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## Generative Artificial Intelligence in Education, Part One: The Dynamic Frontier

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## **Generative Artificial Intelligence in Education, Part One: The Dynamic Frontier**

### **Abstract**

Generative artificial intelligence (GenAI), such as ChatGPT, has taken the world by storm. ChatGPT attracted 1 million users in 5 days and 100 million users in 2 months since its launch in November 2022. In this first article of a two-part series, we discussed the overall dynamic frontier of GenAI, its potential uses and benefits in education, essential abilities in the age of GenAI, and the corresponding issues and concerns of this new technology. In the next article of this series, we will expand upon the discussion of the dynamic frontier of GenAI to examine various aspects related to GenAI in education in international contexts.

**Keywords:** ChatGPT, GenAI in Education, Generative Artificial Intelligence, OpenAI

## **Generative Artificial Intelligence in Education, Part One: The Dynamic Frontier**

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### **Introduction**

Generative artificial intelligence (GenAI) utilizes unique algorithms to generate new content such as text, images, and music. One prominent GenAI example, ChatGPT, gained immense popularity since its public release in November 2022, attracting an estimated 1 million users within 5 days (Chatr, 2023) and reaching 100 million users in just two months (Tuebner et al., 2023). Traditional AI systems often rely on discriminative modeling, which classifies existing data points through supervised machine learning, offering computational efficiency and cost-effectiveness (Altextsoft, 2022; Sorribas, 2018). In contrast, GenAI's strength lies in its ability to process large amounts of data using transformer-based machine learning algorithms, although it incurs higher costs and requires more training time. A notable advantage of GenAI is its flexibility and adaptability in data processing, without relying on explicit and predefined classifications (Altextsoft, 2022; Lawton, 2023). ChatGPT, a cloud-based chatbot program, exemplifies Generative AI's capabilities, generating coherent and contextually appropriate text responses through natural language interaction with users.

With ChatGPT's natural language capability and smooth performance while interacting with users, people of all professions have leveraged this software tool for various tasks and purposes involving text generation, such as composing simple to relative complex textual codes of computer programming (professional) (Rahman & Watanobe, 2023). Other uses include

drafting essays (Fitria, 2023), preparing checklists for traveling, or even recommending restaurants. Some people also utilize ChatGPT as a personal companion, engaging in casual conversations to pass the time or simply have fun. In educational settings, ChatGPT can provide instantaneous feedback on student assignments (Dai et al., 2023), offer personalized learning experiences, generating lesson plans (Koraishi, 2023), or facilitate language acquisition (Kohnke et al., 2023). The potential uses for ChatGPT are virtually limitless, providing interactive and enjoyable experiences for users.

This article is the first in the two-part series of GenAI in Education. In this first article, we discussed the overall dynamic frontier of GenAI, its potential uses and benefits in education, essential abilities in the age of GenAI, and the corresponding issues and concerns of this new technology. In the next article of this series, we will expand upon the discussion of GenAI to examine the attitudes, applications, policies, initiatives, regulations, and adoption related to GenAI in education in international contexts.

### **The Dynamic Frontier of GenAI**

The recent development of GenAI technology pushes the limits of what is possible in terms of creative content generation using AI tools. Since 2019, Microsoft has partnered with and invested in OpenAI, the company that developed ChatGPT (Etherington, 2019). Witnessing the huge success and popularity of ChatGPT, Microsoft further integrated ChatGPT-style chat function and the latest GPT-4 technology into their search engine, Bing. The resulted product/service, Bing Chat, was released to all public starting May 4<sup>th</sup>, 2023 (Warren, 2023). The goal is to provide a more powerful and updated chatbot user experiences as ChatGPT was trained on pre-2021 data without real-time Internet access (e.g., search engines). Following the move of

Microsoft, major technology companies like Google also refocus resources and try to catch the trend by rolling out their own GenAI product (e.g., Bard) in direct response to ChatGPT.

In addition to text-generation GenAI, there are increasingly more stand-alone products and services powered by GenAI to create different types of content and serve various purposes. For example, Leonardo.ai and Midjourney are known for image generation capabilities. Leonardo.ai enables users to create unique production-ready game assets such as characters, props, textures, and environments, which helps game developers save time and reduce cost (Alves, 2023). Midjourney allows users to generate realistic images based on text prompts and provides the ability to vary the artistic styles, including realistic or abstract, for similar image generation (Yalalove, 2022). DALL-E, a text-to-image AI generator developed by OpenAI lab, allows edits on specific sections of an image based on further natural language text prompts (OpenAI, 2021).

