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Generative artificial intelligence (AI) powered conversational educational agents: The inevitable paradigm shift

Aras Bozkurt

Abstract: Generative AI, specifically ChatGPT, represents a significant technological advancement in natural language processing (NLP) large language models (LLM) with far-reaching implications in many dimensions of our lives, including education. This paper discusses the prospects of generative AI in utilizing language and its potential role as a conversational agent within the educational realm. Emulating the most advanced human technology, language, generative AI's success relies on understanding and generating human-like text. However, its comprehension is solely based on patterns and structures it learns from its training data. With the advent of AI-driven conversational agents, prompt engineering emerges as a vital form of digital literacy. The convergence of general and educational technologies necessitates preparedness for a future dominated by AI. This paper highlights the importance of vigilance and prudence in harnessing the potential of generative AI technologies, emphasizing the responsibility of humans, as creators, in mitigating any potential mishaps. In conclusion, this paper suggests that preparedness for a future dominated by AI is essential, as generative AI technologies have the potential to profoundly impact teaching and learning methods, and necessitate new ways of thinking.

Keywords: ChatGPT, generative artificial intelligence (AI), machine and deep learning, natural language processing (NLP), artificial intelligence in education (AIEd), education, teaching and learning.

Highlights

What is already known about this topic:

- AI has been used in many dimensions of our lives, including teaching and learning processes.
- Generative AI is capable of mastering one of the most sophisticated soft human technologies, that is, language.
- Generative AI's comprehension is limited to patterns and structures learned from training data, which may result in imperfect outputs.
- While humans learn and reason, machines are indeed trained, and they predict.

What this paper contributes:

- This paper explores generative AI's success in understanding and generating human-like text relies on analyzing complex patterns and structures of human language.
- This paper provides a critical approach to human-computer interaction enabled by generative AI.

Implications for theory, practice and/or policy:

- The ability to effectively communicate with generative AI is critical and thus prompt engineering emerges as new digital literacy.
- Research on responsible AI can be prioritized to balance the rising concerns and to better benefit from generative AI.
- The distinction between human and artificial intelligence may become subtle in the future, with the nuances lying in the difference between human creativity and algorithmic generation.
- Generative AI is poised to have a profound impact on teaching and learning methods and requires preparedness for a future dominated by generative AI.

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Introduction: Generative AI and the next big thing (!)

The real technology -behind all our other technologies- is language. It actually creates the world our consciousness lives in. — Andrei Codrescu

Throughout history, technologies utilizing language have been major turning points. These include the invention of writing, which enabled the symbolic processing of language; the printing press, which facilitated the dissemination of knowledge more widely and rapidly; and the creation of computers, which were capable of processing binary language. In the age of digital information and technology, ChatGPT, a generative AI model developed by OpenAI (2022) using natural language processing (NLP), represents one of the most significant technological advancements. ChatGPT is specifically designed to excel in NLP applications such as chatbots, virtual assistants, language translation, and text generation. Generative AI has the potential to master human language, one of the most complex and sophisticated technologies ever created, and to use human knowledge to identify patterns that may elude human perception. When properly trained, ChatGPT is a powerful tool that can learn, unlearn, and relearn language, allowing it to adapt and evolve with human communication needs.

From our current perspective, it is difficult to determine whether this will emerge as the next big thing; however, its potential to trigger transformative change is undeniable. Within this context, this paper examines generative artificial intelligence, focusing on the prospects it offers as a technological innovation adept at utilizing language. As a conversational agent, it also investigates the implications of generative AI within the realm of education.

Generative AI and Reflections from the Scholarly Domains

Language is the armory of the human mind, and at once contains the trophies of its past and the weapons of its future conquests. — Samuel Taylor Coleridge.

