

**SECTION 2. INFORMATION AND COMMUNICATION TECHNOLOGIES IN
EDUCATION**

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2.1 The benefits and challenges of artificial intelligence for educators and students

Artificial intelligence (AI) has been penetrating our everyday lives in various ways such as through web search engines and mobile apps. The swift advancement of AI technologies also has important implications for learning and teaching. In fact, AI-supported instruction is expected to transform education. Thus, considerable investments have been made to integrate AI into teaching and learning. A significant challenge in the effective integration of AI into teaching and learning, however, is the profit orientation of most current AI applications in education. AI developers know little about learning sciences and lack pedagogical knowledge for the effective implementation of AI in teaching. Moreover, AI developers often fail to consider the expectations of AI end-users in education, that is, of teachers. Teachers are considered among the most crucial stakeholders in AI-based teaching, so their views, experiences, and expectations need to be considered for the successful adoption of AI in schools. Specifically, to make AI pedagogically relevant, the advantages that it offers teachers and the challenges that teachers face in AI-based teaching need to be understood better. Therefore, it is necessary to consider AI-based education from the perspective of teachers.

To begin with, it is necessary to point out that AI is used in education in different ways. For example, AI is integrated into several instructional technologies such as chatbots, intelligent tutoring, and automated grading systems. These AI-based systems offer several opportunities to all stakeholders throughout the learning and instructional process. The educational use of AI involves AI's support for student collaboration and personalization of learning experiences, scheduling of learning activities and adaptive feedback on learning processes, reducing teachers' workload in collaborative knowledge construction, predicting the probability of learners dropping out of school or being admitted into school, profiling students' backgrounds, monitoring student

progress, and summative assessment such as automated essay scoring. Despite these opportunities, the educational use of AI is more behind what is expected, unlike in other sectors (for example, finance and health). To achieve successful AI implementation in education, various stakeholders, specifically, teachers should participate in AI creation, development, and integration.

The evolution of education towards digital education does not imply that people will need fewer teachers in the future. Rather than speculating about whether AI will replace teachers, it makes more sense to understand the benefits that AI offers teachers and how these benefits can change teachers' roles in the classroom. It is possible to highlight such advantages of AI as planning, implementation, and assessment.

- **Planning.** The advantages of AI related to planning involve receiving information on students' backgrounds and assisting teachers in deciding on the learning content during lesson planning. For example, in terms of teacher assistance in planning learning content, machine learning can be used to classify the readability of English fiction texts. The classification can help English teachers to plan the course contents considering the readability features.

- **Implementation.** The most prominent advantage of AI is timely monitoring of learning processes. For example, a sensor-based learning concentration detection system can be used in a classroom environment. The system allows teachers to monitor the degree of students' concentration on lesson activities. Such AI-based monitoring can help teachers to provide immediate feedback and quickly perform the necessary interventions. For example, teachers are able to discover critical moments in group learning and provide adaptive interventions for all the groups. Hence, AI systems can decrease the teaching burden on teachers by providing them feedback and assisting them with planning interventions and with student monitoring. Therefore, reduced teaching load may be another significant advantage of AI systems in education.

- **Assessment.** AI helps teachers in exam automation and essay scoring and in decision-making on student performance. It has been found that an automated essay scoring system can significantly advance the effectiveness of essay scoring and make scoring more objective. Therefore, researchers are interested in the use of AI

affordances to investigate automated systems. An important utility of AI-based applications in the context of assessment is to detect plagiarism in student essays. Several existing AI-based systems (for example, Turnitin) allow teachers to check the authenticity of essays submitted by students in graduate courses [38].

It is worth noting that many priorities for improvements to teaching and learning are unmet today. Educators seek technology-enhanced approaches addressing these priorities that would be safe, effective, and scalable. Educators see opportunities to use AI-powered capabilities like speech recognition to increase the support available to students with disabilities, multilingual learners, and others who could benefit from greater adaptivity and personalization in digital tools for learning. Teachers are exploring how AI can enable improving lessons, as well as the process of finding, choosing, and adapting material for use in their lessons. Educators are also aware of new risks. Useful, powerful functionality can also be accompanied with new data privacy and security risks. Educators recognize that AI can automatically produce output that is inappropriate or wrong. They are wary that the associations or automations created by AI may amplify unwanted biases. They have noted new ways in which students may represent others' work as their own. They are well-aware of "teachable moments" and pedagogical strategies that a human teacher can address but are undetected or misunderstood by AI models. They worry whether recommendations suggested by an algorithm would be fair. Educators' concerns are manifold. It is clear that everyone in education has a responsibility to harness the good to serve educational priorities while also protecting against the dangers that may arise as a result of AI being integrated in education. There are certain reasons to address AI in education nowadays.

First, AI may enable achieving educational priorities in better ways, at scale, and with lower costs. Addressing varied unfinished learning of students due to the pandemic is a policy priority, and AI may improve the adaptivity of learning resources to students' strengths and needs. Improving teaching jobs is a priority, and via automated assistants or other tools, AI may provide teachers greater support. AI may also enable teachers to extend the support they offer to individual students when they run out of time. Developing resources that are responsive to the knowledge and

experiences students bring to their learning (their community and cultural assets) is a priority, and AI may enable greater customizability of curricular resources to meet local needs.

