

# Diving Deep into Technology: A Systematic Literature Review on the Utilization of Chatbots in Education

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**Abstract.** *A chatbot is a piece of technology that mimics a conversation between a software application and a human. This technology has advanced quickly in recent years, and this technology has undergone significant advancements in recent years, particularly education. For this purpose, the researcher used the Systematic Literature Review (SLR) method to examine how this technology has developed and evolved over the past five years in the educational field. The findings of this study are intended to enable educators who want to create a conversational assistant for their course and developers who want to create chatbot systems for the educational space with a concise overview of the information acquired.*

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## INTRODUCTION

Artificial Intelligence (AI) has emerged as a transformative technology in the digital era, exerting profound influence across various sectors, including education (Zh et al., 2024). Advances in AI have facilitated the development of sophisticated interactive systems, such as chatbots, which are designed to comprehend and respond to human language with increasing precision. In educational contexts, chatbot technology offers significant potential to enhance learning experiences, provide personalized support for students, and optimize administrative processes. The integration of chatbots within educational frameworks aligns with the imperatives of the Fourth Industrial Revolution (4IR) and contributes to fostering adaptive and individualized learning environments.

Building a chatbot with AI that can understand human speech and make judgments is a huge undertaking (Khan & Rabbani, 2021). When it comes to AI, the two most important components of developing an effective chatbot are machine learning (ML) and natural language processing (NLP) (Bird et al., 2023). A growing number of educational institutions are incorporating AI into their curricula (Roos, 2018), with the chatbot system being one of the most frequently used AI technologies to improve educational activities (Okonkwo & Ade-Ibijola, 2020). Chatbots are seen as advantageous technology for enhancing education in academic environments (Clarizia et al., 2018). During the Fourth Industrial Revolution (4IR), educators can provide teaching in conventional classroom environments or through online platforms, employing a range of technological tools, such as chatbot systems (Mendoza et al., 2020). The integration of chatbot technology in education is a crucial approach for enhancing and enabling a more individualized learning experience (Cunningham-Nelson et al., 2019).

Recent studies on this topic have focused on chatbot technology, a subtype of dialog systems, due to the development and deployment of applications across various technical

platforms. By limiting themselves to text or voice interfaces, chatbots facilitate feedback and include generic language models derived from vast segments of the Internet. Consequently, they have been proposed and examined for many educational applications (Winkler & Söllner, 2018). Numerous research projects have been conducted on chatbots, particularly in how they can be used in schools to teach, such as answering students' questions (Clarizia et al., 2018), evaluating students' performance capabilities (Smutny & Schreiberova, 2020), and offering administrative support (Lee et al., 2019). Moreover, prior research has utilized literature reviews to make limited attempts at thoroughly encapsulating the current understanding of chatbot technology's uses in education.

Despite the growing body of research on chatbot technology in educational contexts, there remains a significant gap in the comprehensive understanding of its full potential and limitations. Much of the existing literature has focused primarily on specific applications, such as student interaction, performance evaluation, and administrative support, often without considering the broader implications of chatbot integration across diverse educational settings. Additionally, while several studies have explored the technical aspects of chatbot development, there is a lack of in-depth investigation into the pedagogical effectiveness and long-term impact of chatbot systems on student learning outcomes. This research gap underscores the need for further studies that examine the scalability, adaptability, and holistic integration of chatbot technology in various educational environments, emphasizing both its technological capabilities and educational effectiveness.

The primary objective of this study is to investigate the integration of chatbot technology within educational contexts, with a focus on its advantages, challenges, and potential applications across diverse educational domains. Specifically, the research aims to identify the principal benefits of chatbot systems in enhancing educational outcomes, improving student engagement, and optimizing administrative processes. Additionally, the study seeks to examine the challenges and obstacles to the effective implementation of chatbot technology in educational settings, as highlighted in the existing literature. Lastly, this research intends to explore the educational domains that could benefit most from the adoption of chatbot systems, providing a comprehensive understanding of their potential for enhancing educational practices and outcomes.

## **METHODS**

This research employs a systematic literature review (SLR) methodology to identify, select, and compile all relevant research materials related to the application of chatbots in education. The goal is to provide a comprehensive and detailed understanding of how chatbots are being utilized in educational settings. The SLR process ensures that a wide range of studies and findings are included, offering a well-rounded analysis of the topic. Given the significant prior research in the field, the SLR is particularly useful in synthesizing existing knowledge and identifying gaps. By addressing specific research questions, the study aims to offer a clearer view of the advantages, challenges, and potential areas for the future use of chatbots in education. These research questions include: (1) What are the principal advantages of chatbot applications in education? (2) What difficulties have been identified in the literature regarding the implementation of chatbot systems in educational environments? (3) Which areas of education could benefit most from the integration of chatbots?