While some contest its potential, highlighting its limited reasoning abilities and asserting that generative AI will "undermine our scientific pursuits and compromise our moral principles by integrating a fundamentally erroneous understanding of language and knowledge" (Chomsky et al., 2023, para 1), and even form a community that declares an open letter arguing that giant AI experiments should be halted (FOL Open Letters, 2023), others maintain its promise (Lee, 2023) and argue that the era of AI is already underway with the emergence of generative AI technologies (Gates, 2023). In accordance with this perspective, recent literature on generative AI displays a mixture of enthusiasm and apprehension (Lim et al., 2023), stemming from its capacity to comprehend and produce text on par with human capabilities (Floridi, 2023; Lim et al., 2023; Teubner et al., 2023). Described as being "designed to generate sophisticated text indistinguishable from that produced by a human" (Dwivedi et al., 2023), generative AI can be applied across various domains, including education (Cao et al., 2023; Dwivedi et al., 2023; Haleem et al., 2022; Kasneci et al., 2023), and is poised to reshape teaching and learning methods (Atlas, 2023; Megahed et al., 2023). Owing to its content-generation capabilities, generative AI has incited numerous critical discussions and prompted researchers to examine its opportunities and challenges (Bozkurt et al., 2023; Bozkurt and Sharma, 2023; Crawford et al., 2023; Johinke et al., 2023; Neumann et al., 2023; Tlili et al., 2023).

In the midst of such developments that challenge divergent thinking, some recent studies examining the opportunities and challenges created by generative AI in the educational landscape provide significant insights. For instance, in their recent article, Tlili et al. (2023) assert the necessity for a novel pedagogical approach that can effectively incorporate AI-driven innovations. They emphasize the importance of creating ethical, personable chatbots and enhancing our digital proficiency to fully leverage the potential benefits of AI. Additionally, they urge researchers to prioritize the inclusion of AI literacy as a crucial technological competency for the 21st century. Bozkurt et al. (2023) argue that The current moment presents an opportune time to redefine the roles of human educators and AI in education, as AI has the capacity to take on increasingly more educational tasks that were once the sole responsibility of human

educators. Consequently, it is crucial to adopt a forward-thinking perspective and reconsider the respective contributions of technology and human educators to education. Bozkurt et al. (2023) also reported that the advent of generative AI presents an opportunity to redefine the roles of human educators and AI in education, as AI has the capacity to take on increasingly more educational tasks that were once the sole responsibility of human educators. Bozkurt et al. (2023) also provided opportunities and challenges that emerged by the advent of generative AI. Accordingly, generative AI offers various opportunities, including personalized learning, the provision of inclusive curriculum, enhancing collaboration and cooperation during educational processes, benefiting from automated assessment, ensuring improved accessibility, improving efficiency in terms of time and effort, developing language skills, and the availability of such technologies 24/7. However, generative AI also poses various challenges, including algorithmic bias, the need for reliable knowledge sources and quality control, inequality and inequity in access, a lack of creativity and critical thinking, manipulated AI models or manipulation by AI trainers, ignoring human agency in educational processes, the possibility of teacher replacement, privacy and ethics concerns, technical complexity, and dependence on technology.

Emulating the most Sophisticated Technology: Language(s)

"Language as the technology of human extension, whose powers of division and separation we know so well, may have been the "Tower of Babel" by which men sought to scale the highest heavens. Today computers hold out the promise of a means of instant tr." — Marshall McLuhan

Many people in the field of technology believe that technological advances are based on models from nature. When it comes to developing technologies for artificial intelligence, it is argued that humans serve as the ideal model to emulate. This perspective also necessitates the replication of one of the most advanced technologies created by humans: language. From the perspective of ChatGPT as a generative artificial intelligence technology, which utilizes both machine and deep learning techniques (OpenAI, 2022), language is considered a soft technology (Bozkurt, 2020) that can be emulated. By using the Generative Pre-training Transformer (GPT) model, ChatGPT and other similar generative AI technologies can analyze the complex patterns and structures of human language, and they are primarily trained to understand and generate human language.

As a generative AI technology in the realm of natural language processing, ChatGPT represents a significant breakthrough advancement in the field. It is capable of generating human-like text and understanding natural language input in a way that is similar to a human. However, it is important to keep in mind that while ChatGPT is a powerful tool for natural language processing, it is still a machine and does not possess the same level of understanding and context awareness as a human. Unlike humans, ChatGPT lacks the same level of context awareness and understanding, with its comprehension of language based solely on the patterns and structures learned from its training data. Therefore, while ChatGPT is an incredibly valuable tool for aiding humans in processing and understanding natural language, at least for the time being, it cannot replace the complexity and nuances of human language.

