Applications of Artificial Intelligence in Education

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Abstract: Education is the most crucial foundation of a building called life. Once Abraham Lincoln said," If I only had an hour to chop down a tree, I would spend first 45 minutes sharpening my axe". In this statement, the mind is the axe that becomes sharper with a good education which further makes a person successful. In earlier times, passing knowledge and skills of living life and working for the betterment of the society was taught through storytelling. From then to the present time education system has evolved a lot. Artificial intelligence is the most useful and significantly growing technology that can take the state of education to some unexpectedly delightful position by using it for data analysis. This article covers all the strategies to include this tool in the education system. The highlights of this article that will cover all the aspects are observation, prediction and challenges.

I. INTRODUCTION

We have chosen this subject to spotlight on one among the foremost technological trend of late referred to as AI (Artificial Intelligent). Artificial Intelligence is the sector of study that describe the potential of machine learning rather like humans and {also the} ability to retort to bound behaviors also called (A.I.). the requirement of AI is increasing daily. Since AI was initial introduced to the market, it's been the rationale of the fast amendment in technology and business fields. Scientist area unit predicting that by 2025, "90% of client interactions are going to be managed while not a human". This means that humans easy request can rely on computers and computing a bit like after we use Siri or Galaxy to raise concerning the weather temperature. It is important to be ready for AI revelation a bit like UAE have by putting in a state minister for AI in Dubai. The objectives of AI analysis are reasoning, information illustration, planning, learning, tongue process, realization, and talent to maneuver and manipulate objects. There are long-run goals within the general intelligence sector.

Application field of AI is extremely large. Some are mentioned below:

Artificial Intelligence in Healthcare
Artificial Intelligence in business
AI in education
AI in Autonomous vehicles
AI for robotics
Cyborg Technology

Out of assorted application, during this paper we have a tendency of highlighting the application of AI in education i.e., AI IN EDUCATION: It automates grading, giving educators longer. It may assess students and adapt to their wants, serving to them work their own pace. Below are a few of applications of AI that are serving to in shaping and shaping the tutorial expertise of this and the future.

1. Personalized Learning: -
Artificial Intelligence is being used for personalizing learning for every student. With the utilization of the hyper-personalization construct that is enabled through machine learning, the AI technology is incorporated to style a custom-made learning profile for every individual student and to tailor-make their coaching materials, taking into thought the mode of learning most well-liked by the scholar, the student's ability, and skill on a private basis. numerous AI-powered apps and systems facilitate the scholars in accessing instant and customized responses similarly as in obtaining their doubts cleared from their academics. AI is additionally enjoying a job in augmenting tutoring and coming up with personal colloquial, education assistants United Nations agency can give them aid in education or assignment tasks.

2. Voice assistants: -
Yet another AI part being profitably used by educators in

learning is voice assistants. These embrace Amazon's Alexa, Apple Siri, Microsoft Cortana, etc.

3. Aiding educators in administrative tasks: -
Since half of the time of the educators is endowed in non-educational activities, AI systems are a vital aid at handling back-office and task-related duties like grading tasks similarly as facilitating personalized responses for college students. Aboard they will conjointly upset the routine and monotonous work, matters associated with provision similarly as personnel problems.

4. Breaking barriers: -
Artificial intelligence tools and devices are aiding in creating world school rooms accessible to any or all no matter their language or disabilities. These programs are wide.

II.   AI FOR INSTRUCTIONAL APPLICATIONS

AI initially took the shape of computer and computer related technologies, transforming to web-based and online intelligent education systems, and ultimately with the utilization of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructors' duties and functions severally or with instructors. With the help of these platforms, instructors have been able to perform completely different administrative functions, like reviewing and grading students' assignments more effectively and expeditiously and succeed higher quality in their teaching activities.

The introduction, advancements, and proliferation of technology, specially, artificial intelligence, has created it easier for instructors to perform their duties more effectively and efficiently. These technological evolutions have also affected other sectors of the academia, fostering effectiveness and efficiency.
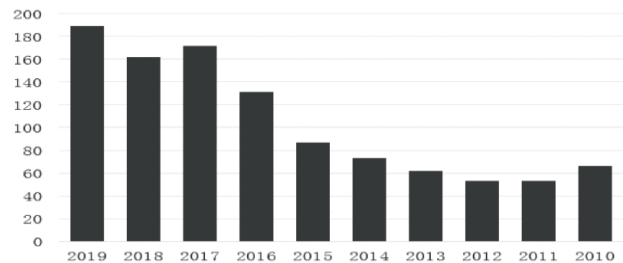

FIGURE 1.
Papers in Web of Science and Google Scholar in the last ten year with key words "AI" and "Education".

