

Artificial Intelligence (AI): A Modern Concept for Mathematics Education

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ABSTRACT

Technology is crucial for modern education. Technology developing in recent times, which affects all areas of life, including education. Artificial intelligence (AI) could help learners understand the lessons and topics they find difficult and it may also serve as a powerful tool for teachers not only to support the education process but to cultivate critical thinking and problem-solving skills in their students. Artificial Intelligence (AI) driven tools can respond to students thinking interest in ways that previous tools could not. By utilizing extensive language databases, AI has the capability to adapt applications to address the specific problems that students have encountered, even if they have made mistakes in their responses. Students will still require teachers' mathematical, pedagogical, and relational skills, but teachers can also benefit from I-driven tools. Through this study, the researcher addresses the concept of Artificial intelligence, the impact of AI on Mathematics, AI mathematics tools, Key benefits of AI tools for mathematics and the benefits of AI.

Keywords: Artificial Intelligence, AI tools, Mathematics, Mathematics Education

Education is a light, that shows mankind the right direction to surge. The purpose of education is not just to make a student literate but to add rational thinking, knowledge, and self-sufficiency. Education is today's need for the progress of a human being as well as a significant factor in the success of the nation. Without education human life is incomplete. Technology is crucial for modern education. Technology developing in recent times, which affects all areas of life, including education. Artificial intelligence (AI) could help learners understand the lessons and topics they find difficult and it may also serve as a powerful tool for teachers not only to support the education process but to cultivate critical thinking and problem-solving skills in their students. One of the most important school subjects is Mathematics as it has applications in various fields such as natural science, economics, social sciences, medicine, computing, banking, and many others.

Technological advances, especially AI systems, give an opportunity to enhance the understanding of mathematics by diagnosing difficulties in learning and providing personalized support. Such systems could also increase interest in mathematics through gamification and more impressive visualization, especially in functional analysis and geometry. Teachers and students could use numerous means to support mathematics learning from information sources on the Internet (e-textbooks, reference books, blogs, forums, presentations). AI is transforming mathematics, offering tools for solving problems, enhancing teaching, and potentially revolutionizing research by automating tasks and generating new insights through algorithms and machine learning. AI methods leverage mathematics, especially

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statistics. Integrating Artificial Intelligence (AI) into mathematics education offers promising advancement and potential pitfalls. Through this study, the researcher addresses the concept of Artificial intelligence, the impact of AI on Mathematics, AI mathematics tools, Key benefits of AI tools for mathematics and the benefits of AI.

Artificial intelligence

Artificial intelligence is not an unfamiliar concept. In fact, already in 1943, Mcculloch and Pitts started to develop algorithmic approaches to learning by mimicking the functionality of the human brain, through artificial neurons which are connected and arranged in several layers to form artificial neural networks. By that point, they had already formed a clear vision for the integration of artificial intelligence into their operations. The community did not fully grasp the potential of neural networks. Consequently, this wave of artificial intelligence was not successful and disappeared. In the early 1980s, machine learning experienced a resurgence in popularity, leading to notable advancements and achievements during that time. The significant breakthrough and subsequent wave of artificial intelligence emerged around 2010, thanks to the extensive utilization of deep neural networks. In this article, we will primarily discuss this particular model, which is widely regarded as the backbone of artificial intelligence. The structure of deep neural networks is precisely the structure Mcculloch and Pitts introduced, which consists of numerous consecutive layers of artificial neurons. Today two main obstacles from previous years have also been eliminated, due to the drastic improvement of computing power the training of neural networks with hundreds of layers in the sense of deep neural networks is feasible, and we are living in the age of data, hence vast amounts of training data are easily available.

Artificial Intelligence has always been a term that intrigues people all over the world. Artificial Intelligence (AI) refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem-solving, and decision-making; it is inspired by the ways people use their brains to perceive, learn, reason, and decide actions.

AI refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning,

problem-solving solving and decision-making. Initially conceived as a technology that could mimic human intelligence, AI has evolved in ways that far exceed its original conception. With incredible advances made in data collection, processing, and computation power, intelligent systems can now be deployed to take over a variety of tasks, enable connectivity, and enhance productivity.

