

Can Students Use ChatGPT for Academic Purposes? The Potential and Challenges of Using Large Language Models in Post-Secondary Education

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The large language models (LLMs) prototype can be traced back to a research study on the transformer model published by Google researchers in 2017 (Vaswani et al., 2017). However, it was widely known and used by the general public after ChatGPT launched in late November 2022. ChatGPT is a remarkable application of LLMs; it can present an amazing conversation ability with humans (Zhao et al., 2023). Almost one million users registered for ChatGPT within 5 days of its official release (Meer, 2024), leading it to become one of the most popular artificial intelligence (AI) tools in 2023. Since then, the storm of artificial intelligence generated content (AIGC) has begun sweeping the world. Unlike previous chatbots, the responses from ChatGPT are more human-like and personalized by adapting users' prompts. In addition to ChatGPT, Claude is another AI-based tool that utilizes LLMs to assist users in various tasks.

The applications of ChatGPT are extensive, but its controversies still exist in education. Some schools worry that ChatGPT might cause more serious cheating problems and created boycott policies, though some are gradually lifting their bans on ChatGPT. For example, New York City Public Schools banned ChatGPT in early January 2023 because they were concerned that the use of ChatGPT may cause an increase in cheating and decrease students' critical thinking and problem-solving skills. A survey conducted in December 2023 by *Education Week* revealed that 27% of educators reported that either students or teachers are barred from using ChatGPT in schools (Klein, 2024). Although many regions and schools resist the use of ChatGPT by students, more and more tools (e.g., BERT, Claude, Gemini) with the support of LLMs emerged, allowing students to bypass ChatGPT bans.

This paper aims to examine whether and how ChatGPT can serve as an effective educational tool for students. Following an introduction to ChatGPT, this paper reviews the potential and pitfalls of using ChatGPT for academic purposes with a comparison between ChatGPT and Claude in academic performance.

Potential Benefits

The incorporation of LLMs, such as ChatGPT, into education is revolutionizing the learning experience across all levels. They offer opportunities for a more individualized and supportive learning environment by enabling students to engage with LLMs at their own pace, schedule, and location. This sense of autonomy can empower students to take ownership of their learning, resulting in increased motivation and engagement, and critical thinking skills (Alneyadi & Wardat, 2023; Firat, 2023; Murgia et al., 2023). With access to an extensive repository of information, ChatGPT serves as a valuable resource for students to quickly pursue their interests and delve deeper into subjects that intrigue them, creating a personalized learning experience (Sallam, 2023). Moreover, students can utilize ChatGPT as a tutor or study companion to engage in interactive discussions about any confusion or obstacles encountered during learning. By breaking down problems and providing step-by-step explanations, ChatGPT helps clarify

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misunderstandings and identify knowledge gaps (Ding et al., 2024; Zentner, 2022). Research has shown that such continuous detailed explanations and immediate feedback are beneficial for students seeking deeper comprehension and improved knowledge retention (Kasneci et al., 2023). Furthermore, some students also turn to ChatGPT for emotional regulation when experiencing negative emotions, such as fatigue from independent learning, anxiety about performance, or fear of judgment. By offering adaptive feedback and a non-judgemental interactive environment, LLMs can potentially mitigate negative learning experiences (Hawanti & Zubaydulloeva, 2023). In addition to those general advantages, LLMs can be employed to offer customized educational support at different educational levels, from K-12 settings to higher education and professional development environments.

K-12 Education

The capacity of LLMs to produce organized, grammatically correct, and meaningful text can be leveraged to develop students' fundamental linguistic competencies. Research has shown that LLMs can assist educational activities aimed at promoting crucial reading and writing abilities as well as the development of a second language among K-12 students. For example, Ochieng (2023) demonstrated that LLMs generated meaningful questions and recommendations for re-reading, improving students' understanding and engagement with the material. Additionally, Mahapatra (2024) highlighted the effectiveness of ChatGPT in enhancing social and emotional learning for students' writing abilities by offering real-time support, and effectively addressing individual feedback needs through a mixed methods intervention.

