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Redefining education: addressing challenges with conversational AI

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ABSTRACT

The world has been consistently experiencing a shortage of teachers. This issue is exacerbated as more developed nations advance technologically. The shortage of teachers disproportionately affects the quality of education in more developed countries, where educators are spread thin. However, technological advancements can provide a solution to the problem. Conversational AI can help enhance educational processes, thereby raising teaching and learning standards for everyone. This paper explores how conversational AI technologies can be utilised to overcome the current challenges in education. Additionally, this paper evaluates the broader implications of implementing Conversational AI including cultural, infrastructural, and ethical challenges and explores comparative educational technologies to present a balanced perspective. We will explore how incorporating these technologies enhances teaching methodologies, bridges the teacher shortage gap, and provides high-quality educational opportunities worldwide.

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Introduction

For sustainable development and the betterment of the world, the United Nations has identified quality education for primary and secondary students worldwide as one of their pivotal goals. In fact, according to UNESCO's 2023 report, the world requires nearly 44 million additional teachers by 2030 to achieve its goal of providing primary education to children (UNESCO & International Task Force on Teachers for Education 2030, 2023). However, developed and developing countries struggle to provide quality education to their children. There has been a growing shortage of teachers all over the world (UNESCO & International Task Force on Teachers for Education 2030, 2023). Teachers' working conditions have deteriorated, with less pay and increased workload (Arnold & Rahimi, 2024; OECD, 2023).

Furthermore, in some countries the teaching profession does not receive the recognition it deserves from society (Dolton et al., 2018) and teachers also feel that their profession is less valued in societies (OECD, 2020). These factors have collectively resulted in many teachers leaving their jobs. Additionally, teaching is not perceived as a desirable career option to people, as more appealing and better-paying jobs exist, discouraging them from pursuing careers in education. The recent COVID-19 pandemic has largely influenced the educational system, by shifting lectures to digital platforms, exhibiting an opportunity to use technology and making education more accessible to more students.

Conversational Artificial Intelligence (AI) is a notable technological advancement with diverse applications in education. It is a type of AI designed to engage in human-like conversations. It can understand and process human language, generate appropriate responses and simulate dialogue, making users feel

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like they are speaking to a human being. Teachers can leverage this technology to score test papers and analyse their teaching materials to ensure they meet the needs of students. For students, it offers an interactive way to engage with the course material by conversing with the AI, helping them deepen their understanding and receive additional support in their studies. Therefore, integrating Conversational AI into education can benefit teachers and students.

Method

To investigate the role of Conversational AI in addressing educational challenges, a systematic literature review was conducted. To guide the review, we adopted a thematic framework grounded in four core educational challenges: Access and equity, teacher workload and shortages, student engagement and learning quality, and mental health and well-being. These themes were selected based on UNESCO's Education 2030 Agenda and recurring concerns in global educational development literature. This conceptual lens informed both the selection and organisation of sources throughout the paper. The databases used for this review were Google Scholar and Web of Science, as they provide access to a broad and interdisciplinary collection of academic resources. The search focused on peer-reviewed journal articles, reports, and relevant grey literature published between 2000 and 2025, and conducted in 2024–2025. This time span was selected to capture the challenges in the educational system from the early 2000s. The relevance of these challenges in current time was validated by the reports published by organisations such as UNESCO, OECD, etc. This approach allowed for a better understanding of how educational challenges emerged, persisted or evolved over time, along with the growth and advancement of Artificial Intelligence (AI). Exceptions were made for two studies from the 1990s, which provided essential empirical evidence supporting key arguments.

Inclusion criteria were as follows:

- Studies that address current challenges in the global education system (e.g. teacher shortages, accessibility, mental health).
- Research exploring the application of Artificial Intelligence (specifically Conversational AI) in educational contexts.
- Reports and publications from reputable international and national organisations (e.g. UNESCO, National Center for Education Statistics (NCES), EY).
- Studies offering global perspectives, including developed, developing, and underdeveloped country contexts.

Exclusion criteria included:

- Non-academic sources lacking empirical evidence.
- Studies not available in full text.
- Articles not written in English.

The search terms used included combinations of keywords such as: "Current Educational System" OR "Challenges to Educational System" OR "Conversational AI" OR "AI in Education". Two authors independently screened titles and abstracts for relevance, followed by full-text reviews to determine eligibility. The selection process involved three stages: (1) Title and abstract screening for relevance. (2) Full-text review based on alignment with the conceptual framework. (3) Final inclusion upon agreement by two independent reviewers, with disagreements resolved through discussion. This approach ensured both breadth and thematic coherence in synthesising a diverse body of literature to support the paper's claims.

Challenges to the current educational system

The existing challenges within our current educational system encompass a range of issues, from scarcity of qualified teachers and access to quality education to inadequate resources for students, particularly those with special needs.

