GENERATIVE AI AND PROMPT ENGINEERING IN EDUCATION

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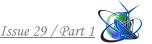
Abstract. *The development of generative AIs and the variability of their use are still at the level of research and active development simultaneously. However, it has already become clear that the emergence of generative AI significantly impacts many industries, including education.*

In this study, we explore the potential applications of generative AI in education, such as personalized learning tools and AI-powered study resources. We also delve into the critical role of prompt engineering in ensuring effective communication between users and AI systems, leading to improved educational outcomes. In addition, we identify the challenges and risks associated with integrating artificial intelligence technologies into the educational environment, including data privacy, security issues, and potential AI "hallucinations". By thoroughly exploring these topics, this study aims to highlight the opportunities and limitations of generative AI and prompt engineering in education.

Keywords: *Generative AI, education, ChatGPT, Prompt Engineering*

Introduction.

Generative AI is an incredibly powerful technology that was popularized by ChatGPT developed by OpenAI. The ChatGPT website has 1.43 billion users as of August 2023 [1]. ChatGPT has brought the revolution to the public by demonstrating the ability to understand not only simple commands but also complex speech patterns and generate well-structured responses. ChatGPT is a product of deep learning [2], which is a subtype of machine learning that mirrors the human brain in learning and responding to data, information, and cues [3]. The big players in the tech world were quick to respond. Google announced its own generative AI - Bard. Generative AI can be defined as a technology that (i) uses deep learning models to (ii) generate human-like content in response to (iii) complex and varied prompts (e.g., languages, instructions, questions) [18]. Several groundbreaking techniques have contributed to the development of generative AI, such as Generative Adversarial Networks (GANs) [5][6]. Eventually, the development of large-scale language models like BERT [7] and GPT [8] paved the way for the practical implementation of generative AI in various industries, including education. It is important to distinguish generative AI from conversational AI. As defined above, generative AI has the ability to not only provide a response but also generate its content based on the information it has been trained on [4], which is a very big difference from conversational AI, which typically relies on pre-formed responses. Key components of conversational AI include natural language processing (NLP), Natural Language Understanding (NLU), and natural language generation (NLG). It should be noted that not all generative AIs are conversational, nor do all conversational AIs lack the ability to generate content. Advanced AIs such as ChatGPT and Bard combine generative and conversational AI, making them much more attractive to the general public.

Generative AI in the educational process.

With the popularization of AI, a lot of research has begun to emerge on how AI can enhance the learning process by improving and optimizing both face-to-face learning and blended and online instruction.

A study of the popularization of online courses and blended learning during the COVID-19 pandemic [10] found that while these types of learning are significant, there are a number of challenges that AI can help solve. For example, an individualized approach to students. During online learning, teachers cannot always track how effective the information is. This problem can be solved by using AI to "tailor" information to the student's needs. Moreover, personalized learning can be facilitated by AI-powered tools that identify individual learning gaps and recommend content tailored to each student's unique context. AI-powered tools can also assist instructors in generating assessments and issuing grades and feedback automatically. This allows teachers to spend more time on actual teaching and student interaction. In addition, AI can help revolutionize assessments by evaluating students' performance over a more extended period, ultimately providing a fairer and more comprehensive evaluation system [11].

Intelligent learning systems, another area where AI is making strides, can mimic teachers, providing students with a personalized learning experience. Although they may be limited in their coverage of a particular field, these systems have proven effective in improving student performance and providing students with the right content.

However, the success of AI depends heavily on the availability and quality of student data, which has historically been a challenge for education companies as well as data researchers. The COVID-19 pandemic has dramatically expanded the use of educational products, thereby providing more data for AI systems. This data, in turn, has the potential to improve further and refine AI-based learning tools and methods.

In addition to the benefits already mentioned, AI technologies offer educators new opportunities to improve teaching methods, including learning analytics. Teachers can increase their effectiveness by using AI tools, and they can also promote self-regulation among their students. Despite these benefits, many educators have not yet used AI-driven technologies. Thus, it is critical to understand what the transition to using such technologies will entail and what obstacles they may face in their implementation. We must provide them with the digital competencies needed to enrich students' learning experiences.

