

## PAPER

# An In-Depth Review of ChatGPT's Pros and Cons for Learning and Teaching in Education

Agariadne Dwinggo  
Samala<sup>1</sup>(✉), Xiaoming  
Zhai<sup>2</sup>, Kumiko Aoki<sup>3</sup>, Ljubisa  
Bojic<sup>4</sup>, Simona Zikic<sup>5</sup>

<sup>1</sup>Faculty of Engineering,  
Universitas Negeri Padang,  
West Sumatera, Indonesia

<sup>2</sup>University of Georgia,  
Athens, Georgia

<sup>3</sup>The Open University of  
Japan, Chiba, Japan

<sup>4</sup>Institute for Philosophy and  
Social Theory, University of  
Belgrade, Belgrade, Serbia

<sup>5</sup>Faculty of Media and  
Communications, Singidunum  
University, Belgrade, Serbia

[agariadne@ft.unp.ac.id](mailto:agariadne@ft.unp.ac.id)

## ABSTRACT

As technology progresses, there has been an increasing interest in using Chatbot GPT (Generative Pre-trained Transformer) in education. Chatbot GPT, or ChatGPT, gained one million users within the first week of launching in November 2022 and had amassed over 100 million active users by February 2023. This type of artificial intelligence uses natural language processing to convert it into a user. This paper presents a comprehensive analysis and review of 34 articles published on ChatGPT and its potential impact on education by utilizing the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. This review analyzed various studies and articles to examine the strengths and limitations of GPT language models in education from 2018 to the present. The advantages of ChatGPT include its capacity to provide personalized and adaptive learning, instant feedback, and improved accessibility. However, there are potential drawbacks, such as the lack of emotional intelligence, the risk of overreliance on technology, and privacy concerns. This review suggests that ChatGPT has significant promise for education yet reinforces the necessity for further research and careful consideration of possible risks and limitations. Specifically, it pointed out potential invisible manipulations by instructing ChatGPT to answer education-related topics. The paper concludes by discussing the implications of ChatGPT for the future of education and emphasizing the need for further research in this field.

## KEYWORDS

ChatGPT, chatbot, generative AI, GenAI, educational technology

## 1 INTRODUCTION

In recent times, various technological innovations such as blockchain, metaverse, virtual reality, extended reality, IoT, 5G, and artificial intelligence (AI) have experienced significant growth [1], [2]. In particular, the advancement of AI technologies, particularly natural language processing, has led to the development of cutting-edge technologies, such as GPT chatbots [3], with the potential

Samala, A.D., Zhai, X., Aoki, K., Bojic, L., Zikic, S. (2024). An In-Depth Review of ChatGPT's Pros and Cons for Learning and Teaching in Education. *International Journal of Interactive Mobile Technologies (IJIM)*, 18(2), pp. 96–117. <https://doi.org/10.3991/ijim.v18i02.46509>

Article submitted 2023-09-05. Revision uploaded 2023-11-03. Final acceptance 2023-11-04.

© 2024 by the authors of this article. Published under CC-BY.

to revolutionize the education sector [4]. ChatGPT, a computer program designed to simulate conversations with human users, has shown great potential for wide application in educational settings, including language learning, test preparation, and personalized tutoring [5].

Given the growing interest in using ChatGPT in education, there is a need to evaluate its advantages and disadvantages to determine its potential impact on the field. To this end, this paper presents a systematic literature review with a comprehensive search strategy for academic databases, including Scopus, Web of Science (WoS), and Google Scholar, following the PRISMA methodology. This methodology is widely recognized for its rigor and transparency in synthesizing evidence from primary research studies. We supported data collection using Publish or Perish (PoP) and utilized Biblioshiny R Studio and Microsoft Excel (MS Excel) for data analysis and visualization.

This review focuses on studies and articles published between 2018 and the present year (2023). The reason for starting the review in 2018 is important because the development of language models such as ChatGPT builds on previous technological advances. In 2018, OpenAI released the GPT, approaching language tasks by predicting the next token. Therefore, by focusing on studies and articles published between 2018 and the present year, we can gain insight into the evolution of the GPT language model and how it is being used and studied by researchers and practitioners. Furthermore, despite its release in 2022, research and development efforts may have occurred before the launch of ChatGPT. By examining recent studies and articles, we may gain insights into the thinking and research that informed the development of ChatGPT. This study examines the main advantages of using ChatGPT, such as its ability to provide personalized and adaptive learning experiences, instant feedback, and increased accessibility. Additionally, this review considers the potential drawbacks of ChatGPT, such as its lack of emotional intelligence, potential privacy concerns, and overreliance on technology.

This review provides a comprehensive analysis of the potential of ChatGPT in education and highlights the latest research in this field. The implications of this review shed light on the possibility of ChatGPT enhancing educational practices while also identifying areas where further research is needed. This review aims to answer research questions (in the methodology section) and serve as a resource for educators, researchers, and policymakers interested in exploring the potential of ChatGPT, a new educational technology.

## 1.1 NLP & OpenAI

Since the 1950s, Alan Turing famously asked, “Can machines think?” [6] NLP has made remarkable strides; Joseph Weizenbaum created Eliza, the first natural language processing bot, in the mid-1960s [7]. These advancements initiated a new era for rule-based systems, machine learning, and deep learning, which have found applications in various fields, including speech recognition and automated translation [8], [9]. Recent developments in the field of NLP, such as the development of models pre-trained with large volumes of data, can help understand language, leading to the deployment of NLP applications in the real world in education, construction, customer service, and more [10]–[14].

A transformer, a neural network released by Google Research in 2017, can comprehend multiple words and analyze their relationships [15]. Furthermore, this architecture is becoming more powerful and can generate complex results [16]. The transformer stands out from other architectures because of its use of attention mechanisms rather than recurrent or convolutional neural networks [17], [18], which makes it useful for a variety of tasks, such as machine translation, text summarization, and question answering [19]. Based on this advancement, OpenAI developed the GPT-3 family of language models [20]. It contains several models with varying sizes and capabilities, including Davinci (175 billion parameters), Curie (100 billion parameters), Babbage (50 billion parameters), Ada (35 billion parameters), GPT-3 75B, GPT-3 120B, and GPT-3 10B [21]. GPT-3 is particularly noteworthy for its ability to generate code from text and includes fine-tuned and embedded language models pre-trained and reinforced by users with domain-specific data [24], [25].

GPT-3 has been used in various applications, such as natural language processing, chatbots, and language translation, demonstrating its power and potential impact on education. GPT-3 has been gaining attention due to its ability to generate human-like text promptly [22], [23]. Achieving this involves using a neural network consisting of multiple layers of “transformers” [25]. By training it on a large dataset of different topics such as books, articles, and websites, GPT-3 can converse with various subjects [26]. Additionally, the algorithm can perform natural language processing tasks such as language translation and summarization [27]. Furthermore, it can even write an original scientific paper [28] and create unique content, such as blogs, poetry, press release material, and resumes [29]. However, GPT-3 cannot access new information outside the data on which it is trained [26].

## 1.2 What is ChatGPT?

Although GPT-3 has been a significant breakthrough in language model development, it has limitations. For instance, GPT-3 is not trained on conversational data; therefore, it may not perform optimally in conversational AI applications like chatbots. This is where the ChatGPT occurs. ChatGPT is a variant of the GPT-3 language model, trained explicitly on conversational data, enabling it to be used in chatbot applications. Moreover, ChatGPT’s training data include dialogue interactions, which allows it to understand the flow of conversation and generate more natural and coherent responses. Therefore, the transition from GPT-3 to ChatGPT is significant because it addresses the specific limitations of the former and provides new possibilities for conversational AI applications. ChatGPT is a state-of-the-art language processing technology that has gained increasing attention in recent years [30]. It is a version of the machine learning Natural Language Processing models known as Large Language Models (LLMs). Developed by OpenAI, this technology utilizes deep-learning algorithms to generate human-like responses to text-based inputs. GPT models are trained on massive amounts of text data, allowing them to recognize and replicate patterns in a language with remarkable accuracy [31].

One of the unique advantages of ChatGPT over its prior version is its ability to provide more personalized and adaptive learning experiences. ChatGPT is trained

explicitly on conversational data related to education, which allows it to understand the context and tailor its responses to the user's specific needs. This personalized approach can provide a more engaging and effective learning experience for students, as ChatGPT can adjust its responses and provide targeted feedback based on users' knowledge and preferences.

Additionally, the increased accessibility of ChatGPT can be a significant advantage in education. ChatGPT allows students to access educational resources anytime and anywhere through their digital devices. This feature benefits students with limited access to traditional classroom resources. Moreover, the unique advantages of ChatGPT make it a promising tool for improving the quality and accessibility of education. It has the potential to revolutionize our interactions with machines and has numerous practical applications, such as virtual assistants, customer service, and language translation [32]. ChatGPT can deliver tailored learning content, provide real-time feedback, and even simulate individualized interactions with educators due to its ability to comprehend natural language and generate human-like responses. Overall, the unique features of ChatGPT make it a powerful tool for improving the quality and accessibility of education [33].

