning.

Teaching progressions with the help of artificial intelligence is becoming an important part of modern education systems. This approach increases the effectiveness of teaching mathematical concepts, particularly arithmetic and geometric progressions. Through AI technologies, students' knowledge levels are assessed, appropriate learning materials are selected, and the learning process is organized in a more interactive and engaging way.



Figure 1. A lesson based on artificial intelligence

Individual approach and adaptive teaching Artificial intelligence analyzes students' knowledge level, mistakes, and learning speed, and creates an individual learning path for each student. For example, if a student has difficulty finding the common difference (d) in an arithmetic progression, they are given additional exercises specifically on that topic. Students who have a better understanding are given more complex problems to work on. This helps not all students develop at the same uniform level, but allows each of them to achieve maximum results based on their own abilities.

Deep explanation of formulas. In traditional teaching, there is often an emphasis on memorizing formulas. Artificial intelligence, however, explains the origin of formulas step by step. For example, it provides a detailed explanation of how the general term formula of an arithmetic progression is derived and what each added value represents. As a result, the learner understands the essence of the formula instead of simply memorizing it.

Visual and interactive learning opportunities. With the help of artificial intelligence-based tools, progressions are presented through graphs and animations. An arithmetic progression is shown as a straight line, while a geometric progression is represented as a rapidly increasing curve. Such a visual approach helps learners understand the topic more quickly and easily, as they not only see the sequence of numbers but also observe the process of their change.



Figure 2. Interactive learning

Instant feedback. Artificial intelligence immediately checks every task completed by the learner. If an error occurs, the system identifies it, explains the reason, and shows the correct solution. This allows the learner to quickly work on mistakes and avoid repeating them. As a result, knowledge becomes stronger and more accurate..

Comprehensive exercise database. Artificial intelligence is capable of generating an unlimited number of problems at different difficulty levels. This helps students practice more, strengthen their knowledge, and gain experience in working with various types of problems. Continuous practice is an important factor in developing mathematical skills.

Connection to real life. Progressions are explained through real-life examples with the help of artificial intelligence. For example, a geometric progression is related to bank interest or investment growth, while an arithmetic progression is connected to the regular increase in income or expenses. This helps students develop the ability to apply mathematical knowledge in practice.

Analytical support for teachers. Artificial intelligence analyzes students' results and identifies which topics are difficult to master. This information enables teachers to organize the learning process more effectively, focus more on problematic areas, and improve their teaching methods.

Opportunities for independent learning. Artificial intelligence-based systems allow students to learn at any time. They can independently complete exercises, check their knowledge, and review topics they do not understand. This helps students develop skills in independent work and self-improvement.

Increasing motivation. Artificial intelligence enhances students' interest by incorporating game elements into the learning process. Points, levels, and reward systems encourage students to be more active. As a result, they learn mathematics with greater interest.

Relevance. In the 21st century, technologies are becoming an inseparable part of human life. In particular, in recent years, artificial intelligence (AI) technologies have been deeply influencing not only our work and daily activities but also the processes of education and learning. With the help of AI, students are gaining the opportunity to master complex topics, study through an individualized approach, and develop independent thinking skills.

Understanding the history of artificial intelligence is important for grasping its relevance. The term was introduced by John McCarthy in 1955, and in 1956 the Dartmouth Research Conference opened new scientific directions in AI. During this period, technologies such as machine learning, deep learning, and predictive analytics emerged. This, in turn, stimulated the development of a new scientific field—data science. In the 1990s, a new stage in the development of artificial intelligence began, and in 1997 IBM's Deep Blue computer defeated world chess champion Garry Kasparov. This event demonstrated that AI algorithms are capable of successfully solving complex strategic tasks. Thus, artificial intelligence, by imitating human cognitive processes, created opportunities to solve complex problems in a fast computational environment.



Figure 3. Individual approach to lessons



Simply put, artificial intelligence is a technology that enables computers to think, analyze, and find solutions like humans. Today, it is fundamentally changing not only our daily lives but also the education process. For example, in topics such as progressions, algebra, and other subjects, AI makes it possible to determine students' level of knowledge, offer personalized exercises, and individualize the learning process. At the same time, AI also provides teachers with the ability to effectively manage the educational process, monitor students in real time, and assess their performance. This makes education more fair, continuous, and motivating.

Overall, the relevance of artificial intelligence is reflected in its scientific, pedagogical, and practical significance. It is an innovative direction in 21st-century education and a key tool for fully developing students' potential and effectively organizing the learning process.