It is All About Giving the Right Prompts

"Words - so innocent and powerless as they are, as standing in a dictionary, how potent for good and evil they become in the hands of one who knows how to combine them." — Nathaniel Hawthorne

Generative AI technologies do not learn per se, but rather undergo training. The offerings they present are ultimately a product of the content we provide, which feeds their algorithms. Consequently, this viewpoint emphasizes the importance of big data, as it functions as a rapid data repository, metaphorically a data farm, from which generative AI can extract and harvest information, contextualize it into knowledge, and ultimately attain a so-called algorithmic wisdom. This positions big data and online networks as extensions of generative AI's neurons, eventually transforming the web into a global brain.

A potential concern arises from the utilization of language, arguably humanity's most effective tool, by non-human entities. The management of information through language is a hallmark of intelligence that differentiates humans from other organisms, and presently, artificial intelligence represents another user of this technology. It is plausible that, in the near future, the demarcation between human and artificial intelligence will be characterized by subtle nuances. In this sense, the fine red line separating these forms of intelligence lies in the distinction between human creativity and algorithmic generation.

Learning is inherently social (Bandura, 1977; Dewey, 1938; Vygotsky, 1978), and as such, interaction and communication serve as vital elements of educational processes. In light of this view, the capacity to adeptly engage with generative AI becomes crucial, positioning prompt engineering as an emerging form of digital literacy. The emphasis shifts from extensive knowledge to the mastery of inquiry. While it is unlikely that generative AI will supplant humans, it is plausible that individuals proficient in effective prompting will outpace their less skilled counterparts. In the end, the magic of generative AI will happen with well-structured, well-designed, and well-devised prompts.

Conclusion: We created technology in our own image

"We create machines in our own image, and they, in turn, recreate us in theirs." — David Lochhead

In all, we are not only transitioning into the era of AI but are also witnessing the emergence of the AI-empowered semantic Web, commonly known as Web 3.0. During such times, new technologies, like generative AI, can be disruptive and, in some cases, scary. These technologies possess their own strengths and limitations, but it is crucial to remember that they will improve over time, and many of their limitations may disappear before we even realize. In the face of it, we can neither disregard, resist, nor deny the enduring presence of generative AI-driven conversational agents. The capacity for these agents to employ human language for communication and interaction implies an inevitable paradigm shift. Generative AI is likely to catalyze the convergence of numerous conventional and educational technologies, necessitating our preparedness for a future dominated by AI.

There are instances where generative artificial intelligence has been criticized for generating superficial or false information and not living up to initial expectations. However, it is important to acknowledge that this limitation is not exclusive to AI, as humans are also fallible and imperfect. It would be naive to expect these technologies to be error-free. The ongoing discourse on AI brings to mind an old song. Many of us heard this song with the introduction of television, and later, computers, the internet, and smart mobile devices presented us with a familiar tune. These technologies did not deceive or fool us; rather, they significantly contributed to human progress and accelerated the rate at which knowledge doubled. Presently, the song remains unchanged, but the technology has evolved, and the pace of the song has quickened. At this point, what we need to do is genuinely listen to the song and creatively adapt our dance moves to harmonize with the melody.

This killer technology will undoubtedly have a profound impact on not only our ways of teaching and learning but also the ways we think. As we continue to explore the possibilities of generative AI in education, it is critical that we maintain a critical and reflective stance, carefully considering the promises and challenges associated with this technology. Future research should aim to identify ways to mitigate the risks associated with generative AI in education, while also maximizing its potential to support and enhance student learning.

In short, humanity is experiencing a storm of change and transformation driven by technological developments, with all of us situated in the midst of this storm. The vast potential of this groundbreaking technology necessitates increased vigilance and prudence from humans, bearing in mind a critical aspect: should any mishaps transpire, the responsibility ultimately lies with us, the creators. After all, if to err is human, so too is it inherent in machines, as we create technology in our own image.

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Aras Bozkurt: Conceptualization, Funding acquisition, Project administration, Supervision, Methodology, Writing – original draft, Writing – review & editing.

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I was a child and she was a child,
In this kingdom by the sea,
But we loved with a love that was more than love
I and my Annabel Lee,
With a love that the wingèd seraphs of Heaven
Coveted her and me.

Annabel Lee - By Edgar Allan Poe

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Because this study doesn't involve any living entities, an ethics review is not applicable.

Conflict of Interest

The author does not declare any conflicts of interest.

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