### 1.3 History of ChatGPT

OpenAI traced the development of ChatGPT back to 2018, when they released the first iteration of GPT-1, a significant breakthrough in natural language processing [34]. This language model can generate coherent and human-like texts based on its input. In 2019, OpenAI released GPT-2, an even more advanced version of GPT that generated high-quality text with minimal input. Concerns were raised about its potential misuse; therefore, OpenAI initially withheld the full version of the model. In 2020, OpenAI released GPT-3, the most potent version of GPT, with 175 billion parameters. This model can generate almost indistinguishable text from human-written text, with significant implications for various fields, including education. In 2021, OpenAI released a new version of GPT-3 called Codex, which was explicitly trained in programming languages and could generate code based on natural language descriptions. Finally, in November 2022, OpenAI launched ChatGPT, built on GPT-3.5, and fine-tuned it using supervised and reinforcement learning techniques (see Figure 2). ChatGPT has gained attention for its detailed responses and articulated answers across various knowledge domains, although its uneven factual accuracy has been identified as a drawback. According to The Guardian and other sources, ChatGPT is supported in 161 countries and has reportedly reached 100 million active users as of February 2023 [35].

As technology advances rapidly, OpenAI announced the release of GPT-4 on March 14, 2023, now available for ChatGPT Plus users. GPT-4 is expected to surpass its predecessors' capabilities and revolutionize natural language processing. Figure 1 shows the evolution of the GPT language model, including the most recent releases of GPT-3.5 and GPT-4. One potential difference between GPT-4 and GPT-3.5 is the number of parameters, as GPT-4 may have up to a trillion parameters, increasing its potential performance on language tasks and its ability to handle more

complex languages. Additionally, GPT-4 may have access to more diverse and specialized training data, enabling it to excel in specific domains.

Furthermore, GPT-4 is anticipated to have superior capabilities for multi-modal understanding, enabling it to comprehend text and other forms of data, such as images or audio. Expanding its abilities could produce new applications such as image captions or speech recognition. However, GPT-4 has certain limitations that must be addressed, including social biases, hallucinations, and susceptibility to adversarial prompts. Transparency, user education, and a greater understanding of AI are encouraged and promoted as these models are adopted by society. Moreover, the avenues of stakeholder input are expanded to shape these models. Overall, the release of GPT-4 is expected to push the boundaries of natural language processing further, creating opportunities for innovation and development.

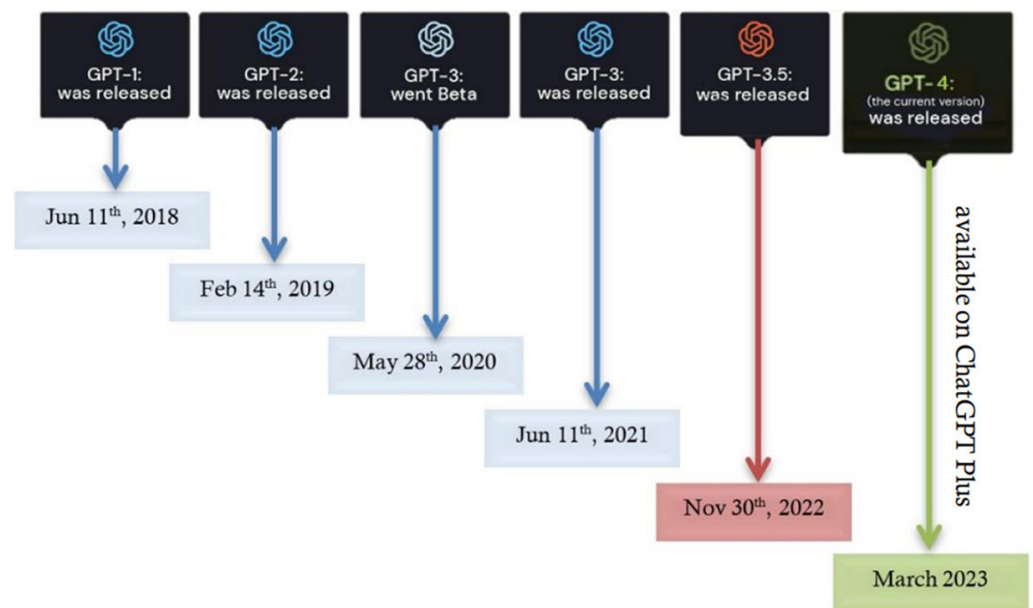


Fig. 1. ChatGPT timeline

## 2 METHODOLOGY

Using the well-known Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) method, this study carefully and openly looked at all the relevant literature about how ChatGPT can be used in education, including all of its different versions. The PRISMA framework provides a standardized process for collecting and analyzing data, enhancing the reproducibility and reliability of the study [36]. Figure 2 displays the four stages of the process (4S): searching, screening, selecting, and synthesizing, which involve collecting, filtering, and analyzing data based on its relevance to the topic of study.

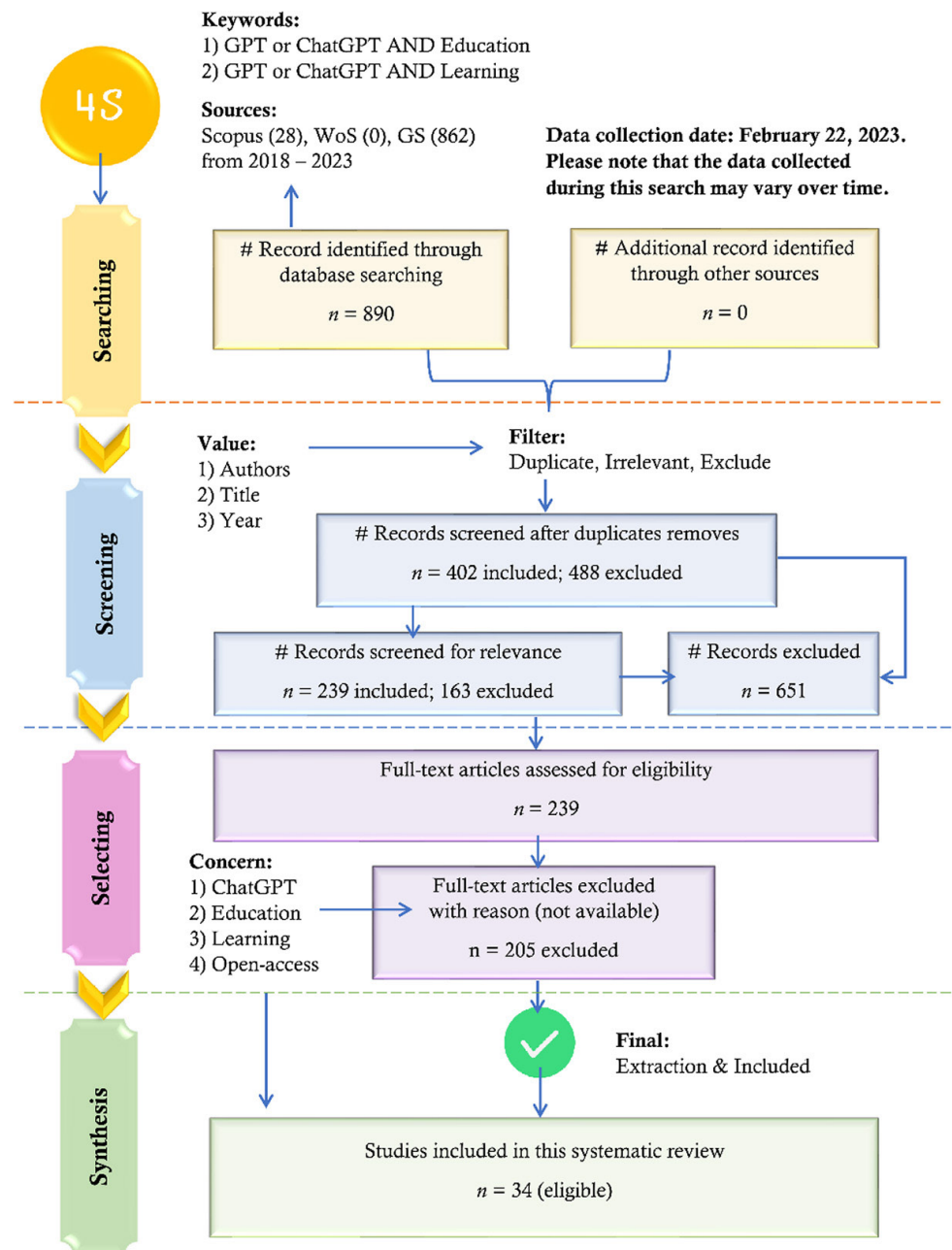


Fig. 2. The PRISMA flow diagram

This study transparently and rigorously conducted a systematic literature review to increase the reliability and validity of the findings. The data collection criteria included focusing on keywords related to “GPT,” “ChatGPT,” “Education,” and “Learning” and selecting articles written only in English. The search spanned the time GPT was developed by OpenAI in 2018, including the release of ChatGPT in 2022. Since ChatGPT had limited usage before 2022, the search primarily focused on articles published from 2022 onwards. This search strategy ensured that the literature review captured the latest developments and insights on using the OpenAI language model, particularly ChatGPT, in education and learning. However, for this study, it may be necessary to conduct additional reviews of articles published since 2018 that pertain to the GPT or OpenAI language model, as explained in the Introduction section.