Second, urgency and importance arise through awareness of system-level risks and anxiety about potential future risks. For example, students may become subject to greater surveillance. Some teachers worry that they may be replaced. Examples of discrimination from algorithmic bias are on the public's mind, such as a voice recognition system that does not work as well with regional dialects, or an exam monitoring system that may unfairly identify some groups of students for disciplinary action. Some uses of AI may be infrastructural and invisible, which creates concerns about transparency and trust. AI may provide information that appears authentic, but actually is inaccurate or lacking a basis in reality. Of the highest importance, AI brings new risks in addition to the well-known data privacy and data security risks, such as the risk of scaling pattern detectors and automations that result in "algorithmic discrimination" (for example, systematic unfairness in the learning opportunities or resources recommended to some populations of students).

Third, urgency arises because of the scale of possible unintended or unexpected consequences. When AI enables instructional decisions to be automated at scale, educators may discover unwanted consequences. In a simple example, if AI adapts by speeding curricular pace for some students and by slowing the pace for other students (based on incomplete data, poor theories, or biased assumptions about learning), achievement gaps could widen. In some cases, the quality of available data may produce unexpected results. For example, an AI-enabled teacher hiring system might be assumed to be more objective than human-based résumé scoring. Yet, if the AI system relies on poor quality historical data, it might de-prioritize candidates who could bring both diversity and talent to a school's teaching workforce.

In summary, it is imperative to address AI in education now to realize key opportunities, prevent and mitigate emergent risks, and tackle unintended consequences [39].

As artificial intelligence systems play a bigger role in everyday life, they are changing the world of education, too. In the realm of education, AI holds great promise in transforming the learning experience for students. OpenAI's ChatGPT, Microsoft's Bing and Google's Bard all come with both risks and opportunities. There are four ways in which such systems can be used to help students learn, engage, and succeed academically.

1. Differentiated instruction

Teachers are taught to identify the learning goals of all students in a class and adapt instruction for the specific needs of individual students. But with 20 or more students in a classroom, fully customized lessons are not always realistic. Everyone learns differently. An AI system can observe how a student proceeds through an assigned task, how much time they take and whether they are successful. If the student is struggling, the system can offer help; if the student is succeeding, the system can present more difficult tasks to keep the activity challenging. This type of real-time feedback is often difficult for an educator or school to do for a single student, let alone an entire class or campus. AI adaptive learning tools have been shown to quickly and dynamically make changes to the learning environment, content, and tasks to help individuals learn more and quickly improve.

2. Intelligent textbooks

Researchers at Stanford have been developing and testing a prototype of what is called an "intelligent textbook," titled "Inquire." It is an iPad app that monitors students' focus and attention while they read by paying attention to how students interact with the app. The interactive text includes definitions of key words accessible by touch or click and allows students to highlight and annotate while reading. The textbook can also suggest questions about the content and areas for future inquiry that are customized for each individual. It can change the reading level of the text and also include supplemental photos, videos and materials to help students understand what they are studying.

3. Improved assessment

Educational assessment focuses on how an educator knows whether a student is learning what is being taught. AI has the potential to change traditional assessments (essays, multiple-choice tests, short-answer questions) by identifying patterns in learning that may not be apparent to individual teachers or administrators. For example, the language-learning company Duolingo uses AI and machine learning to create and score tests of English proficiency for universities, companies and government agencies. The tests start with a series of standard questions, but based on how the student does with those, the system will select harder or easier questions to more quickly identify a student's exact abilities and weaknesses.

4. Personalized learning

Personalized learning occurs when the students' interests and goals guide learning. The teacher is more of a facilitator, while the what, why and how of learning are mostly dictated by the student. Artificial intelligence systems can provide individualized instruction tailored to each student's individual interests. AI adaptive learning systems can quickly identify when a student is struggling and then provide more or different support to help them succeed. As the student shows that they have mastered the content or skill, the AI tool provides more difficult tasks and materials to further challenge the learner. Chatbots with artificial intelligence systems can guide students with personalized, just-in-time feedback or assistance. These chatbots can answer questions about course content or structure. This helps students keep track of their own learning while keeping them motivated and engaged.

Much like an automated playlist of musical or video recommendations, an AI-powered recommender system can generate tailored assessment questions, detect misunderstandings and suggest new areas for a learner to explore. These AI technologies have the potential to help learners today and in the future [40].

Educators are still learning how AI technologies will integrate into the education sector as they develop, and they do not yet have a full picture of how AI will affect critical issues of ethics, equity and data safety. However, it is possible to pinpoint several key uses for artificial intelligence in education, including the following:

1. AI-Powered Educational Games

Teachers have long recognized the value of play-based learning, and schools have used educational computer games since the early days of computer gaming. Today's AI-powered games can deliver targeted learning thanks to user-responsive programming.

2. Adaptive Learning Platforms

Educational technology leaders such as Carnegie Learning and Knewton offer adaptive platforms that customize learning activities and content in real time. Continuous assessment allows for immediate feedback and helps the system adjust its approach. Adaptive learning methodologies vary from simple rules-based systems to multifaceted machine learning algorithms.

3. Automated Grading and Feedback Systems

By automating grading, planning and administrative work, artificial intelligence systems can free up educators' time and energy for increased student contact. This is a common argument in support of using AI in the classroom.

