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# AI teachers (AI-based robots as teachers): history, potential, concerns and recommendations

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Although Artificial intelligence (AI) has been used in education for a long time, its popularity and spread have witnessed exponential growth since the launch of ChatGPT. It can be used as a tool, teaching assistant, or teacher. AI teacher (AI-based robot as a teacher) is not a new concept with the first teaching robots used in the 1970s; however, most of the research and usage of AI in education is focused on AI as a tool or a teaching assistant. This article looks at AI teachers' history, some key cases, potential and benefits, and concerns and challenges associated with their use in classrooms. Overcoming teachers' shortage, flexibility, transparency, unbiasedness, and improving students' motivation were some of their key benefits; while being untested and unreliable, cost, need for specific infrastructure and technical expertise, resistance to change, ethical issues, and fears of dehumanizing and desensitizing students were the main concerns and challenges. We suggest co-teaching with AI teachers using four different approaches. Through them, AI teachers and human teachers can work together in classrooms to maximize the effectiveness of the teaching-learning process.

## KEYWORDS

artificial intelligence, ChatGPT, AI teacher, teaching robot, classroom teaching, co-teaching, education

## 1 Introduction

Artificial intelligence (AI) is not a new concept, and researchers and scholars have used it for decades. ELIZA, developed by MIT in the 1960s, was the first chatbot that employed AI (Berry, 2023; Shum et al., 2018). Whereas ELIZA was just a conversational agent, the later iterations could perform more complex tasks, be predictive, and even perform roles that originally required human abilities (Chandra et al., 2022; Malik et al., 2024). In the beginning, AI was employed by only a few organizations, institutions, and scholars; however, since the advent of ChatGPT and other Large Language Models (LLMs), it has seen exponential growth (Malik, 2024). Due to the large amount of data that they are trained upon, and the advanced neural networks (Tan et al., 2023); recent AI-based chatbots and tools can be used in different fields such as healthcare, engineering, business, accounting, computer sciences, creative writing, and education (Lee and Yoon, 2021; Malik et al., 2024; Oke, 2008).

### 1.1 Artificial intelligence in education

AI, LLMs, Generative Pre-trained Transformers (GPTs), and Natural Language Processors (NLPs) have made an incredible impact on education in recent years (Floridi and Chiriatti, 2020). Although, they had been used earlier as well; since the advent of ChatGPT, their popularity and usage witnessed unprecedented growth (Malik, 2024). AI

TABLE 1 Use of AI in the teaching-learning process.

Nature	AI as a tool	AI teacher (AI as a teaching robot)
Function	AI as a self-learning tool	As a teacher assistant
	AI as peer	AI as a co-teacher
	AI as a teaching aide	AI as a solo teacher

can be used in the teaching-learning process in different functions and capacities. Table 1 shows how AI can be used in the teaching-learning process. It (Table 1) can also be used as a guideline to conduct studies about AI in education. Researchers can select nature (either AI as a tool or a teaching robot) and then choose any function to focus on.

In the teaching-learning process, AI can be used as a tool (as a self-learning tool for both teachers and students, as a peer for students, or as a teaching aide to assist teachers during the teaching process), and as a teaching robot (as a teacher assistant, co-teacher, or solo teacher).

Before the recent popularization and widespread use of AI in education (Malik, 2024), there were quite a lot of studies about teaching robots a.k.a. robotteachers, robot teachers, roboeducators, teacherbots, and educational service robots (Breazeal et al., 2004; Edwards and Cheok, 2018; Mubin et al., 2013; Reich-Stiebert and Bysse, 2016); however, in the recent years, most of the studies have been focused on AI as a tool. We believe that with the recent innovations and inventions in both AI and robotics, it is high time to draw the attention of researchers, scholars, and educationists toward teaching robots. Consequently, this review of literature study is conducted to discuss AI teachers (AI-based robots as teachers) and the opportunities and concerns associated with their use in the classroom.

