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ChatGPT in Education: Risks to Fairness of Access

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Abstract: In the rapidly changing ChatGPT world, human skills training is the need of the hour. With a large amount of data, ChatGPT is training itself day by day to understand human prompts and to provide appropriate results. A lot of prompt engineering courses educate learners in structuring the prompts based on how the ChatGPT engine processes any prompt and response. However, these courses do not target specific cognitive skills required by users (learners) to unfold, understand, and express what they really need and want to know from ChatGPT. In this paper, we look at ChatGPT as a tool to support knowledge acquisition and we discuss the questioning skill as an essential cognitive skill required to interact with and make optimal use of ChatGPT capabilities. We argue that risk to the fairness of access does not just stem from the monetary availability of such technologies, but it can also arise from the unpreparedness of the target users. The AI and ethics of AI literacy communities should also focus on training individuals on the cognitive skills needed to become optimal users of such technologies.

Keywords: ChatGPT, Cognitive skill, Question Posing, Prompt Engineering

1. Introduction

The advancement of AI-powered chatbot, ChatGPT has opened a new door to education. It is trained to perform complex tasks and give answers like humans. In education, ChatGPT is a more efficient tool compared to traditional search engines as it searches possible multiple sources and offers a written answer in a human-understandable form instead of only providing a list of multiple sources (Cascella et al., 2023). It can help students to access fine-grained information in a simplified way using prompts. ChatGPT can be used by learners to solve tasks such as writing code and explaining code and can be used to scaffold instructors in creating personalized programming exercises in computing education (Prather et al., 2023). ChatGPT has the potential to provide personalized support and feedback to students at different levels of complexity (Farrokhnia et al., 2023). It also has shown the capability to stimulate critical thinking among students by providing a set of questions designed based on every student's knowledge level and preferences to challenge them (Cotton et al., 2023).

However, a large array of articles has also discussed the limitations and drawbacks of ChatGPT. Gao et al. (2023), emphasize on lack of thorough comprehension of the meaning of the words that ChatGPT processes. Although it can spot patterns and arrive at reasonable solutions, it does not fully understand the meaning of the words (Bogost, 2022). This could lead to responses that occasionally lack depth and insight (Borji, 2023). Particularly for performing tasks that require a nuanced understanding of specific domain knowledge (Dimitrov, 2023). As pointed out by Zhong et al. (2023), while exploring the understanding ability of ChatGPT, it was observed that ChatGPT may generate some contradictory or unreasonable responses. They proposed that it can be overcome by advanced prompting strategies, i.e., the manual few-shot or chain of thought (CoT), which provides manual intermediate reasoning steps. Zheng (2023), tried to understand the failures of ChatGPT in complex open-domain question-answering

sessions. They found that the model gives general answers, not specific ones, and found the problem of ChatGPT in knowledge memorization, recall, and reasoning. So, they recommended providing background information, and external knowledge as specific as possible and decomposing complex problems into subproblems.

Loconte et al. (2023), showed that a large language model like ChatGPT lacks cognitive ability that needs to integrate with human prefrontal lobes, known as “prefrontal functions”. They investigated ChatGPT’s intelligence power using the same test used to evaluate prefrontal functioning in humans. They found poor planning abilities and difficulty in understanding others’ intentions and mental states. Hence ChatGPT lacks such demonstrable cognitive abilities.

2. User Competencies needed for ChatGPT

2.1 *Prompt Engineering Skill*

Prompt engineering allows learners to communicate effectively with ChatGPT by providing specific refined prompts. There exist different courses that aim at improving learner’s prompt engineering skills. These courses center on instructing prompt patterns and structuring sentence components to address specific challenges. The courses primarily aim to enhance learners’ understanding of Natural Language Generation (more specifically GPT) systems, such that the learners can determine the refinements of prompt patterns before engaging with ChatGPT. The process of refining prompt patterns involves selecting appropriate words while defining the prompt's focus, scope, and boundary. White et al. (2023), introduced a comprehensive catalog of prompt engineering techniques, classified into six pattern categories: input semantics, output customization, error identification, prompt improvement, interaction, and context control. The input semantics category focuses on understanding human prompts to generate relevant output, serving particularly well when faced with ill-structured prompts. Within the prompt improvement category, the use of question refinement prompt patterns allows ChatGPT to produce improved versions of user prompts.