AI can enhance efficiency, personalization, and provide teachers with additional time to utilize their unique understanding and adaptability, which are characteristics that machines find challenging. By combining the strengths of artificial intelligence machines and teachers, the education system can be propelled towards achieving the best outcomes for students. Given that the students of today will be working in a future where artificial intelligence is no longer a concept but a reality, it is crucial that our educational institutions provide them with exposure to current technologies and their practical applications. It is undeniable that artificial intelligence (AI) capabilities would assist teachers in attaining the desired learning outcomes.

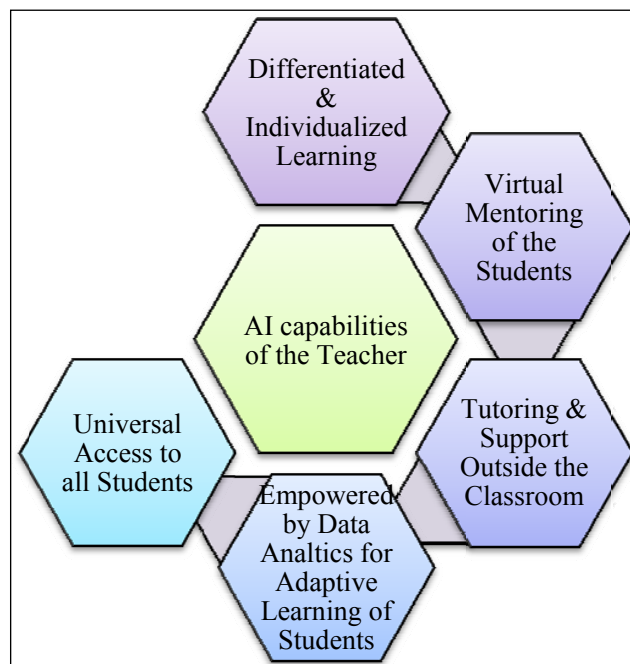


Fig. 1

Artificial Intelligence (AI) driven tools can respond to students thinking interest in ways that previous tools could not. By utilizing extensive language databases, AI has the capability to adapt applications to address the specific problems that students have

encountered, even if they have made mistakes in their responses. Students will still require teachers' mathematical, pedagogical, and relational skills, but teachers can also benefit from I-driven tools. In certain instances, AI may act as a teaching assistant, but students will require teachers to assist them in establishing a connection between their existing knowledge, new knowledge, and shared knowledge. Educators should caution students to approach Artificial Intelligence (AI) results with skepticism, particularly when considering the specific difficulties associated with utilizing tools that may have been trained on datasets. The future we have seen in science fiction movies is here. From virtual reality to functional gadgets, AI has invaded our lives in ways that no one has seen or expected before. Here's a more detailed breakdown of how AI utilizes mathematical methods.

Core Mathematical Foundations

1. **Linear Algebra:** Fundamental for representing and manipulating data, including vectors and matrices, which are crucial for tasks like image recognition and machine learning model training.
2. **Calculus:** Essential for optimizing AI models and algorithms, particularly in training machine learning models using techniques like gradient descent.
3. **Optimization:** Enable for optimizing AI models and algorithms, particularly in training machine learning models using techniques like gradient descent.
4. **Probability and Statistics:** Provide a framework for modelling relationships and connections, making it indispensable in AI for tasks like social network analysis and recommendations system.
5. **Graph Theory:** Provides a framework for modelling relationships and connections, making it indispensable in AI for tasks like social network analysis and recommendation systems.
6. **Numerical Analysis:** Used for the optimization of algorithms and the development of numerical methods to solve complex problem in AI.

Impact of AI on Mathematics

The emergence of artificial intelligence also had a substantial influence on numerous branches of mathematics. Maybe the first area that embraced these novel methods was the area of inverse problems, in particular, imaging science where such approaches have been used to solve highly ill-posed problems such as de-noising, in-painting, super-resolution, or (limited-angle) computed tomography, to name a few. It is worth mentioning that since there is no exact mathematical model of what an image represents, this field is highly conducive to learning methods. Consequently, after a few years, a shift in perspective could be noticed, and new solvers are often at least partially derived from methods in artificial intelligence. We will elaborate more on the topic in the following section. The field of partial differential equations was slower to adopt these new techniques, as it was not immediately clear how methods from artificial intelligence could benefit this area. In fact, there appears to be no necessity to employ learning-type methods, as a partial differential equation is a highly rigorous mathematical model. However, recently, it was discovered that deep neural networks can overcome the curse of dimensionality in high-dimensional settings, which caused a shift in the approach to this problem. Since around 2017, research at the intersection of numerical analysis of partial differential equations and artificial intelligence has been progressing rapidly.

