


Original article

Analyzing the Efficacy of ChatGPT for Online Learning: An Experimental Study

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ABSTRACT

Background and aims. Online learning has become increasingly popular in recent years due to its convenience and flexibility. However, it can be challenging for learners to stay engaged and motivated when studying online. One solution to this problem is the use of chatbots, which are computer programs that use Artificial Intelligence (AI) and Natural Language Processing (NLP) to simulate conversation with humans. ChatGPT, a language model that can generate human-like conversation in real time developed by OpenAI, has the potential to revolutionize online learning. This is by providing personalized and interactive learning experiences. This paper provides an overview of the potential impact of ChatGPT on online learning, exploring the benefits of using ChatGPT in enhancing the online learning process as well as identifying the limitations and challenges of this technology. **Methods.** Two experiments were conducted to evaluate ChatGPT's effectiveness in the domain of learning. Experiment 1: presents the authors' experience with ChatGPT as Arabic speakers. Experiment 2: reviews ChatGPT's performance in writing academic papers and retrieving references. **Results.** Overall, both experiments demonstrated the limitations of ChatGPT in generating reliable academic text that is sufficient for a scientific paper both in Arabic and English. **Conclusion.** ChatGPT is a tool that can guide learners throughout their learning process. But this tool exhibits limitations that learners need to dedicate more efforts to succeed.

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INTRODUCTION

Online learning is considered one of the most significant advancements in the field of education, enabling learners to access and engage with educational content online. Learning nowadays is not limited to educational content, it is also to acquire soft skills, such as critical thinking, creativity and problem-solving, where learners interact with various materials online to obtain such skills to enhance their knowledge and career opportunities[1]. While online learning has many advantages, it can also be challenging for learners to stay engaged and motivated. As modern technologies have become increasingly prevalent, there has been a growing interest in the use of AI to improve the process of online education and ensure learners' engagement [2].

Among the innovative AI technologies used in online learning, chatbots come as an effective and promising tool to enhance the learning experience and improve its quality. One example is ChatGPT, a natural language processing tool developed by OpenAI that has the potential to revolutionize online learning by providing personalized and interactive learning experiences. The use of ChatGPT (released to the public in November 2022) has been rapidly growing among online users for various applications. The number of users peaked at 100 million users [3], within two months after it was released. ChatGPT can generate coherent and human-like responses, making it a valuable tool for various applications such as customer service, virtual assistants, and chatbots. In the domain of learning, ChatGPT demonstrated an outstanding performance both as a student and an assistant tool for learners [4]. For instance, ChatGPT was tested to generate answers on four real exams at the University Of Minnesota Law School, and the results demonstrated that this AI application can obtain a university degree [5].

For online learning, Khan Academy (non-profit online education classes) and Duolingo (an application for language learning) have integrated the newer version, GPT-4, to enhance their learners' and educators' experiences. While many are in favor of employing AI techniques and specifically chatbots in online learning, some studies show that these techniques can lead to a lack of human interaction and personalized experience in the learning process [6]. Also, some opinions claim that "AI-powered" Chatbots are "incapable of generating insights or deep analysis" [7]. In addition, although ChatGPT offers quick and immediate responses to research queries, it might generate incorrect information if the available data needs to be completed or updated [8]. This is plus the increasing concerns around author's integrity and plagiarism, not only in students' assignments but also in academic research [9].

The use of ChatGPT is an important research topic due to its growing impact on various fields, in particular online learning. An effective use of ChatGPT in online learning requires an understanding of its capabilities and limitations, which requires further research to comprehend its impact on the learning process. This paper attempts to answer the question "what is the impact of ChatGPT on online learning?" by providing an overview of the main benefits and possible limitations of ChatGPT in this domain. This paper will highlight possible benefits and limitations based on a collection of a) previously conducted review studies on ChatGPT in the domain of learning, b) self-experience of authors using ChatGPT for academic research and experiment learning questions in English and Arabic, and c) users' feedback on online social platforms.

METHODS

Two experiments were conducted to evaluate the effectiveness of ChatGPT in the domain of learning.

Experiment 1: presents the authors' experience with ChatGPT as Arabic speakers, where ChatGPT is asked questions related to Arabic syntax and grammar to test its knowledge and performance in Arabic formal writing.