4. Chatbots for Student Support

At many higher education institutions, university chatbots support learners by responding to admissions queries, connecting students to course information and student services and delivering reminders. Other chatbots can help students brainstorm ideas, improve their writing skills and optimize their study time.

5. Intelligent Tutoring Systems

Often dedicated to a single subject such as math or language, intelligent tutoring systems simulate the one-on-one experience of working with a human tutor. Examples include the Duolingo app and Khan Academy's Khanmigo tutoring system.

In October 2023, Forbes Advisor surveyed 500 practicing educators from around the U.S. about their experiences with AI in the classroom. The following results reveal a snapshot of how artificial intelligence is impacting education.

More than half of the teachers who responded to Forbes Advisor's survey said they believe AI has had a positive effect on the teaching and learning process. Less than 1 in 5 cited a negative effect. 60% of educators use AI in their classrooms.

Moreover, AI tools for teacher and student support are growing in popularity. The survey found that younger teachers are more likely to adopt these tools, with respondents under 26 reporting the highest usage rates. Teachers use AI-powered educational games more often than any other AI tools, but adaptive learning platforms and automated grading and feedback systems are also popular. As the adoption of AI in the classroom proliferates, students, teachers and schools must grapple with how to use these technologies responsibly. Chatbots such as ChatGPT have sparked controversy among educators about their potential to facilitate cheating and generate misinformation. Moreover, professionals and observers have raised critical questions about data privacy, algorithmic bias and access disparities as they relate to AI. Academic dishonesty tops the list of educators' concerns about AI in education. Teachers also worry that increased use of AI may mean learners receive less human contact. Most of the teachers have observed students using AI, particularly generative AI, which can compose essays and supply answers on demand, to cheat.

In response to the growing presence of AI in education, organizations like the U.S. Department of Education (ED) and UNESCO have called for a transparent, human-centered approach to the use of these technologies. ED recommends prioritizing educators' perspectives in developing AI solutions that enhance and support teachers' traditional roles rather than attempt to replace them. UNESCO advocates for equity-focused AI in education policies aimed at narrowing technological gaps within communities and worldwide.

Although artificial intelligence presents novel concerns for the education sector, most teachers reported a positive outlook on the future. Ninety-eight percent of the survey respondents identified a need for at least some education on ethical AI usage. More than 60% recommended comprehensive education. Nearly all of the teachers predict that artificial intelligence will continue to impact classrooms of the future. However, most do not envision it playing a central role.

Thus, today's education professionals are watching a technological revolution unfold in real time as AI-enabled learning platforms, educational games, chatbots, virtual tutors and organizational tools become more widespread every day. As

observers on the front lines, teachers are well-positioned to identify major concerns regarding the education sector's adoption of AI-powered tools. The survey found that respondents were the most worried about issues like cheating, loss of human interaction, job security, equity and safety.

Despite these concerns, educators seem optimistic about the potential of AI in the classroom. Acknowledging that artificial intelligence will likely play an expanding role in education, most teachers have already begun to integrate AI tools into their daily work routines [41].

It is a matter of common knowledge that the traditional education system faces several issues, including overcrowded classrooms, a lack of personalized attention for students, varying learning paces and styles, and the struggle to keep up with the fast-paced evolution of technology and information. As the educational landscape continues to evolve, the rise of AI-powered chatbots emerges as a promising solution to effectively address some of these issues. Some educational institutions are increasingly turning to AI-powered chatbots, recognizing their relevance, while others are more cautious and do not rush to adopt them in modern educational settings. Consequently, a substantial body of academic literature is dedicated to investigating the role of AI chatbots in education, their potential benefits, and threats.

It should be noted that AI-powered chatbots are designed to mimic human conversation using text or voice interaction, providing information in a conversational manner. Chatbots' history dates back to the 1960s and over the decades chatbots have evolved significantly, driven by advancements in technology and the growing demand for automated communication systems.

Chatbots are now used across various sectors, including education. Most of the latest intelligent AI chatbots are web-based platforms that adapt to the behaviors of both instructors and learners, enhancing the educational experience. AI chatbots have been applied in both instruction and learning within the education sector. Chatbots specialize in personalized tutoring, homework help, concept learning, standardized test preparation, discussion and collaboration, and mental health support. Some of the most popular AI-based tools /chatbots used in education are:

- Bard, introduced in 2022, is a large language model chatbot created by Google AI. Its capabilities include generating text, language translation, producing various types of creative content, and providing informative responses to questions. Bard is still under development, but it has the potential to be a valuable tool for education.
- ChatGPT, launched in 2022 by OpenAI, is a large language model chatbot that can generate text, produce diverse creative content, and deliver informative answers to questions. However, there are numerous concerns related to the use of ChatGPT in education, such as accuracy, reliability, ethical issues, etc.
- Ada, launched in 2017, is a chatbot that is used to provide personalized tutoring to students. On the one hand, it can answer questions, provide feedback, and facilitate individualized learning for students. On the other hand, it could misinterpret context and provide inaccurate responses.
- Replika, launched in 2017, is an AI chatbot platform that is designed to be a friend and companion for students. It can listen to students' problems, offer advice, and help them feel less alone. However, given the personal nature of conversations with Replika, there are valid concerns regarding data privacy and security.
- Socratic, launched in 2013, had the goal of creating a community that made learning accessible to all students. Currently, Socratic is an AI-powered educational platform that was acquired by Google in 2018. It has a chatbot-like interface and functionality designed to assist students in learning new concepts. Like with other chatbots, a concern arises where students might excessively rely on Socratic for learning. This could lead to a diminished emphasis on critical thinking, as students may opt to use the platform to obtain answers without gaining a genuine understanding of the underlying concepts.
- Habitica, launched in 2013, is used to help students develop good study habits. It gamifies the learning process, making it more fun and engaging for students. Students can use Habitica to manage their academic tasks, assignments, and study schedules. By turning their to-do list into a game-like experience, students are motivated to complete their tasks and build productive habits. However, the gamified

