Discover Education

Review

Exploring the opportunities and challenges of ChatGPT in academia

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Abstract
The Artificial Intelligence (AI) natural language model ChatGPT (Chat Generative Pre-trained Transformer), often referred to as ChatGPT-4, has a wide range of possible uses in the fields of research, business, academia, health, and similar fields. This language model can accomplish a number of academic jobs that were previously completed by people, taking a significant amount of time and effort. The purpose of the article is to investigate ChatGPT's potential opportunities and challenges in academia. To attain this objective, a review of relevant literature and online resources (news, articles, etc.) was carried out. The noticing-collecting-thinking approach was adopted to explore and categorize all observed concerns. The outcome of this study reveals that research, education, personal skill development, and social aspects constitute the four broad perspectives that articulate the opportunities and constraints of ChatGPT in academia. For instance, from the *education* perspective, ChatGPT can help students have a personalized learning experience. On the other hand, it might provide false information as well as lack the ability to generate responses on its own because those responses depend on training datasets, which may contain errors. Similarly, from the point of view of the *personal skill development*, this model may impair a person's capacity for critical thought and content production; while providing reading and writing practice sessions and relevant content, it can improve a person's language proficiency.

Keyword ChatGPT, GPT-3, GPT-4 academia, Challenges, Opportunities, Conceptual analysis, Artificial Intelligence, Education, Writing

1 Introduction

ChatGPT is an artificially intelligent chatbot initially based on GPT-3, a Natural Language Processing (NLP) model based on deep learning algorithms [1, 2]. GPT-3 is a multi-modal machine learning model trained on a large text data set to generate human-like text [3]. This Large Language Model (LLM) can perform several tasks like language modeling, language translation, and generating text for applications or chatbots (i.e.: ChatGPT) with more reliability and creativity. ChatGPT was developed by a San Francisco-based Artificial Intelligence (AI) research and deployment organization OpenAI [4, 5]. Currently, ChatGPT is freely accessible through the OpenAI web portal. Recently, OpenAI has launched a new version GPT-4 which can work with images also [6]. GPT-4 is more powerful with lots of new features and fewer mistakes than the previous version. This model can create, modify, and collaborate with users on creative and technical writing assignments, such as music composition, scripting films, and adapting to a user's writing tone [7]. The objective of developing ChatGPT was to assist users as a dialogic agent in natural language providing helpful and accurate information like

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customer service, chatbot, and alike [1]. For this, ChatGPT was trained with a massive dataset sourced from the internet. This dataset includes a wide range of text genres, such as news, articles, scientific papers, social media posts, etc. in different topics and languages [8]. The exact size and composition of the training dataset can be estimated to be on the order of hundreds of gigabytes or more [9]. The goal of the training process is to learn patterns and relationships within the text data that allow the model to generate human-like responses to various questions and prompts [10].

Several existing LLMs include BERT [11], Transformer-XL [12], Megatron [13], Jurassic-1 [14], ELECTRA (Efficiently Learning an Encoder that Classifies Token Replacements Accurately) [15], Gopher [16], etc. These LLMs were developed to understand and generate natural language [17]. All of these existing language models can analyze task-specific data, generate a response, and fine-tune the generated output. These models can be instructed to generate outputs according to a user inquiry. These previous LLMs were only able to handle one-time probing and also generate responses with a large variation in case of similar instructions [18]. Usually, LLMs like GPT-3 and GPT-4 can work with more than a hundred billion parameters.

Being a smart language model with an IQ score of 147 [19], ChatGPT can perform a wide range of functions in the academic sector, for example, generate, alter, and optimize creative and technical writings based on the context and mode (formal, informal, etc.) by enhancing the quality, interactivity, and accessibility to education. On the other hand, ChatGPT can create some challenges in the academic sector also including generating biased output, difficulties in ensuring academic integrity, reducing individual writing skills, having limited abilities being a machine, etc. Additionally, there may be concerns about reducing personalization and the potential for job loss in academia. As such, the motivation of this research is to address the implications (positive and negative) of ChatGPT in the academic domain.

Since academia is continuously progressive, adapting innovative technologies may enhance the teaching and learning experience significantly. By investigating the challenges and opportunities of ChatGPT in academia, this research aims to contribute to improving the quality of education with effective and efficient use of this AI model. Therefore, the objective of this research is to explore the insights of ChatGPT in academia in terms of opportunities and challenges assisting students, teachers, and researchers. To attain this objective, data collected from different sources were analyzed following the noticing-collecting-thinking model. Then, the impacts of ChatGPT in academia were derived as opportunities and challenges.

The significance of this study is that it aims to clarify the impacts of using ChatGPT and similar AI-based natural language models in learning environments. The purpose of the research is to significantly contribute to the state of knowledge on AI in education by investigating possible benefits, and concerns of this technology in educational contexts. Again, this study intends to fill a theoretical gap in the literature by focusing on the practical implications of ChatGPT in educational environments. Although a lot of research has been conducted regarding the general applications of AI in education, there is a lack of in-depth exploration into the specific challenges and opportunities offered by ChatGPT, a state-of-the-art language model, in the academic setting.

The rest of the article is organized as follows. A review of the related literature is presented in Sect. 2. Next, in Sect. 3, the methodology adopted in this research is presented. Then, the results are discussed in Sect. 4 as the architecture of ChatGPT (Subsect. 4.1), the opportunities (Subsect. 4.2), and the challenges (Subsect. 4.3) of ChatGPT in the academic domain. Finally, Sect. 5 concludes this article along with future work and limitations.