Teachers' concerns about the introduction of AI into the classroom should also be taken into account. Some fear that they will be replaced, believing that AI will weaken their professional positions [12]. This may contribute to reluctance and slow down the adoption of AI technologies, as teachers may not understand that AI can complement, not replace them.

Teachers may hesitate to adopt AI-based tools because they often lack a clear understanding of how student data privacy is ensured and how to avoid algorithmic bias. In addition, a lack of infrastructure, funding, and support is often an obstacle to the widespread adoption of AI systems. Finally, teachers may not have the necessary technical and pedagogical knowledge and experience to successfully integrate AI

tools into the classroom, which may cause them to be hesitant and resistant to using them.

Effective use of Prompt Engineering in the educational context.

Prompt engineering is the process of structuring text that can be interpreted and understood by a generative AI mode [16], [17].

It is crucial to understand that the effectiveness of AI language models is influenced not only by the algorithms they use and the training data, but also by the quality of the instructions they receive [13], [15].

The capabilities of generative AI can be dramatically expanded with careful prompt engineering. Teachers can improve the assessment process, students can receive accurate, contextually relevant information. However, it should be realized that in some cases, users can even extract results from the generative AI model that it is not allowed to generate. This is known as reverse engineering or jailbreaking [14]. It is very important to take these features and concerns into account when integrating AI into the learning process.

Generative AI can contribute to the creation of learning content. However, communication and interaction between humans and generative AI revolve around engaging in critical conversations between these entities, which emphasizes the importance of creating appropriate prompts that require us to understand prompt engineering.

The goal of prompt engineering is to improve the model's responses by adapting them to the structure, content, and tone of the question. This, in turn, helps to achieve more accurate, valuable, or consistent answers. In the field of AI language models, prompt development involves creating well-designed prompts that elicit predictable responses, ensuring clarity, relevance, and accuracy.

To write good promos, the following strategies can be considered:

1. Clarify the objective: Explicitly state the intended purpose of your prompt. What type of response or information do you aim to obtain? Clearly define the desired learning outcome or the interaction you seek.

2. Be direct and concise: Craft prompts that are clear, concise, and free of ambiguity.

3. Provide context: Establish the setting or background for your prompt, allowing the AI model to better grasp the task or subject matter. Contextual cues aid in guiding the model's response and maintaining relevance.

4. Offer examples: If possible, furnish illustrations of the output you expect from the language model.

5. Specify the format: If you require a particular response format or structure, make sure to explicitly state it in the prompt. For instance, if you need a step-by-step answer or a pros-and-cons analysis, provide clear instructions accordingly.

6. Refine, optimize, and debug prompts: Continuously fine-tune your prompts to elicit more accurate, relevant, and contextually suitable responses from the model [18].

By adhering to these tactics, educators, researchers, and users can enhance the art of prompt engineering, yielding meaningful and precise responses from AI language models while aligning with their unique goals and prerequisites. From this

perspective, it can be argued that in education, prompt engineering can serve as a tool to stimulate critical thinking, and nurture a deeper understanding of the subject matter.

Generative AI full power becomes visible when it is guided by human prompts. Under human guidance, generative AI opens up endless creative possibilities. The key to ensuring effective communication and interaction between humans and generative AI is the skillful creation of prompts. The skillful creation and engineering of appropriate prompts is of paramount importance, as they directly affect the capabilities of generative AI.

Summary and conclusions.

Generative AI has significant potential to revolutionize the educational process by offering personalized learning experiences, improving assessments, and optimizing teaching methods. The role of prompt engineering is crucial to ensure effective communication between users and AI systems, leading to improved educational outcomes.

However, the integration of generative AI into the educational process also comes with certain challenges and risks, such as data privacy, security, potential misinformation, and the impact on human interaction. Addressing these issues and equipping teachers with the necessary digital competencies are important steps to fully utilize the potential of generative AI and rapid engineering, which will ultimately contribute to enriching and engaging students in the learning process. Suggested methods of effective use of Prompt engineering can notably enhance the interaction with Generative AIs.

Nevertheless, it is important to understand that the exploration of Prompt engineering and engagement with Generative Models are in preliminary stages and could undergo significant changes over time.

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