Methods. The article examines the use of artificial intelligence in the educational process based on various scientific research methods and principles. The study adopts the principles of historical analysis, scientificity, objectivity, and consistency as its main approaches. At the same time, the integration of AI technologies into practical pedagogical processes is also considered in detail.

Currently, changes and innovations in the field of education, particularly the role of artificial intelligence, are explored through scientific analysis and examples. As a method, interactive and adaptive teaching approaches are used to identify students' individual needs, assess them, and adapt the learning process accordingly.

AI technologies deeply analyze students' level of knowledge and offer customized learning materials, tests, and exercises. For example, in mathematics, if a student has difficulty solving complex problems, the system provides step-by-step explanations or supports them with simpler tasks. In this way, it is possible to create individual lesson plans and maximize the student's learning pace and abilities.

With the help of artificial intelligence, solving interactive tests and exercises is also simplified. The AI system dynamically adapts questions based on the student's answers: if the student answers correctly, the next question becomes more difficult; if the answer is incorrect, the system provides an explanation and simplifies the question. This method allows real-time assessment of the student's knowledge level and rapid analysis of mistakes.

AI-based interactive textbooks and video materials are also an important part of the methodology. Through these tools, when students pause a lesson or ask a question, they receive real-time explanations. In continuously relevant



Academia Review-A Multidisciplinary Online Journal

ISSN (Online): 3070-6726

Website: <https://academia.org>

Volume 2, Issue 5, May, 2026



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fields such as language learning, chatbots and virtual teachers provide assistance. A virtual teacher conducts lessons remotely via the internet, answers students' questions, and guides them to apply knowledge in practice.

Creating interactive dialogues using AI is also one of the main directions of this method. By communicating with virtual teachers, students master topics more effectively, absorb cognitive material, and receive individualized learning plans. At the same time, AI ensures maximum accuracy in testing and assessment. The system automatically analyzes students' answers, provides explanations for incorrect responses, and rewards correct ones. Tests and exercises are generated according to the individual level of each student.

As a result, AI technologies not only improve students' knowledge but also make the learning process more individualized and effective, reduce financial costs, and develop students' independent learning skills. These methods play an important role in making education more interactive, engaging, and result-oriented.

The article is based on the principles of historical, scientific, objective, and unbiased analysis. During the research process, the role of integrating artificial intelligence and robotics into the education system was studied. Through these methods, the effectiveness of automating the learning process, supporting students' individual development, and implementing interactive approaches was analyzed.

AI-based methods are applied in the educational process in the following areas:

Personalized teaching and adaptive learning systems; Interactive learning materials and video lessons; Automation of testing and assessment; Distance learning through virtual teachers and chatbots.



Figure 4. The learning process through interactive educational materials

Methods and discussion. The methods used in the article are based on the principles of historical, scientific, objective, and unbiased analysis. During the research process, the integration of modern technologies in education—particularly artificial intelligence and robotics—was studied. This approach demonstrates its effectiveness in automating the learning process, supporting students' individual development, and implementing interactive teaching methods.

One of the current changes in the field of education is *the development of personalized learning with the help of artificial intelligence*. This technology creates a learning process tailored to students' abilities, level of knowledge, and interests.

Practical application of methods through examples

1. Adaptive learning systems. For example, the Khan Academy platform uses AI to analyze students' level of knowledge and provide them with customized exercises. If a student has difficulty with complex algebra problems, the system first offers easier tasks and then gradually more difficult ones. In this way, the student learns at their own pace and strengthens their understanding of the subject.

2. Virtual teachers and chatbots. In language learning, AI-based chatbots and virtual teachers, such as Duolingo, identify which words or grammar rules users have not sufficiently mastered and provide appropriate exercises. At the same time, interactive dialogues help develop students' communication skills.



3. Interactive video lessons. With the help of AI, video lessons can be tailored to students' questions. During the video, when a student presses the pause button, the system automatically provides explanations or clarifies the topic with additional examples. This method is used in many online course platforms and makes the learning process more engaging.

4. Automated testing and assessment. AI systems analyze students' test answers in real time and explain mistakes. For example, if a student makes an error while solving an equation in mathematics, they immediately see the mistake and receive step-by-step correct solutions. The next questions are adapted to the student's level, which allows for individual and accurate assessment of knowledge.