The results of this process were further analyzed using Biblioshiny R Studio for bibliometric data visualization and exploration, as well as MS Excel for data management (see Figure 3). Table 1 shows the research questions (RQ) this study aims to answer.

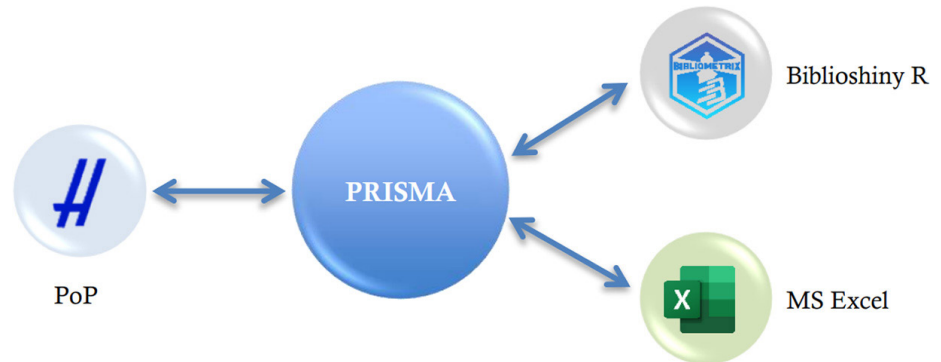


Fig. 3. The PRISMA: supported by Publish or Perish (PoP), Biblioshiny R, and MS Excel

Table 1. Research questions (RQ)

No.	Research Questions (RQ)
1	What are the pros and cons of using ChatGPT in education?
2	How can ChatGPT be used to support learning in education?

### 3 RESULTS

#### 3.1 Searching

The search process for this study was initiated by identifying relevant keywords related to the research topics under investigation. Specifically, we employed “GPT” OR “ChatGPT” AND “Education” and “GPT” OR “ChatGPT” AND “Learning” as search terms. To ensure consistency and accuracy in the data collection, we included articles published in English from 2018 to 2023 from reputable databases, such as Scopus, WoS, and Google Scholar. We identified 890 articles, comprising 28 from Scopus, 0 from WoS, and 862 from Google Scholar. However, we excluded 70 articles due to missing publication years. Figure 4 shows the detailed breakdown of the data distribution.

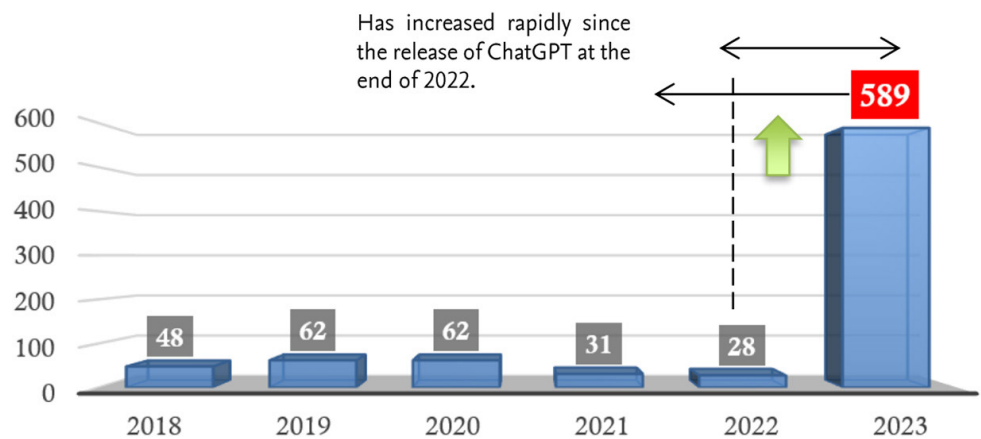


Fig. 4. Total data by year

### 3.2 Screening

In a PRISMA review, screening is a critical step that involves a comprehensive evaluation of potentially eligible studies identified through the initial search process. This typically involves two stages: (1) title and abstract screening, and (2) full-text screening. During the title and abstract screening stage, one of the first steps is to eliminate duplicate data based on the author, title, and year. After removing duplicates, the reviewers assess the relevance of each study by evaluating the title and abstract against the established inclusion and exclusion criteria, excluding studies that do not meet the criteria.

The purpose of the screening was to ensure the inclusion of only relevant studies that met the established criteria in the final analysis. This process enhanced the rigor and validity of the review by guaranteeing the inclusion of high-quality studies pertinent to the research question. We identified and removed 488 duplicate entries from the dataset using Microsoft Excel for data management. Among the remaining 402 papers, 163 were excluded after screening their titles and abstracts, while 239 were considered relevant and met the inclusion criteria (Figure 5). Therefore, up to this screening stage, 651 data points were excluded from the analysis because they were duplicates, irrelevant, or did not meet the established inclusion criteria. After the last screening process based on the title and abstract, 163 articles were excluded from the study, leaving 239 articles that were selected for a more in-depth analysis of their content (Figure 6).

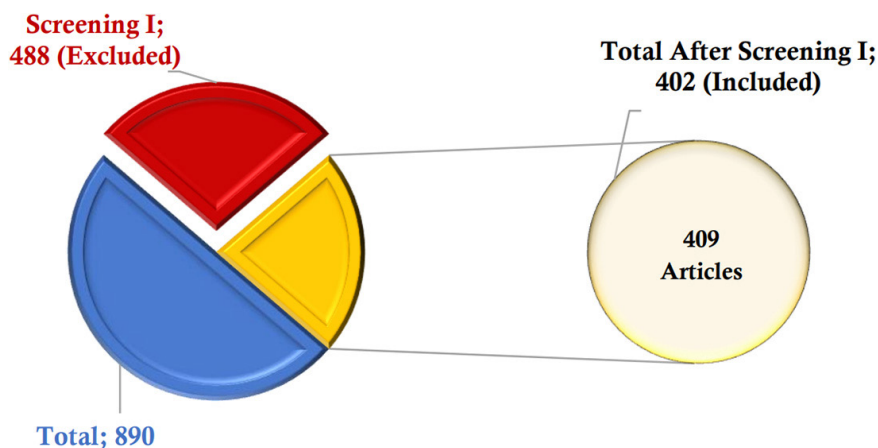


Fig. 5. Screening I

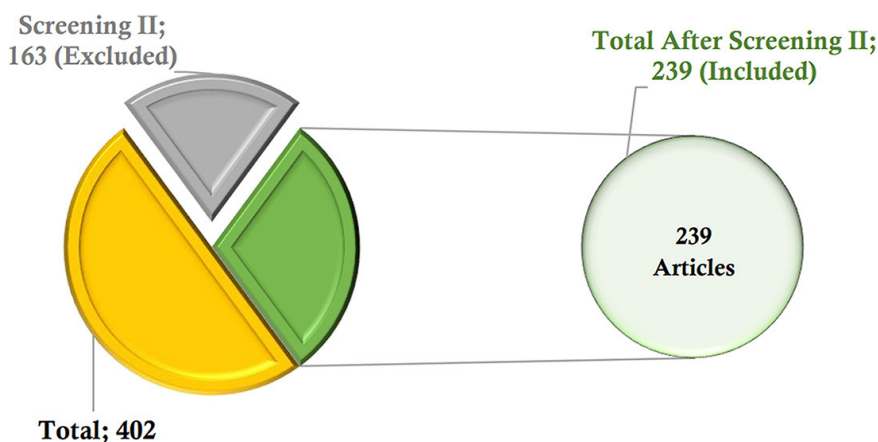


Fig. 6. Screening II



### 3.3 Selecting

Selecting appropriate studies for inclusion is critical to ensure the reliability and validity of the review findings. Only articles that discussed ChatGPT, education, and learning were deemed relevant, with open-access availability serving as an additional criterion. Of the 239 articles, only 34 met the established criteria and were eligible for inclusion in the review (see Figure 7). This selection process guarantees that the final data used for the study are relevant and reliable, thus enhancing the credibility and generalizability of the review's findings. This will ultimately provide valuable insights for researchers, educators, and practitioners seeking to understand the applications and implications of ChatGPT in educational and learning contexts.