The research process begins with the article search, which is a crucial step in identifying the relevant studies for inclusion in the systematic review. To ensure a comprehensive collection of materials, various sources are consulted, including Research Rabbit, Google Scholar, Publish or Perish (POP), and Litmap. These databases were chosen due to their wide range of accessible academic articles, which include both published and unpublished studies. The search process involves setting specific parameters to filter articles that are most relevant to the research questions. This phase is critical for gathering a diverse set of studies, as it provides the foundation

for the subsequent stages of the review. It also ensures that the selected studies are academically credible and that their findings contribute to answering the research questions effectively.

Following the initial article search, the next phase involves criteria selection. During this stage, the research focuses on specific keywords such as efficacy, development, chatbot, and education to filter through the articles. These terms help narrow down the selection to studies that are closely aligned with the research objectives. The chosen articles must meet certain inclusion criteria, such as being peer-reviewed, relevant to the educational context, and focused on the use or development of chatbots. The criteria ensure that only the most pertinent and high-quality studies are considered for review. This phase also includes a careful evaluation of the methodology and findings of each study to determine how well they contribute to answering the research questions. This rigorous selection process helps ensure that the review provides a reliable and thorough analysis of chatbot applications in education.

Quality assessment is a vital part of the SLR process, as it ensures the credibility and relevance of the included articles. Only publications from reputable sources are included in the review, such as those published in journals indexed in Open Journal Systems (OJS), which is known for its rigorous peer-review process. The quality of each article is thoroughly examined by reviewing its title, abstract, and overall relevance to the research questions. Additionally, each article's methodology, sample size, and findings are scrutinized to assess its robustness and validity. This step guarantees that the literature selected for the review is of high academic quality and provides reliable data that can contribute to answering the research questions.

Finally, during the data extraction phase, the most relevant and high-quality studies are selected for detailed analysis. A total of 10 journals were chosen based on their direct focus on the implementation of chatbots in educational contexts. These articles were published within the last five years (2019-2024), ensuring that the review reflects the most up-to-date research in the field. The data extracted from these journals is then analyzed and synthesized to draw meaningful conclusions about the current state of chatbot applications in education. This up-to-date selection ensures that the review captures recent trends, innovations, and challenges, offering valuable insights into the future directions of chatbot integration in educational settings.

## RESULTS AND DISCUSSION

Table 1. Data Extraction Result

No	Author/year	Title	Purpose
1.	(Lee, Jo, Kim, & Kang, 2019)	Can chatbots help reduce the workload of administrative officers?- Implementing and deploying FAQ chatbot service in a university.	The purpose of this research is to create a chatbot for addressing Frequently Asked Questions (FAQs) and implement it in a college environment to assist students and department offices.
2.	(Elnozahy, El Khayat, Cheniti-Belcadhi, & Said, 2019)	Question answering system to support university students' orientation, recruitment and retention.	The purpose of this research is to develop an information extraction framework to assist educational institutions in identifying and selecting suitable students for academic programs
3.	(Cunningham-Nelson et al., 2019)	A review of chatbots in education: practical steps forward.	One way to encourage and develop a more customized learning experience is through the application of chatbots within an educational context.
4.	(Lin & Tsai, 2019)	A conversational assistant on mobile devices for	The purpose of this research is to explore the potential of using a conversational assistant (chatbot) to

		primitive learners of computer programming.	support and enhance learning experiences in a programming course for non-technical students.
5.	(Okonkwo & Ade-Ibijola, 2020)	Python-Bot: A Chatbot for Teaching Python Programming.	The purpose of this research is to address the challenge of program comprehension among novice programmers in Computer Science Education (CSE) through the use of Chatbot technology.
6.	(Sinha, Basak, Dey, & Mondal, 2020)	An educational chatbot for answering queries	The objective of this research is to create an automated system capable of providing answers to user inquiries on behalf of an individual for educational reasons.
7.	(Wu et al., 2020)	Advantages and constraints of a hybrid model K-12 E-Learning assistant chatbot.	The purpose of this study is to demonstrate the potential of chatbots to support learning and enhance the E-Learning experience, while offering a more interactive and engaging alternative to standard platform features
8.	(Chatterjee & Bhattacharjee, 2020)	Adoption of artificial intelligence in higher education: A quantitative analysis using structural equation modelling	This study aims to investigate how stakeholders can integrate artificial intelligence in higher education.
9.	(Chatterjee & Bhattacharjee, 2020)	Vision, challenges, roles and research issues of Artificial Intelligence in Education	Present a framework to aid in implementing AIED in various educational contexts, supporting researchers with expertise in both education and computing
10.	(Chatterjee & Bhattacharjee, 2020)	Chatbots for learning: A review of educational chatbots for the Facebook Messenger	The purpose of this research is to evaluate and provide insights into the use of educational chatbots on the Facebook Messenger platform to support learning.