2.2 *Question Posing Skill*

We argue that improved prompt generation necessitates not only a nuanced comprehension of generative AI technology, as taught through prompt engineering courses, but also demands cognitive skills essential for formulating relevant inquiries, commonly known as "question posing” (chin et al., 2010). The optimal utilization of the tool hinges on the capacity to formulate a well-constructed prompt that in turn depends on both the learner’s prompt engineering skills and their skill to precisely articulate the needed question. Crafting adequately useful prompts involves an individual’s competency at various levels including:

1. **Analysis and Identification of Knowledge Gap:** Identifying the gaps, inconsistencies, and conflicts in the prior understanding of the context. These are commonly expressed in the form of questions.
2. **Prompt Generation:** Generation of prompts based on the identified question and prompt engineering techniques.

Users should be able to express what they truly need from the generative AI system. Individuals must be able to reflect and express what they don't know and what they want to know. They must be able to decompose their knowledge needs based on their priorities. ChatGPT may solve complex open-question answering problems if prompts are carefully decomposed based on user priorities. Users who have been trained with question-posing (and prompt engineering) skills have a completely different ChatGPT experience than users who have not been trained.

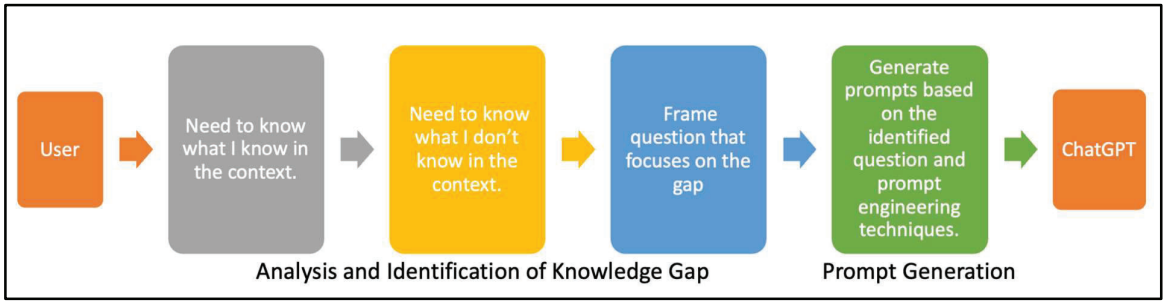

Figure 1. Antecedent cognitive processes to prompt generation

As illustrated in Figure 1, before writing any prompt, learners need to know what they know, what they don't know, or what they want to know, in order to receive a more specific response from ChatGPT. It is essential that users are aware that "what I know" represents prior knowledge checking, and "what I don't know" represents the context gaps. By identifying gaps in knowledge, users will be able to frame more focused questions from the beginning.

Prompt engineering has its own challenges like achieving the desired results on the first try, controlling the level of creativity of the result, and understanding and evaluating the reasoning behind the generated responses. Question posing (QP) can help to overcome some of the challenges of prompt engineering. QP is a cognitive tool that helps learners to think at a deep level and articulate their conflicts and beliefs to take meta-linguistic moves and formulate their concepts (Sasson et al., 2018). Question posing contains three parts. (1) Learners need to formulate what they know in the context based on their prior experience in the learning situation (Hwang et al., 2020). (2) Learners need to know what they don't know in the current context. (3) Frame questions targeting the gap (Mishra et al., 2015). According to Hwang et al. (2020), learners have difficulty in posing questions. Question posing is a skill that may help to pose the correct question on the first try.