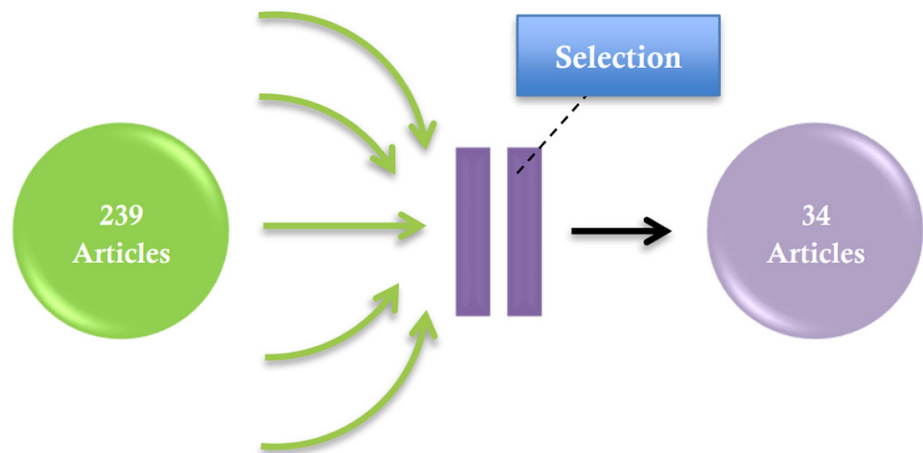


Fig. 7. Selection: 34 Articles

### 3.4 Synthesis

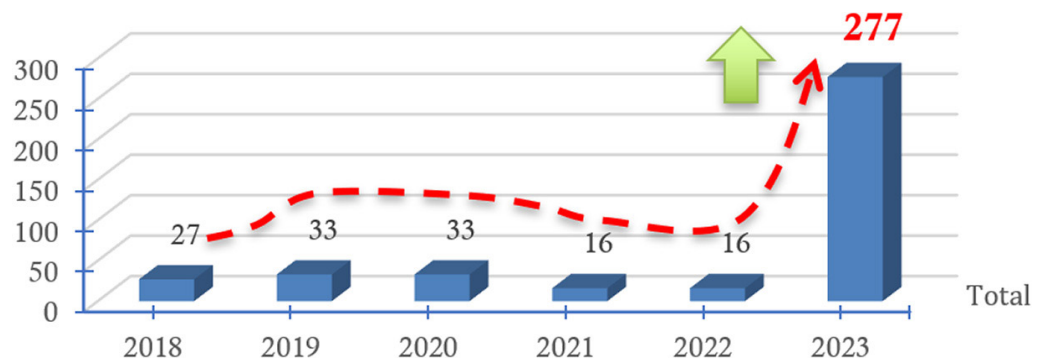
The synthesis process is essential to ensure that the systematic review is comprehensive and to provide a clear and reliable understanding of the current state of research on ChatGPT, education, and learning. In this study, the synthesis process involved conducting a thorough review of the 34 articles that met the established inclusion criteria (see Table 2), all published between 2022 and 2023. First, we set the scope of this study from 2018 to 2023; however, articles discussing ChatGPT emerged only in 2022 and were mostly published in 2023. Throughout the review process, we extracted and analyzed data from each article to identify key findings related to the topic. This analysis will include comparing the studies' similarities and differences and examining each study's strengths and limitations. The conclusions of the synthesis process were then used to determine the current state of the research. This will involve critically evaluating the evidence presented in the selected studies and identifying gaps or limitations in the existing research. Ultimately, the synthesis process is essential to provide a comprehensive and reliable understanding of the current state of research on the topic of interest.

**Table 2.** List of 34 articles by year

No	Year	Articles
1	2022	[30], [31], [37], [38]
2	2023	[3]–[5], [33]–[35], [39]–[63]

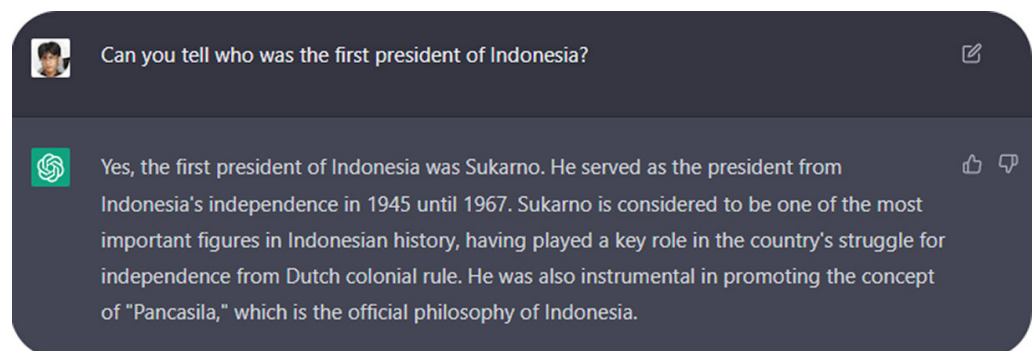
### 3.5 Exploring the pros and cons of using ChatGPT in education

An analysis of research publications related to ChatGPT reveals a remarkable surge in scholarly attention from 2022 onwards, with a nearly twenty-fold increase in articles published compared to 2018–2022. This trend highlights the growing significance of ChatGPT as a popular AI chatbot that has gained widespread recognition among academics and researchers. The New York Times even dubbed it “the best AI chatbot ever released.” [41], [53]. ChatGPT belongs to a family of large language models, such as Grammarly, which uses AI to write, spell check, autocorrect, translate, and perform other language-related tasks [30], [54]. Unlike Grammarly, ChatGPT can generate AI-generated content and answer queries, making it a valuable tool for various applications.



**Fig. 8.** A significant upsurge of ChatGPT in 2023

The capacity of the ChatGPT to provide quick and succinct answers and explanations to students’ queries facilitates knowledge acquisition. The ChatGPT can supply relevant conversational responses while preserving its accumulated knowledge and generalizability. ChatGPT is proficient in comprehending conversational contexts and generating meaningful responses (See Figures 9–12).



**Fig. 9.** ChatGPT's response to questions about History

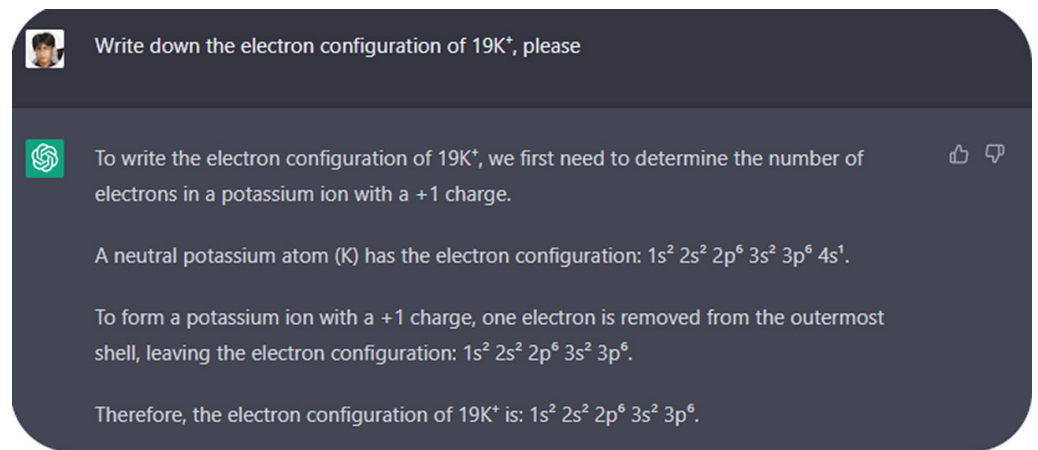


Fig. 10. ChatGPT's response to questions about Chemistry

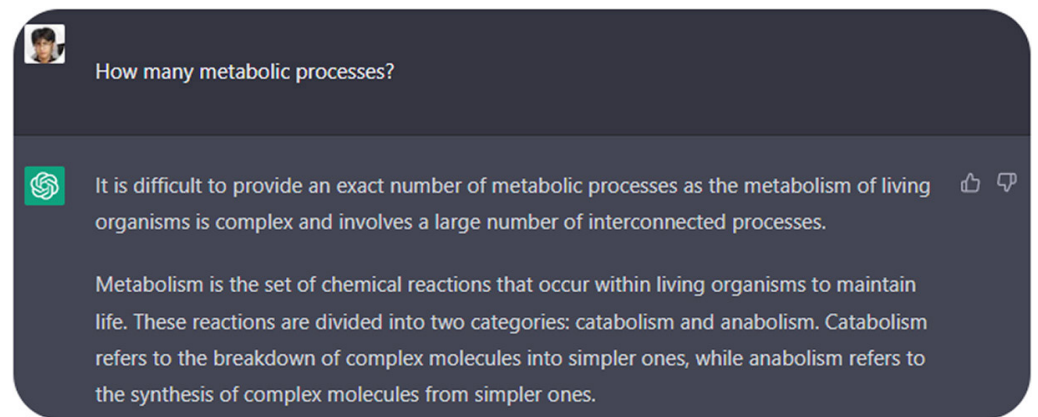


Fig. 11. ChatGPT's response to questions about Biology

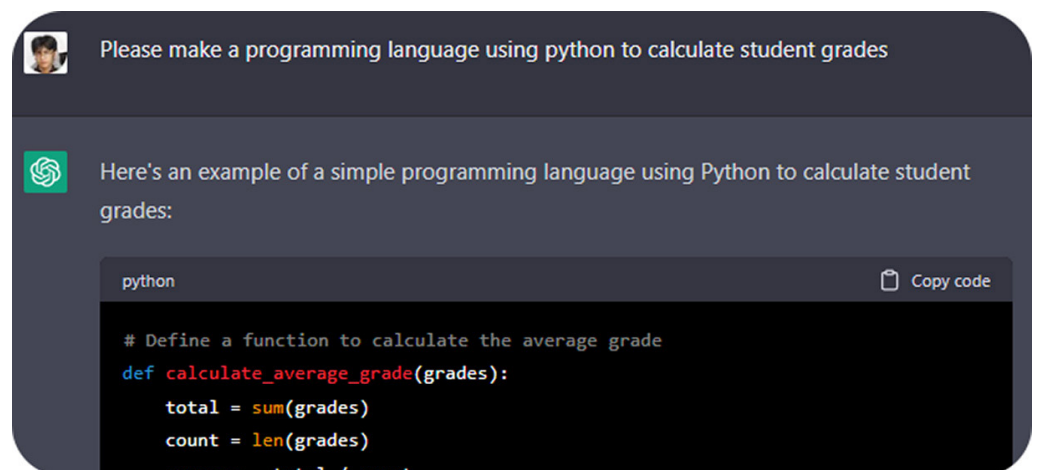


Fig. 12. ChatGPT's response to questions about Programming

ChatGPT has emerged as a powerful tool in education; however, it also has disadvantages that should not be ignored. One of the primary drawbacks of using the ChatGPT in education is the potential for misinformation. Although ChatGPT

has been trained on vast amounts of data, there is still the risk that it may provide incomplete or incorrect information. Detecting and correcting misinformation may be difficult without human intervention and oversight. This presents a significant challenge for educators who may not have the expertise or time to monitor ChatGPT responses.