Shortage of teachers and access to education

To ensure the delivery of quality elementary and secondary education to every child, it is essential to maintain the balance between the demand and supply of teachers. However, this balance has greatly been disturbed due to the growing shortage of teachers. Though there has been an increase in teachers worldwide in the last couple of decades, this is not enough to meet the sustainable development goals of UNESCO & International Task Force on Teachers for Education 2030, 2030 (2021). According to the National Center for Education Statistics data, the percentage of bachelor's degrees awarded in education has dropped from 20.9% in 1971 to 4.4% in 2022 (NCES, 2023). This has become a global issue, as not only developing countries but also developed countries are facing this problem.

In recent times, the once highly esteemed teaching profession has experienced a decline in its perceived value. While in countries like China, Russia, and Malaysia, the profession of teaching holds a status comparable to that of a doctor, in other countries such as the US, Canada, and Brazil, the profession is not only undervalued but equated with occupations like that of a librarian (Dolton et al., 2018). This diminishing prestige, coupled with comparatively lower wages, has rendered the teaching profession less appealing compared to other professions. Many who enter the teaching profession consider it a temporary occupation until a more favourable and financially rewarding opportunity arises (Wiggan et al., 2020). This shift in perception regarding the attractiveness and viability of teaching as a sustained career choice is contributing to a decline in the number of individuals pursuing teaching roles (Ovenden-Hope, 2022). The situation in rural areas is even worse, as qualified teachers prefer to teach in cities with better-paying jobs and enhanced benefits (Xuehui, 2018). Due to this, schools in rural areas have to settle for and hire teachers who are partially or not fully qualified. Nguyen (2020) found that rural schools have fewer qualified teachers on average than urbanised ones, providing empirical support to this phenomenon.

Due to the shortage of teachers in schools, teachers are required to teach larger classes, more hours per week, and even assigned subjects they are not trained to teach. All these things, together with the notion that a majority of students are perceived to be not engaged or interested in learning, contribute to burnout (Shackleton et al., 2019). This leads to high rates of teachers leaving the profession within the first five years (Ingersoll et al., 2018). Furthermore, Capone et al. (2019) found a direct correlation between burnout levels and the onset of depression in teachers. Finally, society views their profession as less esteemed, and their efforts are often unappreciated (Dolton et al., 2018). Therefore, a vicious cycle emerges: The shortage of teachers leads to heightened workloads, subsequently leading to teacher burnout, stress, and compromised mental well-being. This, in turn, increases teacher attrition and turnover, exacerbating the shortage of teachers.

A shortage in the number of teachers and an absence of quality education in underdeveloped countries reinforce existing socioeconomic inequalities. A significant portion of the population that often gets affected the most is children from impoverished areas, leading to a vicious cycle of poverty (Buckingham et al., 2013). Acute teacher shortage and lack of standard education restrict upward social mobility, severely limiting the scope of a better life for these children. All these factors limit not only individual opportunities but also hinder the regions' overall development, as education is a cornerstone for social and economic progress (Pal, 2023; Spiel et al., 2018).

In addition, developing or less developed countries face several other barriers for allowing children to access quality education ranging from schools being overcrowded or located far away from the villages where children live, poor learning materials and lower quality of teaching, to families believing it to be better for children to work and support the family than pursue education (Global Affairs Canada, 2017). Many families face a trade-off between immediate household consumption and children's expected future income when deciding to send their children to schools (Chimombo, 2005). Another major challenge facing education in these countries is the quality of education. This is because improving educational quality is perceived as more costly than increasing the number of educational institutions (Nicolai et al., 2014). According to Barrett et al. (2015), over the past two decades, the predominant focus has been on achieving universal access to education, which has not yet been translated into universal educational attainment. While many students attend primary education, a lot of them leave school with inadequate literacy and numeracy skills.

Inadequate attention to students with special needs

When talking about special needs, we refer to students who need additional support or adjustments due to learning difficulties, physical disabilities, emotional and behavioural problems, or giftedness. Dishearteningly, these students often do not get the level of attention they need to thrive. There is a need to prioritise the inclusion of children with special needs in regular classrooms through the implementation of the inclusion or mainstreaming model (Hibbert & Sprinthall, 1995). Inclusive education involves educating all students in a regular classroom setting, providing tailored teaching that aligns with their abilities and interests (Haug, 2017). Over 60% of students with disabilities now spend 80% or more of their day in regular classrooms (Gilmour, 2018). The essential aspect of effective teaching and inclusive practices lies in the capacity and competence to actively engage every student in the classroom, establishing a teacher-student relationship that promotes learning at each student's level of engagement (Jordan et al., 2009). However, students with ASD and ADHD generally experience increased conflicts and reduced closeness in their interactions. Additionally, students with dyslexia commonly report feeling less connected, which may go unnoticed by their teachers (Zee et al., 2020).