## 1.2 Objectives of the study

This study has the following objectives.

- To discuss the opportunities brought forward by the use of AI teachers in the classroom.
- To discuss the challenges and concerns associated with the use of AI teachers in the classroom.
- To give recommendations for effective use of AI teachers in the classroom.

## 2 AI teachers in classrooms

### 2.1 History of teaching robots in classrooms

Automation in education is not a new concept. Simple robots started to be used in education in the early 1970s. LOGO Turtle, developed by MIT in 1967, was one of the first robots (Proven Robotics, 2023). It could instruct students to draw different geometrical shapes (Druin, 2002). Later decades witness further developments and advancements in them. They are mostly employed

to teach science, technology, mathematics, education, and languages. Although, they can be used as tutors, peers, or tools in the classroom (Mubin et al., 2013); due to their complexity and higher cost, “robots as teachers are not as common as robots as tools” (Chen et al., 2023, p. 11633).

Humanoid robots were the next step which used artificial intelligence to perform teaching duties effectively. The fourth industrial revolution also emphasized AI and robotics in education (Pavlov et al., 2017). Whereas developed countries had already started employing AI teachers in the classrooms; the recent developments in AI, improved features, increased production, and decreased cost are making them more accessible and popular in the other parts of the world as well.

### 2.2 Some cases of humanoid robots in classrooms

Although they have not seen widespread use, numerous humanoid robots have been developed to facilitate the teaching-learning process. With the newer developments and innovations in robotics and AI, the list of AI-based humanoid teaching robots is growing longer. Here some cases of humanoid robots in classrooms are discussed.

Japan, China, and Korea are among the countries which have observed some of the more widespread use of robotics. In 2018, it was reported that more than five hundred Japanese classes would employ AI-assisted robots to teach English to Japanese students (The Straits Times, 2018). Keeko (a miniature robot although not entirely humanoid) started to be used in Chinese kindergarten schools to assist in different classroom activities such as storytelling, and learning problem-solving and computational skills (Low, 2018).

Pepper, a semi-humanoid robot, was launched by Soft Bank Robotics (2014). It can be used for multiple purposes by different kinds of organizations. In education, it can be used for personalized learning, improving social and emotional skills, and assisting teachers in tracking detailed data about the students and their progress (Gottsegen, 2024). Iris was the first AI-assisted humanoid robot that was used in classrooms in India. Wrapped in a sari (a traditional dress for women in India), Iris is a multilingual AI robot that can assist teachers, deliver educational content, offer personalized voice assistance, and help with interactive and personalized learning (Chowdhury, 2024).

Humanoid robots have also been used to facilitate special students in their learning. In 2005, Kaspar (Kinesics and Synchronization in Personal Assistant Robotics), a doll-like humanoid robot, was developed by the University of Hertfordshire (Wood et al., 2021). Later, its more advanced versions were developed. Kepon is another robot that has been used for autism therapy (Hideki and Michalowski, 2009).

### 2.3 Potential of AI teachers in classrooms

AI teachers have a lot of potential as they can bring many advantages and benefits to the teaching-learning process. They can solve the shortage of teachers as they can be produced in large

quantities (Edwards and Cheok, 2018). Being mechanical robots, they are less vulnerable to human frailties such as physical and mental exhaustion, and disobedience. These qualities make them ideal for places where human teachers are prone to overwork.

The recent advancements in AI, LLMs, GPTs, and NLPs; and the fact that they have been trained on an extensive amount of data (Tan et al., 2023), empower AI teachers to respond to a wide variety of questions about different contexts, subjects and levels. As a result, they can teach different subjects, classes, and levels, making them more flexible and useful.