Furthermore, some students may benefit more from the human connection and personal touch of interacting with teachers or tutors. ChatGPT can provide quick and convenient responses but cannot replicate face-to-face interactions' social and emotional benefits. Therefore, the lack of human interaction is another disadvantage of using ChatGPT in education.

Moreover, ChatGPT raises ethical concerns regarding privacy, data security, and the potential for bias in the data on which it was trained. It is essential to carefully consider these issues, take appropriate measures to protect student privacy, and ensure that the use of the ChatGPT is fair and unbiased. In conclusion, while ChatGPT can be a valuable educational tool, its advantages and disadvantages should be considered. The limitations of the ChatGPT must be carefully considered and addressed to maximize its benefits in the education sector. Therefore, educators should be aware of the potential disadvantages of using ChatGPT in education and factor them in when making decisions regarding its implementation.

## 4 DISCUSSION

The capabilities demonstrated by ChatGPT suggest that it could soon emerge as a formidable competitor to Google, owing to its responsiveness to user requests [40]. Like Google, ChatGPT provides learners with the convenience of accessing reliable and expeditious information [39]. ChatGPT can be particularly helpful to students seeking assistance with their academic assignments, such as essay writing, answering questions, or clarifying complex concepts [37]. However, over-reliance on ChatGPT could pose a significant challenge to educators, as it may encourage a lack of self-reliance among students, leading to a decline in motivation and critical thinking.

Concerns have been raised regarding the possibility of AI replacing human workers, which could become a significant issue in the future [64]. Although AI is more efficient than human labor regarding intelligence, programmability, and adjustability [42], many jobs may be lost to AI. The emergence of ChatGPT has also raised questions about its potential to replace educators in the classroom entirely. However, experts suggest that ChatGPT is not a substitute for educators but rather a complement to them in the learning process. ChatGPT still requires user input; therefore, it is currently the only tool used to help humans. Hence, it is unlikely that ChatGPT will entirely replace educators at this stage. Instead of focusing on whether one option is superior, it is crucial to recognize the significance of coexisting AI technology. This could create a new living environment where humans and AI or robots work together, offering several benefits, such as heightened productivity, efficiency, and profitability [65]–[67].

The ban on ChatGPT use is complex and multifaceted. As technology cannot be limited, schools and districts must decide whether to block ChatGPT access to school networks and devices [56]. However, this decision alone will not solve the problem, as students can access it through their devices, much like social media. Blocking access to the ChatGPT is only a partial solution, and instead of attempting to stop

its use altogether, it is more productive to consider how it can be used more constructively. Therefore, it is crucial to establish regulations for the ethical use of AI, particularly in education.

Designing learning experiences incorporating ChatGPT to enhance learning while promoting social interaction and student participation is essential. It is also crucial to ensure that ChatGPT does not replace educators in the classroom. Instead, they should be used to assist educators by providing suggestions for more effective learning strategies and up-to-date materials for students. Additionally, the ChatGPT can provide broader access to education for people from all levels of society and improve writing skills [45], [50], [51].

Despite the many benefits of ChatGPT, it also faces challenges, such as privacy and data leakage concerns, as well as the potential misuse of personal data. Moreover, not all information provided by ChatGPT can guarantee 100% accuracy. ChatGPT implemented measures to warn users about the accuracy of the information provided to address this issue. Therefore, while the ChatGPT can be a valuable tool in education, it is essential to exercise caution and not rely solely on the information provided by the chatbot.

ChatGPT is a highly sophisticated AI language model; however, it has certain limitations. One of the challenges OpenAI faces is the issue of 'hallucination,' where the tool can sometimes produce plausible-sounding answers that do not make any sense. Current Reinforcement Learning (RL) training cannot verify the truth, making it difficult to fix this problem without causing the model to decline to answer specific questions. Additionally, changes in input phrasing or using the exact prompt multiple times can affect the accuracy of the ChatGPT.

Another limitation of the tool is its tendency to guess what the user is asking instead of asking questions to clarify ambiguous queries. The model may also exhibit biased behavior or respond to harmful inputs. To address this, OpenAI uses the Moderation API to provide warnings or block some unsafe content types. Furthermore, the model sometimes overuses specific phrases owing to bias in the training data, such as repeatedly stating that it is a language model developed by OpenAI. Despite these limitations, ChatGPT remains a powerful and valuable tool for natural language processing and continues to improve.

#### 4.1 ChatGPT as a supportive learning tool in education

The natural language processing and machine learning capabilities of ChatGPT make it a promising support tool for education [4], [32]. Its capacity to generate text on demand offers numerous benefits to educators and students. Educators can benefit from ChatGPT in the following ways [31], [32]:

1. ChatGPT can provide support for teaching by assisting with various tasks, such as writing course syllabi, lesson plans, classroom rules and policies, learning objectives, directions for learning activities, discussion prompts, plans for substitute teachers, mini-lecture presentation scripts, and tips for classroom management [30].
2. ChatGPT can support student assessment by writing student progress reports, quizzes, test questions, grading rubrics, and offering automatic grading and feedback to students [33].

3. ChatGPT can help support student learning by writing study guides, math, and science word problems, text for students to read at different lexile levels, directions for conducting a science experiment or designing a multimodal project, writing samples for students to critique, individualized educational plan goals, choose-your-own-adventure stories, and Reader's Theatre scripts.
4. ChatGPT can offer suggestions for improving teaching by providing advice for creating more inclusive and accessible learning activities, tips for diversifying the authors in a class reading list or syllabus, strategies for using digital tools and apps to enhance teaching and learning, and examples of how to communicate concepts to students of different age levels.
5. ChatGPT can provide language translation to aid language learning, offer conversation practice, and provide feedback to students learning a new language [44].
6. ChatGPT or similar models can facilitate student discussions and collaboration providing prompts and guidance for group projects and assignments, thus enhancing collaborative learning [68].

The ChatGPT provides personalized and interactive support for students. Its key advantage is its ability to offer immediate feedback and support, which can be particularly helpful for struggling students or those needing extra help. ChatGPT can provide personalized tutoring in any subject, research assistance, guidance for completing tasks, explanations of complex concepts in simplified language, note-taking, text summaries and outlines, advice for overcoming writer's block, assistance with computer programming code, translations of the text into multiple languages, and directions for problem-solving. Additionally, it can function as a "teachable agent," encouraging students to learn by teaching a concept through text-based conversation, as well as providing creative thinking support, such as helping students write scripts for multimodal projects, identifying local, national, or global issues for a civic engagement project; suggesting ways to write or rephrase sentences for more creativity; and offering ideas for inventions and supporting students with brainstorming and idea formation for writing and class projects. Moreover, ChatGPT can assist students in improving their reading and writing comprehension skills, as well as their language and research abilities. It can guide students through each step of the writing process, including selecting a topic, brainstorming, outlining, drafting, soliciting feedback, revising, and proof-reading [41], [47], [49], [51], [54].

ChatGPT can create customized learning pathways that cater to each student's needs and preferences by analyzing their learning history and performance, reducing educators' workload by grading assignments, answering frequently asked questions, and providing support outside regular class hours. However, there are limitations to ChatGPT, such as generating incorrect information, producing biased or harmful content, having limited knowledge of world events after 2021, and a lack of ethical decision-making skills. To get around these problems, people have come up with different ways to teach teachers how to use AI. Some of these are critical interrogation and interaction with AI technologies, reflection on how to teach in the age of AI, showing teachers how to evaluate teaching materials and information generated by AI writing tools, encouraging teachers to use AI in their lessons, and making teaching and learning more open and honest. Matt Miller, creator of Ditch That Textbook, has introduced 20 ways to implement AI in education, detailed in Figure 13 [69].



Fig. 13. 20 ways to use ChatGPT in the classroom by Matt Miller

While assigning tasks in the form of written work can effectively assess a student’s understanding and encourage critical thinking, it is not necessarily the only way. Technology integration into education allows students to engage in active learning and promotes creativity, such as microlearning, digital storytelling, podcasting, and video production [73]–[78].