#### **RQ1: What are the principal advantages of chatbot applications in education?**

The use of chatbot technology in education has garnered significant attention for its potential to revolutionize the learning experience. As revealed through the analysis of various studies, including those by Winkler & Söllner (2018), chatbots are becoming an essential tool in modern educational environments, offering a range of benefits for both students and educators. These technologies are shown to improve learning outcomes and student satisfaction, demonstrating their value in educational settings. Additionally, research by Okonkwo & Ade-Ibijola (2020) further illustrates the effectiveness of chatbots, highlighting their ability to enhance the learning experience in a meaningful and impactful way.

One of the most prominent advantages of chatbots is their ability to provide quick access to instructional content. As indicated in the reviewed literature, chatbots facilitate the rapid delivery of learning materials, allowing students to access important resources without unnecessary delays. This ability to quickly obtain relevant information not only saves time but also enhances students' learning capabilities, leading to improved academic performance. By offering on-demand access, chatbots empower students to engage with educational content more effectively, enabling them to study at their own pace and revisit material as needed.

Beyond facilitating access to content, chatbots also support the seamless integration of educational materials. Through chatbots, educators can upload key information such as lecture topics, deadlines for assignments, and schedules for assessments and exams, all in one accessible online platform. This centralized approach ensures that students have easy access to the information they need, contributing to better organization and time management. Furthermore, chatbots can keep students informed about upcoming school events, such as workshops, extracurricular activities, and sports events, which enhances student engagement both inside and outside the classroom. The integration of this content helps students stay on track and remain informed at all times, making their learning experience more organized and efficient.

In addition to improving access and content integration, chatbots are particularly effective in sustaining student motivation and engagement, two critical components of a successful educational experience. With the growing use of online platforms, students are increasingly turning to smartphones for browsing and accessing educational materials, rather than relying on traditional textbooks. Studies, including those by Wu et al. (2020), emphasize that interactive systems like chatbots play a key role in maintaining student interest and engagement. By providing an interactive and dynamic learning environment, chatbots help students remain motivated and actively involved in their studies, fostering a more engaging and productive learning atmosphere.

Quantitative data further support the effectiveness of chatbots in education. A study conducted by Winkler & Söllner (2018) found that 78% of students using chatbots reported higher satisfaction with the learning process, noting increased engagement and a better understanding of the course material. Additionally, research by Okonkwo & Ade-Ibijola (2020) showed a 22% improvement in student performance after the introduction of chatbot-assisted learning platforms. These figures suggest that the use of chatbots in education not only enhances learning outcomes but also contributes to greater student engagement and satisfaction, providing a solid foundation for the widespread adoption of chatbot technology in educational settings.

Ultimately, the advantages of chatbots in education are undeniable. From providing quick access to instructional content and integrating educational materials to enhancing motivation and engagement, chatbots offer a range of benefits that can significantly improve the overall learning experience. Based on the findings from the articles reviewed, it is clear that the use of chatbots has the potential to enhance both learning outcomes and student satisfaction. As the adoption of chatbot technology continues to grow, its role in transforming educational practices will likely become even more impactful.

## **RQ2: What difficulties to the introduction of chatbot systems in education have been identified in the literature?**

The use of chatbots in education is gaining increasing traction as it promises to address various aspects of the educational environment. This technology offers swift and personalized services to individuals within the sector, including both institutional staff and students. However, the deployment and use of chatbots in educational settings also present specific challenges. The literature identifies several significant issues with the use of chatbots in classrooms, including ethical concerns, user attitudes, and challenges related to oversight and maintenance of the system.

Ethical considerations are a key challenge. A chatbot system represents a form of AI technology that is becoming increasingly embedded in daily life. It is important for chatbots to clearly define what they can do, and users should have the autonomy to decide how to interact with them. Chatbots must be transparent about their capabilities to avoid misleading users. For individuals to trust and rely on a chatbot system, it needs to demonstrate consistency in its behavior. One major concern is the privacy of user data: "What happens to the data collected by the chatbot, and how is it stored?" As chatbot systems are implemented across various sectors, including education, user privacy becomes increasingly significant. Addressing privacy concerns in compliance with regulatory requirements or privacy standards is critical. Furthermore, user



characteristics such as gender, age, ethnicity, cultural background, and socioeconomic status can influence how the chatbot's persona is perceived. It is essential to evaluate the impact of the agent's persona on user relationships, ensuring that the design of the agent's persona and dialogues does not promote harmful behavior (Lin & Tsai, 2019).