5. Integration of STEM and robotics. In some schools, students conduct physics and mechanical experiments using AI-integrated robots. For example, with LEGO Mindstorms robotics kits, students learn to program robots using AI and solve problems. This approach strengthens their practical skills and fosters an interest in technology.

6. Monitoring individual progress. AI systems continuously track a student's learning dynamics, identify the topics they are struggling with, and provide recommendations to the teacher. For example, in a class of 30 students, a teacher can use AI to quickly see each student's strengths and weaknesses at a glance, allowing the lesson to be effectively adapted to an individualized approach.

Conclusion. These examples show that with the help of AI, the educational process becomes not only more interactive and engaging, but also more individualized, adaptive, and continuously improving for students. At the same time, it eases the teacher's pedagogical workload, saves time, and contributes to improving the quality of education.

Quizzes to reinforce the topic

Test 1 (Complex arithmetic construction)

There are cards numbered from 1 to 60 on the table. A new sequence is formed as follows: First, the largest 3 numbers are taken and placed at the beginning of the new row. Then, from the remaining cards, the smallest 2 are taken and placed at the end of the row. This process continues until all the cards are used. In the resulting sequence, which two numbers end up next to each other?

A) 58 and 2 B) 57 and 3 C) 56 and 5 D) 55 and 4 E) 54 and 6

Test 2 (Shapes and logical relationships)



Sevara drew a 3×3 grid consisting of 9 cells. Each cell contains one of three shapes: \blacktriangle (triangle), \bigcirc (circle), \blacksquare (square).

Conditions:

In each row, all shapes must be different (no repetition).

In each column, all shapes must also be different.

Along the diagonal, there must be only one type of shape.

Which shape should be placed in the center cell?

- A) \blacktriangle B) \bigcirc C) \blacksquare D) \blacktriangle or \bigcirc E) Cannot be determined

Test 3 (Geometric growth model)

An artificial intelligence system modeled climbing a structure: Each step is 2 cm higher than the previous one. The first step is 10 cm. There are 12 steps. Only 8 are shown in the diagram. Find the total height of the steps that are not shown.

- A) 168 cm B) 176 cm C) 184 cm D) 192 cm E) 200 cm

Test 4 (Mixed progressions)

Two progressions are given: Arithmetical: 7, 11, 15, ... Geometrical: 3, 6, 12, ... At which term can they be equal?

- A) never B) at the 2nd term C) at the 3rd term D) at the 4th term E) at the 5th term

Test 5 (Inverse reasoning)

In a geometric progression:

$$a_4 = 16$$

$$a_6 = 64$$

Find a_1 .

- A) 1 B) 2 C) 4 D) 8 E) 16

Test 6 (Complex sum)

In an arithmetic progression:

$$S_n = 4n^2 + n$$

Find a_n .

- A) $8n - 3$ B) $8n - 1$ C) $8n + 1$ D) $4n + 1$ E) $8n - 5$

Test 7 (Combined logic)

A student used AI to generate the following sequence: 2, 5, 10, 17, 26, ...

Find the pattern and determine the next term.

- A) 35 B) 36 C) 37 D) 38 E) 39

Test 8 (Complex arrangement)

Numbers from 1 to 40 are arranged in a circle. Every 3rd number is eliminated.

Find the last remaining number.

- A) 19 B) 22 C) 25 D) 28 E) 31



Test 9 (Model and analysis)

An artificial intelligence system evaluated a student's knowledge level as follows: Each day it increases by 10% Day 1: 50 units What will it reach on day 7?

A) 88 B) 89 C) 90 D) 97 E) 100

Test 10 (Advanced level – combination + progression)

In an arithmetic progression: $a_1 = 3$, $d = 2$ In a geometric progression: $b_1 = 1$, $q = 3$ For which value of n does $a_n = b_n$ hold?

A) $n = 2$ B) $n = 3$ C) $n = 4$ D) $n = 5$ E) never

Conclusion. Artificial intelligence is bringing a fundamental revolution to education, taking the learning process to a completely new level in terms of quality. AI technologies ease teachers' workload by enabling test automation, as well as personalized and interactive lesson delivery. Students, in turn, learn at their own pace using materials adapted to their interests quality, identifying students' weak areas and offering tailored recommendations. Through virtual teachers, chatbots, and adaptive learning systems, the educational process becomes more interactive, engaging, and effective. As a result, artificial intelligence not only modernizes education but also helps solve key challenges by improving students' knowledge levels, optimizing teachers' methodological work, and integrating the education system with modern technologies. AI is increasingly strengthening its role as the future of education.

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