Research on pedagogy in special and mainstream education indicates that the teaching strategies employed in mainstream education can be modified to support students identified with special educational needs (Florian, 2008). These students face educational models that cater to their typically developing peers, exacerbating feelings of alienation and failure, further constraining their educational and personal growth (Haug, 2017). Furthermore, the unique learning needs of children with disabilities often result in the loss of instructional time (Jordan et al., 2009). This lack of attention stems from various factors, including a significant shortage of specialists, misconceptions about special needs, underfunded special education programs, and unconsolidated inclusion practices (Loopers et al., 2023), and is not just a flaw within the educational system but a societal issue. It hinders those individuals' academic progression, self-esteem, and future opportunities. This leads to a wider issue of the mental well-being of students.

The mental well-being of students

In today's ever-more connected world, where social media plays an important role, students are exposed to many stimuli that make them compare themselves to public figures and their peers and feel less valued (Foroughi et al., 2021). Growing competition within the job market compels students to excel academically, take up internships and apprenticeships to develop themselves professionally, and stand out. Lower academic achievement is another factor that affects students' mental health (Karaman & Watson, 2017). Moving away from home can make students feel lonely and lead to emotional distress (Richardson et al., 2017). International students, in particular, grapple with depression and loneliness as they struggle with the challenges of living alone and lack emotional support (Sandhu, 1994). Students' mental health is a significant contributor to their performance, and in severe cases, this may have a dramatic effect (Mirhosseini et al., 2021).

However, studies have explored various barriers to mental health help-seeking attitudes, including interpersonal openness and stigma (Del Mauro & Jackson Williams, 2012; Mendoza et al., 2015). Del Mauro and Jackson Williams (2012) conducted focus groups to explore participants' attitudes toward mental health help-seeking and the influence of demographic and historical factors on these attitudes. Their findings revealed that while participants generally supported others seeking help, they displayed reluctance when it came to seeking help for themselves. Critical barriers to seeking help included concerns of confidentiality and interpersonal openness. Another study investigated the interplay of stigma, self-concealment, age, and prior help-seeking experiences on attitudes toward seeking help (Mendoza et al., 2015). Their findings indicated a negative correlation between mental health stigma and help-seeking attitudes. In conclusion, interpersonal openness, stigma, concerns over confidentiality, and self-reliance have emerged as the main barriers to mental health help-seeking among students.

Educational system flaws

The existing flaws with the current educational system hinder students from achieving deeper levels of learning. The prominent issue lies in lecture-based instruction, which does not allow active student

engagement. Consequently, students encounter boredom and struggle to focus during lectures. Moreover, educators follow a rigid system to maintain grade performance and meet the needs of the curriculum, constraining them from innovating their teaching methods to enhance the classroom experience; this lack of flexibility limits opportunities for interactive learning experiences that could better support students' learning.

Furthermore, the prevalence of distractions in the form of devices like mobiles, and handheld games poses challenges to student engagement in educational processes. While the internet offers access to vast amounts of information, it also introduces distractions, leading them to a state of hyperstimulation. Additionally, at home, in the absence of parental support, students are free to do whatever they like, which may lead to further distractions. In less developed countries, students may face distractions of a different nature, such as dealing with more pressing issues like access to clean water, which can significantly impact their ability to engage in learning. Hence, there is a need to implement innovative teaching methods and provide additional support systems that foster student engagement and facilitate deeper learning.

Assessment plays a crucial role within the educational system, serving as a means to evaluate students' comprehension of the material covered within a course. Assessment manifests in the form of marks or grades, which represent students' performance. These assessments often influence advancement to the next grade level or their eligibility for school completion certificates. However, traditional testing and evaluation methods in education often focus on assessing students' ability to memorise information, raising concerns about the depth of understanding and conceptualisation. This tendency impedes students' development of critical thinking, creative problem-solving abilities, and ability to apply information to real-world situations (Zhao et al., 2023). Luc et al. (2018) conducted a study on an online-based thoracic surgery test and found that students classified as 'crammers' were able to produce similar results to non-crammers. However, studies show that cramming leads to rapid deterioration of the information over time (McIntyre & Munson, 2008). Hence, these evaluation methods do not effectively gauge whether students have understood and grasped the concepts.

As AI gains prominence and demonstrates its efficacy across various domains, including education, it can help us better address these challenges. In the next part of this article, we will delve into the potential applications of Conversational AI in addressing these issues.

What is conversational AI?

Conversational AI is an AI tool that can understand human language due to the nature of its underlying mechanisms, such as Natural Language Understanding (NLU), Natural Language Generation (NLG), and Machine Learning (ML). The NLU component enables it to understand how people communicate. It can recognise the intentions behind someone's words, which helps it respond accurately. Conversational AI can vary in form and function as the nature of what is considered Conversational AI has improved over the decades. Initially, basic chatbots were considered conversational AI due to their ability to handle structured tasks. However, modern Conversational AI surpasses the traditional chatbot, as it can perform a wider range of tasks. Chatbots, unlike conversational AI, have a limited set of pre-defined answers and cannot provide any answers outside of their data set (Sudhakar, 2021). Additionally, Chatbots need to be manually trained each time changes are made to their responses, which is time consuming. What is considered to be conversational AI in this day and age is essentially a program capable of having a conversation with a human being and can understand human language (Clark, 2023). It can understand text or speech and reply with either as well. Some common examples in everyday use are SIRI and ALEXA.