ChatGPT in education has the potential for personalized tutoring and support for students. By generating human-like responses to user queries, ChatGPT can provide real-time feedback and support to help students identify areas for improvement and adjust their learning strategies accordingly. This could lead to improved academic performance. Another benefit of ChatGPT in education is the potential to increase student engagement and motivation. By providing an interactive and engaging learning experience, ChatGPT can help students remain engaged and motivated, resulting in better learning outcomes. Furthermore, ChatGPT’s availability 24/7 can reduce barriers to learning, allowing students in remote or underserved areas to access educational resources and support when needed, ultimately leading to more significant equity in education [75].

Despite the opportunities presented by the ChatGPT in education, several challenges must be addressed. One of the critical challenges is the potential for cheating, making ChatGPT a potentially powerful tool for students seeking to cheat in exams or assessments [43], [47], [54]. To prevent this, educational institutions must establish clear policies and guidelines for the use of chatbots and other AI-powered tools in learning and assessment and implement measures such as monitoring student

activity during exams and reviews, as well as using anti-plagiarism software to detect instances of cheating [31], [34].

In addition, successfully integrating ChatGPT with existing educational systems and platforms is challenging. This can present difficulties regarding data privacy and security; therefore, educational institutions must ensure that student data are kept secure and confidential. Educators, administrators, and policymakers should proactively seek to educate themselves and their students using these tools morally and ethically [59], [70]. Finally, ensuring that ChatGPT and other AI-powered education tools are used ethically and responsibly is crucial. This requires careful consideration of these tools' potential benefits and risks and the development of strategies that promote responsible and ethical use [77].

However, one challenge related to ChatGPT in education has not been addressed in previous research. ChatGPT is a recommender system and an AI search engine, as it can understand questions and provide answers to them [71]. ChatGPT, similar to the human perceptual apparatus, acts as an eye and ear in the online world [72]. However, the ChatGPT does not provide sources for answers. This opens novel possibilities for manipulation, or, in other words, invisibly directing public opinion and mood in the desired direction, because how exactly this language model is trained, with supervised and enforced learning, is not transparent. Thus, when viewed from this perspective, ChatGPT poses a challenge because, for example, there are corporate policies about how NLP models are supposed to talk about various educational areas, such as religion and science. Corporate guidelines on how these chatbots are allowed to talk about important topics such as values, rights, and faith will affect how people think about these things and how they engage with them. These policies are decided by a handful of people in rooms that the public cannot access. This may have significant educational implications and is an under-researched topic that should be addressed in the future.

## 5 CONCLUSIONS

The ChatGPT has the potential to be a valuable tool for education and learning when used appropriately and in conjunction with traditional teaching methods. Using chatbots in education presents exciting opportunities, such as providing instant and customized feedback, reducing the workload of educators, and making educational resources available 24/7. However, there are also potential challenges associated with using chatbots, such as the absence of personalization and the requirement to integrate them into existing educational systems while guaranteeing data privacy and security. ChatGPT is an AI search engine that acts as a recommender system and can understand and answer questions but does not provide the sources for its answers. This opens the door for manipulation because learning the language model is not transparent. As a result, corporate policies that select a few people may have important implications for education, and this is an under-researched topic that should be addressed in the future.

It is important to note that ChatGPT cannot replace human interaction and support in education but rather serves as a supportive learning tool. Educators should consider individual students' unique needs and learning styles and determine the appropriate level of chatbot integration into their teaching methods. Additionally, measures should be taken to ensure students are not overly reliant on chatbots and develop critical thinking and problem-solving skills. Overall, the use of ChatGPT



in education can revolutionize how students learn and engage with educational resources. By leveraging the capabilities of natural language processing and machine learning, the ChatGPT can provide personalized and interactive support to students, helping them achieve their academic goals. As technology advances, it is essential to explore the potential of chatbots and other AI tools to ensure that students have access to high-quality education and resources.

## 6 REFERENCES

- [1] A. D. Samala and M. Amanda, "Immersive learning experience design (ILXD): Augmented reality mobile application for placing and interacting with 3D learning objects in engineering education," *International Journal of Interactive Mobile Technologies (IJIM)*, vol. 17, no. 5, pp. 22–35, 2023. <https://doi.org/10.3991/ijim.v17i05.37067>
- [2] A. D. Samala, F. Ranuharja, B. R. Fajri, Y. Indarta, and W. Agustiarmiti, "ViCT-virtual campus tour environment with spherical panorama: A preliminary exploration," *International Journal of Interactive Mobile Technologies*, vol. 16, no. 16, 2022. <https://doi.org/10.3991/ijim.v16i16.32889>
- [3] E. A. M. van Dis, J. Bollen, W. Zuidema, R. van Rooij, and C. L. Bockting, "ChatGPT: Five priorities for research," *Nature* 2023, vol. 614, no. 7947, pp. 224–226, 2023. <https://doi.org/10.1038/d41586-023-00288-7>
- [4] C. Leiter *et al.*, "ChatGPT: A meta-analysis after 2.5 months," 2023. <https://doi.org/10.48550/arxiv.2302.13795>
- [5] M. Wölfel and V. Taecharungroj, "What can ChatGPT do? analyzing early reactions to the innovative AI chatbot on Twitter," *Big Data and Cognitive Computing* 2023, vol. 7, no. 1, p. 35, 2023. <https://doi.org/10.3390/bdcc7010035>
- [6] A. M. Turing, "I.—computing machinery and intelligence," *Mind*, vol. LIX, no. 236, pp. 433–460, 1950. <https://doi.org/10.1093/mind/LIX.236.433>
- [7] J. Weizenbaum, "ELIZA a computer program for the study of natural language communication between man and machine," *Commun ACM*, vol. 9, no. 1, pp. 36–45, 1966. <https://doi.org/10.1145/365153.365168>
- [8] K. R. Chowdhary, "Natural language processing," *Fundamentals of Artificial Intelligence*, pp. 603–649, 2020. [https://doi.org/10.1007/978-81-322-3972-7\\_19](https://doi.org/10.1007/978-81-322-3972-7_19)
- [9] J. Copeland, "The turing test," *Minds Mach (Dordr)*, vol. 10, no. 4, pp. 519–539, 2000. <https://doi.org/10.1023/A:1011285919106>
- [10] T. Goyal, J. J. Li, and G. Durrett, "News summarization and evaluation in the era of GPT-3," 2022. <https://doi.org/10.48550/arxiv.2209.12356>
- [11] M. Chary, S. Parikh, A. F. Manini, E. W. Boyer, and M. Radeos, "A review of natural language processing in medical education," *Western Journal of Emergency Medicine: Integrating Emergency Care with Population Health*, vol. 20, no. 1, pp. 78–86, 2019. <https://doi.org/10.5811/westjem.2018.11.39725>
- [12] A. Yuan, A. Coenen, E. Reif, and D. Ippolito, "Wordcraft: Story writing with large language models," in *International Conference on Intelligent User Interfaces, Proceedings IUI*, 2022, pp. 841–852. <https://doi.org/10.1145/3490099.3511105>
- [13] M. Sri, "NLP in customer service," *Practical Natural Language Processing with Python*, pp. 13–63, 2021. [https://doi.org/10.1007/978-1-4842-6246-7\\_2](https://doi.org/10.1007/978-1-4842-6246-7_2)
- [14] Y. Ding, J. Ma, and X. Luo, "Applications of natural language processing in construction," *Autom Constr*, vol. 136, p. 104169, 2022. <https://doi.org/10.1016/j.autcon.2022.104169>
- [15] D. Adiwardana *et al.*, "Towards a human-like open-domain chatbot," 2020. <https://doi.org/10.48550/arxiv.2001.09977>