One of the key areas wherever AI systems have created an excellent impact, is teaching or instructions. AI has facilitated the creation and deployment of systems that are evidently very powerful pedagogical tools. These tools have improved instructional quality. Different platforms and applications of AI as an instructional tool are discussed and mentioned within the numerous articles evaluated. Timms discusses various applications of AI as a educational tool or instructional platforms; simulation-based instructions, which include utilizing different technologies, such as virtual reality to demonstrate or show students concepts, ideas or practically demonstrate materials, giving students a practical learning experience.

AI in education as an instruction tool is the combination of AI in education principles in robots, the evolution and use of robots as teacher assistants and colleagues, can be called "cobots", which can be used to perform basic and even advanced teaching tasks, such as teaching students to read and spell words.

The integration of AI in education, and with other technologies and use as instructional tools, has lead to the development of better teaching tools. AI makes the humanoid or other robots with cognitive and psychological features, as well as dialogue and conversation skills, and thus, enable their use as instructional and pedagogical tools.

The Aim is to equip AI systems with human intelligence to be used as educational tools, so focus is on four dimensions of AI.

Figure 1. Different dimensions of AI

Thinking Humanly

'The exciting new effort to make computers think… *machines with minds*, in the full and literal sense.' (Haugeland, 1985)

'[The automation of] activities that we associate with human thinking, activities such as decision-making, problem-solving, learning…' (Bellman, 1978)

Thinking Rationally

'The study of mental faculties through the use of computational models.' (Charniak & McDermott, 1985)

'The study of the computations that make it possible to perceive, reason, and act.' (Winston, 1992)

Acting Humanly

'The art of creating machines that perform functions that require intelligence when performed by people.' (Kurzweil, 1990)

'The study of how to make computers do things at which, at the moment, people are better.' (Rich & Knight, 1991)

Acting Rationally

'Computational Intelligence is the study of the design of intelligent agents.' (Poole, et al., 1998)

'AI… is concerned with intelligent behavior in artifacts.' (Nilsson, 1998)

How AI can be practically implemented for use in education field?

These are some basic areas which need to be focused for using AI as instructional tool and thus will lead to greater heights of success in educating students.

- Smart Tutors and Personalization

- Virtual Lectures and Learning Environment

- Teachers' Support

- Students' Communication

- Catering to the needs of variety of students

- Intelligent Tutoring Systems

Roles and framework of AIED

From the perspective of educational applications, there are various roles of AI in education, that is, serving as an intelligent tutor, tutee, learning tool/partner, or policy-making advisor, as shown in Figure.
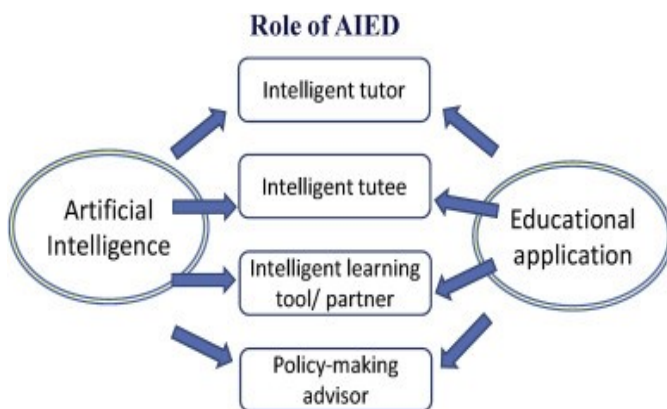

Figure: Framework for the roles of AIED.

In the past decades, many AIED research have categorized its roles in four categories. These are described as follows:

(1) **Intelligent tutor**: This could be the largest category of AIED applications. IT includes intelligent tutoring systems, personalized learning systems, or recommendation systems. Several analyses have described the effectiveness of intelligent tutoring systems to promote learning. A more recent example is ASSISTments that integrates the features of intelligent tutoring with assessment to provide real-time feedback to students while working on assignments and provides data-driven reports to teachers on each assignment.

