

Leveraging Large Language Models in Education: Enhancing Learning and Teaching

Professor Hossein Saiedian

The University of Kansas

Abstract. The integration of Large Language Models (LLMs) into education represents a significant advancement in the realm of teaching and learning. This paper explores the potential benefits, challenges, and ethical considerations surrounding the use of LLMs in education. Through a detailed analysis of various LLM tools, including ChatGPT, and practical examples, this paper demonstrates how LLMs can enhance personalized learning, improve teaching practices, and empower both students and educators in the digital age.

Keywords: Large language models, OpenAI ChatGPT, Google Bard

The Landscape of LLM Tools

Artificial Intelligence (AI) has rapidly evolved and has found its way into various sectors, including education. Large Language Models (LLMs) like ChatGPT and Bard have emerged as powerful tools that can revolutionize the way education is delivered and experienced. LLMs possess the ability to engage in interactive conversations, generate human-like text, and assist in various educational tasks. This paper aims to delve into the capabilities of LLMs, focusing on ChatGPT, and explore their potential to transform education by promoting personalized learning, facilitating content creation, and augmenting instructional methodologies.

The realm of LLMs in education encompasses a diverse range of tools that exhibit varying degrees of sophistication and utility. Among the most prominent LLM tools are ChatGPT 3.5 and ChatGPT 4.0, developed by OpenAI. ChatGPT 3.5, a free version based on pre-2021 content, laid the foundation for subsequent advancements. In contrast, ChatGPT 4.0, available via a subscription model, represents a more powerful iteration

capable of nuanced responses and enhanced engagement. Additionally, Bing AI, which utilizes a similar advanced AI model as ChatGPT 4.0, provides internet-connected responses with supplemental online links. Google Bard, a creation of Google, also stands as a contender in the LLM landscape. These tools collectively offer educators and students a versatile set of options for integrating LLMs into educational activities.

ChatGPT: Enabling Interactive Learning

At the forefront of LLMs for education is ChatGPT, developed by OpenAI. Rooted in the concept of Generative Pretrained Transformers (GPT), ChatGPT serves as a dynamic conversational partner, generating text that simulates human-like interaction. It is proficient in answering queries, solving problems, and participating in discussions. However, it is important to acknowledge that ChatGPT's responses are not infallible and may occasionally generate incorrect or inappropriate content. To cater to different needs, ChatGPT offers two versions: Version 3.5, designed for pre-2021 data, and Version 4.0, available through a subscription and seamlessly incorporated into Microsoft Bing's platform. To summarize, ChatGPT is

- A powerful generative LLM tool
- Trained to generate human-like responses
- It generates responses based on what it has learned
- Engages in discussions, answers questions, solves problems
 - Tell it its expected role as well as the audience for its response (i.e., contextualize it)
 - Characterize the expected response/tone (formal, humorous, ...)
 - Prepare complete and precise prompts
 - Carefully check the generated output
 - If you do not like an output, rephrase the prompt and ask again
- May generate incorrect responses

Understanding the Basis of ChatGPT's Responses. The core functionality of ChatGPT is rooted in its ability to generate responses based on a vast corpus of internet-derived information. This generative process involves establishing intricate connections

between words, phrases, and concepts. Effectively prompting ChatGPT requires a clear articulation of its intended role and the target audience for its responses.

Contextualization plays a crucial role in guiding the model's output, including the desired response tone, such as formal or humorous. To harness ChatGPT's capabilities, it is essential to craft precise and specific prompts, carefully review generated output, and iteratively refine prompts to achieve the desired results. This process of experimentation and iterative refinement fosters an understanding of ChatGPT's potential applications and limitations. Quick examples of LLMs as teaching tools include:

- Ask for a lecture session (or semester) plan for a given topic
 - Topics, assignments, project, exam questions
- Let the tool generate explanations of the concepts in varying levels of detail
 - Ask for examples, formal definition, humorous analogies, references, questions
- Ask the tool to generate a quiz
 - Ask for the types of question you prefer
 - Evaluate for accuracy; modify to suit your purpose

