AI and ChatGPT for Advancing Teaching and Learning

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Technological advancements, especially artificial intelligence (AI), have significantly transformed educational practices. The development and adoption of Generative Pre-trained Transformers (GPT), particularly OpenAI's ChatGPT, has sparked considerable interest. The unprecedented capabilities of these models, such as generating humanlike text and facilitating automated conversations, have broad implications in various sectors, including education and health.

Keywords: artificial intelligence (AI) ; ChatGPT ; education

1. Introduction

Over the last decade, the world has experienced a rapidly changing landscape in educational practices, primarily due to technological advancements. Among these technologies, arguably the most impactful has been artificial intelligence (AI) [1] Recent progress and expansion in machine learning have led to the generation of sophisticated digital content, like generative artificial intelligence (GAI), capable of assisting education [2][3]. GAI is an unsupervised or partially supervised machine learning framework that generates outputs using statistics and probabilities [4][5] Through advances in deep learning (DL), the generative AI creates artificial relics using existing digital content, such as, but not limited to, video, images/graphics, text, and audio, by examining training examples and learning their patterns and distribution [6]. The extant literature has identified two major types of generative AI—Generative Adversarial Networks (GAN) and Generative Pre-trained Transformer (GPT) [6].

Generative Pre-trained Transformer (GPT) models have mainly been discussed during the past six months due to the advent of OpenAI ChatGPT, a technology often defined as a world changer [7]. GPT technology uses a large amount of publicly available digital content data (natural language processing) to process and produce humanlike text and can exhibit creativity in writing texts convincingly on most topics. GPT models can even engage customers in humanlike conversation and have been successfully implemented to perform several work tasks as customer service chatbots [8]. The latest technology development, Chat GPT, developed by OpenAI, is a versatile tool designed to streamline automated conversations and potentially make human operators redundant [9].

The ChatGPT technology has been through several iterations [10]. GPT-3 has 175 billion parameters, which is 10 times more than any previously developed language model. GPT-3 has become the basic NLP engine that runs the recently developed language model ChatGPT, which has attracted the attention of various fields, including, but not limited to, education [11][12] and health [13][14][15].

Following its launch on 30 November 2022, ChatGPT amassed over one million subscribers in just a week [16]. More recently, an even newer and more powerful model, GPT-4, was released on 14 March [17], featuring a staggering 170 trillion parameters, representing a staggering increase in computational processing capacity compared to the earlier model [18]. Moreover, as a demonstration of its language prowess, OpenAI declared that its LLM can pass the US bar exam in the legal profession with results in the ninetieth centile, compared with the 10th centile for the previous version of ChatGPT [19]. However, the technology remains limited in its accessibility, requiring users to pay a subscription fee and adhere to quantitative usage restrictions. While the achievements of this technology have been remarkable, the scientific community has expressed frustration due to OpenAI's lack of transparency regarding the training methods and data sources employed for the model, as well as the inner workings of GPT-4 beyond its user interface [20]. This new era of AI-driven revolutions has been defined by some authors as "the new AI gold rush" [21], emphasizing how all the most prominent players in IT are currently rushing to develop better and better models to beat the competition, in a freshly created fast-phased market.

These AI models' impact, especially ChatGPT's remarkable possibilities of use in the education sector, has led to a mix of emotions among educators [12]. This breakthrough in AI technology seems to be overhauling current educational norms, leading to debates. Some educators see ChatGPT and similar AI as a progressive step toward the future of education and

research. In contrast, others are doubtful and view it as a potential danger, with a risk of leading to a decrease in educational activities and fostering laziness among teachers and students due to reduced analytical skills [22][23]. Recently, as the topic has gained attention in the media, several scientific authors have attempted to evaluate possible possibilities and problems related to the advent of AI technologies in the sphere of education [11][12][23][24][25], and the UNESCO has also published a report attempting to discuss the main challenges and the emerging ethical implications of AI in higher education [26].

2. AI and ChatGPT for Advancing Teaching and Learning

The published scientific literature broadly suggests that AI technology possesses the potential to serve as a significant asset in education, occupying various roles that enrich both learning and pedagogical experiences. Authors have suggested that AI technology is an instrumental tool in essay grading [27][28], although the value and the efficacy of these AI-based grading tools remain largely unclear within the confines of the existing scientific literature. The literature has reported that ChatGPT exhibits the potential to automatize and improve the grading system and has suggested that ChatGPT could be utilized to semi automate the grading process for students' work by discerning both the strengths and weaknesses within a given task in a broad spectrum of assignments, including research articles, academic essays, and other forms of written coursework [29]. In this context, educators can adapt the reports generated by such a model to deliver beneficial feedback to students, whether in formative or summative assessment scenarios. Furthermore, with the assistance of ChatGPT, a more precise evaluation of a student's learning challenges, and progression can be ascertained. This can aid teachers in pinpointing the areas where learners encounter difficulties, allowing them to target interventions more effectively [29].