Conversational AI is a powerful EdTech tool, but it should be understood in relation to other technologies commonly used in education. This comparison highlights its unique advantages and limitations. Learning Management Systems (LMS) such as Moodle or Google Classroom are excellent for content delivery, grading, and administrative tasks. However, they lack interactivity. Conversational AI complements LMSs by enabling real-time, two-way communication that supports deeper engagement and instant feedback. Intelligent Tutoring Systems (ITS) provide subject-specific feedback and adapt to student performance, but are often limited in scope. Conversational AI, especially when built on large language models, offers greater flexibility across subjects and supports open-ended inquiry, though it may lack the precision of domain-specific ITS. Video-based learning platforms like Khan Academy offer high-

quality, expert-led instruction, but are inherently passive. Conversational AI encourages active learning by allowing learners to ask questions and explore content dynamically. However, it may not yet match the rich multimedia capabilities of video platforms. Mobile learning apps such as Duolingo use gamification and habit-building techniques. While effective for structured learning, they are limited to predefined interactions. Conversational AI allows for more natural, spontaneous dialogue and can be combined with gamified elements for enhanced engagement. In short, Conversational AI stands out for its interactivity, adaptability, and accessibility. While not a replacement for other tools, it serves as a valuable complement, particularly where personalised, student-centred support is needed.

Conversational AI – promising solution to these challenges

The aforementioned challenges pose a significant threat to the quality of education. In addressing these obstacles, emerging technologies, such as Conversational AI, offer innovative solutions to bridge educational gaps and ensure equitable access to quality learning experiences for all students. Table 1 provides an overview of these before each is described in detail.

Making education more accessible

Addressing a significant global challenge to education, the scarcity of teachers and accessibility issues, Conversational AI emerges as a promising solution to streamline the information-providing process. Most of the work on conversational AI is done on the backend by algorithms, and these backend processes can be managed via cloud servers like Google Dialog Flow and NVIDIA EGX™ Platform. This means that if the system is set up to be cloud-based, all we need is an internet connection and a device that can access the internet, such as a tablet or smartphone. Currently, the entry price for satellite-based internet access remains high due to substantial production costs associated with satellite launching and installing ground equipment (EY, 2023). However, its existence means we can enable internet access in more rural areas with less equipment and infrastructure set up (Burkinshaw, 2023). Current iterations of the resources are already providing better broadband than some common internet providers. Additionally, the technology for satellite internet is still advancing and has the backing of technology-leading companies such as Elon Musk's SpaceX (van der Lande, 2020). Therefore, in areas that are less developed, adequate investments can be made to enable this kind of technology to uplift the communities.

Moreover, Conversational AI can ensure that every student has access to high-quality education. Learners can use devices like smartphones or tablets to educate themselves. Conversational AI can be designed not to care what characteristics an individual has, allowing equal access to any learner. The use of a device eliminates the need for learning materials such as books and allows learners to do so from their homes without having to travel long distances to go to school. An example of this is m-Shule, a mobile learning platform that combines AI with text messaging and educates girls from Africa (M-Shule, 2023). It also analyses performance data and shares it with parents and teachers, making

Table 1. Framework: Addressing educational challenges with conversational AI.

Educational challenge	Contribution of conversational AI
Teacher shortage	Supports teaching through automated grading, FAQs, content generation, and personalised tutoring.
Access to quality education	Provides scalable, low-cost, device-based learning with localisation for rural and underdeveloped areas.
Support for special needs learners	Offers tailored content, adaptive learning paths, and persistent, judgment-free interaction; hyper-personalisation.
Student mental health	Serves as an anonymous first-line emotional support tool, encouraging openness and help-seeking.
Low student engagement	Promotes active, interactive learning and can integrate gamification to maintain motivation.
Limitations of traditional assessment	Enables real-time, formative assessment with adaptive feedback and deeper learning analytics.
Second language barriers	Facilitates practice through natural conversation, pronunciation help, and cultural contextualisation.
Time management and academic pressure	Assists students with scheduling, reminders, and workload balancing through intelligent planning tools.

it easier for educational organisations to identify the needs of their students and provide personalised teaching. In rural areas of developed countries, conversational assistant teaching can be marketed as a new experience that some teachers can use to develop new pedagogical approaches that will improve the learning and development of students.