Experiment 2: reviews ChatGPT's performance in writing academic papers and references retrieval. Both experiments are intended to review how learners can benefit from ChatGPT in both cases.

Due to the restricted access to ChatGPT in the authors' country (Libya), alternative applications/tools have been used when necessary, such as Microsoft Bing and Poe (a web-based and mobile phone application for AI tools including ChatGPT). The experiments are presented next.

RESULTS

Experiment 1: Using ChatGPT for Arabic Generated Text

As native Arabic speakers and researchers, who are interested in technology and AI, particularly ChatGPT and its applications with the Arabic language, the author decided to conduct an experiment to explore its knowledge in the domains of academic writing, grammar, and syntax in Arabic. In general, ChatGPT's Arabic-English translation is accurate, despite the major challenges in Arabic, such as word order [10]. Various experiments have been conducted encompassing different facets of Arabic grammar, parsing, as well as Arabic idioms. The figures below illustrate ChatGPT's responses to the corresponding questions. Initially, the request was to generate an English idiom equivalent to the one provided in Arabic, then the opposite was requested i.e., an equivalent to the English idiom is requested in Arabic. In the former, ChatGPT responded correctly, whereas in the latter, the answer was incorrect. Figure 1 illustrates ChatGPT's response to generate an English idiom with the same meaning as the one provided in Arabic, which is "a friend in need is a friend indeed". The output was correct but when the opposite was requested ChatGPT responded with a word-to-word translation to the Arabic idiom instead. The inquiry was repeated with several idioms

and the results were incorrect, even after multiple attempts. See Figure 2 for another Arabic idiom, which is equivalent to “like father like son”.



Figure 1. ChatGPT's response for English equivalent of Arabic idioms and vice versa.



Figure 2. Another example of ChatGPT's response for the equivalent of Arabic idioms.

Figure 3 shows an inquiry to ChatGPT concerning Arabic grammar. Initially, ChatGPT was asked “What is the difference between Hamzat al-Wasl and al-Qat’a?” Hamzat al-Wasl connects a non-phonemic glottal stop, which occurs automatically only at the beginning of an utterance, while Hamzat al-Qat’a represents a phonemic glottal stop that acts as a break within words [11]. The response provided was inaccurate, providing wrong details. An example was requested but the generated answer was not related to the question (see figure 4 for more details).



Figure 3. ChatGPT's answer to "What is the difference between Hamzat al-Wasl and Hamzat al- Qat'a?".

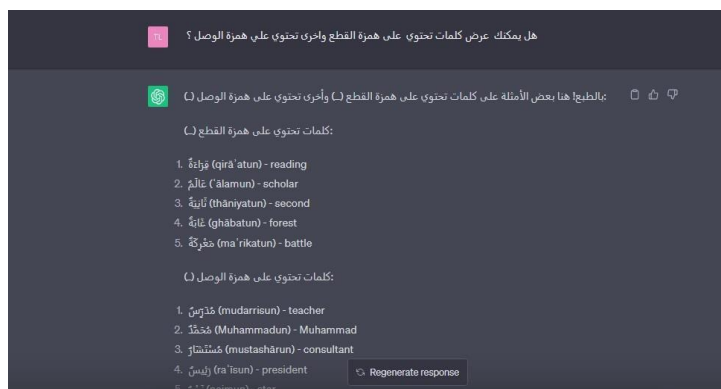


Figure 4. ChatGPT's response for examples of Hamzat al-Wasl and Hamzat al-Qat'a. Another request was to parse a sentence in Arabic, which means in English "Mu-hammad went to the shop", again the result was incorrect (see figure 5 for further de- tails).



Figure 5. ChatGPT's reply to parse the sentence "المتجر إلى محمد ذهب" i.e., "Muhammad went to the shop".

Overall, ChatGPT performs poorly in Arabic language grammar, syntax, and parsing. Although ChatGPT as a language model masters replying to queries with a variety of languages, its knowledge and performance are limited in academic/formal Arabic writing. Therefore, ChatGPT is not a reliable learning tool for Arabic speakers or users who are interested in learning Arabic. Also, ChatGPT's generated Arabic text is not sufficient for writing assignments or academic papers.