nature of Habitica could inadvertently introduce distractions, especially for students who are easily drawn into the gaming aspect rather than focusing on their actual academic responsibilities.

- Piazza launched in 2009, is used to facilitate discussion and collaboration in educational settings, particularly in classrooms and academic institutions. It provides a space for students and instructors to engage in discussions, ask questions, and share information related to course content and assignments. The quality and accuracy of responses can vary because discussions on Piazza are user-generated. This variability may result in situations where students do not receive accurate and useful information [42].

We will likely see even more widespread adoption of chatbots in education in the years to come as technology advances further. Chatbots have enormous potential to improve teaching and learning. A large body of literature is devoted to exploring the role, challenges, and opportunities of chatbots in education.

It is evident that chatbot technology has a great impact on overall learning outcomes. Specifically, chatbots have demonstrated significant enhancements in learning achievement, explicit reasoning, and knowledge retention. The integration of chatbots in education offers benefits such as immediate assistance, quick access to information, enhanced learning outcomes, and improved educational experiences. However, there have been contradictory findings related to critical thinking, learning engagement, and motivation.

In terms of application, chatbots are primarily used in education to teach various subjects, including but not limited to mathematics, computer science, foreign languages, and engineering. While many chatbots follow predetermined conversational paths, some employ personalized learning approaches tailored to individual student needs, incorporating experiential and collaborative learning principles.

It is essential to acknowledge that the field of chatbot development is constantly evolving and requires timely and updated analysis to ensure that the information and assessments reflect the most recent advancements, trends, and developments in chatbot technology. The latest chatbot models have showcased remarkable capabilities in

natural language processing and generation. Additional research is required to investigate the role and potential of these newer chatbots in the field of education. It is necessary to focus on reviewing and discussing the results of using these new-generation chatbots in education, including their benefits and challenges from the perspective of both educators and students.

The integration of chatbots and virtual assistants into educational settings has the potential to transform support services, improve accessibility, and contribute to more efficient and effective learning environments. AI tools have the potential to improve student success and engagement. A few existing research studies addressing the student's perspective of using ChatGPT in the learning process indicate that students have a positive view of ChatGPT, appreciate its capabilities, and find it helpful for their studies and work. Students acknowledge that ChatGPT's answers are not always accurate and emphasize the need for solid background knowledge to utilize it effectively, recognizing that it cannot replace human intelligence. Common most important benefits identified by scholars are:

- Homework and Study Assistance. AI-powered chatbots can provide detailed feedback on student assignments, highlighting areas of improvement and offering suggestions for further learning. For example, ChatGPT can act as a helpful study companion, providing explanations and clarifications on various subjects. It can assist with homework questions, offering step-by-step solutions and guiding students through complex problems. Students can also use ChatGPT to quiz themselves on various subjects, reinforcing their knowledge and preparing for exams.
- Flexible personalized learning. AI-powered chatbots in general are now able to provide individualized guidance and feedback to students, helping them navigate through challenging concepts and improve their understanding. These systems can adapt teaching strategies to suit each student's unique needs. Students can access ChatGPT anytime, making it convenient. ChatGPT's interactive and conversational nature can enhance students' engagement and motivation, making learning more enjoyable and personalized.

- Skills development. It can aid in the enhancement of writing skills (by offering suggestions for syntactic and grammatical corrections), foster problem-solving abilities (by providing step-by-step solutions), and facilitate group discussions and debates (by furnishing discussion structures and providing real-time feedback).

It is important to mention the existing concerns about excessive reliance on AI-generated information, potentially leading to a negative impact on student's critical thinking and problem-solving skills. For instance, if students consistently receive solutions or information effortlessly through AI assistance, they might not engage deeply in understanding the topic.

With the current capabilities of AI and its future potential, AI-powered chatbots, like ChatGPT, can have a significant impact on existing instructional practices. Major benefits from educators' viewpoint identified in the literature are:

- Time-Saving Assistance. AI chatbot administrative support capabilities can help educators save time on routine tasks, including scheduling, grading, and providing information to students, allowing them to allocate more time for instructional planning and student engagement. For example, ChatGPT can successfully generate various types of questions and answer keys in different disciplines. However, educators should exercise critical evaluation and customization to suit their unique teaching contexts. The expertise, experience, and comprehension of the teacher are essential in making informed pedagogical choices, as AI is not yet capable of replacing the role of a science teacher.

- Improved pedagogy. Educators can leverage AI chatbots to augment their instruction and provide personalized support. There are various ways in which teachers can utilize ChatGPT to enhance their pedagogical approaches and assessment methods. For instance, educators can leverage the capabilities of ChatGPT to generate open-ended question prompts that align precisely with the targeted learning objectives and success criteria of the instructional unit. By doing so, teachers can tailor educational content to cater to the distinct needs, interests, and learning preferences of each student, offering personalized learning materials and activities.