Reducing teachers' workload

Beyond teaching, teachers are burdened with tasks such as exam paper preparation, assessment, record-keeping of students' performance, and providing tailored support to their students. A study on teachers from the Northern Region of Peninsular Malaysia found that autonomy and work-life balance were significant factors that affected teachers' work performance (Johari et al., 2018). Conversational AI can reduce teachers' workload by helping them with a few tasks, like evaluating papers and preparing teaching content, allowing them to focus more on professional development and innovative teaching approaches that enhance students' learning outcomes. For instance, the Automated Essay Scoring system, developed and tested by Westera et al. (2018), was able to mark essays and provide accurate grades consistently. These systems can identify what is right and wrong in the essays and provide feedback to the students, pointing out areas they need to work on. As marking essays can take a considerable amount of time, AI systems can instead be used in schools, which will reduce teachers' workload, enabling a better work-life balance.

Conversational AI can also be used to answer some FAQs. When students enrol at a new institution, there tends to be a general unfamiliarity as they don't know where resource packs and curriculum content are. Naturally, they turn to staff for assistance with their queries. However, instead of flooding staff's inboxes with mundane questions, Conversational AI can provide necessary information to the students, expediting the process of adapting to the new learning environment. By leveraging conversational AI, students can receive immediate feedback on queries related to accessing learning materials, campus facilities, and other essential resources (Dilmegani, 2024). In fact, educators recognize that ChatGPT can be useful for addressing routine inquiries, such as questions about course materials, assignment deadlines, and requirements (Limna et al., 2023). Moreover, to ensure accuracy and reliability, a robust system can be put in place that redirects students to staff in cases where AI is unable to handle a query. Through this system, staff can investigate the query history, address any discrepancies, and update the AI system accordingly to better handle similar situations in the future.

Due to increasing workload, teachers cannot keep a record of students' academic performance and provide personalised teaching to each student. Since Conversational AI is equipped with NLU capabilities, it can help teachers address this challenge. Conversational AI can analyse and store user interaction, which educators can use to gain valuable insights into individual student needs and preferences. These data enable customisation of learning materials and content delivery to suit each student's unique learning profile and ensure that each student receives the optimal learning experience, fostering greater engagement and academic success.

Improving the mental well-being of teachers and students

Although mental health awareness has increased in recent times, access to it is still costly (Puras & Gooding, 2019). Moreover, people find it difficult to talk about their problems to a counsellor due to the fear of being judged (Lucas et al., 2014; Mendoza et al., 2015). Previous research showed that digital resources can be used for learning under lockdown to improve wellbeing (Otermans & Aditya, 2021). AI-based software has been developed to act as a mediator, allowing people to access professional help. Conversational AI, in particular, can help people open up about their issues, which they might be hesitant to do in front of a counsellor. A study showed that even after having a traumatic experience, a lot of soldiers did not report any PTSD-related symptoms on a Post Deployment Health Assessment (PDHA) even though their answers were anonymous. However, when the same questions were asked by an AI agent, Ellie, they were more likely to report their symptoms (Lucas et al., 2017). Findings from this study suggest that people are more likely to confide in AI agents, not only because these agents maintain anonymity but also because of their ability to build rapport and not feel as if they are judged. In

another study, participants interacted with a Virtual Human (VH) interviewer, with half of them informed that humans controlled the VH. In contrast, the other half believed the computer controlled the VH (Lucas et al., 2014). Results from this study showed that participants who thought they were interacting with an automated VH demonstrated a greater willingness to disclose personal information. They also engaged in a more candid conversation and displayed more intense emotions of sadness. Despite the assurance of anonymity in both scenarios, the perceived absence of judgement from an AI encouraged individuals to share more freely. These studies shed light on the potential of conversational AI to facilitate meaningful interactions in situations where individuals cannot interact openly with therapists due to fear of judgement. Hence, it can serve as an initial point of interaction for teachers and students so they can vent their feelings and cope with the burden. Subsequently, this may encourage them to seek further professional help, fostering improved mental well-being.

The system would allow itself to build up a knowledge base about each individual interacting with it, enabling a human therapist to provide specialised, patient-specific help. Inkster et al. (2018) suggest that integrating language analysis into conversational AI is a logical progression. With this advancement, the system will be able to determine if an individual is developing mental health problems by conversing with them. Corcoran et al. (2018) were able to determine the onset of psychosis via language analysis and distinguish diagnosed psychosis patients from healthy ones with high accuracy. For instance, the mobile app WYSA can detect and distinguish between various mental health issues and is designed to engage users anonymously. It was developed by therapists and other professionals to ensure natural and empathetic conversation. The app also acts as a mentor or a coach, guiding users towards developing better mental health attitudes and improving their emotional intelligence. Another App known as WOEBOT has proved to be better at reducing depression levels among college students compared to an online depression guide (Fitzpatrick et al., 2017).