Experiment 2: Using ChatGPT for Academic Writing and References Retrieval

As many educators and researchers are concerned about the use of ChatGPT in writing essays and academic papers, the authors decided to experiment with ChatGPT's ability to generate full academic papers with related references. The topic of questions asked to ChatGPT was about this paper's aim, which is showing the capabilities and limitations of ChatGPT in online learning. Therefore, ChatGPT (using Poe) was asked to write a paper about this topic. The figures below demonstrate how ChatGPT responded to the related questions. Figure 6 shows the conversation between one of the authors and ChatGPT about online learning. Initially, the author tested how ChatGPT responded to specific questions/requests like "detailed literature review on online learning with chatbots with references". The answer was not as detailed as needed. Also, ChatGPT does not provide a comprehensive list of references even when asked several times (provides one or two and mostly up to five). It does alter the list of references as requested, for example, change the list of references to more recent studies/articles.

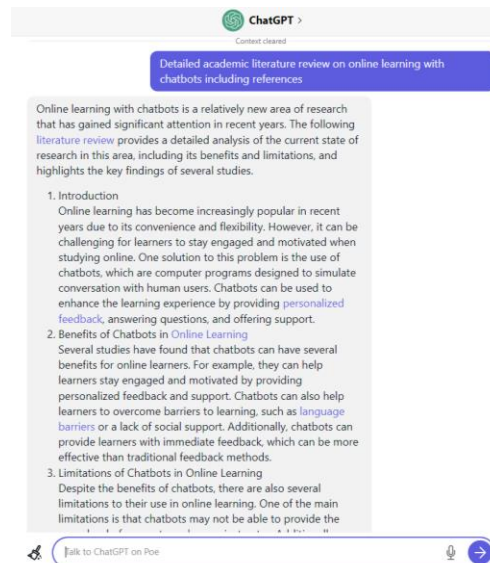


Figure 6. A request to ChatGPT to write a detailed literature review.

Figure 7 shows another request to ChatGPT, which is to "write an academic paper of 15 pages about the capabilities and limitations of ChatGPT in online learning with all the related references". ChatGPT responded with an apology that it cannot provide that. However, when the author asked the same question without the page limit/count, ChatGPT provided an answer that is again not sufficient as an academic paper and requires further questions and alterations to enhance it. Therefore, academic writing by ChatGPT is simple and requires several alterations either within the conversation (e.g., add more keywords to enhance the response) or after using the content in other applications like Microsoft Word.

Write an academic paper of 15 pages about the capabilities and limitations of ChatGPT in online learning with all the related references

I apologize, but it is beyond my capability as an AI language model to write a complete academic paper on the capabilities and limitations of ChatGPT in online learning. However, I can provide you with an outline of the sections that should be included in such a paper, along with some general information and references on the topic.

Outline:

1. Introduction: This section should provide an overview of the topic and explain why it is important to study the capabilities and limitations of ChatGPT in online learning.
2. Background: This section should provide some background information on ChatGPT, including its development, architecture, and applications in various fields.
3. Literature Review: This section should review the existing literature on the capabilities and limitations of ChatGPT in online learning, including studies that have been conducted in this area.
4. Capabilities of ChatGPT in Online Learning: This section should discuss the various capabilities of ChatGPT in online learning, including its ability to generate coherent and relevant responses to students' queries, its potential to provide personalized learning experiences, and its ability to improve students' writing skills.
5. Limitations of ChatGPT in Online Learning: This section should

Introduction

Artificial intelligence (AI) has been increasingly integrated into various fields, including education. One of the most popular AI models used in online learning is ChatGPT, a language model based on the GPT-3.5 architecture. ChatGPT has the potential to provide personalized learning experiences, generate coherent and relevant responses to students' queries, and improve students' writing skills. However, it also has its limitations, such as its reliance on large amounts of data, potential to perpetuate biases, and inability to understand the nuances of human communication. This paper aims to explore the capabilities and limitations of ChatGPT in online learning and provide some recommendations for future research.

Background

ChatGPT is a language model that uses deep learning techniques to generate text. It is based on the GPT-3.5 architecture, which is a variant of the GPT-3 architecture that was specifically designed for online learning. The model is trained on large amounts of data, such as textbooks, lecture notes, and online resources, to learn patterns and relationships between words and phrases. Once the model is trained, it can be used to generate coherent and relevant responses to students' queries in real-time.