Scholars' opinions on using AI in this regard are varied and diverse. Some see AI chatbots as the future of teaching and learning, while others perceive them as a potential threat. The main arguments of skeptical scholars are threefold:

- **Reliability and Accuracy.** AI chatbots may provide biased responses or non-accurate information. If the chatbot provides incorrect information or guidance, it could mislead students and hinder their learning progress. Although ChatGPT exhibited captivating and thought-provoking answers, it should not be regarded as a reliable information source.
- **Fair assessments.** One of the challenges that educators face with the integration of chatbots in education is the difficulty in assessing students' work, particularly when it comes to written assignments or responses. AI-generated text detection, while continually improving, is not yet foolproof and can produce false negatives or positives. This creates uncertainty and can undermine the credibility of the assessment process. Educators may struggle to discern whether the responses are genuinely student-generated or if they have been provided by an AI, affecting the accuracy of grading and feedback. This raises concerns about academic integrity and fair assessment practices.
- **Ethical issues.** The integration of AI chatbots in education raises several ethical implications, particularly concerning data privacy, security, and responsible AI use as AI chatbots interact with students and gather data during conversations, necessitating the establishment of clear guidelines and safeguards.

To summarize, incorporating AI chatbots in education brings personalized learning for students and time efficiency for educators. Students benefit from flexible study aid and skill development. However, concerns arise regarding the accuracy of information, fair assessment practices, and ethical considerations. Striking a balance between these advantages and concerns is crucial for responsible integration in education.

As technology continues to advance, AI-powered educational chatbots are expected to become more sophisticated, providing accurate information and offering even more individualized and engaging learning experiences. They are anticipated to

engage with humans using voice recognition, comprehend human emotions, and navigate social interactions. Consequently, their potential impact on future education is substantial. This includes activities such as establishing educational objectives, developing teaching methods and curricula, and conducting assessments. Educational institutions may need to rapidly adapt their policies and practices to guide and support students in using educational chatbots safely and constructively. Educators and researchers should continue to explore the potential benefits and limitations of this technology to fully realize its potential [42].

There is a strong consensus that creativity is a crucial 21st-century competency. Education systems report the importance of creativity. Similarly, AI is significantly impacting a growing number of fields, including education. Globally, education systems are developing strategic plans to embed AI in classrooms adequately. Whilst the importance of both creativity and AI are well established, less is known about how students perceive and value the relationship between AI and creativity.

Artificial Intelligence is a branch of computer science that uses algorithms and machine learning techniques to replicate or simulate human intelligence. Within the education context, artificial intelligence development will likely remain in the form of narrow AI. Current educational technologies include speech semantic recognition, image recognition, augmented reality/virtual reality, machine learning, brain neuroscience, quantum computing, blockchain, etc. These technologies are rapidly being integrated within classrooms. Literature studies show that artificial intelligence technology in education has been used in at least 10 aspects: automatic grading system, interval reminder, teacher's feedback, virtual teachers, personalized learning, adaptive learning, augmented reality/virtual reality, accurate reading, intelligent campus, and distance learning.

The Artificial Intelligence in Education (AIED) community emphasizes the creation of systems that are as effective as one-on-one human tutoring. Over the last 25 years, there have been significant advances toward achieving that goal. However, by enforcing the human tutor/teacher as the gold standard, a typical example of AIED practices has often included a student working with a computer to solve step-based

problems focused on domain-level knowledge in subjects such as science and mathematics. However, this example does not consider the recent developments in education practices and theories, including introducing 21st-century competencies. The 21st-century competency approach to education emphasizes the value of general skills and competencies such as creativity. Today's classrooms strive to incorporate authentic practices using real-world problems in collaborative learning settings. To maintain its relevance and increase its impact, the field of AIED has to adapt to these changes [43].

Increasingly, students are using AI for help with their schoolwork. Whether it is for drafting essays, learning new languages or studying history and science, AI tools are becoming a staple in students' academic toolkit.

Students tend to view AI as having a positive impact on their creativity as it is helpful for brainstorming. AI is useful for kick-starting brainstorming sessions. When using AI, students generate more diverse and detailed ideas. AI can also serve as a nonjudgmental partner for brainstorming, which can prompt a free stream of ideas students might normally withhold in a group setting.

The downside of brainstorming with AI is that some students voice concerns about overreliance on the technology, fearing it might undermine their own thoughts and, consequently, confidence in their creative abilities. Some students report a "fixation of the mind," meaning that once they see the AI's ideas, they have a hard time coming up with their own. Some students also question the originality of ideas generated by AI. This is likely due to generative AI recycling existing content rather than creating original thought.

It is clear that allowing students to practice creativity independently first will strengthen their belief in themselves and their abilities. Once they accomplish this, AI can be useful in furthering their learning. Students often use AI in the idea-generation phase of creativity, but it is necessary to emphasize the importance of developing skills at the start and end of the creative process. The essential tasks of defining problems and critically evaluating ideas still rely heavily on human input.

The creative process typically involves three phases, such as problem identification, idea generation and evaluation. AI shows promise in aiding students in the idea generation phase of the creative process. However, the current generation of AI, such as ChatGPT-3, lacks the capacity for defining the problem and refining ideas into something actionable.