Improving student engagement

Conversational AI can drastically improve students' engagement with learning material (Procter et al., 2018). Phillips-Gary (2020) showed that conversational agents can enhance the recall rate of students more than traditional methods of memorisation learning. The conversation nature of these agents acts as active learning, which is known to have better effects than passive learning. In this study, Phillips-Gary (2020) used a flashcard app and a self-made chatbot version of a flashcard app. The results indicated that students interacted with the chatbot version more, highlighting the efficacy of conversation AI in engagement. Conversational AI can also seamlessly integrate with gamification methods and improve student engagement. Fadhil and Villafiorita (2017) present a model whereby implementing gamification features incentivises children to achieve the goals set out by the app, like allocating the correct amount of food to their virtual plate. In the process, children learn about healthy diets and daily caloric intake to promote healthy lifestyles. During the game, a conversational agent guides children, providing instruction and hints, enhancing the overall learning experience.

Assessment methods

Traditional assessment methods often focus on students' memorisation abilities, but Conversational AI offers an understanding of whether students have comprehended the concept or encountered challenges. By analysing students' interaction with AI, teachers can gain insight into individual strengths, weaknesses, and areas of focus. With this information, they can set parameters for desired learning outcomes, allowing for a more dynamic educational experience. Additionally, they can identify concepts students are finding challenging and adapt their teaching strategies for better understanding. Using conversational AI, teachers can also design assessment methods to test whether students can apply and implement knowledge in different situations.

There is growing empirical evidence that Conversation-based assessment can measure students' knowledge and skills and foster better learning outcomes than traditional assessment methods (Lopez et al., 2021; Ruan et al., 2019). In their study, Lopez et al. (2021) used the ELLA-Math conversation-based assessment (CBA) to evaluate English language proficiency and mathematical content knowledge. The

assessment process commenced with presenting the initial question to the students, who then responded accordingly. Following each response, the agent provided feedback, categorising the answer as correct, partially correct, or incorrect. Additionally, the agent offered support through hints or follow-up questions, enabling students to elaborate on their responses or provide additional information. The results of this study demonstrated the systems' accuracy in interpreting students' responses. Including follow-up questions and hints enabled students to explain their initial answers or additional information, thereby ensuring an accurate assessment of their proficiency in both English and mathematics. In another study, Ruan et al. (2019) employed Quizbot within classroom settings to teach factual knowledge to students. The Quizbot interface prompted students with questions. Students could input their responses, which the Quizbot assessed for correctness, offering tailored feedback. In cases where students opted for hints, the Quizbot presented the correct answer alongside distractors, encouraging students to discern the accurate response. Incorrect answers prompted immediate feedback from the Quizbot, displaying the correct answer and allowing students to ask why it was the correct answer. The study revealed a significant increase in student engagement facilitated by Quizbot and improved quiz performance, indicating that students learnt well with this AI system. These studies underscore the potential of Conversational AI in not only accurately assessing students' knowledge but also enhancing student engagement, ultimately resulting in improved learning outcomes.

Second language learning

Conversational AI can help improve second language learning. Learners can practise and improve their writing skills by providing a platform for engaging and interactive conversation. NLU allows conversational agents to understand what is being said, be it via text or speech. NLG allows them to generate language responses to converse with the user via text or speech, depending on what the user wants. However, by integrating text-to-speech, the user can converse with the conversational agent, allowing them to practise vocalisation and understand how terms and phrases are used in real-life scenarios. Such a system could even be designed so that it can be accessible via mobiles, allowing users to learn at their own pace and convenience (Altinkaya & Smeulders, 2020). One well-known example is Duolingo, a web-based mobile app that uses gamification features such as points and leaderboards to encourage users to continue learning a new language. These advancements present promising avenues for addressing problems faced by non-native speakers and promoting inclusivity in education.

Additional support to students

Conversational AI is a valuable tool for students, offering assistance in time management and planning. As students enter university, they grapple with many responsibilities, ranging from academics to household chores, social engagements, and part-time employment. This can significantly impede their ability to concentrate on their studies, consequently affecting their academic performance. However, an AI assistant who knows how much time students may need to put towards their studies can efficiently help them allocate time for each of the daily tasks and send timely reminders to help them stay on track. Research by Khiat (2019) showed that with the help of automated time management tools, students were as efficient with time management as those who had taken a time management course before their studies. Its conversational nature makes the setup process easier, as students need just to communicate their scheduling needs and preferences.

Somasundaram et al. (2020) suggest that AI can analyse students' data and performance to identify learning gaps and create a personalised learning experience. A study by Katsuki and Constantinidis (2013) emphasises the need for breaks to replenish one's cognitive ability and to work efficiently. By adding a layer of Conversational AI to the methods used by Khiat (2019), the agent can help assist learners with this balance by providing alerts to take breaks and generating schedules that prioritise academic success and overall well-being. This is something that OIAI by Otermans Institute has developed. They built AI teachers capable of teaching almost any subject using their own fine-tuned LLM OIMISA-7B. Their AI teachers are currently providing L&D training for corporates and subject-training for Higher Education (HE) and connect to an enterprise dashboard for module creation and deep learner analytics. The academic/line manager