- [16] A. Vaswani *et al.*, "Attention is all you need," *Adv Neural Inf Process Syst*, vol. 2017, pp. 5999–6009, 2017. <https://doi.org/10.48550/arxiv.1706.03762>
- [17] J. Gehring, M. Auli, D. Grangier, D. Yarats, and Y. N. Dauphin, "Convolutional sequence to sequence learning," in *34th International Conference on Machine Learning, ICML 2017*, 2017, vol. 70, pp. 1243–1252. <https://doi.org/10.48550/arxiv.1705.03122>
- [18] N. Shazeer *et al.*, "Outrageously large neural networks: The sparsely gated mixture-of-experts layer," in *5th International Conference on Learning Representations, ICLR 2017—Conference Track Proceedings*, 2017. <https://doi.org/10.48550/arxiv.1701.06538>
- [19] R. Jozefowicz, O. Vinyals, M. Schuster, N. Shazeer, and Y. Wu, "Exploring the limits of language modeling," 2016. <https://doi.org/10.48550/arxiv.1602.02410>
- [20] R. Dale, "GPT-3: What is it good for?" *Nat Lang Eng*, vol. 27, no. 1, pp. 113–118, 2021. <https://doi.org/10.1017/S1351324920000601>
- [21] L. Floridi and M. Chiriatti, "GPT-3: Its nature, scope, limits, and consequences" *Minds Mach (Dordr)*, vol. 30, no. 4, pp. 681–694, 2020. <https://doi.org/10.1007/s11023-020-09548-1>
- [22] L. Floridi and M. Chiriatti, "GPT-3: Its nature, scope, limits, and consequences," *SSRN Electronic Journal*, 2020. <https://doi.org/10.2139/SSRN.3827044>
- [23] B. Zhang, D. Ding, and L. Jing, "How would stance detection techniques evolve after the launch of ChatGPT?" 2022. <https://doi.org/10.48550/arxiv.2212.14548>
- [24] "Introduction – OpenAI API," <https://platform.openai.com/docs/introduction>. [Accessed March 13, 2023].
- [25] "GPT3 – Explore – Google Trends," <https://trends.google.com/trends/explore?date=2020-12-05%202023-01-03&q=GPT3>. [Accessed March 13, 2023].
- [26] Z. Yang *et al.*, "An empirical study of GPT-3 for few-shot knowledge-based VQA," in *Proceedings of the AAAI Conference on Artificial Intelligence*, 2022, vol. 36, no. 3, pp. 3081–3089. <https://doi.org/10.1609/aaai.v36i3.20215>
- [27] M. Binz and E. Schulz, "Using cognitive psychology to understand GPT-3," 2022. <https://doi.org/10.1073/pnas.2218523120>
- [28] "We asked GPT-3 to write an academic paper about itself. Then we tried to get it published In Scientific American," <https://www.scientificamerican.com/article/we-asked-gpt-3-to-write-an-academic-paper-about-itself-mdash-then-we-tried-to-get-it-published/>. [Accessed March 13, 2023].
- [29] M. Zhang and J. Li, "A commentary of GPT-3 in MIT technology review 2021," *Fundamental Research*, vol. 1, no. 6, pp. 831–833, 2021. <https://doi.org/10.1016/j.fmre.2021.11.011>
- [30] X. Zhai, "ChatGPT user experience: Implications for education," *SSRN Electronic Journal*, 2022. <https://doi.org/10.2139/ssrn.4312418>
- [31] A. Azaria, "ChatGPT usage and limitations," 2022. [Online]. Available: <https://hal.science/hal-03913837>; <https://doi.org/10.31219/osf.io/5ue7n>. [Accessed: March 10, 2023].
- [32] A. Najmaei and Z. Sadeghinejad, "ChatGPT, AI-driven world and the new reality of online education," 2023.
- [33] X. Zhai, "ChatGPT for next generation science learning," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4331313>
- [34] G. H. Sun and S. H. Hoelscher, "The ChatGPT storm and what faculty can do," *Nurse Educ*, 2023, [Online]. Available: [https://journals.lww.com/nurseeducatoronline/The\\_ChatGPT\\_Storm\\_and\\_What\\_Faculty\\_Can\\_Do.183.aspx](https://journals.lww.com/nurseeducatoronline/The_ChatGPT_Storm_and_What_Faculty_Can_Do.183.aspx); <https://doi.org/10.1097/NNE.0000000000001390>
- [35] J. Rudolph, S. Tan, and S. Tan, "ChatGPT: Bullshit spewer or the end of traditional assessments in higher education?," *Journal of Applied Learning & Teaching*, vol. 6, no. 1, 2023. <https://doi.org/10.37074/jalt.2023.6.1.9>
- [36] A. D. Samala *et al.*, "Metaverse technologies in education: A systematic literature review using PRISMA," *International Journal of Emerging Technologies in Learning (ijET)*, vol. 18, no. 5, pp. 231–252, 2023. <https://doi.org/10.3991/ijet.v18i05.35501>

- [37] I. Pesek, N. Nosovic, and M. Krasna, "The role of AI in the education and for the education," in *2022 11th Mediterranean Conference on Embedded Computing, MECO 2022*, 2022. <https://doi.org/10.1109/MECO55406.2022.9797189>
- [38] M. U. Haque, I. Dharmadasa, Z. T. Sworna, R. N. Rajapakse, and H. Ahmad, "I think this is the most disruptive technology': Exploring sentiments of ChatGPT early adopters using twitter data," *ArXiv*, 2022. <https://doi.org/10.48550/arxiv.2212.05856>
- [39] Md. S. Rahaman, M. M. T. Ahsan, N. Anjum, Md. M. Rahman, and M. N. Rahman, "The AI race is on! Google's bard and OpenAI's ChatGPT head-to-head: An opinion article," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4351785>
- [40] T. Hoppner and L. Streatfeild, "ChatGPT, bard & co.: An introduction to AI for competition and regulatory lawyers," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4371681>
- [41] Y. Gao, W. Tong, E. Q. Wu, W. Chen, G. Zhu, and F.-Y. Wang, "Chat with ChatGPT on interactive engines for intelligent driving," *IEEE Transactions on Intelligent Vehicles*, pp. 1–3, 2023. <https://doi.org/10.1109/TIV.2023.3252571>
- [42] G. Adamson, "Explaining technology we do not understand," *IEEE Transactions on Technology and Society*, pp. 1–1, 2023. <https://doi.org/10.1109/TTS.2023.3240107>
- [43] S. Krügel, A. Ostermaier, and M. Uhl, "The moral authority of ChatGPT," *ArXiv*, 2023. <https://doi.org/10.48550/arxiv.2301.07098>
- [44] W. Jiao, W. Wang, J. Huang, X. Wang, and Z. Tu, "Is ChatGPT a good translator? A preliminary study," *ArXiv*, 2023. <https://doi.org/10.48550/arxiv.2301.08745>
- [45] S. Jalil, S. Rafi, T. D. LaToza, K. Moran, and W. Lam, "ChatGPT and software testing education: Promises & perils," *ArXiv*, 2023. <https://doi.org/10.48550/arxiv.2302.03287>
- [46] A. Borji, "A categorical archive of ChatGPT failures," *ArXiv*, 2023. <https://doi.org/10.48550/arxiv.2302.03494>
- [47] M. Khalil and E. Er, "Will ChatGPT get you caught? rethinking of plagiarism detection," *ArXiv*, 2023. <https://doi.org/10.48550/arxiv.2302.04335>
- [48] Z. A. Pardos and S. Bhandari, "Learning gain differences between ChatGPT and human tutor generated algebra hints," 2023. <https://doi.org/10.48550/arxiv.2302.06871>
- [49] A. Subaveerapandiyan, A. Vinoth, and N. Tiwary, "Netizens, academicians, and information professionals' opinions about AI with special reference to ChatGPT," 2023. <https://doi.org/10.48550/arxiv.2302.07136>
- [50] I. Islam and M. N. Islam, "Opportunities and challenges of ChatGPT in academia: A conceptual analysis," *Authorea Preprints*, 2023. <https://doi.org/10.22541/au.167712329.97543109/v1>
- [51] A. J. Bowers, "Unpacking the caveats of ChatGPT in education: Addressing bias, representation, authorship, and plagiarism," 2023. <https://doi.org/10.7916/6q72-hm22>
- [52] M. Perkins, "Academic integrity considerations of AI large language models in the post-pandemic era: ChatGPT and beyond," *Journal of University Teaching & Learning Practice*, vol. 20, no. 2, p. 7, 2023. <https://doi.org/10.53761/1.20.02.07>
- [53] S. Atlas, "ChatGPT for higher education and professional development: A guide to conversational AI," *College of Business Faculty Publications*, 2023. [Online]. Available: [https://digitalcommons.uri.edu/cba\\_facpubs/548](https://digitalcommons.uri.edu/cba_facpubs/548). [Accessed: March 10, 2023].
- [54] D. R. E. Cotton, P. A. Cotton, and J. R. Shipway, "Chatting and cheating. Ensuring academic integrity in the era of ChatGPT," *EdArxiv Preprints*, 2023. <https://doi.org/10.35542/osf.io/mrz8h>
- [55] M. A. AlAfnan, S. Dishari, M. Jovic, and K. Lomidze, "ChatGPT as an educational tool: Opportunities, challenges, and recommendations for communication, business writing, and composition courses," *Journal of Artificial Intelligence and Technology*, 2023. <https://doi.org/10.37965/jait.2023.0184>