Empowering Faculty and Students: Key Skills for Harnessing GAI

Utilizing LLMs effectively demands a set of key skills that empower both educators and students to engage with these tools in meaningful ways. Problem formulation is foundational, requiring clear articulation of the problem or query before prompting the LLM. Exploratory skills are essential to navigate and become proficient with major LLM tools like ChatGPT, Bing AI, and Google Bard. Hands-on experimentation allows for direct interaction, fostering a deeper understanding of LLM capabilities. Willingness to reflect is paramount, as it encourages critical evaluation of AI-generated content and personal beliefs. An illustrative diagram emphasizes the interplay between prompting LLMs and receiving responses, underscoring the iterative nature of refining prompts for optimal outcomes.

Ethical Considerations and Academic Integrity. The integration of LLMs in education brings forth ethical considerations, particularly in maintaining academic integrity. Concerns arise regarding the potential for AI-generated content to compromise the authenticity of students' work. To address these concerns, transparency and clear expectations play a pivotal role. Educators are encouraged to engage in open conversations with students, acknowledging the existence of LLMs and their potential benefits and limitations. It is essential to guide students in ethical usage, encouraging them to incorporate AI tools as aids rather than replacements for intellectual efforts. Assignments can be adapted to include reflection statements, requiring students to detail their usage of LLMs and the extent to which they influenced their work.

Key skills for faculty/students to harness GAI includes the following (Okar 2023):

- **Problem formulation:** define and formulate a problem before prompting the LLM tool; many online suggestions
- **Exploration:** explore and familiarize with, and excel in using major LLM tools such as ChatGPT, Bard, Bing, ...
- **Experimentation:** hands-on interaction with LLM tools
- **Willingness to reflect:** AI systems can stir emotions; reflect on own thoughts, beliefs as opposed on AI output

The above is shown in Figure 1 (Akar 2023).

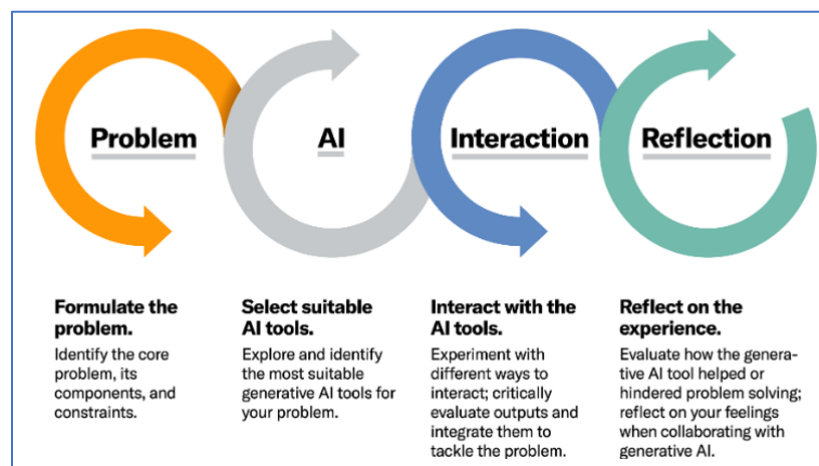


Figure 1: Key skills to harness GAI (Acar 2023)

The Future of Education: Leveraging LLMs for Pedagogical Enhancement

The future of education is intricately linked with the integration of LLMs, promising transformative enhancements in both teaching and learning. LLMs offer personalized learning experiences by leveraging data from students' past performances to tailor instructional content and interactive experiences. Interactive tutoring powered by LLMs provides real-time feedback and support, extending beyond traditional classroom hours. LLMs also serve as content creation tools, assisting both educators and students in generating study materials, explanations, summaries, and study guides. The potential applications span diverse disciplines, making LLMs an indispensable asset in fostering a culture of lifelong learning.