2 Literature review

Several existing research has focused on outlining the impact of ChatGPT in the academic domain. For example, Lund and Wang [2] presented different contributing concerns of ChatGPT (i.e.: language processing activities, research and project implementations, ethics and privacy issues, etc.) in terms of questions and answers. In another article; Curtis [20] briefly explained the strengths (improvement in education, training, clinical care, and research) and limitations (i.e.: ethical concerns, fake referencing) of this AI model in academic publishing. In another empirical study, AlAfnan et al. [21] investigated the challenges and opportunities that may arise due to ChatGPT in the case of student-teacher communication, business writing, and composition courses. After 30 test sessions, it was found that this AI model is used mostly to seek answers to theory-based questions and generate practical ideas. The challenge was to differentiate between the AI-generated text and human written test by the instructors which has a greater chance of deriving incorrect course outcomes. Meanwhile, Kasneci et al. [22] presented the benefits and challenges of LLMs mostly focusing on ChatGPT in education from a teaching and learning perspective while Cotton et al. [23] found enhanced student engagement, collaboration, and accessibility as opportunities; and several concerns like academic honesty and plagiarism were raised

due to ChatGPT in the context of academic integrity. In another research, Fuchs [24] discussed the opportunities and challenges of ChatGPT in higher education. The opportunities included personalized learning, on-demand support, and independent working ability; and challenges included insufficient research data, over-reliance on the bot, biases in the experimental result, and so on. Sullivan et al. [25] conducted a content analysis on available Western news articles to derive the impact of ChatGPT on academic integrity and student learning. Whalen and Mouza [26] examined the impact of AI in K-16 education. ChatGPT can be used to automate the aspects of teaching and learning, be augmented as a teaching assistant, as a language tool, as a student monitoring tool, and alike.

Two studies conducted by Xames and Shefa [27], and Donmez et al. [28] presented the challenges and opportunities of ChatGPT in publication and research. Xames found that opportunities like ChatGPT may generate ideas, synthesize existing works, identify context for the researchers; check article quality, format, plagiarism, and eligibility for the editors; and evaluate the novelty, quality, clarity, conciseness, coherence, and even the strength and weakness of an article for the reviewers. On the other hand, Donmez et al. outlined the implication of ChatGPT in finding, checking, the research question; determining the research design; collecting data; and finalizing the title, etc. with examples. Rahman et al. [29] highlighted the application of ChatGPT in academic research considering research articles, websites, and visual and numerical artifacts with practical examples.

From the medical point of view, Alser et al. [30] depicted the involvement of ChatGPT in medical research like authorship, plagiarism, and biased result generation. In another research, Homolak [31] derived the opportunities and risks of ChatGPT in medical, science, and academic publishing. This AI model may perform the tasks of physician and scientist partially but that is not sufficient to replace the involved persons.

Yu [32] presented the stages of the revolution of AI to ChatGPT. He depicted the risks of ChatGPT for the students with statistics. For example, 89% of college students in America use this AI model to complete their assignments. Also, teachers in North America are trying hard to motivate students to write articles on their own. But to be frank, these risks are increasing day by day since it is almost impossible to differentiate between an AI-generated text and a human text through reading only. In another research, Quintans et al. [33] outlined some open research questions related to academia raised due to ChatGPT.

From the related literature review, it can be shown that several existing works have focused on deriving the strengths and weaknesses of ChatGPT in the context of academic integrity, teaching and learning environment, research and publication, and the like. None to very few articles combined all these as their research area. So, extensive research with elaborated and extended visualization of the impact of ChatGPT in academia including education, research, publication, and academic integrity is required.

3 Methodology

To explore the opportunities and challenges of ChatGPT in academia, the related online resources (news, reports, etc.) and articles (published in journals, conferences, or preprints) were searched and selected from scholarly databases like ACM, Scopus, Google Scholar, etc. and Google search engine. Table 1 shows a summary of the sources for data collection.

The sources were categorized into seven categories: academic journals, preprint, conference proceedings, books, technical reports, news articles, blogs, and website articles. The selected literature was then reviewed and analyzed following the noticing-collecting-thinking model [34]. This data analysis model is generally used for the complex and rigorous practice of qualitative data analysis to construct a taxonomic structure into three phases—noticing, collecting,

Table 1 Summary of the data collection source

Ser	Source type	Example	Frequency	Percentage
1	Academic Journals	[14, 36, 37], etc.	17	32.1%
2	Preprints	[1, 8, 38], etc.	15	28.3%
3	Conference proceedings	[39, 40]	2	3.8%
4	Book	[41]	1	1.9%
5	Technical reports	[19, 42]	2	3.8%
6	News article	[10]	1	1.9%
7	Website and blog	[6, 43, 44], etc.	15	28.3%
Total			**53**	**100**

and thinking [34, 35]. This structured and comprehensive data analysis approach makes this model creative, resourceful, and flexible. The first phase encourages one to observe and pay close attention to fine details to develop relevant information. Next, in the collecting phase, findings from the previous phase specifically relevant information are gathered systematically. This includes a more comprehensive analysis of data from a variety range of sources and perspectives to facilitate the next phase. Finally, information is interpreted intelligently and critically considering different viewpoints. This approach is different from other qualitative data analysis approaches since this approach can be adopted in various contexts like research, problem-solving, and decision-making; and integrating noticing-collecting-thinking a topic or subject can be well understood before concluding. As such, adopting this approach for this research allowed a recurring process to reveal the specific concerns (data related to the opportunities and challenges of ChatGPT) from the literature. Again, for extensive analysis, noticing and following by interpretation must consider any concern as an opportunity or as a challenge. Thus, the noticing-collecting-thinking model is adopted here for data collection and analysis.

In Noticing phase, the selected literature was meticulously reviewed and tried to notice if any concern is related to the opportunities and challenges of ChatGPT in the case of academia. In the Collecting phase, all the noticed concerns (opportunities and challenges) were collected and organized in a tabular format. An example of coding the concerns is shown in Fig. 1. For example, the information "ChatGPT can be used as virtual mentors, voice assistants, innovative content, smart classrooms, automatic assessments, and personalized learning" (serial 01)—was collected from research conducted by Shidiq [45]. From this information, the colored portion was marked as codes: i.e. 'virtual mentors, voice assistants' and 'personalized learning' were marked as 'personalized learning'. Thus, codes were extracted from each information and accumulated for the next phase. All the listed concerns were analyzed to highlight the opportunities and challenges in Thinking phase. Each concern was labeled as a challenge or opportunity according to its impact on academia. And finally, a total of 21 opportunities and 16 challenges were found. Then, similar opportunities and challenges were grouped into four broader themes (research, education, personal skill development, and social). While grouping revealed concerns (data), a set of criteria was considered that could differentiate the concerns as similar or correlated following the Iterative Categorization approach [46]. Also, these criteria could distinguish the categories one from another. This development of categories organizes data through a variety of different divisions. This process was