Human teachers are prone to mood swings which may affect their mood and attitude in the classroom. It can also affect the quality and fairness of their assessment. AI-based assessment, on the other hand, is less subjective and biased (Hill et al., 2020). It can also “analyze large amounts of data to provide more accurate and timely feedback to students, helping them identify areas for improvement and track their progress over time” (Igbokwe, 2023, p. 304). As a result, AI teachers are likely to be quite effective in the students’ assessment and evaluation.

Studies have shown that modern technologies can improve students’ engagement and motivation levels (Bond et al., 2020). AI teachers can also enhance students’ interest, motivation, and classroom engagement.

## 2.4 Challenges and concerns associated with the use of AI teachers in classrooms

Despite the aforementioned potentials and advantages associated with AI teachers, there are many concerns and challenges. First and foremost, the concept of AI teachers (AI robots as teachers) is still relatively new. Although multiple studies have been carried out about AI as an educational tool; research about AI as a teachers is “still in its infancy” (Chen et al., 2023, p. 11632). It is premature to leave the students entirely in the hands of machines that are still untested and unreliable. Although they are trained extensively, they may not be able to tackle contextual and unexpected issues, especially since most of the AI tools and machines at this time are based on Artificial Narrow Intelligence (ANI). However, with the further advancements in AI especially Artificial General Intelligence (AGI), this issue may be resolved.

The cost of AI teachers is also an issue, especially in developing countries. A Unicef article puts the price of a humanoid teaching robot at 1,500,000 Serbian dinars- equal to 13,552.83 USD as of December 07, 2024 (Unicef, 2024). Furthermore, the cost of an AI teacher is not limited to upfront purchasing price; but also for improving infrastructure, technical training, and maintenance. In developing countries where teachers’ salaries are quite low (especially in USD), AI teachers are considered more expensive than their human counterparts. Technical support and maintenance not only require money but also infrastructure and technical expertise which is also an issue in many developing countries. Even when implementing ICT in education, technical expertise and infrastructure have been reported to be two of the biggest hurdles in developing countries (Warner et al., 2021).

Lack of acceptance by students and teachers can also be an issue. A study by Reich-Stiebert and Eyssel (2016) about German school teachers found that many had negative attitudes toward AI-based teaching robots. Teachers are often reluctant to new technologies and

innovations (Malik, 2024; Noreen and Malik, 2020). Whereas the lack of acceptance by the students can be attributed to the novelty of the idea (which can be tackled more easily); the issues with teachers can be connected to their fears about job security and unwillingness to step out of their comfort zone (something that is harder to tackle).

It is also feared that AI teachers may cause ethical issues. Tanaka et al. (2007) said that young students especially may view them as more of a toy than a teacher. The element of respect which is so very important in a teacher-student relationship, may mitigate. If such a transition in students’ attitudes is made, it may not be restricted to AI teachers, but also affect their perceptions of human teachers.

Effective teaching does not mean using the same solutions for the same problems all the time. It means looking at the context, background, and student’s mental and emotional condition to make a suitable and effective decision. An AI teacher, no matter how well it is trained, may not be able to evaluate the aforementioned conditions to make a contextually appropriate and suitable decision. A decision made by an AI teacher may be just and equal; however, it may not be contextual and fair which can hurt a student mentally and psychologically.

One of the biggest concerns that we have with AI teachers is that they may dehumanize the students. Education is a socializing process that should also teach moral, ethical, human, and social values (White, 2010). Muhammad et al. (2023) said that education is not meant to “make the students experts in the domain of knowledge only, but also to help them in developing character, refining attitudes, and inculcating ethical and moral values” (p. 455). Frequent interactions with machines tend to lead to mechanical thinking and mindset (Malik et al., 2020). Due to the widespread use and addiction to mobile phones, human beings are already losing face-to-face, personal touch with their fellow human beings (Elsobeihi and Abu Naser, 2017). Replacing human teachers with machines may further add to these woes. Ho et al. (2024) also express their concerns about what they called machinic parentalism a “situation where adults use these toys and digital devices to occupy a child’s attention but also compensate for physical interaction with them” (p. 2).