Sample Prompts and Use Cases. Concrete examples illustrate the practical applications of LLMs in education. For programming and software engineering, LLMs can assist students in coding challenges, debugging, and generating code snippets. In teaching scenarios, LLMs aid educators in formulating course plans, generating explanations of complex concepts, and even creating quizzes. A programming assignment prompt highlights the potential of LLMs to automate the assignment distribution process, simulating real-world scenarios to enhance problem-solving skills.

The incorporation of Large Language Model (LLM) tools like ChatGPT within academic institutions has ignited a thought-provoking discourse regarding their integration. The question of whether academia should embrace or resist ChatGPT underscores a pivotal dilemma. While some fervently champion the seamless assimilation of these tools into the educational milieu, others voice reservations about potential detrimental effects on student learning experiences. This juncture presents an opportune moment to deliberate upon the intersection of technology and pedagogy.

In light of the undeniable march of technological progress, the inevitability of LLM and Generative Artificial Intelligence (GAI) advancements cannot be denied. These tools, having firmly entrenched themselves within academia, necessitate a recalibration of

perspectives. Rather than resisting this tide, it is imperative to recognize and harness the transformative potential these tools offer in the realm of teaching and learning.

Central to this dialogue is the critical concern surrounding academic integrity – a theme that echoes resoundingly. Yet, beyond this concern lies a broader horizon of opportunities. As elucidated by Mucharras (2023), LLM tools serve as conduits for nurturing familiarity with Artificial Intelligence, an indispensable competency for the students' future endeavors. This reframing casts LLMs as educational enablers, fostering ethical engagement and equipping students with essential skills.

Expanding the purview to instructional dynamics, LLM tools extend their influence as invaluable allies to educators. They serve as aids in crafting meticulously structured class sessions, curating comprehensive outlines, and enhancing engagement through dynamic educational resources. Moreover, LLMs facilitate training simulations, language skill development, and constructive feedback mechanisms, effectively enhancing asynchronous learning experiences.

In the endeavor to cultivate a harmonious partnership between students and LLMs, transparent dialogues emerge as a guiding principle. Transparent communication, underscored by The University of Kansas' (2023a) directive, cultivates an environment of trust. This approach involves candidly addressing students' concerns, explaining the intrinsic value of LLMs in their educational journey, and clarifying expectations regarding assignments and assessments.

To navigate the ethical landscape, reflective practices emerge as a potent strategy. Students' engagement with LLMs should transcend mere usage; it should encompass critical introspection. This process engenders metacognitive skills, empowers students to understand the integration of AI into their learning processes, and solidifies academic integrity. Through reflection, the shadow of opacity dissipates, fostering a culture of transparency and fostering a genuine sense of ownership in academic endeavors.

Parallely, the evolution of assignment design acquires newfound significance within the LLM context. Innovative approaches, as advocated by The University of Kansas (2023b), entail assignments that commence with LLM-generated content. Subsequent analysis, discussions, and comparisons of AI-generated outputs enhance students' analytical prowess and critical thinking capabilities. This dynamic approach fosters an environment where students actively engage with AI-generated content, scrutinize its strengths and limitations, and synthesize their insights.

Ultimately, the decision to adapt or resist ChatGPT within academia reframes itself as an invitation to synergize human ingenuity with technological augmentation. By embracing transparent dialogues, cultivating reflection, and reimagining assignment paradigms, academia can harness the full potential of LLM tools. This concerted effort culminates in a holistic educational landscape that capitalizes on AI's transformative capabilities while steadfastly upholding the tenets of academic integrity and critical thinking.

Conclusion: Embracing the Potential of LLMs in Education

As education continues to evolve, the integration of LLMs emerges as a pivotal advancement that bridges the gap between traditional methodologies and modern technological capabilities. These tools possess the potential to enhance learning experiences, facilitate content creation, and revolutionize pedagogical practices. Educators are encouraged to embrace the transformative power of LLMs while remaining vigilant about ethical considerations and academic integrity. By harnessing LLMs effectively, educators can inspire a generation of learners equipped with the skills to navigate an AI-driven world.

Resources

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