Ser	Information	Codes	Ref
	Opportunities		
1	ChatGPT can be used as virtual mentors, voice assistants, innovative content, smart classrooms, automatic assessments, and personalized learning	Personalized learning, Automatic assessment, Creativity and innovation	Shidiq (2023)
2	When a student submits a question or response, the model can analyze the input and generate a response tailored to the student's needs.	Personalized learning	Zaremba & Demir (2023)
3	Future education assessment will be more diversified and objective, facilitated by AI technologies such as ChatGPT	Automatic assessment	Zhai (2023)
4	When a student submits a response to a question, the model can analyze the response and provide feedback customized to the student's understanding of the material. This feedback can help the student identify areas where they might need additional support or where they have demonstrated mastery of the material.	Additional support	Zaremba & Demir (2023)
5	the processing models can generate customized learning plans for individual students based on their performance and feedback. These plans may include additional practice activities, assessments, or reading materials designed to support the student's learning goals.	Personalized learning, Additional support	Zaremba & Demir (2023)
6	ChatGPT can help students to generate new ideas and approaches to problems.	Creativity and innovation	Qadir (2022)
	Challenges		
1	There seems to be a real risk that AI-generated articles will soon blur the distinction between original human-written and AI-written or re-edited content. The increase in such applications also raises the question of who the author really is	Ethical concern	DÖNMEZ, Sahin & GÜLEN (2023)
2	Potential concerns and challenges associated with ChatGPT incorporation into medical education include privacy and security risks, limited ability to recognize bias or errors, overreliance on technology, lack of social interaction and communication skills, and potential for reduced critical thinking and creativity.	Weak content creation ability	Sallam, Salim, Barakat & Al-Tammemi (2023)
3	Using the chatbot system can potentially reduce some of the skills that students should master, including critical, creative and collaborative thinking skills, in this study, including creative writing skills.	Weak content creation ability	Shidiq (2023)
4	Using NLP models in higher education is the potential risk of overreliance on technology, which could undermine the development of important critical thinking skills.	Weak content creation ability	Fuchs (2023)
5	The use of generative AI in education raises ethical concerns such as the potential for unethical or dishonest use by students and the potential unemployment of humans who are made redundant by technology	Ethical concern, Unemployment	Qadir (2022)
6	If students do not provide clear, concise, and relevant input, the system might struggle to generate an accurate response.	Inadequate support	Fuchs (2023)
7	If the training data is not adequately diverse or is of low quality, the system might learn incorrect or incomplete patterns, leading to inaccurate responses.	Inadequate support	Fuchs (2023)

Green: Additional Support
Cyan: Automatic assessment
Pink: Creativity and innovation
Yellow: Personalized learning
Red: Ethical concern
Blue: Unemployment
Brown: Weak content creation ability
Gray: Inadequate support

Fig. 1 Coding for opportunities and challenges from the reviewed literature

iterated several times unless the authors reached a consensus level about which information (opportunities and challenges) could be considered final.

Apart from analyzing the related literature and online resources, the ChatGPT application was explored by providing several questions and the responses generated by ChatGPT were analyzed to reveal its opportunities and challenges in academia as well.

4 Result and analysis

This section briefly discusses the findings of the research adopting the noticing-collecting-thinking model. Firstly, the architecture of ChatGPT is briefly described. Then, the opportunities and challenges of this model are presented respectively.

4.1 ChatGPT architecture

The working process of ChatGPT is depicted in Fig. 2 [47]. ChatGPT combines big data, large computing power, and algorithms to act as an intelligent model [32]. Initially, this model was trained on a massive instruct dataset generated by OpenAI [48] with numerous parameters [49] through supervised learning [50].

During the Reinforcement Learning from Human Feedback (RLHF) phase, human AI trainers performed conversations with this model as both a user and an AI assistant. So, this model is able to identify the patterns of input data by determining the statistical structure within the data [40]. To generation process of the reward model of RLHF was repeated several times. The conversations in the initial training phase were considered as comparison data. For this, one randomly selected model-generated message was sampled to some alternative responses and all these samples were ranked by AI trainers. After that, the model was fine-tuned through these reward models.

Interaction with ChatGPT can be divided into Query and Response. Generally, a user can make a Query to the ChatGPT. This query is directly processed by the GPT-4. GPT-4 was developed following the transformer architecture [39] which is highly appropriate for handling long data sequences [36]. The multi-layer transformer network consists of several small circuitry sets each having a different purpose. There are two types of circuitry networks in a transformer architecture. The first one is the Feed Forward network which is responsible for extracting information from the token fed into it and processing the information. Another type of network is Multi-Head Attention circuitry which is designed for Encoder/

