Artificial Intelligence: Potential Benefit of Mathematics Teaching and Learning

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Abstract: Artificial Intelligence is one of the big advancements in technology in the present era. Artificial intelligence (AI) applications in education are becoming more popular and have gotten a lot of press in recent years. One of the leading writers Matthew Lynch writes that "the use of AI in education is valuable in some ways, ….." [1] in our educational system. The purpose of this paper is to discuss the relationship between artificial intelligence and education. Also, stimulates discussion on the potential benefits of A.I. in the field of the mathematics teaching-learning process.

Keywords: Artificial Intelligence, Mathematics teaching-learning process

Introduction:

AI is a process that produces human intelligence through machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition, and machine vision. John McCarthy (2004), defines Artificial Intelligence as, "It is the Science and engineering of making intelligent machines, especially intelligent computer programs. It is related to similar tasks of using computers to understand human intelligence, but AI does not confine itself to methods that are biologically observable." [2]. The application of artificial intelligence drastically changes the fields where it is used. It is being successfully applied in the teaching-learning process so that learners, as well as teachers, perform. AI would be used as the source and cause of improvement in classroom teaching methodology. AI is very useful and effective for developing accessible knowledge, allowing autonomy for students, and assisting. Balacheff (1993) explored that AI has great contributions to the subject of Mathematics such as direct manipulation of abstract objects, personalized explanations, and intelligent microbots that allow exploratory learning [4].

Carl Friedrich Gauss referred to mathematics as the queen of science but unfortunately, students fear this queen, although the subject is very essential to the growth of many other disciplines. So, mathematics plays an important role in the educational system. However, the traditional method of teaching does not encourage and stimulate the students' reflection (Teo & Wong,2000) [5].

Background study of AI and Mathematics Education:

AI enables students to develop and enhance mathematical skills and cognitive skills in learning. The first significant A.I. has some specifications with respect to Mathematics Education is LOGO projects (1973) [6]. It helps students make mathematics more concrete. Students can develop their mathematical reasoning ability. Kimball (1973) [7] is a methodology that focuses on a bottom-up approach, emphasizing the value of the data warehouse to the user as quickly as possible. PIXIE (Sleeman 1982) [8], an intelligent tutorial system, has three separate phases: model generation, tutoring, and analysis. In this system, students are able to practice solving mathematical problems through several tests and analyze their mistakes by themselves. Geometry Tutor (Anderson et al. 1985) [9] is a prototypical example of an intelligent tutoring system. It guides students in constructing a mathematical proof to solve a problem in geometry, providing immediate feedback, clear hints, and help when the learner fails or gets lost. APLUSIX (Nicaud 1992) [10] is an interactive classical software tool for learning school algebra. It also provides appropriate feedback and interactivity. There are many programmes used for mathematics education: Thinkster Math (online mathematics tutor), Jill Watson (Teaching Assistant), Brainly (Social media Site for Classroom questions), Nuance (speech recognition software that transcribes words into text) , Cognil (virtual learning assistant as well as corporate training) , Kidsense (voice to text tool), content technology (content application solutions).

Potential Benefits of AI in Education

There are many benefits of AI in the field of Education. Both students and teachers are helpful to use it in their teaching-learning process. AI helps teachers as well as students with their individual learning. Proper tutoring is made using it. AI can also help the grading system by following the answer key which is set by the educators. The feedback on the course quality can be measured using AI. The students can feel comfortable making mistakes with AI, as it is necessary for learning and receiving the meaningful and immediate feedback they need for improvement. AI reduces the time spent by teachers on tedious tasks. AI also helps teachers with their different administrative tasks: maintaining students' records, preparing their evaluation report cards, etc. AI may also be used for different managerial tasks of the school management like student records systems, transportation, IT, maintenance, scheduling, budgeting, etc. higher education may also be benefited from the use of AI in different fields: plagiarism detection, examination system, student enrolment, and retention, teaching-learning system, transcription of faculty lectures, analyzing students' performances, Research work, collaborating teaching.