3. Generative AI: Threats to Fair Access

In the context of education, today or in the future, if the quality of education is closely linked to artificial intelligence in education (AIED) systems, it becomes imperative to address the potential threats to equitable access to these systems. Ensuring equitable access to such technologies will directly influence equitable access to quality education. Among the common risks associated with these AIED systems is the risk of "access to the system", specifically, access to its capabilities.

Most of the time, we discuss external factors, such as the digital divide, the unavailability of devices for learners from underprivileged socio-economic backgrounds, and barriers to technology integration in education (Tsai et al., 2012; Hsu, 2016; Kopcha, 2012). However, as discussed before, learners' internal characteristics such as questioning skills can also significantly block one's access to the capabilities of intelligent AIED systems, including ChatGPT, as discussed before. In Figure 2, we have classified threats to fairness of access into external and internal factors. For example, the digital divide falls within the external category, while internal threats encompass an individual's lack of knowledge, cognitive skills, or competencies that directly hinder one's ability to make use of the affordances and capabilities that technology has to offer.

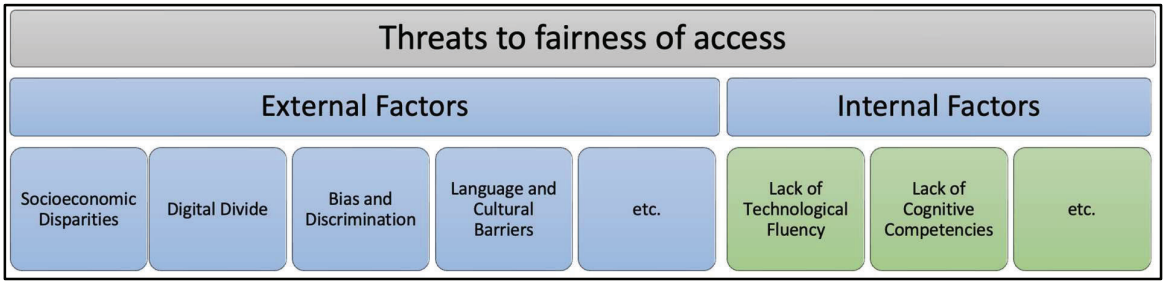

Figure 2. Categories of Threats to Fairness of Access

4. Discussion

UNESCO reports that during COVID-19, 850 million pupils, or half of the world's student population, were not able to attend school or college due to economic and social factors. This was stark evidence of inequitable access to e-learning primarily due to the digital divide. According to Singh et al. (2022), e-learning plays an important role in facilitating access to quality education. In the last eight years, the Government of India launched several e-learning initiatives, such as the Internet Saathi program, DIKSHA platform, Unnati project, E-pathshala, etc., as part of the Digital India campaign. These and similar projects throughout the world demonstrate the already significant reliance on information technology in education. It will not be surprising when quality education will similarly begin to rely on artificial intelligence-based educational technology in the very near future. We can easily anticipate such a future given the example of the technological storm brought in by the popular emergence of generative AI technologies in recent times. It should be noted that ChatGPT was launched on November 30, 2022, and the number of ChatGPT users exceeded 100 million by February 23. At this point, however, it is imperative to ask: How many of these 100 million users already had or have acquired the right competencies to make optimal use of ChatGPT-like technologies? The forthcoming reliance on AI in the educational domain is unavoidable, and at this point, it is imperative that we identify necessary preparations to take these technologies to individuals, including the needed training to develop the necessary competencies in individuals to make optimal use of such technologies.

We did not intend, in this paper, to present an exhaustive categorization of internal and external threats to fair access. Instead, our objective is to emphasize the need to identify and dig deeper into the essential internal competencies needed by users (learners, teachers, etc.) in order to effectively utilize existing and evolving artificial intelligence-based educational technologies, and develop training programs to develop such competencies among individuals. More specifically, we intended to emphasize the need to scaffold the development of question-posing skills with a lens that students' questions are critical to their exploration of new knowledge and deeper conceptual understanding (Mishra et al., 2015), especially in the context of AI supported self-learning modalities.

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