(2) **Intelligent tutee**: Research regarding this category are rarely seen since most AI-based educational systems generally target on nurturing learners instead of encouraging people to function as a educator or advisor. However, this might be a wonderful approach to promote higher order thinking competences and knowledge levels. Though no studies have targeted to develop intelligent tutees, several AI models and techniques are capable of learning the information and experience from the interaction with humans. The training of AI models and methods can facilitate the development of intelligent tutees in the future.

(3) **Intelligent learning tool or partner**: From the perspective of student-centered learning, having an intelligent learning tool or partner is a vital issue. The device will facilitate learners to collect and analyse data in efficient and effective ways, so that they can aim on critical points or higher-order thinking, rather than low-level tasks. Some tools can even analyse and demonstrate data in a "smart" way to help learners think in-depth and to seek out valuable implications underlying the data. For example, traditional Mindtools, like concept mapping tools, facilitate learners to arrange information and knowledge by connecting the relationships between concepts.

(4) **Policy-making advisor**: AI techniques are used to inform and guide development of policy or laws in the recent years. Hence, it is possible and feasible to develop a policy-making advisor for policy building in education. With the assistance of AI technologies, policymakers can better understand the trends and problems in academic settings from both macro and micro views, which might facilitate them build and evaluate effective educational policies.

Intelligent Tutoring Systems

The tutoring process demonstrates that majority of the students have the potential to succeed at this high level of learning. A vital task of analysis and instruction is to find ways of accomplishing this beneath more practical and realistic conditions than the one-to-one tutoring, which is too expensive for many societies to sustain on a large scale. Intelligent tutoring systems (ITS) are the most common applications of AI in education. ITS provide step by-step tutorials, individualized for every student, through topics in well-defined structured subjects like mathematics or physics. Drawing on professional knowledge about the subject and about pedagogy, and in response to individual student's misconceptions and successes, the system describes an optimal step-by-step pathway through the learning materials and activities. As the student move forwards, the system automatically increases the level of difficulty and provides hints or guidance, to make sure that the student is able to learn the given topic effectively. The models utilized by ITS represent information specific to teaching and learning. Specifically, knowledge regarding the topic to be learned is represented in domain model,

knowledge about effective approaches to teaching is explained in a pedagogical model, and knowledge about the student is demonstrated in a learner model. The ITS algorithm works on these three models so as to adapt a series of learning activities for every individual student. A fourth model is found in some ITS is the open learner model.

A Typical ITS Architecture
The following figure shows how the domain, pedagogy, and learner models might be connected in a typical ITS.
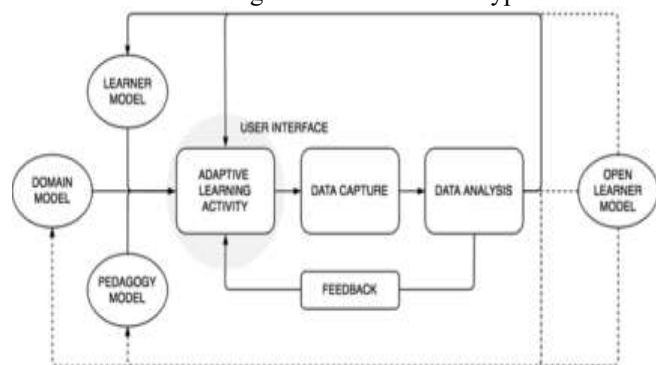

Figure: ITS architecture, including the pedagogy, domain, learner, and open learner Models.

The Domain Model
A domain model describes knowledge about the subject that is aimed to be learned by students through ITS. For example, information and knowledge regarding mathematical procedures, genetic inheritance, or the causes of World War I. In fact, over the years, primary and secondary school students have been taking advantage of ITS in mathematics. Mathematics, physics and computer science, are AIED's lowest branch because they are, at least at a basic and lowest level, well-structured and properly defined.