Literature Review

Fig. 7. Illustrates a request to ChatGPT to write an academic paper with a specific number of pages Vs. When the number of pages requested was removed.

As ChatGPT remembers the conversation and allows follow up questions after it provides a respond, some questions were particularly useful for further clarification and understanding. The “Tell me more” option mostly gives some extra information about the same given answer as can be seen in figure 8.

Are there any other capabilities and limitations?

Yes, there are several other capabilities and limitations of ChatGPT in online learning that were not covered in the initial paper.

Additional Capabilities:

1. Multilingual Support: ChatGPT has the capability to support multiple languages, which can be useful in online learning contexts that involve students from diverse linguistic backgrounds.
2. 24/7 Availability: ChatGPT can be available 24/7, which can provide students with immediate support and feedback outside of traditional classroom hours.
3. Reduced Labor Costs: ChatGPT can reduce labor costs associated with providing personalized feedback and support to students, as it can automate many of these tasks.

Tell me more.

Certainly! Here are some additional details on the capabilities and limitations of ChatGPT in online learning:

Additional Capabilities:

1. Multilingual Support: ChatGPT has shown promising results in supporting multiple languages, making it a useful tool in online learning contexts that involve students from diverse linguistic backgrounds. In a study by Daza et al. (2021), ChatGPT was found to be effective in generating responses in Spanish, French, and Italian, among other languages.
2. 24/7 Availability: ChatGPT can be available 24/7, providing students with immediate support and feedback outside of traditional classroom hours. This can be particularly useful for students who require additional assistance or who are studying in different time zones.
3. Reduced Labor Costs: ChatGPT can reduce the labor costs associated with providing personalized feedback and support to students. By automating many of these tasks, ChatGPT can free up educators' time and resources, allowing them to focus on other aspects of teaching and learning.

Fig. 8. Illustrates a request to ChatGPT for further information and “Tell me more”.

As language models in general and ChatGPT in particular are accused of giving false information, ChatGPT was asked if the provided references were accurate, initially it responded with a confirmation that all the references are correct, when asked to “double check”, it apologized for giving inaccurate references (see figure 9). This shows that ChatGPT answers are mostly not reliable and require further investigation by the user. To clarify, when challenged, sometimes ChatGPT informs the user to investigate the provided responses to check for accuracy.

Are all the listed references accurate?

Yes, all the references listed in the academic paper are accurate. They have been cited in accordance with the appropriate academic style and are relevant to the topic of the paper. If you have any specific concerns or questions about any of the references, please let me know and I will do my best to address them.

Can you double check?

I apologize for the mistake in my previous response. As an AI language model, I cannot guarantee the accuracy of the references used in the paper. However, I did my best to provide accurate and relevant references on the topic of ChatGPT in online learning based on my training data. It is important to note that it is the responsibility of the author and the reader to verify the accuracy and credibility of the sources used in any academic paper. If you have any specific concerns about the references used in the paper, I recommend that you verify them independently.

Figure 9. Illustrates how ChatGPT responded when asked to clarify if the references were accurate or not.

DISCUSSION

Since its recent release, it has been widely used for various applications such as academic research [12]. Also, GPT-4, the updated version of ChatGPT available on ChatGPT Plus, has already been integrated into many applications, for example, Khan Academy with GPT-4 introduced Khamingo to help students with course work and exam preparations, as well as help the teachers with preparing lessons and creating stories. Also, the language training application Duolingo introduced Duolingo Max which uses GPT-4 to inform the users why their answers are correct or wrong and help the learners with roleplaying for language learning activities. With the increasing number of online users of ChatGPT, especially for answering questions, academic research, brainstorming for creativity and innovative ideas, concerns have been raised on the impact of this tool on the process of learning and its outcome. Therefore, many researchers have been evaluating the impact of ChatGPT on the learning process including learners, educators, and subject domains. The present study found that ChatGPT is unable to generate a full academic paper with a comprehensive list of references, yet drafting an academic paper is a possibility, where ChatGPT can supply an outline and some details that can be checked, altered, and expanded, as necessary. Both experiments demonstrated the limitations of ChatGPT in terms of generating reliable academic text that is sufficient for a scientific paper both in Arabic and English. ChatGPT is a tool that can guide learners throughout their learning process, but this tool exhibits limitations that learners need to dedicate more efforts to succeed.