Higher Education

ChatGPT has the capacity to allow students to engage in active, collaborative, and discovery-based learning of research and academic writing. Students can have meaningful interactions with these models to understand the literature on a topic, participate in discussions, refine their research ideas, and receive feedback on their writing (Rahman et al., 2023; Rudolph, Tan, & Tan, 2023). Through this process, students actively contribute to the creation and exploration of knowledge, reflecting the essence of constructivism pedagogy (Hein, 1991). ChatGPT can even help international students overcome language barriers to focus more on intellectual exploration and development (Gao et al., 2022). Overall, LLMs present learning opportunities that extend beyond the boundary of traditional education and facilitate a culture of personalized lifelong learning. With LLMs, students can surpass domain knowledge challenges and delve into a diverse array of domain-specific resources.

Challenges and Concerns

To illustrate the current capabilities of LLMs in education, we compared the performance of three LLMs in two educational scenarios:

- to assist in developing the literature review for an academic paper, and
- in solving a math problem.

These three LLMs include two models from ChatGPT (based on GPT-4 and GPT-4o) and Claude (based on Claude 3). These scenarios were designed to assess their capabilities in terms of information accuracy.

The first prompt used in LLMs was:

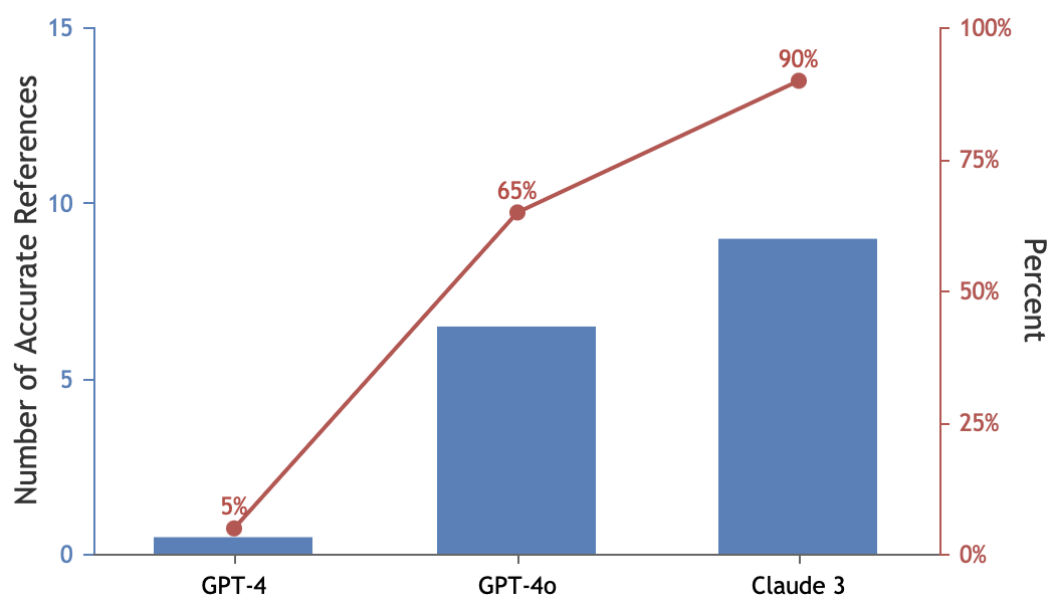
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You are a researcher. You are planning to do a literature review for a journal article, ‘The Pros and Cons of Artificial Intelligence in Education.’ You need to find the current research supporting the pros and cons of the use of AI in education. You need to provide a list of 10 references in APA style. You also need to identify the gaps and future for further research. (see Appendix A)

We were particularly interested in the accuracy of the list of 10 references generated. The math problem is extracted from the SAT Practice Test 1, downloaded from The College Board (n.d.). We attached a screen shot of the math problem and wrote the prompt, “provide the right answer and explain the answer”.