The Pedagogy Model
The ITS pedagogy model describes knowledge about effective approaches to teaching and learning that have been extracted from teaching experts and from research in the learning sciences. Pedagogical knowledge that has been displayed in many ITS include knowledge of instructional approaches, the zone of proximal development, interleaved practice, cognitive load, and formative feedback. For example, a pedagogical model that implements Vygotsky's zone of proximal development will ensure that tasks given by the system to the student are neither too easy nor too challenging, one that implements individualized formative feedback will make sure that feedback is given to the student whenever it could support the student's learning.

The Learner Model
As we have seen, some CAI effectively implement versions of both domain and pedagogical models: knowledge of what was to be learned and knowledge of how to teach.

Although, what distinguishes AI-driven ITSs is that, as described by Pask's SAKI, they also include a learner model: "a representation of the hypothesized knowledge state of the student." In fact, many ITS consists a wide range of knowledge about the student—such as their interactions, material that has challenged the student, their misconceptions, and their emotional states while using the system—all of which can be used to analyse what is being taught and how, combined with what support needs to be provided and when. The knowledge stored about the individual student is combined with knowledge of all the students who have used the system so far, from which the system machine educates itself that which pedagogical approach and which domain knowledge is suitable for any particular student at any specific stage of their learning. It is the learner model that allows ITS to be adaptive, and the machine learning that strengthens this adaptivity.

Regardless of this, AI technologies have been researched in educational contexts for around fifty years. More recently, Successful companies as influential as Amazon, Google and Facebook have invested millions of dollars for evolving AIED products, collaborating with well-established multimillion dollar funded AIED companies like Knewton and Carnegie Learning. Meanwhile, AI is being launched into some mainstream school's curriculum, is being developed to improve online tutoring, and is being studied as a way of enhancing teacher training. Talking in short, the application of AI in educational contexts is growing exponentially, such that by 2024 it is anticipated to become a market of worth almost $6 billion. Even now, new AIED applications and approaches, addressing old and newly identified issues, are being researched and launched all the time—such that, what AIED looks like and what it can do is still growing.

III. AI FOR COMPUTER ASSISTED INSTRUCTION

Computer Assisted Instructions (CAI) is a self-learning technique which involves interaction of students with programmed instructional materials. CAI basically recognizes computer as a tool used for enhancing and improvising instructions. All the instructions are presented through computer and it also monitors the learning process. It makes easier for the students to actively participate in the learning and teaching process. It solves the issues as to when, where and how? For enhancing the learning process, it uses text, graphics, video and sound which helps the teachers as well. CAI is mainly classified into 3 types of technologies:

- ❖ Hardware
- ❖ Software
- ❖ Courseware

CAI is classified into following categories:

i) Simulation:
- Simulation is a technique that provides the approximation of reality without depending on the expenses of realism or its risks.
- It provides the training for the students and the instructional activities provide powerful tools to them.
- With the help of prepared programs, the students are made to face reality or idealized situations.
- Students are ought to play active role and required to take decisions having consequences.
- It is much less expensive.

ii) Problem Solving:
- This approach helps children in developing particular skills and strategies.
- This type emphasizes on finding answers to the questions.
- Students are provided with the means(programs) in order to solve the problems in a systematic manner.
- As suggested by the programs the questions can be modularized and answers can be found in a systematic fashion.

iii) Drill and practice:
- This type of CAI provides opportunity for the students to repeatedly practice the problems given to them earlier and to do it consistently to conquer it.
- It provides consistent exposure to facts or information in a game format or questionnaire.
- It deals mainly with the lower order thinking skills.
- Since it measures student performance, drill and practice software adjusts to the learning and teaching approach.
- Although the application doesn't use the full capacity of computers, students can enhance their rate of progress using this software.

iv) Tutorials:
- In this type of CAI, only teaching is entertained unlike the Drill and practice.
- It performs a vital role of a tutor by conducting effective interaction and dialogues with the students individually and therefore it is interactive.
- It can be linear or non-linear.

v) Tool Software:
- It is the most pervasive computer application used in education presently. It has all the necessary tools for students. The software is used by the students as a source of expressing them and showcasing their understanding. As a result, tool software is not binded to a specific grade or content area. Tool software is used by the students and teachers to manage information. The usage of this approach is effective in curriculum as much the activity that teacher develops.
- Examples of tool software consists of word processors, desktop publishing packages, spreadsheets, data bases, graphic programs, tele communications software and multimedia software.
- It is cost effective because it can be purchased for a wide range of grade levels and content areas.