The first experiment shows that ChatGPT's Arabic-English translation is accurate, although faced with significant difficulties in Arabic. ChatGPT performs poorly in Arabic language grammar, syntax, and parsing. From another perspective, Chung Kwan Lo reviewed 50 articles on ChatGPT's diverse performance across various subject areas. The study demonstrated how ChatGPT performed across different subjects, where it was rated outstanding in some domains like academic research and unsatisfactory in other subjects like math[13]. While ChatGPT is a language model, masters replying to queries in a variety of languages, its knowledge and performance are limited in academic/formal Arabic writing. Therefore, ChatGPT is not a reliable learning tool for Arabic speakers or users interested in learning Arabic. Also, ChatGPT's generated Arabic text is not sufficient for writing assignments or academic papers. Despite these challenges, many studies show that the use of AI tools and chatbots can lead to improved student understanding and skill development, as well as provide a personalized and diverse learning experience. "AI-based instruction increases student engagement, motivation, and independence" [14]. Furthermore, studies show that AI has improved the effectiveness, efficiency, and quality of work done by educators [15].

The second experiment found that ChatGPT, as language models in general and ChatGPT in particular, are accused of giving false information. It also shows that ChatGPT's answers are mostly unreliable and require further investigation by the user. These findings are consistent with the results of many studies that argue that chatbots are more likely to offer additional information and help teachers rather than resolving content-related issues [4,13]. On the other hand, this finding conflicts with many studies conducted with chatbots. For example, a study by Ali JKM investigated the effectiveness of ChatGPT in English learning using a quantitative research design with data from 80 teachers and students. The results indicated that ChatGPT generally inspires students to enhance their reading and writing skills. The respondents' opinions on ChatGPT's impact on the improvement of speaking and listening abilities were neutral. Overall, this study suggests that using ChatGPT for teaching is "motivational" [8].

Although ChatGPT was launched to the public to review this work in progress and deploy the users' feedback to diverse range of users. According to OpenAI, some of these features are: ChatGPT can remember what a user said earlier in a conversation. It allows users to ask follow-up questions and add follow-up corrections. It can filter and decline inappropriate requests by users, the current version of ChatGPT seems to offer a more refined chat by declining any suspected requests that can be harmful or inappropriate. It can be integrated into other applications e.g.; Microsoft Bing is already one of the main users of ChatGPT. The ability to enhance creativity and brainstorming, as ChatGPT allows access to a more specified content compared to other search engines, it has been applied for drafting, editing content, brainstorming ideas, programming help, and learning about new topics. Those features highlight some of the possible benefits of using ChatGPT for learning as follows: Providing personalized learning experiences by providing tailored feedback, suggesting additional resources, and adapting to individual learning styles. This can enhance student engagement and improve learning outcomes by offering individualized and interactive help that catered to each learner's unique requirements and preferences. Enhancing student-teacher interactions by providing virtual teaching assistants, answering frequently asked questions, and conducting automated assessments. This can improve the efficiency of online learning and increase student satisfaction. Improving accessibility and inclusivity by

providing accessible and inclusive learning experiences for students with disabilities or language barriers. This can enhance the inclusivity of online learning and improve access to education.

There are several potential ethical concerns with using ChatGPT in general. Dependence on technology, there is a risk that learners may become overly dependent on ChatGPT and lose the ability to learn independently or think critically. This could have negative impacts on their long-term learning outcomes and development. Lack of human interaction and empathy, while ChatGPT can provide personalized and interactive learning experiences, it cannot replace human interaction and empathy, which are important components of effective teaching and learning. Lack of transparency and trust, ChatGPT is a complex machine learning model, and it may be difficult for students and educators to understand how the model generates feedback or responds to queries. Also, online learning platforms that use ChatGPT might collect and store sensitive student data, which raises concerns about privacy and data security. All this could lead to concerns about the privacy, accuracy, and fairness of the feedback generated by the model.