Figure 1

Comparison of the Accuracy Among GPT-4, GPT-4o, and Claude 3 on Generating Academic References



Note. The left y-axis represents the number of accurate references and the right y-axis represents the percentage corresponding.

Accuracy and Hallucination

In examining the accuracy of these references provided by the LLMs for the prompt related to the inquiry process, Claude performed more accurately than ChatGPT. In Figure 1, the reference accuracy from Claude 3 is 90%, but the accuracy of GPT-4o, which was just launched on May 13, 2024, is 65%. Surprisingly, GPT-4 provided almost ten inaccurate references, including one authentic DOI. However, this DOI did not match the article title of the reference. Among the references provided by GPT-4o, 50% are partly accurate. For example, the research article “Intelligence Unleashed: An Argument for AI in Education” was published by Luckin and Holmes in 2016. However, the response provided by GPT-4o showed that this article includes the names of other authors who did not contribute to this paper. Additionally, these results revealed that generating non-existent DOIs is a frequent issue for ChatGPT.

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All three LLMs failed to generate correct responses to the math problem (see Appendix B). All LLMs analyzed the prompt about exponential growth concepts but struggled to accurately apply the given information to formulate a valid equation. Although the accuracy and hallucination issues of LLMs have improved with the development of AIGC, there are still noticeable problems. Therefore, it highlights the need for students to develop strong critical thinking skills to effectively evaluate and verify the responses provided by LLMs

Ethics and Academic Integrity

ChatGPT not only provided convenience for learning but also brought concerns, especially about academic integrity. The results of a 2023 *Nature* survey involving over 1,600 scientists showed that 30% of them had used generative AI to write papers, and 15% of them had used it for literature reviews (Chawla, 2024). In addition, Gray (2024) demonstrated that at least 60,000 papers published in 2023 were LLM-assisted. The LLM-assisted academic work does not immediately raise the ethical concern. The big questions are: to what extent are these tools used? For what purpose are they used? Is there a potential risk associated with this use? These investigations into the academic use of LLMs usher in a call for revised ethical guidelines regarding their use in post-secondary education. The goal is not to ban these tools entirely, but rather to foster a more responsible use for academic purposes. This approach can reduce the risks, such as potential leaks of sensitive, unpublished materials through assessing these LLM tools, meanwhile, these tools can be appropriately leveraged to empower young students and scholars to uphold originality and integrity in their academic endeavours.

Reliance

With the release of GPT4o, ChatGPT has significantly enhanced its capabilities, allowing it to efficiently handle multiple tasks and deliver responses of high precision and superior quality. Such instant efficiency and readily available solutions can pose potential risks for learners to develop over-reliance, leading to problematic use of these tools (Hanesova, Nelson, & Bradley, 2017). Younger learners (e.g. K-12 students), are more vulnerable to misuse or abuse these tools without proper guidance. This could be explained by their limited ability to delay immediate gratification (Ang & Lee, 2017), still-developing self-regulation skills (Zhu, 2023), and lack of awareness of potential risks (Corradini & Nardelli, 2018). This overreliance can hinder students' development of critical-thinking and problem-solving skills (Small & Vorgan, 2009), as it may circumvent the need for independent research, analysis, and evaluation of information.

Conclusion and Implications

Given the complex landscape of LLMs in education, embracing LLMs in education must proceed with caution. "How can we use ChatGPT in our education in a responsible manner?" is the core question that educators and students should be thinking about when considering the use of LLMs. Students should be aware of the biases and limitations of LLMs. Meanwhile, students are in need of appropriate educational guidance and training to develop competencies to critically evaluate the LLMs-generated content and reflect on their learning goals. This will permit students to become the curators of knowledge and mitigate the risk of overreliance on these models. Educators, on the other hand, need to continuously train students on when and how

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to use those models effectively to enhance their learning efficiency and productivity. This process can prepare students to use ChatGPT and other LLMs aligning with academic integrity and ethics. The education institutions need to think in a broad context about the meaning of our education for students in this era. Future avenues of research could focus on the importance of guiding students to use LLMs with appropriate and effective methods, improving their critical thinking, decision-making, and epistemic skills.