creates the lesson through the enterprise dashboard by uploading their own content. The AI creates the lesson in minutes based on this content (but does not train on that data and therefore the IP stays protected). The human is always in the loop and goes into 'edit' mode to edit the lesson script and/or activities that the AI has created. Then the learner (student/employee) goes through the lesson with the AI teacher which can have any type of output (e.g. avatar). The learner is able to stop the AI at any time and clarify doubts, ask questions and delve deeper into the subject (Aditya et al., 2024; Aditya & Otermans, 2022; Otermans & Aditya, 2024). Aditya and Otermans (2022) found that participants perceived the Virtual Trainer as competent, tolerant, trustworthy, and socially present. Another study reported similar findings, with participants describing the Virtual trainer as useful, engaging and enjoyable to interact with, and expressing the willingness to use it in the future (Otermans & Aditya, 2024). Further research by Aditya et al. (2024) demonstrated significant engagement with AI teachers, as participants actively completed course content and interacted with the AI teacher. Additionally, participants found that AI teacher helpful and expressed overall satisfaction. These findings underscore the potential of AI in education by fostering student engagement and enhancing the learning experience. The academic/line manager receives all this data back through the dashboard where they can see where each learner was struggling, any barriers they had and which concepts they did understand. All these can be used to enhance the support provided by the human to the learner. This shows an example of the possibilities to enhance learning, especially learning outside the classroom, with the use of conversational AI. This idea was also supported by research conducted with parents on their views on conversational AI tools for children (Otermans et al., 2024) as well as the children themselves (Otermans et al., 2024).

Thus, Conversational AI tools are not one-size-fits-all; their effectiveness varies across educational levels and disciplines. At the primary and secondary levels, these tools focus on foundational skills like reading and basic math, often using gamification and simple interfaces to engage younger learners. Age-appropriate language and ethical safeguards are critical at this stage. In higher education, Conversational AI supports academic writing, research assistance, and personalised feedback, helping students develop critical thinking and self-regulated learning. Virtual tutors and chat-based interfaces are increasingly used to enhance university instruction. Disciplinary context also matters. In STEM, AI assists with problem-solving and coding, offering instant error correction or simulation. In the humanities, it's more focused on supporting argumentation, reading comprehension, and writing. Language learning benefits significantly from AI-driven conversation practice and pronunciation feedback. Tailoring AI tools to educational level and subject area is essential to maximise their relevance and impact.

Adapting conversational AI to cultural and linguistic contexts

While conversational AI shows promise in expanding access to education globally, it must be thoughtfully adapted to suit diverse cultural, linguistic, and pedagogical contexts. One of the key challenges is language. In multilingual and underdeveloped societies, many learners speak regional dialects or indigenous languages that may not be well-represented in AI training data. Without proper localisation, conversational AI may fail to understand user inputs accurately or generate culturally appropriate responses, reducing its effectiveness and potentially alienating users. Furthermore, many AI tools are currently optimised for dominant global languages like English, Mandarin, or Spanish. To serve learners in regions such as Sub-Saharan Africa, South Asia, or Indigenous communities in Latin America, AI systems must be trained on local languages, dialects, and linguistic nuances. This requires collaboration with local educators, linguists, and technologists to develop datasets and conversational models that reflect real-world usage in those communities.

Cultural adaptation is equally important. Pedagogical styles vary widely across regions: Some cultures emphasise rote learning and teacher authority, while others prioritise collaborative or inquiry-based learning. A one-size-fits-all AI tool risks clashing with local educational norms. For example, direct questioning by an AI may be viewed as confrontational in some cultures, while valued as a sign of engagement in others. Adapting tone, content delivery, and feedback style is therefore essential for ensuring cultural relevance and user acceptance. Additionally, gender dynamics, religious sensitivities, and social hierarchies may influence how students interact with AI systems. If these aspects are not considered during design and deployment, they can lead to poor adoption or exacerbate digital divides. Thus,

localising conversational AI is not just a technical challenge but a deeply social one. Efforts like UNESCO's AI for Education initiatives stress the importance of culturally aware design, advocating for inclusive AI development that respects linguistic and cultural diversity. Moving forward, investments in multilingual AI models, regional datasets, and participatory design approaches will be critical in ensuring equitable and effective AI-supported education across global contexts.

Limitations, ethical concerns, and challenges of conversational AI in education

While conversational AI offers numerous advantages in addressing educational challenges, its integration is not without limitations. Infrastructure limitations are also a significant barrier to widespread adoption. Implementing AI technologies requires stable internet connectivity, access to devices, and digital literacy resources that are not universally available, especially in rural and underdeveloped regions. While satellite internet and mobile platforms provide potential solutions, these are still under development and may be cost-prohibitive for some communities.

Moreover, there may be resistance from educators and institutions. Teachers might view AI as a threat to their professional autonomy or worry that it could replace human interaction in education. Others may be hesitant due to a lack of training or understanding of how to effectively integrate AI tools into their pedagogical practices. Overcoming this resistance will require targeted training, professional development, and clear communication about AI's role as a supportive, not substitutive, tool in the educational ecosystem. As AI tools can practically do anything for students, it can also lead to over-reliance on AI. Over-reliance on AI tools by students could hinder the development of essential critical thinking, problem-solving, and interpersonal skills. Hence, AI should complement rather than replace traditional teaching methods to ensure that students continue developing critical thinking and problem-solving skills as well as AI literacy required for the 21st century.