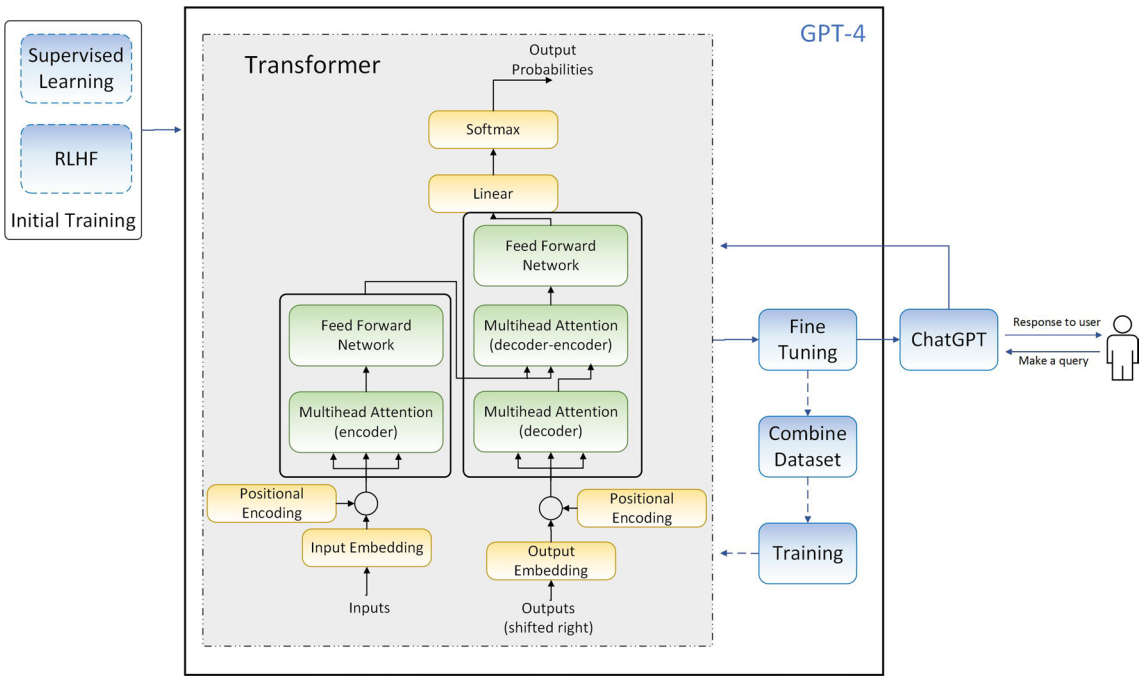


Fig. 2 The working process of ChatGPT

Decoder/ Encoder-Decoder self-attention. In the case of encoder and decoder multi-head attention circuitry queries, keys and values are calculated from the encoder and decoder states respectively. For encode-decoder multi-head attention, the queries are computed from the decoder state; keys and values are computed from encoder states. The output generation circuitry generates the probable outputs and then the output data are fine-tuned. After that, ChatGPT is instructed by GPT-4 to respond. Finally, ChatGPT interacts with a human by providing a human-like response through the conversational interface. After ChatGPT is publicly available, this model is still being learned through conversations with global users. As such, all the conversation data are combined with the existing dataset and used for training the GPT-4.

4.2 Opportunities of ChatGPT

In the field of academia, ChatGPT may have several potential opportunities and applications. These can be divided into four broad categories (Fig. 3):

(a) *Research*: Since ChatGPT is a highly advanced AI language model, it can make significant contributions to the research domain by assisting researchers in various tasks and by facilitating new discoveries. For example,

- Facilitate research activities: ChatGPT can be used as a tool for researchers for example, in the case of NLP, ChatGPT may assist in testing and upgrading the state-of-the-art in language understanding, generation, translation, classification, and categorization, etc [37, 51]. This model is also able to identify different parts of speech, entities (like a person, organization, location, etc.), and sentiment (positive, negative, neutral) for a sentence [51].

  ChatGPT can provide up-to-date information on emerging technologies and their applications, making it easier for individuals to conduct research in these rapidly changing fields. This model can also offer a more cost-effective and efficient solution in some cases [8]. Figure 4 shows a list of articles suggested on a query for a related research paper to a topic.