There are also music GenAIs, like Amper Music and MuseNet, that utilize algorithms to analyze existing music and generate music in various styles such as jazz, pop, and classical (Simpson & Groff, 2023). Regarding video generation, Synthesia lets users create professional videos by typing in text prompts (Pathak, 2023). InVideo also creates videos based on users' text prompts, coupled with professionally designed in-program templates (McFarland, 2023).

## **GenAI in Education**

### **Potential Uses and Benefits**

As mentioned previously, the potential uses of GenAI (e.g., ChatGPT) are virtually limitless. This versatility is particularly applicable in educational contexts, as GenAI has natural language input and output capabilities, allowing it to generate a wide range of content for

teaching and learning. For example, after an exploratory “consultation” with ChatGPT, Trust et al. (2023) listed the 20 things on which ChatGPT suggested it could aid both teachers and students. The authors then further categorized one list for teachers and another for students. For teachers, ChatGPT can 1) provide support with teaching; 2) provide support with student assessment; 3) help support student learning; 4) offer suggestions for improving teaching; 5) support teacher-parent and teacher-student communication. To help students, the chatbot can provide support on the following: 1) personalized learning; 2) creative thinking; 3) assessment; 4) reading and writing comprehension. Teaching and learning are interconnected, making the roles of GenAI as a teaching assistant and learning partner complementary. GenAI has great potential to play a crucial role in facilitating the learning process and supporting assessment tasks, providing valuable assistance to both educators and students.

One of the most beneficial potential uses of GenAI in education is enabling efficient and effective personalized learning (Kuhail et al., 2023). While personalized learning is what every educator is striving for, it is time-consuming and potentially unrealistic in various contexts, depending on the target level of personalization and resources available. With the natural language capability and 24/7 availability, tools such as ChatGPT can provide convenient assistance to educators whenever it is needed in efficient and effective ways (Kohnke et al., 2023). By utilizing such tools, teachers can give prompts and receive reasonably useful text, which can be further customized to provide meaningful student feedback. This approach allows teachers to attend to the needs of every student without exhausting their time or energy. As a stand-alone tool, for example, ChatGPT, can be simply assigned as a chatbot to answer questions, support students to conduct individual/collaborative learning and research with human peers (Cooper, 2023; Ye et al., 2023) or with the chatbot (e.g., Pavlik, 2023), or help plan for

creative problem solving through generating ideas/concepts for facilitating discussions (Ray, 2023). In addition, if the appropriate GenAI algorithms and application programming interfaces (APIs) are integrated into digital learning platforms or learning management systems, students can experience the learning progression adapted to their needs and levels on specific subjects (Firat, 2023).

### **Essential Abilities in the Age of GenAI**

One important ability that learners and teachers need to acquire during the age of booming GenAI is how to create and provide effective prompts that guide GenAI applications in generating useful responses (Lo, 2023). Teachers can facilitate such discussions and provide scaffolding to help students develop strategies and experiences of using GenAI and creating discipline-specific prompts that can be adapted as the process goes. Applications such as ChatGPT will continuously learn and adapt from the interactions with users. For teachers and students alike, it is critical to develop and constantly improve their abilities to create meaningful and effective prompts while using GenAI tools.

Another crucial aspect of using GenAI, such as ChatGPT, is the ability to conduct critical research and evaluation. Teachers and students must carefully assess the generated content to determine its accuracy and potential biases. While GenAI can be a valuable tool, it is important to strike a balance and not overly rely on its capabilities. Maximizing the benefits while being cautious of its potential limitations is essential (Sallam, 2023). By exercising discernment and critical thinking, users can make informed decisions about the information provided by GenAI applications.

### **Issues and Concerns**

Despite the tremendous potential and possibilities of GenAI, there are issues and concerns revealed in the recent trends and discussions of using GenAI in education.