The integration of AI in education also raises important ethical concerns. One major issue is data privacy and security. Since conversational AI systems collect, process, and store sensitive student data to personalise learning experiences, there is an inherent risk of data breaches or misuse. Institutions must ensure robust cybersecurity measures and compliance with data protection regulations to maintain student trust and privacy (Eden et al., 2024). Another concern is bias in AI algorithms, which arises from biases present in the training data. AI systems are only as unbiased as the data they are trained on. If the training data lacks diversity or reflects existing societal biases, the AI may inadvertently reinforce stereotypes or produce discriminatory outcomes. This could worsen educational inequalities rather than alleviate them (Farooqi et al., 2024). Additionally, academic integrity is another ethical issue, as AI tools like ChatGPT can assist students in writing essays, and completing assignments, raising concerns about plagiarism and originality. Educators must establish guidelines for responsible AI use and develop assessments that encourage critical thinking rather than AI-generated responses (Eke, 2023).

Finally, while AI can assist with initial diagnosis and provide supplementary therapeutic support, it lacks human empathy and understanding (Olawade et al., 2024). This makes it unsuitable as a replacement for trained mental health professionals.

Recommendations

Based on this paper, the following are recommendations for educators and educational institutions:

- Implement AI-powered virtual trainers to enhance student engagement, facilitate interactive learning experiences, and provide real-time feedback to support personalised learning.
- Teachers can leverage Conversational AI to assist with grading essays, maintaining student performance records, and generating comprehensive progress reports.
- Educational institutions should integrate conversation-based assessment into their courses. These assessments can guide students toward a deeper understanding of course material by offering hints, allowing answer revisions, and providing instant feedback.
- Institutions can utilise Conversational AI to offer mental health counselling services for both students and teachers alongside human counsellors to support with long waiting times and instant support.

- Institutions can provide students with AI-powered scheduling tools that help them effectively manage their time. These tools can generate personalised schedules by considering lecture timings, assessment deadlines, extracurricular activities, and other commitments such as part-time jobs and social gatherings.

Conclusion

Integrating conversational AI holds significant promise for enhancing teaching and learning experiences across various educational settings. Throughout this paper, we have illuminated the multifaceted ways in which conversational AI technologies can revolutionise traditional pedagogical approaches and contribute to more personalised and engaging learning environments. One key takeaway is conversational AI's capacity to cater to individual learning needs and preferences. By leveraging adaptive learning algorithms and natural language processing capabilities, these systems can tailor educational content and interactions to the unique requirements of each learner. This adaptability fosters a more inclusive and student-centred approach to education, empowering learners to progress at their own pace and style. Furthermore, conversational AI facilitates interactive and immersive learning experiences that transcend traditional classroom boundaries. Through chatbots, virtual assistants, and intelligent tutoring systems, students can engage in dynamic dialogues, receive instant feedback, and access a wealth of educational resources in real-time. This accessibility and immediacy enhance student engagement and cultivate a deeper understanding and retention of course material.

However, there is a need for further research to provide empirical evidence on the effectiveness of conversational AI in education to build greater confidence in its application. Despite its numerous benefits, the widespread adoption of conversational AI in education is not without challenges. Privacy and data security concerns, ethical implications, and the potential for exacerbating educational inequalities are among the issues that warrant careful attention and proactive measures. The future of teaching and learning with conversational AI holds immense potential for innovation and transformation. As these technologies continue to evolve and mature, they will undoubtedly play an increasingly integral role in shaping the educational system, empowering learners, and enriching the educational experience for all.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Dev Aditya is an expert in AI from London, UK. He led the team at Otermans Institute that built the first Digital Human AI teacher (OIAI) with the mission to upskill 750 million learners globally by 2030. His AI teachers have taught in 17 countries from teaching for universities to schools, corporates to direct marginalised learners. Dev Aditya has also developed a specialist teaching and learning LLM OIMISA-7B. Dev Aditya was awarded by the UK Prime Minister for his work and has been a Young Global Innovator and Under 30 Social Entrepreneur (Mint). For research work in AI, he was recognised by Innovate UK and secured national level funding from them. He has conducted AI and HCI research with The Alan Turing Institute and Brunel University of London, regularly publishes in this space, and his work is currently operating globally across 4 continents. His latest achievement is converting all his AI products to run completely offline on EDGE AI to expedite towards upskilling 750 million learners. For this, he was named the Young Innovator of the Year Europe by Alconics at the AI Summit London 2025. His AI system is currently running Africa's largest and fastest AI literacy programme which was presented as Africa's case study at the UN General Assembly in 2025.

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