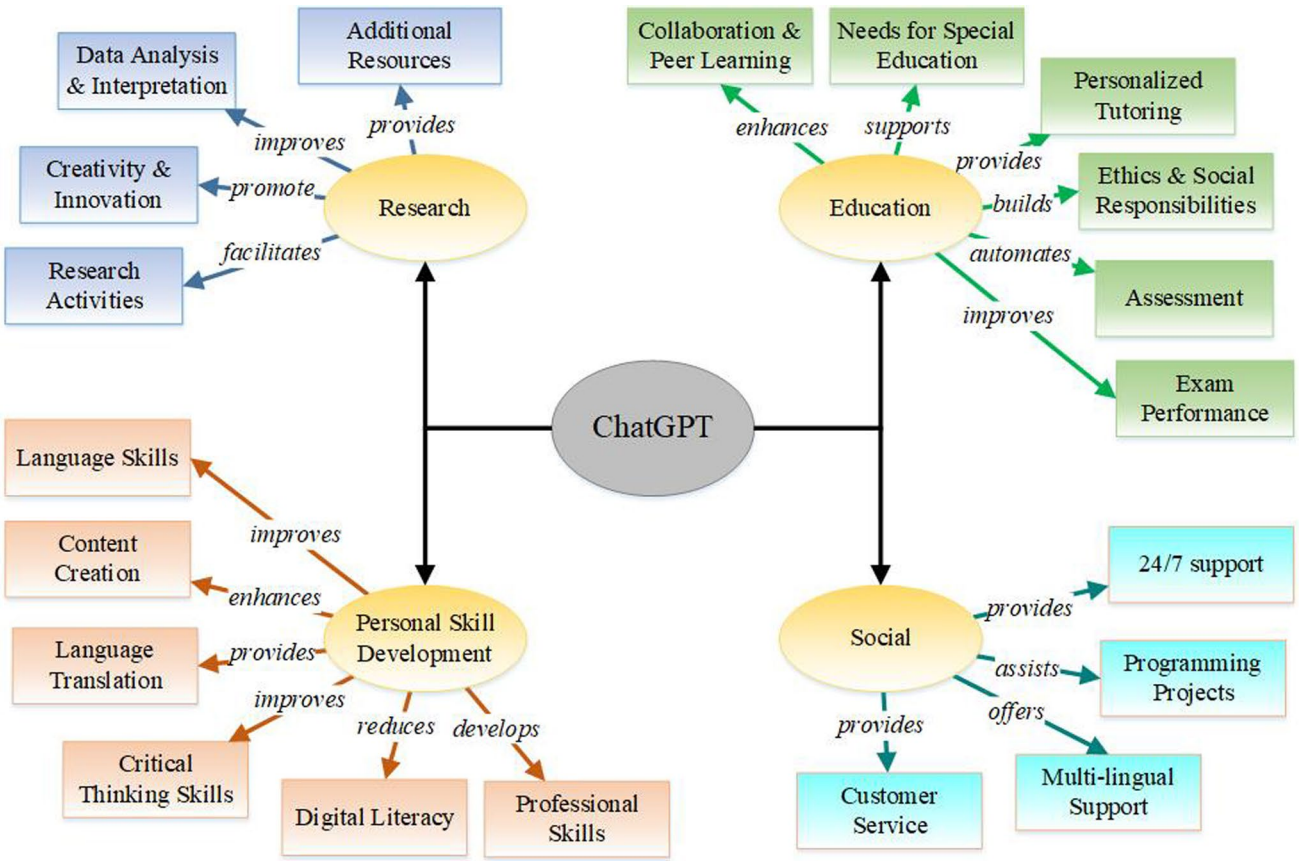


Fig. 3 The opportunities of ChatGPT in academia

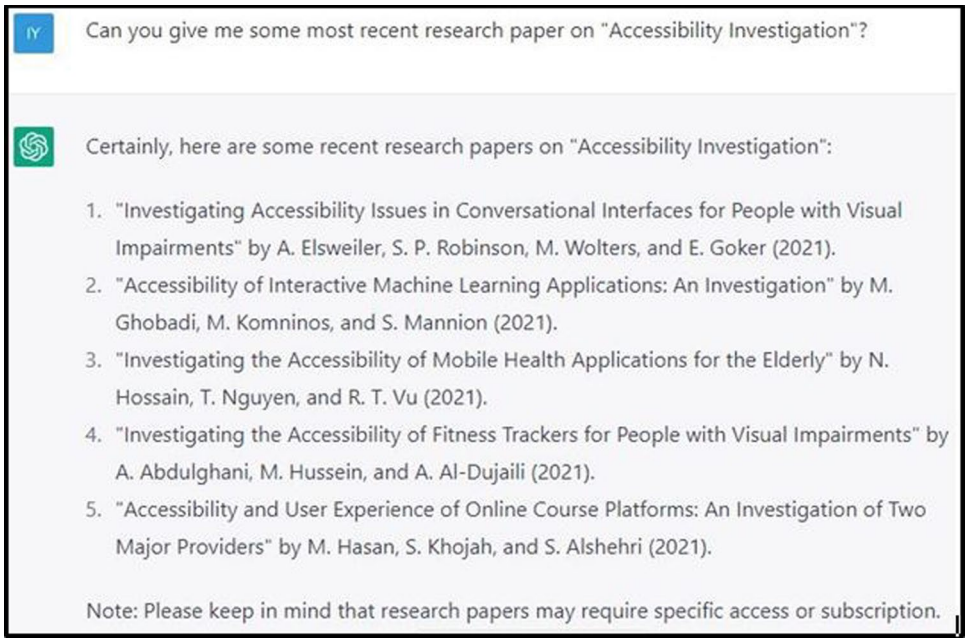


Fig. 4 ChatGPT provided a list of articles related to 'accessibility investigation'

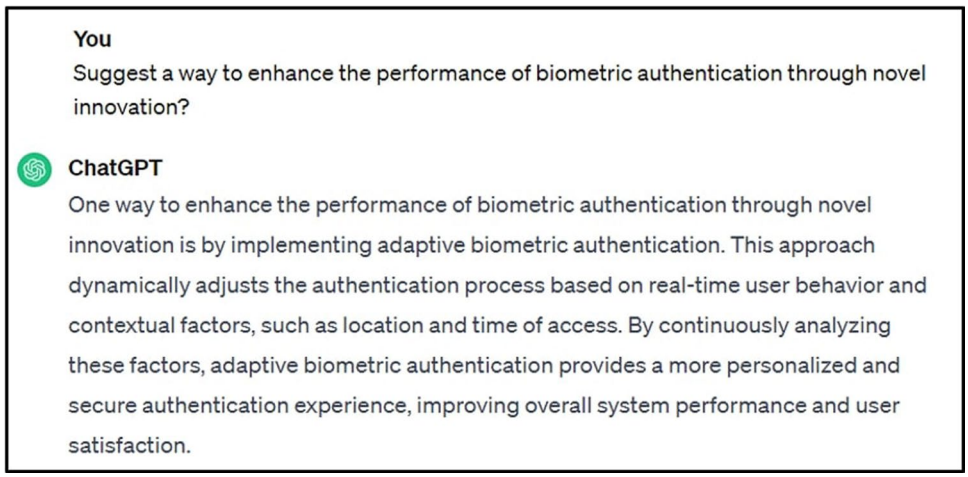


Fig. 5 ChatGPT suggested innovative ways to enhance biometric authentication

- Promote creativity and innovation: By automating the repetitive and troublesome tasks, ChatGPT can assist the researchers as such ChatGPT may assist to collect data, reviewing the literature, and synthesizing data that helps the researchers to contribute more in creative and higher level tasks [52, 53]. Again, this model can help with novel and unique ideas/ ways of thinking. An example of this scenario is presented in Fig. 5. A question was asked about how the performance of biometric authentication can be enhanced. ChatGPT suggested implementing adaptive authentication as a solution.

  Compared to other language models, firstly, ChatGPT is trained on larger and more diverse data sets to adapt a broader range of human language patterns [54]. Second, ChatGPT is more context-aware in case of a conversation which helps to generate more relevant and accurate responses to a set of context information [55]. Finally, ChatGPT is still being trained through the queries and responses. So, this model is updated (with new data and algorithms) to generate innovative responses.
- Improve data analysis and interpretation: The text summarizing capability of ChatGPT can help researchers with a better understanding of existing knowledge on a specific topic. ChatGPT can analyze large data sets refined from a large number of texts without human involvement [56] which in turn may produce interesting patterns that can be difficult to reveal through traditional approaches to data analysis.

- Provide additional resources: ChatGPT can provide users with additional relevant information and resources on a particular topic [52] which may benefit in pursuing academic research and projects.