## 3 Summary, conclusion, and recommendations

AI has been impacting this world in an unprecedented way (Malik et al., 2024). Its influence has really magnified since the launch of ChatGPT. Like other walks of life, education has also been greatly influenced by it (Malik, 2024). Teachers, students, and administrators use its different forms and tools for various purposes. AI can be used for the teaching-learning process in different forms and capacities (see Table 1). Whereas a lot of studies had been previously conducted about teaching robots (Breazeal et al., 2004; Edwards and Cheok, 2018; Reich-Stiebert and Eyssel, 2016); very few have been carried out in the post-ChatGPT era. Understanding the role, importance, potential, and concerns associated with AI teachers in the post-ChatGPT era, this study is carried out.

AI teachers can bring many benefits to the education systems across the world. They are an effective solution to the shortage of teachers as they can be produced at a mass scale (Edwards and Cheok, 2018). Recent advancements in AI enable them to be used for a wide range of subjects and levels, making them more flexible than human teachers. They can work longer hours without

TABLE 2 Approaches for co-teaching with AI teachers.

Approach for co-teaching with AI teachers	Details
Human teaches, AI assists	A human teacher does the main teaching. AI teacher facilitates and assists the human teacher.
Team teaching	Both human and AI teachers teach together.
AI for general teaching, human for special focus	An AI teacher teaches the class while a human teacher focuses on weak students to provide them with special focus.
AI teaches, human observes	Once AI teachers have been tested and matured, they can teach the class; however, a human teacher would still sit in the class (on the back benches) and observe to fix any issue that may arise.

showing signs of fatigue, and are less prone to emotional and biased behaviors, or mood swings. These qualities make them more effective, transparent, and accurate for assessment and evaluation. Introducing newer technologies like AI teachers can also increase students' interest, motivation, and engagement in the classroom (Bond et al., 2020).

Despite the potential that they bring, there are multiple challenges with them. They come at a relatively high cost and also need specialized infrastructure and technical expertise to run them effectively. It reduces their potential and suitability in many contexts and countries, especially the developing ones. There are major concerns about using them as solo and independent classroom teachers. Their accuracy, effectiveness, and impact are still relatively untested (Chen et al., 2023). Although they are trained extensively, they may not be able to tackle contextual and unexpected issues, especially since most of the AI tools and machines at this time are based on Artificial Narrow Intelligence (ANI). However, with the further advancements in AI especially Artificial General Intelligence (AGI), this issue may be resolved.

Our biggest apprehension about AI teachers is pertaining to human values and ethical concerns. AI teachers may be viewed as toys by some students, reducing perceived respect for teachers (Tanaka et al., 2007). Furthermore, prolonged interactions with them may desensitize and dehumanize students. Overreliance on machines and mobile addiction are already turning human beings into machines who are more interested in human-machine interactions than human-human interactions (Elsobeihi and Abu Naser, 2017; Muhammad et al., 2023). The purpose of education is not to provide technical and scientific knowledge only, but also to make them moral, ethical, responsible, and social human beings (Bashir and Malik, 2020; White, 2010). Lack of emotional and human touch in the classrooms may turn students into robots themselves.

We understand that AI and AI teachers are a great addition to the teaching-learning process, and the way forward. However, we believe that in its current form, AI should be used as a tool for blended learning. If the schools can afford AI teachers, they should be used as co-teachers. This co-teaching with AI teachers would not only reduce the workload on human teachers but also maximize the effectiveness of the teaching-learning process through the blend of human and AI teachers. Based on the approaches suggested by Friend and Cook

(1992) for co-teaching, we recommend four approaches for co-teaching with AI teachers (see Table 2).

We believe that co-teaching with AI teachers is the way forward. Even when AI has matured to work as a solo teacher, human presence is recommended to ensure that human touch and connectivity are retained with students.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declare that no Gen AI was used in the creation of this manuscript.

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