- [56] Y. M. Al-Worafi, A. Hermansyah, K. W. Goh, and L. C. Ming, "Artificial intelligence use in university: Should we ban ChatGPT?" 2023. <https://doi.org/10.20944/preprints202302.0400.v1>
- [57] A. Tlili *et al.*, "What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education," *Smart Learning Environments*, vol. 10, no. 1, pp. 1–24, 2023. <https://doi.org/10.1186/s40561-023-00237-x>
- [58] J. Willems, "ChatGPT at universities—the least of our concerns," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4334162>
- [59] D. Mhlanga, "Open AI in education, the responsible and ethical use of ChatGPT towards lifelong learning," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4354422>
- [60] N. M. S. Surameery and M. Y. Shakor, "Use ChatGPT to solve programming bugs," *International Journal of Information Technology & Computer Engineering (IJITC)* ISSN: 2455-5290, vol. 3, no. 1, pp. 17–22, 2023. <https://doi.org/10.55529/ijitc.31.17.22>
- [61] T. Bin Arif, U. Munaf, and I. Ul-Haque, "The future of medical education and research: Is ChatGPT a blessing or blight in disguise?" vol. 28, no. 1, 2023. <https://doi.org/10.1080/10872981.2023.2181052>
- [62] D. Baidoo-Anu and L. Owusu Ansah, "Education in the era of generative artificial intelligence (AI): Understanding the potential benefits of ChatGPT in promoting teaching and learning," *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4337484>
- [63] L. Z., "Why and how to embrace AI such as ChatGPT in your academic life," 2023. <https://doi.org/10.31234/osf.io/sdx3j>
- [64] L. Chen, P. Chen, and Z. Lin, "Artificial intelligence in education: A review," *IEEE Access*, vol. 8, pp. 75264–75278, 2020. <https://doi.org/10.1109/ACCESS.2020.2988510>
- [65] F. J. García-Peñalvo, "The perception of artificial intelligence in educational contexts after the launch of ChatGPT: Disruption or panic?" *Ediciones Universidad de Salamanca*, 2023. <https://repositorio.grial.eu/handle/grial/2838>. [Accessed March 10, 2023].
- [66] J. E. (Hans) Korteling, G. C. van de Boer-Visschedijk, R. A. M. Blankendaal, R. C. Boonekamp, and A. R. Eikelboom, "Human- versus artificial intelligence," *Front Artif Intell*, vol. 4, 2021. <https://doi.org/10.3389/frai.2021.622364>
- [67] J. Lee, "Is artificial intelligence better than human clinicians in predicting patient outcomes?" *J Med Internet Res*, vol. 22, no. 8, 2020. <https://doi.org/10.2196/19918>
- [68] E. Opara, A. Mfon-Ette Theresa, and T. C. Aduke, "ChatGPT for teaching, learning and research: Prospects and challenges," 2023. [Online]. Available: <https://papers.ssrn.com/abstract=4375470>. [Accessed: March 10, 2023].
- [69] "ChatGPT, Chatbots and artificial intelligence in education—ditch that textbook," <https://ditchthattextbook.com/ai/>. [Accessed March 13, 2023].
- [70] L. Avila-Chauvet and D. Mejía, "Can professors and students detect ChatGPT essays?" *SSRN Electronic Journal*, 2023. <https://doi.org/10.2139/ssrn.4373643>
- [71] "ChatGPT Statistics for 2023: Comprehensive facts and data," <https://www.demandsage.com/chatgpt-statistics/>. [Accessed March 13, 2023].
- [72] L. Bojić, M. Zarić, and S. Žikić, "Worrying impact of artificial intelligence and big data through the prism of recommender systems," *Etnoantropološki problemi / Issues in Ethnology and Anthropology*, vol. 16, no. 3, pp. 935–957, 2021. <https://doi.org/10.21301/eap.v16i3.13>
- [73] A. D. Samala, R. Marta, S. Anori, and Y. Indarta, "Online learning applications for students: Opportunities & challenges," *Educational Administration: Theory and Practice*, vol. 28, no. 3, pp. 1–12, 2022. <https://doi.org/10.17762/kuey.v28i03.409>
- [74] A. D. Samala, L. Bojic, D. Bekiroğlu, R. Watrionthos, and Y. Hendriyani, "Microlearning: Transforming education with bite-sized learning on the go—insights and applications," *International Journal of Interactive Mobile Technologies (IJIM)*, vol. 17, no. 21, pp. 4–24, 2023. <https://doi.org/10.3991/IJIM.V17I21.42951>

- [75] A. D. Samala *et al.*, “Global publication trends in augmented reality and virtual reality for learning: The last twenty-one years,” *International Journal of Engineering Pedagogy (ijEP)*, vol. 13, no. 2, pp. 109–128, 2023. <https://doi.org/10.3991/ijep.v13i2.35965>
- [76] Syahrastani, H. Hidayat, A. Komaini, A. Gemaini, and Zulfahri, “Smart application for smart learning: How the influence of the factors on student swimming learning outcomes in sports education,” *International Journal of Interactive Mobile Technologies (ijIM)*, vol. 16, no. 17, pp. 116–129, 2022. <https://doi.org/10.3991/ijim.v16i17.34365>
- [77] A. D. Samala, I. P. Dewi, and L. Mursyida, “‘E-labsheet project’ 4Cs-based supplementary media for flexible learning: Is it well implemented?” *International Journal of Online and Biomedical Engineering (ijOE)*, vol. 19, no. 1, pp. 4–20, 2023. <https://doi.org/10.3991/ijoe.v19i01.35523>
- [78] A. Mubai, K. Rukun, M. Giatman, and E. Edidas, “Needs analysis in learning media development based on augmented reality (AR) for computer network installation courses,” *JPTK*, vol. 3, no. 1, pp. 30–34, 2020. <https://doi.org/10.24036/jptk.v3i1.3723>

## 7 AUTHORS

**Agariadne Dwinggo Samala** is a dedicated researcher and an Assistant Professor at the Faculty of Engineering, Universitas Negeri Padang (UNP), Indonesia, specializing in Informatics and Computer Engineering Education. Additionally, he is the Founder and Coordinator of the EMERGE (Emerging Technologies, Multimedia, and Education Research Group), where he contributes to advancing research initiatives. He is an external member and researcher of the Digital Society Lab at the Institute for Philosophy and Social Theory (IFDT), University of Belgrade, Serbia. In addition, he is a member of the International Society for Engineering Pedagogy (IGIP) in Austria. With a deep passion for education, he has conducted impactful research on Technology-Enhanced Learning (TEL), Emerging Technologies in Education, Flexible Learning, 21st Century Learning, and Technology, Vocational Education and Training (TVET). He has also fostered collaborative partnerships with other experts in the field to drive progress in education. He holds certifications in Microsoft Certified Educator (21st Century Learning), Microsoft Certified: Power BI Data Analyst Associate, and Google Certified Educator, showcasing his dedication to technology-driven education (E-mail: [agariadne@ft.unp.ac.id](mailto:agariadne@ft.unp.ac.id)).

**Xiaoming Zhai** is an Associate Professor in Science Education and Artificial Intelligence, Director of the AI4STEM Education Center at the University of Georgia, and a Visiting Professor at Leibniz Institute of Science and Mathematics Education. He obtained a Ph.D. at Beijing Normal University and was a Postdoctoral Research Associate at Stanford University and Michigan State University. Dr. Zhai’s research focuses on developing AI-based innovative assessments and supporting assessment practices in science. He is a consultant for several federal grants. Dr. Zhai’s research has been recognized by receiving the American Educational Research Association’s TACTL Early Career Researcher Award, NAEd/Spencer Research Development Award, Alexander von Humboldt Fellowship, Jhumki Basu Scholar Award, Sarah Moss Fellowship, and three UGA Provost’s awards (E-mail: [xiaoming.zhai@uga.edu](mailto:xiaoming.zhai@uga.edu)).

**Kumiko Aoki** is the Professor of Informatics at the Open University of Japan (OUJ). Since receiving her Ph.D. in Communication and Information Sciences (CIS) from the University of Hawaii, she was Assistant Professor of Information Technology at Rochester Institute of Technology (1995–1998), Assistant Professor of Communication at Boston University (1998–2003), Associate Professor at the National Institute of Multimedia Education (NIME) in Japan (2004–2009), and Professor of Informatics at

the Open University of Japan (OUJ) (2010-current). Her recent research interest is the effective use of metaverse and AI in lifelong and life-wide learning (E-mail: [kaoki@ouj.ac.jp](mailto:kaoki@ouj.ac.jp)).

**Ljubisa Bojic** is a communication scientist, and futurologist. Bojic received his Ph.D. from the University of Lyon II, France, in 2013 and is currently a senior research fellow and coordinator of the Digital Society Lab, Institute for Philosophy and Social Theory, at the University of Belgrade, senior research fellow at The Institute for Artificial Intelligence of Serbia, senior research fellow at the Department of Communication, University of Vienna, researcher for AI at the United Nations Development Programme and visiting fellow of the Institute for Human Sciences Vienna (IWM). Bojic was appointed to the United Nations Environment Programme Foresight Expert Panel by UNEP's Chief Scientist Andrea Hinwood. Bojic is associate editor of Springer's journal *Humanities & Social Sciences Communications* and serves as an executive board member on Horizon's Project 2022 TWin of Online Social Networks Project. The current focus of Bojic's work is the development of global AI policies and the alignment of AI with human values and well-being. The media frequently invite him to comment on the latest developments in AI from the perspective of digital humanism. Bojic speaks at universities and events across the world about his latest research (E-mail: [ljubisa.bojic@instifdt.bg.ac.rs](mailto:ljubisa.bojic@instifdt.bg.ac.rs)).

**Simona Zikic** is a communicologist whose research and work focus on two main areas. On one hand, she specializes in applied communication, including public relations, marketing, and new technologies. On the other hand, she explores the meta-level of communication through leadership as an integrative process in contemporary societies. Simona completed her undergraduate and master's studies in Communication in Belgrade. She defended her doctoral dissertation titled "Aspects of Communication in Contemporary Team Leadership" at the Faculty of Media and Communications in Belgrade. In addition to her formal education, she has received training in internal and external communications, both domestically and internationally. She has also undergone training to become a trainer and advisor in multinational companies. Simona is a communication consultant at the Youth with Disabilities forum (E-mail: [simona.zikic@fmk.edu.rs](mailto:simona.zikic@fmk.edu.rs)).