AI's growing role in education brings many advantages, but keeping the human element at the forefront is crucial. Content ownership, plagiarism and false or misleading information are among the current challenges for implementing AI in education. As generative AI gains popularity, schools are pressed to set guidelines to ensure these tools are used responsibly. Some states, such as California and Oregon, have already developed guidelines for AI in education. Ethical considerations are vital for a positive relationship between creativity and AI. AI in education is not just about the latest technology. It is about shaping a future where human creativity and technological advancement progress hand in hand [44].

As gloomy predictions foretell the end of homework, education institutions are hastily revising their policies and curricula to address the challenges posed by AI chatbots. It is true that the emergence of chatbots does raise ethical and philosophical questions. Yet, through their interactions with AI, students will inevitably enhance skills that are crucial in our day and age: language awareness and critical thinking.

We are aware that this claim contradicts the widespread worries about the loss of creativity, individual and critical thinking. However, a shift in perspective from the 'output' to the 'user' may allow for some optimism.

It is not surprising that the success of ChatGPT passing an MBA and producing credible academic papers has sparked worry among educators about how students will learn to form an opinion and articulate it. This is indeed a scary prospect: from the smallest everyday decisions to large-scale, high-stakes societal issues, people form their opinions through gathering information, (preferably) doing some research, thinking critically while they evaluate the evidence and reasoning, and then make their own judgement. In contrast, ChatGPT evaluates the vast dataset it has been trained on,

and save people the hard work of researching, thinking and evaluating. The AI application does not explain its actions and their consequences. Moreover, a chatbot does not communicate the way humans do; it does not know the actual purpose of the text, the intended audience or the context in which it will be used – unless specifically told so.

Users need to be savvy in both prompting and evaluating the output. Prompting is a skill that requires precise vocabulary and an understanding of how language, style or genres work. Evaluation is the ability to assess the output. In academic scholarship this kind of knowledge is called language awareness. Language awareness has several levels: the first one is simply noticing language(s) and its elements. The second level is when users can identify and label the various elements, and creatively manipulate them. For the best results, users need to prompt it right, and then check the produced text against the prompt criteria. For this they need to understand the nuances of language, context and intended purpose.

This knowledge is important because of the third level of awareness. This is when people realize how language creates, affects and manipulates their perceptions of reality. This knowledge is invaluable in our age of misinformation and populism when the issues society grapples with are mostly abstract and intangible. The more people know about how language works, the more they start to notice how politicians and the media create versions of the world for them through their communications.

It is impossible to predict the extent to which AI applications like ChatGPT will disrupt the world of education and work. For now, society can both prepare for the dangers of AI and embrace its potential. In the process of learning how to interact with AI well, however, people are bound to become “prompt savvy”, and with that more aware of how language works. The power to consume texts with a critical eye comes with such language awareness. A glimmer of optimism for a sustainable future is that critical reading leaves less room to manipulation and misinformation [45].

The question of how generative AI tools, such as large language models and chatbots, can be leveraged ethically and effectively in education is ongoing. Given the

critical role that writing plays in learning and assessment within educational institutions, it is of growing importance for educators to make thoughtful and informed decisions as to how and in what capacity generative AI tools should be leveraged to assist in the development of students' writing skills.

Automated writing evaluation (AWE) systems such as Grammarly and Pigai assist learners and educators in the writing process by providing corrective feedback on learner writing. These systems, and older tools such as spelling and grammar checkers, rely on natural language processing to identify errors and infelicities in writing and suggest improvements. However, with the recent unleashing of highly sophisticated generative pretrained transformer (GPT) large language models (LLMs), such as GPT-4 by OpenAI and PaLM 2 by Google, AWE may be entering a new era. GPT-powered programs are capable of not only correcting errors in essays, but can also compose essays. Given a simple prompt, generative artificial intelligence (GenAI) LLMs and chatbots that allow users to interface with LLMs, such as ChatGPT and Bard, can produce complete essays that are passable at the university level. It is also possible for English as a new language (ENL) writers to use GPT-powered machine translation to turn their essays written in their first language (L1) into an English essay, take problematic writing and correct any mistakes, change its tone from informal to academic, or add cohesive elements like discourse markers. Educators have begun to use AI-powered plagiarism detectors to identify student submissions that were generated by AI, yet AI paraphrasing programs like Quillbot have been found to render AI-generated text undetectable by such tools [46].

ChatGPT is a public-facing GenAI chatbot that allows users to interface with LLMs. GenAI chatbots have been trained on a large corpus of language from the Internet to statistically predict the next most probable word in response to a user prompt; these responses are then put through an algorithm of reinforcement learning. From this relatively simple premise these tools can generate, synthesize, or modify natural language to a high degree of sophistication, and are rapidly becoming more sophisticated. GenAI has proven capable at a variety of tasks including writing essays

or creative texts such as poems or stories, writing or correcting computer programming code, answering questions, summarizing and paraphrasing provided text, and synthesizing disparate tones and styles to generate new and creative text. The vast capabilities and ease of use of GenAI chatbots have led to widespread concerns of the misuse of these tools by students.