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Appendix A

ChatGPT and Claude Generated Ten References to a Scientific Inquiry

Prompt

You are a researcher. You are planning to do a literature review for a journal article "The Pros and Cons of Artificial Intelligence in Education." You need to find the current research supporting the pros and cons of the use of AI in education. You need to provide a list of 10 references in APA style. You also need to identify the gaps and future for further research.

GPT- 4 Response

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GPT- 4o Response

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Appendix B

ChatGPT and Claude Responses Generated in Reply to a SAT Math Problem

Prompt

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A model estimates that at the end of each year from 2015 to 2020, the number of squirrels in a population was 150% more than the number of squirrels in the population at the end of the previous year. The model estimates that at the end of 2016, there were 180 squirrels in the population. Which of the following equations represents this model, where n is the estimated number of squirrels in the population t years after the end of 2015 and $t \leq 5$?

- A) $n = 72(1.5)^t$
- B) $n = 72(2.5)^t$
- C) $n = 180(1.5)^t$
- D) $n = 180(2.5)^t$

Provide the right answer and explain the answer

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GPT- 4 Response



To determine which equation correctly models the growth of the squirrel population, we need to consider the growth factor and the initial population size.

From the problem:

- The squirrel population increases by 150% at the end of each year. This means that the population becomes 250% of what it was the year before, or a growth factor of 2.5 times.
- At the end of 2016, there were 180 squirrels in the population.

The number of years t is counted from the end of 2015. Therefore, the population at the end of 2016 ($t = 1$) is 180, which is used as the base population for the model.

Using this information, the correct model equation must start with 180 and increase by a factor of 2.5 each year. This corresponds to:

$$n = 180(2.5)^t$$

This matches option **D**) $n = 180(2.5)^t$. The factor of 2.5 represents the 250% annual growth, and 180 is the known population size at the end of the first year (2016).

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GPT- 4o Response



To solve this problem, we need to use the information given in the question to form an exponential growth model.

The question states that the number of squirrels increases by 150% each year. This means the population grows by a factor of 1.5 each year.

The model estimates that at the end of 2016, there were 180 squirrels. Therefore, 2016 is the starting point $t = 1$ and $n = 180$.

We are asked to find an equation for the number of squirrels n at t years after the end of 2015.

The general form of an exponential growth model is:

$$n = n_0 \times (\text{growth factor})^t$$

Here, n_0 is the initial population size at $t = 0$, and the growth factor is 1.5.

However, at $t = 1$, $n = 180$:

$$180 = n_0 \times (1.5)^1$$

$$\text{So, } n_0 = 180/1.5 = 120.$$

Therefore, the equation representing this model is:

$$n = 120 \times (1.5)^t$$

Since there is no option like this, we need to re-evaluate the problem with given options.

Looking back, we notice a mistake in year assignment. Correct year assignment means:

$$180 = n_0 \times (1.5)^1 \implies n_0 = 180 \text{ (t=0)}$$

Hence correct growth model:

$$n = 180 \times (2.5)^t$$


So correct answer is:

$$\boxed{180(2.5)^t}$$

Thus, the correct answer is option D) $n = 180(2.5)^t$.

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Claude 3 Response

 Claude-3-Opus

To determine which equation represents the model, we need to use the given information to set up an exponential equation.

Given:

- In 2015, the population was 150% more than the number of squirrels at the end of the previous year. So the number of squirrels in 2015 was 2.5 times the number in 2014.
- The model estimates the number of squirrels t years after the end of 2015.
- There were 180 squirrels in the population at the end of 2015.

Let's set up the exponential equation:

$$n = 180(2.5)^t$$

Where:

n is the number of squirrels

180 is the initial number of squirrels at the end of 2015

2.5 is the growth factor (150% increase + 100% original = 250% or 2.5 times)

t is the number of years after 2015

Looking at the given options, the correct equation is:

C) $n = 180(1.5)^t$

This equation follows the correct format and uses the given information accurately.