AI as a Math Tool

Problem Solving: AI powered tools like Julius AI and Wolfram Alpha can solve complex mathematical problems, providing step by step solutions and visualizations.

Personalized Learning: AI can personalize math education by generating tailored problems and explanations for different learning levels and interest.

Teaching Assistance: AI can assist teachers in creating engaging and relevant math problems and providing feedback to students.

Automated Research: AI can automate certain research tasks, potentially accelerating mathematical discovery.

Key Benefits

- ❑ **AI enhances math accuracy and learning efficiency:** AI-powered tools provide exact solutions, step-by-step explanations, and real-time feedback, reducing anxiety and improving problem-solving skills for students and professionals.
- ❑ **AI personalizes math education and makes learning more engaging:** Through adaptive learning, gamification, and interactive experiences, AI tailor's instruction to individual needs, keeping students motivated and improving comprehension.
- ❑ **AI improves accessibility and mathematical inclusion:** AI simplifies complex concepts, supports students with learning difficulties like dyscalculia, and provides instant access to information, making advanced math more approachable for all.

Type of AI in Mathematics

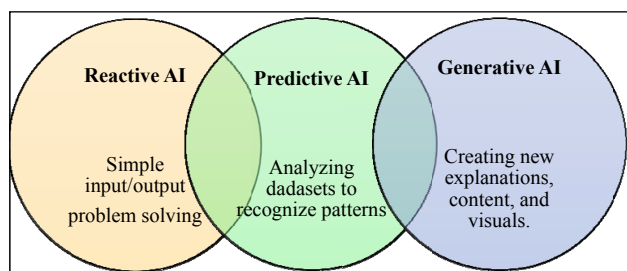


Fig. 2

AI Tools for mathematics

Mathematics has always been a subject that either captivates or terrifies students. However, in the modern era, artificial intelligence has emerged as a transformative force, reshaping our approach to learning and comprehending mathematics. For students struggling with math concepts or aiming to enhance their abilities, artificial intelligence tools have become invaluable companions. There are some innovative AI tools that are revolutionizing math education, making it more accessible, interactive, and enjoyable.

1. Wolfram Alpha: Wolfram alpha, a powerful computational engine, is renowned for its ability to solve complex mathematical problems and offer comprehensive explanations. Its ability to accommodate various mathematical disciplines

makes it an indispensable tool for students aiming to enhance their understanding and problem-solving skills or abilities.

2. Julius AI: Julius stands out among other educational AI tools due to its advanced AI math-solving engine, which is considered the most powerful in the field. With its features like scan-and-solve, step-by-step answer generation, and chat explanations, Julius AI is not just a tool but a trusted companion on the path to math mastery. Whether for academic assistance or gaining a deep understanding of intricate mathematical concepts, Julius is the ultimate AI math tutor.

3. Socratic: Empowered by Google's artificial intelligence, socratic serves as a versatile homework assistant. By capturing an image of a math problem, students gain access to comprehensive explanations, detailed guides, and valuable resources. Socratic's thorough method guarantees that students not only complete their assignments but also develop a deep understanding of the underlying principles.

4. Photomath: Photomath serves as a guiding light for students who find themselves grappling with mathematical concepts. This cutting-edge mobile app, equipped with advanced artificial intelligence, enables users to scan printed or handwritten math problems and obtain immediate, detailed solutions. Photomath encompasses a wide range of mathematical concepts, from basic arithmetic to advanced calculus, simplifying complex problems and promoting a comprehensive understanding and proficiency in math.

5. Maple Calculator: Maple algebra calculator, a free tool developed by Maplesoft, is specifically designed to efficiently solve intricate mathematical equations. Its strength lies in its comprehensive features, such as advanced function solving, graphing tools, and educational games, which make math learning both effective and engaging.