Comprehensive Approach to AI in Mathematics Education

Technology plays an important role in the mathematics teaching-learning process. A single unified theory of learning mathematics is almost impossible because learning is such a complex conjectural process. The essence of understanding a mathematical concept is to have a mental representation that can reflect the structure of the concept. A learner needs to solve mathematical problems independently once he/she understands certain concepts, theorems, rules, and problem-solving skills. AI enables students to develop and enhance more mathematical skills and cognitive skills in learning.
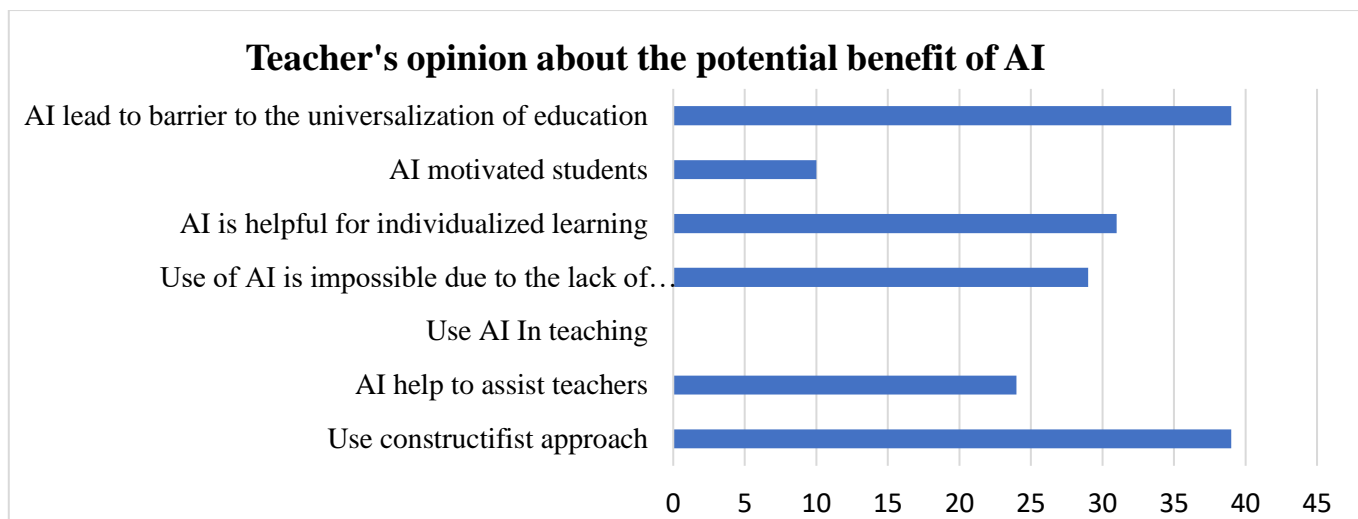
- AI-assisted mathematics teaching: Effective strategies for Mathematics teaching have changed in the present day. In the traditional system teachers only get instruction with rote procedural practice but nowadays teachers focus on exploring mathematics and discussing its ideas.
- Clear conception of abstract knowledge of mathematics through AI: The AI is able to assess the student's abilities for each topic and respectively give useful suggestions or move on to a new mathematical topic. Overall, the results of the studies encouraged the hypothesis that software can be a useful and motivating educational tool (Beal, Arroyo, Cohen, Woolf, & Beal, 2010).
- AI acts as a tutoring system: AI may be used as an intelligent tutoring system. It is designed to integrate a microworld system with an intelligent support system.
- Improve the educational process: AI can have a substantial impact on student's educational experiences by making relevant courses more accessible, boosting teacher-student communication, and allowing students more time to pursue interests outside of school.
- AI encourages Individualized Learning: AI offers an individualized learning experience for every student. This is very beneficial for the student's mathematics learning. one study by Xie et al. (2017) used the genetic algorithm to implement a personalized e-learning system to provide personalized curriculum development recommendations for students by promoting their learning performance.
- Immediate feedback: AI helps students with immediate feedback that enhances their motivation of the student toward their mathematics learning.

Study Regarding Potential Benefit of AI in Mathematics Teaching-Learning Process:

A study was done on the awareness of the impact of AI on the Mathematics Teaching- learning process. The necessary data was collected from the 39 teachers teaching mathematics at the secondary level. 39 teachers are involved in this study from 13 different schools under the West Bengal Board of Secondary Education. The Purposive sample was used to collect the data. A questionnaire was constructed for this purpose.
The study showed the following:
- ✓ All Teachers consider that rote procedural practice should not use in classroom teaching.
- ✓ They focus on exploring mathematics and discussing its ideas through a constructivist approach.
- ✓ Only 24 teachers are aware that AI may help to assist teachers effectively to explore and selecting strategies.
- ✓ No teachers use AI in their teaching-learning process.
- ✓ 29 teachers think AI in the Mathematics classroom is impossible due to infrastructural barriers.
- ✓ About 31 teachers agreed that AI is very much beneficial for individualized learning.
- ✓ 10 teachers think that motivated students improve their mathematics learning through AI without the help of the teacher in the classroom.
- ✓ All teachers agreed that AI leads to a barrier to the universalization of education.

Teacher's opinion about the potential benefit of AI

Category	Value
AI lead to barrier to the universalization of education	~39
AI motivated students	~10
AI is helpful for individualized learning	~31
Use of AI is impossible due to the lack of…	~29
Use AI In teaching	0
AI help to assist teachers	~24
Use constructifist approach	~39

(Horizontal axis: 0 5 10 15 20 25 30 35 40 45)

Conclusion:

The potential of using artificial intelligence in education to enhance learning, assist teachers and also be beneficial for school management. There is also considerable optimism around the idea that artificial intelligence becomes a more integral part of the classroom teaching-learning process. Effective individualized learning is possible with the help of AI. But this is beneficial for those students who are very much motivated towards their learning. It may increase the digitally divided world. AI may reduce the imaginative power of the student. Because when teachers use AI in education, they minimize human activity. But the use of AI is very beneficial for mathematics learning. The drill work is very much essential for mathematics learning which can be done by the use of AI very effectively. Though there continues to be widespread debate over the pros and cons of deploying AI technology in education, now it is proven that there are many exciting possibilities for AI in education.

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