Educational systems currently rely on student formative and summative writing in assessment and instruction to develop and assess critical thinking, argumentation, synthesis of information, knowledge and competence, and language proficiency; but the benefits of writing extend in other ways, such as learning about oneself, participating in a community, or simply to occupy free time. With writing being a beneficial and critical component of many educational systems, the task of reforming these systems to accommodate GenAI authoring apps seems both daunting and unappealing. Yet the historical lesson of pocket calculators shows that it is equally unappealing to prohibit the technology, or even ignore it.

From the perspective of learners, the use of AI by teachers and institutions may need to be negotiated in terms of what is appropriate and ethical. Major exams such as the GRE and TOEFL often rely on AI-enabled AWE programs to score large numbers of essays, as algorithmic assessment of writing reduces bias and noise and is likely more consistently accurate than the judgments of human experts. But with easily accessed AWE tools like Grammarly, and GenAI tools like ChatGPT, it is simple for any teacher to offload the responsibility of essay evaluation to automated processes. Personalized learning through evaluating and giving feedback on essay writing has been identified as a potential strength of GenAI, which can, in turn, help decrease teacher workload and prevent teacher burnout. However, teachers will need to make informed decisions regarding if and when to incorporate AWE by consulting learner perceptions and considering the benefit to learning.

Although Grammarly has been shown to be useful as an AWE tool, it is not yet known whether ChatGPT and similar GenAI tools can effectively or reliably be used for this purpose, and whether learners will accept feedback from these tools. Programs like Grammarly and Pigai are specifically designed for essay evaluation and scoring

using latent semantic analysis, a modeling approach that relies on large corpora of essays to determine whether a student's writing is statistically similar to writing in that corpora in terms of both mechanics and semantics.

GenAI has many known and unknown limitations which need to be considered before using it as an AWE tool. One of the limitations identified by OpenAI itself is the tendency for ChatGPT to produce text that is untruthful and even malicious. ChatGPT does not function as an information retrieving program in the way that internet search engines do, for example, and only produces text that is tailored to the user prompt using the statistically best-fitting combination of words. Considering students' tendency to accept information from AWE tools without verifying it, this suggests a need to teach learners to approach GenAI-produced output critically. Other relevant concerns about the use of GenAI are bias in output and privacy of user data. Although OpenAI is working on solutions to these issues, safeguards are still vulnerable to certain prompting practices.

The accuracy and efficacy of GenAI chatbots relies to some extent on prompt engineering. Prompt engineering is the practice of optimizing the language of a prompt with the intention of eliciting the best possible performance from LLMs. With prompt engineering, users can guide ChatGPT to desired behaviors by specifying things like task, context, outcome, length, format, and style.

Prompting for optimal AWE application is not yet fully explored. It is not yet known whether such a practice would produce corrective feedback reliably from LLMs.

Ultimately, the success of any learning technology depends on whether users adopt it. It is clear that the primary influences on user adoption of technology are in its perceived ease of use and perceived usefulness. Several studies reported that students and teachers viewed AWE scores negatively compared to scores provided by human raters. However, studies with ENL populations have noted that students often find human feedback to be confusing. One advantage of LLMs is the ability to tailor the output by, for example, asking the chatbot to reiterate feedback in easier to understand terms or to explain things further [46].

Artificial intelligence-based programs are quickly improving at writing convincingly on many topics, for virtually no cost. It is likely in a few years they will be churning out C-grade worthy essays for students. One could try to ban them, but this software is highly accessible. It would be a losing battle. Long-form writing, especially essay writing, remains one of the best ways to teach critical analysis. Teachers rely on this mode of assessment to gauge students' understanding of a topic.

Thus, it is necessary to find ways to help students of all disciplines thrive alongside advanced automation and smart systems, rather than resist them. This involves training students to work with AI tools, rather than banning them.

In February 2019, GPT-2, an AI-powered text generating system was released by OpenAI. Those interested can try the system themselves by following the instructions, or experiment with Talk to Transformer, an online tool made using GPT-2. The idea behind GPT-2 is similar to the predictive text function on a smartphone. A machine learning system was given 8 million web pages, and told to look at blocks of text to predict what word would come next. The system compared its guess with the actual text to “learn”. This was repeated billions of times, resulting in the GPT-2 software. Often within minutes, GPT-2 can generate texts that look like they were written by a human. They are grammatically correct, thematically coherent, engaging and even informative.

There are a number of systems similar to GPT-2, including Google's BERT, ERNIE2.0, XLNet and Facebook's RoBERTa. But GPT-2 has caught on with tinkerers across the web – lauded for its power and ease of use in generating new texts. GPT-2 comes in forms that let anyone use it easily, even without a powerful computer. Such tools are a looming problem for schools and universities. People are already experimenting with GPT-2 for poetry, text-based role-playing games, and plays written in a Shakespearean style. Worryingly, it can also produce endless streams of fake news.

At this point, the following question arises: what can institutions do about such “plagiarized” work flooding their classrooms? One response would be to ban AI tools. Leaders of 40 universities in the UK have taken this approach against essay

mills, pushing to make them illegal. Essay mills are run by people who charge students a fee in exchange for completing their work.

But it is unclear how such a ban could be enforced once AI software is easy to access. Institutions could look to existing rules against academic misconduct, but accurate detection becomes a challenge. Additionally, as AI-generated texts get better, it is difficult to prove (without watching them) that a student did or did not write a text themselves.