The deployment of AI for grading short answer responses in an online learning environment has been evidenced successfully in past studies [30][31]. Furthermore, it has been argued that an AI-powered automatic grader (to be used to prepare an exam preparation) could potentially serve as a teaching aid for the students and help them achieve higher exam scores. Furthermore, AI graders may contribute to a more impartial grading process [30][31]. However, it is worth considering that it is essential to study the importance of the grading explanation and transparency of the grading process that these systems are reporting to the students, which may be a pivotal aspect considering both ethical concerns related to the technology and its acceptability [30][32].

Additionally, since AI systems rely on existing data from prior evaluations for training, they may be suited explicitly for assessing standardized tests, such as nationwide professional education examinations, where data from past tests are abundant and standardized assessment is a priority. However, these systems may be less competent when assessing individual university exams that often undergo annual format alterations and where past evaluation data might be limited.

Moreover, deploying AI for evaluating complex assignments might prove insufficient, necessitating that AI grades be calibrated or weighted by considering various variables unique to each assignment. These variables could include the student's independent work and contribution, their comprehension and representation of the existing literature on a given topic, and scenarios with limited training data. A balanced evaluation procedure that synergizes both a transparent or explainable AI system (for perspectives and definitions of explainable AI, see, for example, [33][34]) and human involvement is likely to yield the most favorable results in terms of the quality of assessments and the acceptability of using AI for evaluating student work, at least in the foreseeable future [30].

Because of future AI support, teachers could potentially lessen their workloads, redirecting their primary focus towards crafting innovative lesson plans, engaging in professional development, and offering personalized coaching and mentorship to each student. All these activities are instrumental in enhancing students' learning performance for the skills and challenges of the future.

The potential of AI tools extends beyond grading and assessment; they can also be deployed for translating educational materials and fostering interactive and adaptive learning environments. Notably, generative models, such as GPT-4, exhibit substantial promise in these domains. GPT-4 has demonstrated high proficiency in translation tasks, surpassing previous solutions in terms of quality [9][35][36]. However, the novelty of this application is partially tempered due to the preexisting success of machine translation technologies, which have delivered satisfactory results in document translation already for several years [37][38]. Although this is not an entirely new development, it underscores the continuous advancements and improvements in the AI field, specifically in the sphere of machine translation. Envisioning learning materials translated quickly and automatically into several different languages is nowadays a potential perspective in the short term. These improvements hold the potential to further enhance and revolutionize learning experiences by providing

precise and efficient translations of educational content. This not only expands the accessibility of materials to a more diverse student population but also contributes to creating more responsive and adaptable learning environments.

The realm of individualized tutoring illustrates another dimension where AI demonstrates its great utility. The AI systems could adapt the instructional approach to accommodate each student's unique learning style and progress. This personalized guidance system has undergone successful testing across a variety of tutoring categories, such as medical training [39][40]; for a review, see [41]), computer science [42], and mathematics [43]. Additionally, AI systems have seen successful deployments as tutors beyond the traditional academic disciplines, serving as personal mindset coaches [44]. In the context of Adaptive Learning—where education is tailored to accommodate individual learning styles and progress [45]—AI systems can play an instrumental role. It has been suggested [46] that AI can offer a bespoke pedagogical approach finely tuned to each student's specific abilities, interests, and requirements. Such attempts have been reported in the scientific literature, underlining the feasibility and potential of this approach in enhancing learning experiences [36][47][48]. Thus, the emergence of AI as a powerful enabler of personalized learning attests to the technology's transformative potential and underscores its capacity to redefine educational experiences. As technology continues to evolve, the integration of AI within education is expected to become more sophisticated and effective.

The advanced features offered by ChatGPT present compelling opportunities for educators to enhance pedagogical practices by conceiving and integrating interactive classroom activities. According to [49], with the support of ChatGPT, educators are empowered to devise innovative teaching techniques. A case in point is the adoption of the flipped classroom approach, where learning opportunities are not confined to the classroom but extend to remote environments, thus fostering an atmosphere of independent study among students.

Atlas (2023) [50] claims that the capabilities of ChatGPT extend far beyond assisting teachers in creating quizzes, exams, and syllabuses. It is also a powerful tool for producing comprehensive lesson plans, engaging presentations, and other educational resources. This added support allows teachers to adapt and enhance these materials in more dynamic and captivating ways to meet diverse learning needs. With the burden of routine tasks lessened, teachers gain more time to reflect, innovate, and devise new teaching techniques and activities. ChatGPT also serves as a platform for interactive communication, allowing teachers to orchestrate more engaging classroom activities. Teachers can utilize ChatGPT to help generate teaching aids, such as slides that present the expected learning outcomes and the criteria needed to complete coursework [51]. Moreover, the AI tool's ability to quickly generate a more significant number of questions and prompts based on the course materials may serve to stimulate the students' problem-solving and critical-thinking abilities [29], parts of the learning process that are crucial in the context of modern education.

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