### ***Information Accuracy***

GenAI is very powerful in creating responses by leveraging the large data corpus it is trained on; however, tools such as ChatGPT have the limitations in terms of its information being up to date. For instance, ChatGPT are primarily trained on pre-2021 data, and not connected to the Internet while users interact and doing queries with ChatGPT (Temsah, 2023; Sallam, 2023). This means inaccurate information could cause some serious issue when teachers try to utilize GenAI for teaching and when students use it for learning. Along with the popularity and widespread uses of ChatGPT, users have reported the chatbot sometimes tend to make up wrong or nonexistent information in response to prompts. “ChatGPT hallucination” is a term coined to describe the issues of the chatbot providing information that is scientific plausible but factually inaccurate (Sallam, 2023; Surameery, 2023). To address this weakness, Microsoft integrated GPT-4 technology into its Bing search engine, hoping to maintain the strength of GenAI technology with the support of updated web search information. On the other hand, Google has provided a convenient button linked to Google’s search engine after users’ queries on Bard, encouraging users of its GenAI to explore further through more Internet search.

### ***Data Privacy***

After being released for public use, GenAI tools keep evolving every day and take in all kinds of user input to further train itself and improve. It is quite likely that sensitive personal information is entered as part of users queries and used for GenAI training (Sighn et al., 2022). This issue can especially be amplified when such a tool is integrated into learning management systems where students’ activities (e.g., inquiries, demographics etc.) are tracked. At the



burgeoning stage, GenAI tools attract many users including students, while at the same time lack the transparency on the types of data collected and how the data are handled (Ray, 2023). To safeguard user data privacy, it is crucial for regulatory scrutiny to stay abreast of the ever-evolving GenAI technology (Baidoo-Anu & Owusu Ansah, 2023). This includes ensuring appropriate measures are in place for personal data collection and usage, such as the provision of opt-out mechanisms by AI companies to prevent user data from being utilized in training the GenAI they employ (e.g., Lomas, 2023).

### ***Bias, Discrimination, and Ethical Issues***

Depending on the purposes, access, and resources, GenAI developers use a great variety of data and data sources to train their models. While the data volume used for training is large, the sources might still be tilted toward a certain side/aspect of controversial issues such as politics, history, and religions etc. Due to lacking transparency of data sources in general, it is possible to introduce discrimination associated with the bias in the data used to train GenAI. This can result in biased and unbalanced perspectives reflected in the responses generated by the AI applications based on user queries (Mhlanga, 2023). With GenAI's fluent natural language output and seemingly credible responses, bias can go unnoticed if students and teachers are not cognizant and solely rely on the information provided by GenAI. Scrutiny and measures need to be implemented to prevent the generation of harmful or offensive content. (Ray, 2023).

Also, there is ongoing debate on ethical and accountable uses of GenAI to assess students' learning and making decisions about students' performance. Additional ethical concerns arise when GenAI technology is manipulated for malicious purposes, including generating deceptive content and spreading propaganda. Mitigating these issues and ensuring the

safe and responsible use of GenAI, particularly in educational settings, requires collective efforts from stakeholders to guide and regulate its usage (Sallam, 2023).

## **Conclusion**

The powerful capabilities of GenAI capture the imagination of the public and take the world by storm. By taking and analyzing user prompts, GenAI can process natural language and generate meaningful content including all kinds of textual information, images, music, and video. While there are arguably endless possibilities of applications, GenAI can be especially useful in education, such as providing personalized learning experiences by adapting to learners' levels, serving as students' learning partner and teachers' teaching assistant, efficiently helping to provide individualized feedback, and supporting collaborating learning and research among students. Meanwhile, it takes careful planning and learning to optimally leverage GenAI's capabilities. It is important for students and teachers to develop abilities and experiences of giving effective and meaningful prompts so they can guide GenAI to respond with useful information.

While GenAI shows powerful capabilities, it is important to acknowledge the issues and concerns associated with this technology. For instance, the accuracy and up-to-dateness of information may be compromised due to the training data GenAI relies on and the absence of real-time access to Internet databases and search engines. Data privacy is also of significant concern, as users could provide various types of input that may include sensitive personal information, particularly in the case of students and minors. As the user base of GenAI technology continues to grow exponentially, it becomes crucial to prioritize the ongoing development of regulations and guidelines that ensure transparency and security in its

development. This will help address the ethical concerns associated with GenAI and promote responsible and accountable practices in its usage. Educators, positioned at the dynamic frontier, hold a unique role and play a critical part in facilitating learning and empowering learners by harnessing the potential of this new technology.

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