(b) *Education and knowledge retrieval*: ChatGPT can be used as an educational tool to assist students as well as teachers in retrieving knowledge and information:

- Enhance collaboration and peer learning: ChatGPT's sophisticated language processing abilities can facilitate cross-field collaboration that may enable students from diverse disciplines to communicate and collaborate more effectively [22] The model's ability to answer questions and provide information can encourage knowledge sharing and peer-to-peer learning among students. ChatGPT's language generation features can aid in better communication, promoting the exchange of ideas and knowledge, resulting in more productive collaboration and peer learning.
- Support needs for special education: ChatGPT has the capacity to address a broad spectrum of disabilities, including difficulties with reading, writing, and communicating [22] High-quality education for people with disabilities can be achieved through the implementation of inclusive education practices, the provision of assistive technology and accommodations, and the training of teachers and staff to support students with disabilities [57]. ChatGPT can allow students to access educational resources like a wide range of subjects, study materials, and online courses. This can help students from low-income, rural, and remote communities and provide them with the same educational opportunities as their peers [8].
- Provide personalized tutoring: Since ChatGPT can reply to user questions, it can offer students a personalized learning experience in their own learning styles and pace [24, 58, 59]. This model is designed to answer the questions asked of it. If any answer is not understood, this model also supports asking again or regenerating the answer [60]. Also, ChatGPT is also able to offer resources for the professional development of the teachers [41].
- Build ethics and social responsibilities: ChatGPT allows the user access to information related to ethical and socially responsible practices. This will help individuals understand the significance of these practices and how they can apply them in their personal and professional lives.
- Automate assessment: ChatGPT is able to grade and generate feedback on a given text which can be utilized as automated scoring and feedback on student assignments and other writings [58]. This will save time for the teachers and students by providing instant feedback on student assignments [61].
- Improve exam performance: ChatGPT can help students to prepare better for their examinations by exploring a number of related practice problems and solutions [60].

(c) *Personal skill development*:

- Improve language skills: ChatGPT can play a significant role in improving individual language skills. This model is able to perform machine translation to overcome language barriers and make information more accessible [38]. Again, this model can improve users' language proficiency by answering questions and providing practice (speaking and writing) sessions in real time [60].
- Enhance content creation: Since ChatGPT can provide feedback and suggestions on a given text, this feature can improve individual content creation [44]. ChatGPT can generate written content on a specific topic, helping content creators save time and effort in writing articles, blog posts, and other written materials [56].
- Provide language translation: ChatGPT can translate text from one language to another, providing real-time translation services and improving communication between individuals using different languages [38]. Moreover, ChatGPT can aid human translators by offering alternate phrasing, defining uncommon terms, and enhancing the accuracy of the translation process.
- Improve critical thinking skills: ChatGPT can improve critical thinking skills by providing access to information and generating new topics as well as debates, encouraging reflection and analysis [8]. Individuals can broaden their knowledge, and evaluate information critically with improved mathematical reasoning and computational skills, leading to more informed decisions.
- Reduce digital illiteracy: ChatGPT can reduce digital illiteracy by accessing and utilizing technology and providing individuals with information and support in using it. This helps to increase individuals' technology skills and confidence, reducing barriers and providing greater opportunities for accessing information and participating in a tech-driven world [62].

- Develop professional skills: ChatGPT can offer additional resources for a specific topic that can be beneficial for career development and job training [8]. This model can improve professional skills i.e.: project management and teamwork skills by providing relevant information and support to individuals, helping them to understand project management methodologies, best practices, and strategies; presentation skills by giving access to information on effective presentation methods, providing constructive feedback and recommendations [63].

(d) *Help and support*:

- Provide student service: ChatGPT allows for quicker and more efficient support to students by offering pre-written responses to questions [64]. This model is able to answer Frequently Asked Questions (FAQ) to support students and teachers effectively while accessing any online portal related to education [43].
- Offer multi-lingual support: ChatGPT can generate text in multiple languages, making it accessible to a wider audience across language barriers [38].
- Assist programming projects: ChatGPT is able to provide code snippets and suggestions, generate documentation and commenting, and help to find solutions to problems [53].
- Provide 24/7 support: ChatGPT can be used as an online tool making educational resources and support available to students immediately during not only regular business hours but also at all times [24, 60].

4.3 Challenges of ChatGPT

Though ChatGPT is a powerful tool with numerous potential benefits, some challenges may arise with its use. The challenges can be categorized into four major categories (Fig. 6):

(a) *Research*:

- Inconsistent performance: Being an AI model, ChatGPT gives machine-generated replies. Though this model is trained on huge datasets, there is a chance of containing biased data which may generate biased output [24, 60,