IV. CHALLENGES

Artificial Intelligence is taking its place in every other field. And with the increasing accuracy in predicting the correct data information required by the user more people believe in it. The user has to simply use the pre-built techniques for getting the result. With this rise in trust toward AI comes the responsibility for the system to maintain it for the users joining the technology for the first time.

So, here are some challenges that we need to overcome to have great usage of artificial intelligence in the educational sector.

Public policies approval: -

Adding Artificial intelligence into the learning curriculum needs proper public support. The government has to ask its people and pass policies accordingly. These documents require a great amount of discussion before coming into existence in the syllabus. The government will have to be aware of the public regarding the benefit of learning Artificial Intelligence. Telling them that learning this technology can take them to a position where they will be future-ready to accept the growth of the human race, because Artificial Intelligence is going to be the next electricity for everyone.

Implementation of policies: -

This process is much more difficult than telling and making people believe in the promises done to them. Bringing all

the facilities required by the students for learning Artificial intelligence is also a task in itself that is not completed by making the government passing the bill in its favor. Arranging many software and hardware stuff together for a large number of curious audiences is not an easy job to do.

Preparing educators: -

For teaching students aspiring to learn Artificial intelligence, it's equally important for the teachers to learn the concept of Artificial Intelligence. And hence, they will be ready to train the students in future. Since, the technology is brand new less number of people know the details about it. Even for making the correct set of people ready for the job we require a trained force to teach them. This includes a good amount of expenditure of money. Money is to be paid to the manpower giving all their input in teaching the future trainees.

Creating quality data system: -

All the analyses done on the data and predictions received through working on it, require an efficient and reliable data system. Therefore, data is the most crucial factor to work on, while we consider this technology for education. The data that is used for teaching the students should be clean. If there is a huge variation in the data. If it is showing the result tilted for one particular set of entities, not for the other, the predictions that we obtained in this kind of case are dicy. Also, many times data on which the processing is taking place is not ethical that bring faulty results for the users. This thing leads to putting a seed of unassertive vision for the technology in the eyes of the public.

Lack of understanding: -

One of the major drawbacks of artificial intelligence is that machines predict the result according to its learning techniques that are pre-defined into its system, but it cannot consider other undefined attributes while giving out the result.

V.   CONCLUSION

The paper gives an insight into the technological trend, Artificial Intelligence (AI), which is at par and is evolving along with advancements in technology at an exponential rate. There are several dimensions which needs to be taken care of while implementing the technology. The four dimensions of AI studied in this paper includes - thinking humanly, acting humanly, thinking rationally, and acting rationally. AI technology has involved so much in our day-to-day life, that every gadget (mobile phones, laptops, smart watches) or appliance (fan, bulb, music player) to autonomous vehicles, healthcare, robotics, etc. surrounding us has the capability to get smarter and work on its own.

One such field which is getting flooded with AI technology is the education. AI in education (AIED) technology is advanced from the registers for maintaining records to digital database. The key characteristic of AIED discussed are – personalized learning and voice assistants. AIED utilizes embedded computer system along with humanoid robots and web-based chat robots to solve queries, examining the answers, assistance in grading and attendance, making AI work efficiently with minimal human interference, thus, easing the duty of mentors/instructors. The framework of AIED is – intelligent tutor, intelligent tutee, intelligent learning tool and policy making advisor.

AI can't eliminate the role of an instructor or human mentor but, instead helps in efficiently optimizing the work along with facilitating the teaching. Several institutions are adopting CAI technology which is a digital tool with programmed instruction materials. CAI is classified into three categories, termed as – hardware, software, and courseware. The instructions and content (courseware) are provided by the machine (hardware) and are monitored and gets evaluated by machine (software) itself. The CAI utilizes various tools such as – text, graphics, videos along with simulations, problem solving assessment, tutorials, etc. to express the ideas and impart the right knowledge with better understanding to the students.

Though, AIED is the future in the education field but every aspect comes with cons also. Thus, this research paper is not limited to the pros of the AIED and highlights several challenges which will be faced on implementing the idea and technology in the practical world on global scale. Some of the challenges highlighted includes – public policy approvals, implementing the policies, preparing educators, creating quality data system, and most importantly helping the elders (or seniors) with the new trending technology.

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