Rather than pretending AI does not exist, it might be time to train people to write with AI. Most good writers do not write in isolation; they talk and revise their work with others. Also, 90% of writing is revision, which means the ideas and arguments in a text change and develop as a writer reads and edits their own work. Thus, systems such as GPT-2 could be used as a first-draft machine, taking a student's raw research notes and turning them into a text they can expand on and revise. In this model, teachers would evaluate a work, not just on the basis of the final product, but on a student's ability to use text-generating tools.

Powerful AI tools could help us analyze and communicate complex ideas. There is one more question we need to consider: why do we teach students to write at all if we are to live in an AI-friendly world?

One major reason is many jobs rely on being able to write. When teaching writing, it is important to think about the social and economic implications of a type of text.

Much of today's media landscape, for instance, runs on the continuous production and circulation of blog posts, tweets, listicles, marketing reports, slide presentations, and e-mails. While computer writing might never be as original, provocative, or insightful as the work of a skilled human, it will quickly become good enough for such writing jobs.

If educators teach students to write things a computer can, then they are training them for jobs a computer can do, for cheaper. Educators need to think creatively about the skills they give students. In this context, educators can treat AI as an enemy, or they can embrace it as a partner that helps learn more, work smarter and faster [47].

The arrival of AI in the classroom is more than just a technological breakthrough; it raises fundamental questions about the current education system. This fusion of technology and teaching is not only transforming the way students learn, but is also generating a debate about its implications, challenges, and opportunities in the academic sector. Therefore, the irruption of AI in the world of education is a paradigm shift that is worth analyzing in depth. While some professionals and teachers see AI as a tool that could offer a qualitative leap in the field of education, others express caution and concern about its ethical and pedagogical implications. AI promises to open up new horizons and new ways of learning. Let us summarize the advantages and disadvantages of using AI in education. It is possible to highlight the following advantages of AI for teachers and students:

- Personalization of learning. AI allows adapting study materials to the level of each student. This means that each individual can learn at their own pace, strengthening their weaknesses and advancing in areas where they show greater ability.
- Administrative efficiency. Educational institutions can use AI to automate administrative tasks, allowing educators to focus more on teaching and less on bureaucracy.
- Accessibility. AI facilitates student access to high-quality educational resources, regardless of economic status or geographic location.
- Continuous assessment. AI can assess each student's progress and provide real-time feedback, helping them identify their strengths and areas for improvement.
- Despite these advantages, there are the following disadvantages of using AI in education:
 - Technological dependency. With the integration of AI, there is a risk that both educators and students will become too dependent on technology, affecting the development of what we know today as power skills.
 - Privacy issues. When using AI-based platforms, student data may be at risk if not properly managed.
 - Depersonalization. While AI can personalize learning, it can also cause the educational process to become mechanized and unnatural.

- Memory weakening. Previously, students were forced to memorize all types of data such as historical dates, authors, etc. The Internet has made knowledge ubiquitous and easily accessible. Therefore, the ability and habit of memorization has gone decreasing as the Internet advanced. This process of “collective forgetting” will increase exponentially with AI [48].

The power of AI systems is placing a huge question mark over our education and assessment practices. Assessment in schools and universities is mostly based on students providing some product of their learning to be marked, often an essay or written assignment. With AI models, these “products” can be produced to a higher standard, in less time and with very little effort from a student. In other words, the product a student presents may no longer provide genuine evidence of their achievement of the course outcomes. Thus, it is necessary to think of ways AI can be used to support teaching and learning, rather than disrupt it. Here are three ways to do this.

- Just as Wikipedia and Google did not spell the end of assessments, neither will AI. In fact, new technologies lead to novel and innovative ways of doing work. The same will apply to learning and teaching with AI. Rather than being a tool to prohibit, AI models should be meaningfully integrated into teaching and learning.

- One thing an AI model cannot emulate is the process of learning, and the mental aerobics this involves. The design of assessments could shift from assessing just the final product to assessing the entire process that led a student to it. The focus is then placed on a student’s critical thinking, creativity and problem-solving skills. Students could freely use AI to complete the task and still be marked on their own merit.

- Instead of switching to in-class examination to prohibit the use of AI (which some may be tempted to do), educators can design assessments that focus on what students need to know to be successful in the future [49].

According to experts and the best educational leadership magazines, it is important to implement AI in education efficiently, in a strategic and orderly manner. Teachers must be equipped with the skills and knowledge necessary to effectively use

AI in education. This includes understanding the tools available and how to adapt them to the needs of their students. Finding a balance between traditional teaching and AI-based tools is critical to ensure successful implementation. Technology should be a complement, not a substitute, for human interactions in the classroom. Ethics must be a primary consideration during the implementation of AI in education. Educational institutions must ensure that student data is protected and that the technology is used responsibly. Technology and its applications are constantly evolving. Institutions must be willing to adapt and change, regularly reviewing how AI is used and whether it meets their stated educational goals. There is no doubt that we are facing a new pedagogical era, where digital tools must be combined with traditional ones to offer a more enriching educational experience [48].

AI holds a tremendous potential to reshape education, making it more personalized, accessible, and effective. AI technologies can revolutionize the way students learn, grow, and succeed. By embracing AI in education, teachers can equip students with the necessary skills and knowledge to thrive in a future that increasingly relies on technological advancements.