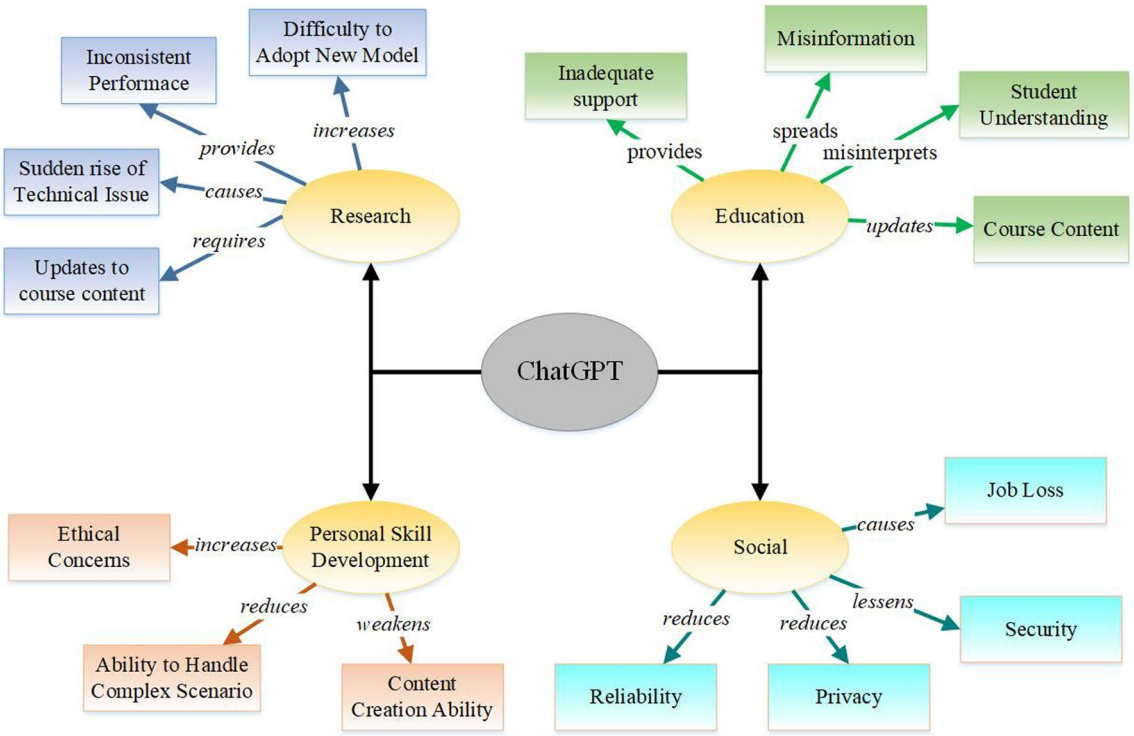


Fig. 6 Challenges of ChatGPT in academia

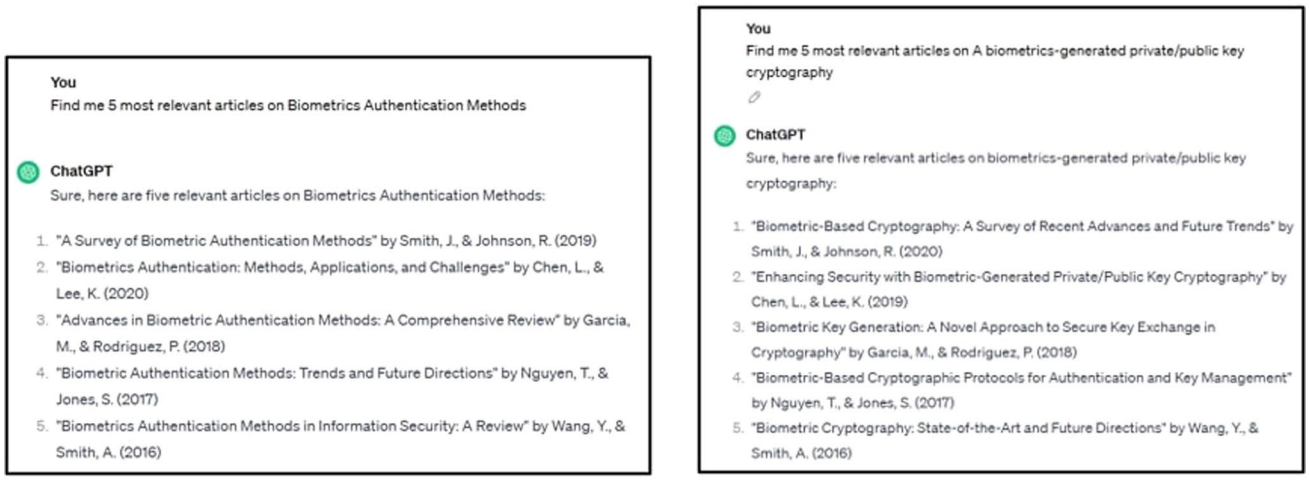
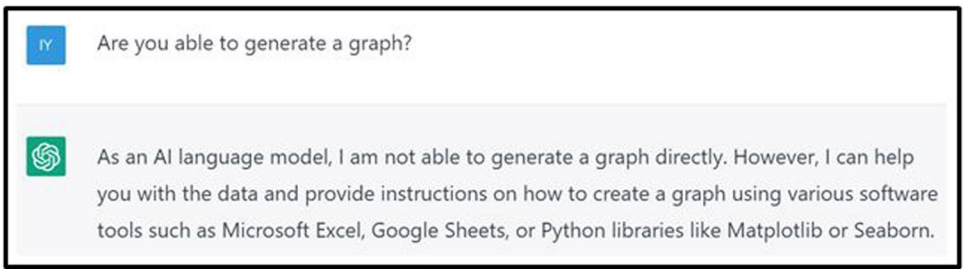


Fig. 7 ChatGPT provided five articles with same authors and different titles for different topics (a) articles on biometric authentication methods (b) articles on biometric generated private/public key cryptography

Fig. 8 ChatGPT is not able to generate graph



65]. Again, this model may generate different replies on the same question when asked separately [62]. Moreover, ChatGPT may lead to outline inconsistent performance which in turn may affect the reliability and validity of research findings [49]. Figure 7 (a) and (b) shows that ChatGPT offered five articles related to each topic that was asked for. For the two ideas that ChatGPT suggested, the authors and years are the same, also the articles don't exist.

- Difficulty to adopt new models: ChatGPT can be integrated to develop a new system. However, usage and integration of this model with existing ones can be complex and difficult. Since all queries to this model are stored and used to train this model further, there is always a data privacy and security concern which may make students adopt ChatGPT [58].
- Sudden rise of technical issues: ChatGPT is an AI model having limited understanding and background information. So, sudden technical issues such as compatibility issues with existing systems, software bugs, or hardware malfunctions, may occur [58].

(b) *Education and knowledge retrieval:*

- Provides inadequate support: ChatGPT may provide inadequate user support [1]. If the user doesn't provide the clear, concise, and relevant input, ChatGPT may generate an accurate response [24]. This model was developed following transformer architecture which is highly appropriate for handling text data. So, this model isn't able to generate graphs or images. But ChatGPT can provide necessary data and instructions on how to create a graph using various software tools [66] (Fig. 8). This model also can't provide any direct reference, link, or source for any responses [66]. This may create difficulties in writing assignments and articles with references that may ensure the authenticity of the statements. For example, a link for accessing a research article was