6. CameraMath: Cameramath, a comprehensive AI app, provides solutions, tutoring, and a vast array of math resources. Its distinctive features, such as personalized tutoring and a math solver, offer tailored assistance and detailed solutions, addressing students' varying requirements in calculus, algebra, and other subjects.

7. Mathway: Provided by chegg, mathway is an online tutor that assists with various math problems,

ranging from simple algebra to complex calculus. By entering or scanning problems, students gain access to detailed step-by-step explanations, which in turn improves their comprehension and empowers them to solve similar questions on their own.

8. MyScript: Myscript converts handwritten text into digital format and instantly solves mathematical equations. Its integration with note-taking apps enhances the learning experience, enabling students to delve into intricate problems with ease and accuracy.

9. Microsoft Math Solver: Microsoft's introduction of advanced artificial intelligence tools for calculus provides a comprehensive solution for tackling a wide range of mathematical problems. Thanks to its user-friendly interface, students can easily input or scan problems to obtain detailed solutions and explanations, enhancing the learning experience and promoting active engagement.

10. Symbolab: Symbolab is a formidable tool for tackling and comprehending math problems in various academic disciplines. Its wide array of calculators and problem-solving tools equips students with the necessary resources to solve equations, analyze graphs, and enhance their mathematical skills, fostering confidence and expertise in the subject.

Benefit of AI in Maths

1. Accurate Answer: That anxiety is likely born from math being both a complex subject and one that requires a great deal of accuracy to get right. AI guarantees accuracy as long as you input the correct equation to alleviate the anxiety that many individuals experience when performing mathematical calculations.

2. Step by Step Solution: One of the significant advantages of AI for mathematics is that combining the various forms of AI enables your tool to provide a detailed explanation of how it arrived at a solution. Predictive AI offers the solution directly, while generative AI can provide explanations based on the vast amount of information that the language model behind the AI has been trained on.

3. More engaging and Fun: Some light-heartedness might be necessary in mathematics education, and artificial intelligence can make the learning process more enjoyable through gamification. AI can be

utilized to develop math games where students solve equations to earn rewards, such as digital medals or in-game currency that can be used to purchase virtual items.

4. Personalized Learning: Predictive AI can play a crucial role in creating tailored learning experiences for students. This type of artificial intelligence can 'predict' a student's current knowledge level and preferred learning style, enabling it to create a customized curriculum that tailors math education to the student's individual requirements. This leads us to another one of the key benefits of AI for math, it creates a personalized learning experience that is not possible in a traditional classroom setting. The teacher needs to prepare the students collectively for their upcoming math exams.

5. Better Accessibility: AI simplifies math concepts for better understanding. Students are not required to buy textbooks or waste time searching the internet to find the solutions to their inquiries. AI has essentially done all of that for them by incorporating the information provided to it during the training process of large language models by engineers. AI enables instant access to data. It's perfect for those working in time-sensitive contexts.

Conclusion: According to the above information the researcher concluded that the integration of AI into math education has expanded the possibilities for personalized, interactive, and impactful learning experiences. AI successfully improves mathematics education and equips students with the essential skills needed for the future. AI has the potential to transform mathematics education, providing customized learning experiences, adaptive assessments, and interactive environments. These AI tools empower students to overcome math difficulties with self-assurance. AI math tool provides students with personalized learning experiences, immediate feedback, and increased engagement, resulting in a deeper understanding and greater confidence in mathematics. They also offer assistance and resources for students who find math challenging. As technology advances, the future of math education appears promising, envisioning a world where every student can thrive in mathematics with the assistance of artificial intelligence. Mathematics has been essential to the advancement of artificial intelligence since its inception, with mathematicians

playing a vital role in shaping the field. There has been substantial advancement in fields like linear algebra, optimization theory, and deep learning. The combination of mathematics and artificial intelligence opens up fresh avenues for scientific investigation and enables practical applications in healthcare, finance, robotics, and various other domains. The combination of mathematics and artificial intelligence has the potential to transform multiple industries, improve our quality of life, and drive ground-breaking innovations.

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