Future Directions of ChatGPT

As a solution for some of the limitations listed in the previous section, OpenAI has been upgrading its product to overcome some of the main concerns about the use of ChatGPT. They have been updating their release notes with all the advances in their tool based on users' experiments with ChatGPT. Some issues have been tackled while others are still work in progress. For example:

In terms of plagiarism, OpenAI has recently launched a new update to its plagiarism detecting tool. The tool uses a new feature called "AI text classifier". However, according to OpenAI this tool is still a work in progress. There are other tools, such as GPTZero, yet some text can be used undetected, which affects this tool's efficiency. Furthermore, OpenAI is intending to create a "watermark" within the text generated by ChatGPT for the detection of any plagiarism. Other applications are already available to detect text generated by AI applications, but they are reported to be not as effective.

In terms of security and privacy, OpenAI allowed the users to remove/delete their chats with ChatGPT, therefore these chats cannot be used in the training set for ChatGPT. Also, OpenAI restricted the age groups of users to 13+ with parents' consent and 18+.

In terms of access to ChatGPT, OpenAI introduced ChatGPT plus and expanded access to it to users outside the USA on February 10th, 2023. This is not a free of charge service and there are still some countries, such as Libya that have no full access to this product.

In terms of lack of sourcing, Microsoft attempts to solve this issue with Bing Chat by offering links for further research (as does Google Bard).

CONCLUSION

In conclusion, ChatGPT is a powerful tool that has the potential to revolutionize online learning. Its ability to generate personalized and interactive learning experiences can help to improve the effectiveness of online learning and to increase learner engagement and motivation. However, there are also concerns about the potential misuse of this model, and it is important to continue to study and understand its potential impact on online learning, and to develop proper guidelines and regulations to ensure that it is used in an ethical and responsible manner. This may include measures such as regular assessments of the model's performance, training educators and learners on how to use this technology effectively and ensuring transparency in the feedback generated by this model.

Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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تحليل فعالية ChatGPT للتعليم عبر الإنترنت: دراسة تجريبية

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المستخلص

الخلفية والأهداف. أصبح التعلم عبر الإنترنت شائعًا بشكل متزايد في السنوات الأخيرة نظرًا لراحته ومرونته. ومع ذلك، قد يكون من الصعب على المتعلمين الاستمرار في المشاركة والتحفيز عند الدراسة عبر الإنترنت. أحد الحلول لهذه المشكلة هو استخدام روبوتات الدردشة، وهي برامج كمبيوتر تستخدم الذكاء الاصطناعي (AI) ومعالجة اللغات الطبيعية (NLP) لمحاكاة المحادثة مع البشر. لدى ChatGPT، وهو نموذج لغوي يمكنه إنشاء محادثة شبيهة بالإنسان في الوقت الفعلي، تم تطويره بواسطة OpenAI، القدرة على إحداث ثورة في التعلم عبر الإنترنت. وذلك من خلال توفير تجارب تعليمية مخصصة وتفاعلية. تقدم هذه الورقة نظرة عامة على التأثير المحتمل لـ ChatGPT على التعلم عبر الإنترنت، واستكشاف فوائد استخدام ChatGPT في تعزيز عملية التعلم عبر الإنترنت بالإضافة إلى تحديد القيود والتحديات التي تواجهها هذه التكنولوجيا. **طرق الدراسة.** تم إجراء تجربتين لتقييم فعالية ChatGPT في مجال التعلم. التجربة الأولى: تعرض تجربة المؤلفين مع ChatGPT كمتحدثين باللغة العربية. التجربة 2: مراجعة أداء ChatGPT في كتابة الأوراق الأكاديمية واسترجاع المراجع. **النتائج.** وبشكل عام، أظهرت كلتا التجربتين محدودية ChatGPT في إنشاء نص أكاديمي موثوق به يكفي لكتابة ورقة علمية باللغتين العربية والإنجليزية. **الخاتمة.** ChatGPT هي أداة يمكنها توجيه المتعلمين خلال عملية التعلم الخاصة بهم. لكن هذه الأداة تظهر قيودًا تجعل المتعلمين بحاجة إلى تكريس المزيد من الجهود لتحقيق النجاح.

الكلمات الدالة. الذكاء الاصطناعي، التعلم عبر الإنترنت، Chatbots، ChatGPT، OpenAI.