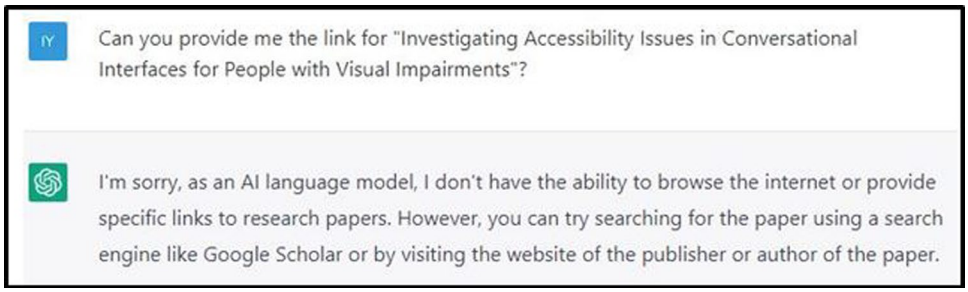


Fig. 9 ChatGPT was not able to provide an HTML link for an article

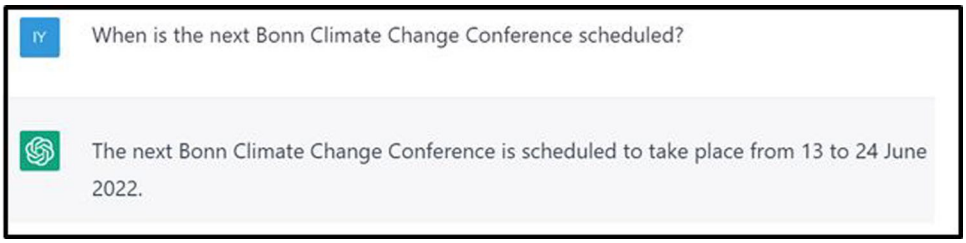


Fig. 10 ChatGPT generated wrong response

asked to ChatGPT. In response, it was not able to provide an HTML link for the original source of the article (Fig. 9).

- Spread misinformation: ChatGPT is trained on a huge but limited data set up to 2021. In 2023, there is a chance to provide incorrect information as well as results through this model [49, 60]. Figure 10 shows, while ChatGPT was asked: "When is the next Bonn Climate Change Conference scheduled?"; ChatGPT replied that the schedule is from 13 to 24 June 2022. This query was made on 17th July 2023. The next Bonn Climate Change Conference after the date of query is scheduled from November 11 to 22, 2024. This scenario refers that ChatGPT may generate an inconsistent response.
- Misinterpret student understanding: Incorrect assessment of student understanding may happen if ChatGPT is not able to properly account for different learning styles or prior knowledge and experiences [67]. However, it is also difficult for the teachers to differentiate between the AI-generated text and the student's own writing which may lead to misinterpreting the actual scenario of student understanding or knowledge [23].
- Lead to update course contents: Since ChatGPT is able to assist students with any textual content, students may use this model for their assignments, online exams, etc. It is very difficult for a human to detect AI-generated text. So, the course contents may require to be updated in innovative ways especially assignments that can't be solved easily by any AI model [68].

(c) *Personal skill development:*

- Increase ethical concerns: ChatGPT is able to provide aids related to research and studies. This may increase ethical concerns for the teachers (i.e.: integrity and plagiarism, accuracy and reliability, privacy and security, fairness and bias, etc. in responses) [60]. Again, students may make a wrong usage of ChatGPT to complete their assignments, online quizzes, etc. pretending that they have done it on their own [23, 32]. These may affect their ethics as well as personality [69].
- Reduce ability to handle complex scenarios: ChatGPT is operated based on algorithms and pre-existing knowledge, rather than human insight and critical thinking which may reduce compatibility in academia. This can result in limitations in the ability to cope with complex and new situations or consider multiple perspectives [42].
- Weaken content creation ability: Since ChatGPT is able to assist both teachers and students with their writing, regular work, study, and research, some users may become over-reliant on this AI model [24]. This may weaken individual critical thinking skills reducing productivity to create innovative and new content [45, 70].

(d) *Social:*

- Reduce reliability: Since ChatGPT can generate inconsistent and incorrect information related to a topic, it may lead to reduced reliability [1]. This may discourage users from adapting this model for their study and research purposes.
- Reduce privacy: While using ChatGPT, users may share their sensitive information like corporate business policy, military tactics, financial data, or personal data [2]. This data is very private and must not be shared with others [71, 72]. Since ChatGPT is continuously trained on a vast amount of data (even from the conversation with the users) to generate a response, sensitive or personal information may be leaked or misused [22].
- Lessen security: ChatGPT can be vulnerable to cyber attacks resulting in theft or loss of data. This can also hamper the overall system security [73]. Again, ChatGPT is basically trained on the data available over the internet (both authenticated and unauthenticated). ChatGPT can be manipulated to generate misleading or harmful content, such as fake news, phishing attempts, or malicious code, which can be used to deceive users or compromise systems [74].
- Increase unemployment: ChatGPT can automate tasks that were previously performed by human workers (data entry and processing, language translation, code generation and debugging, content generation) that may result in reduced workload as well as manpower. In turn, it is also possible to create job replacements for human teachers and tutors [60].

5 Conclusions

ChatGPT is an AI model which is already used by millions of users. This article highlights the possible opportunities and challenges that could arise due to the innovation of ChatGPT in academia. Although the challenges of ChatGPT include inaccuracy, fairness, ethical issues, and the like, these can be addressed by improving the effectiveness and responsible usage of this language model. Again, the conversations with every user are stored and used further to learn the model (ChatGPT) for improving its accuracy to provide better user support. So, for the time being, the opportunities of ChatGPT will increase while the problems raised due to ChatGPT will decrease. As such, the implementation of ChatGPT may impact very positively all concerns related to academia in the near future. Therefore, this article provides an depth understanding of ChatGPT in the academic domain.

By addressing the challenges of ChatGPT depicted in this research, students can easily navigate and utilize emerging technologies effectively. Another implication of this research can be the identification of the areas to improve further in ChatGPT by analyzing knowledge gaps, ineffective principles, and inefficient procedures encountered in academia. Addressing the areas can assist in the development of more efficient procedures and interfaces. Future studies may focus on addressing these issues to ensure improved quality education. Performing the usability and UX analysis through evaluation studies of this AL model will also help to ensure more acceptability among the teachers and students [75]. However, since AI technology is a rapidly growing area of computer science, potential measures must be taken to address all the challenges that may arise in the future.

This research has a few limitations as well. This study reviewed and analyzed the limited online and published resources that were available till March 2023. Again, the methodology adopted for analyzing the data is qualitative in nature, which mostly depends on the analyst or researcher's skills and experiences. Finally, a few cases were discussed with appropriate examples and scenarios for better understanding.

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Declarations

Competing interests The authors declare no potential competing interests.

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