User attitudes also represent a significant challenge in the adoption of chatbots in education. Studies have found that people's perceptions significantly affect their willingness to use AI technologies in higher education. Negative attitudes or a lack of trust in the chatbot's effectiveness may hinder widespread adoption, especially among educators and students who may be unfamiliar with or resistant to AI tools in the learning environment. Overcoming these concerns requires addressing users' hesitations through education and engagement (Chatterjee & Bhattacharjee, 2020).

Finally, oversight and maintenance are crucial for the successful implementation of chatbots in education. Effective supervision ensures the accuracy of the chatbot's input and output, as well as alignment with the system's design objectives. Maintenance is necessary to ensure the continued optimal performance of the chatbot and the accuracy of the information in its database. The accuracy of the chatbot's responses depends heavily on the data it receives, and any errors in data input or outdated information can lead to misunderstandings or misinformed decisions. Regular updates and reviews are essential to ensure the system remains relevant and functional (Cunningham-Nelson et al., 2019).

In conclusion, while the integration of chatbot systems in education offers significant potential to enhance learning experiences and streamline educational processes, it is crucial to address the challenges identified in the literature. Ethical considerations, such as privacy concerns and the transparency of chatbot systems, need to be carefully managed to build trust among users. Additionally, overcoming negative user attitudes and fostering confidence in AI technologies is essential for successful adoption. Finally, ensuring proper oversight and maintenance is vital to maintaining the accuracy and relevance of the system. By addressing these obstacles, educators and institutions can maximize the benefits of chatbot technologies, creating a more effective and personalized learning environment for all users.

### **RQ3: Which prospective domains of education could gain advantages from the implementation of chatbots?**

In recent years, the implementation of chatbots in education has garnered significant interest as a potential tool to enhance teaching and learning experiences. As automated systems, chatbots have the ability to engage students in personalized interactions, support learning outside of the classroom, and provide immediate responses to queries, which can improve overall educational outcomes. However, the full potential of chatbots in education still needs to be fully explored, with several areas of research warranting further investigation to realize their benefits across various educational settings.

To fully integrate chatbots into educational environments, technological advancements are essential. Future research should focus on automating technical testing at each phase of chatbot development, ensuring they can handle a wide variety of educational queries across subjects. This will help ensure that chatbots can be applied in diverse contexts. Furthermore, the development of new entities and intents for chatbots will enhance their versatility, enabling them to address a broader range of student needs. Research by Lin & Tsai (2019) suggests that future studies should also explore the use of AI-driven analytics to better understand student behavior and needs, allowing chatbots to provide more customized assistance. Additionally, developers should prioritize creating tools that simplify the integration of chatbots into existing educational technologies, making it easier for educators to adopt them in their classrooms. Smutny & Schreiberova (2020) propose that this includes building user-friendly frameworks that enable educators to use chatbots effectively without requiring advanced technical knowledge. An important avenue for future research would be the development of systems that can seamlessly

interact with other classroom technologies, such as learning management systems (LMS), to create a more integrated educational experience.

Another critical area for exploration is the creation of chatbot models. According to Sinha et al. (2020), there is a need for the development of specific standards and guidelines for the responsible and ethical use of chatbots in the classroom. As chatbots become more widespread, it is essential to ensure that they are used appropriately, without compromising students' privacy or learning experiences. Researchers should focus on establishing frameworks that define how chatbots should be designed and used across various educational settings, considering key factors such as data security, transparency, and the balance between automation and human interaction. This includes determining which educational tasks are best suited for automation through chatbots and the role human educators should play in overseeing or guiding chatbot-driven learning.

The assessment of user experience is equally important in determining the effectiveness of chatbots in education. Future research should aim to understand how students engage with chatbots and how these interactions impact their learning motivation, anxiety levels, and academic success. Elnozahy et al. (2019) emphasize that students' perceptions of using chatbots can significantly influence their learning outcomes. Therefore, evaluating how students perceive chatbots—whether they feel more supported, motivated, or overwhelmed—is crucial. Smutny & Schreiberova (2020) suggest that content analysis of actual student-chatbot interactions could provide valuable insights into how students engage with these systems and how the content delivered by chatbots influences learning outcomes. Additionally, exploring students' emotional responses to chatbot interactions is essential, as these responses can offer deeper insights into how chatbot designs can be optimized to enhance student engagement and satisfaction.

Medeiros et al. (2018) stress the need for more comprehensive research into the reasons why effective teaching approaches, including the use of chatbot systems, are not widely implemented in higher education. The integration of chatbots into educational practices has faced resistance due to various factors, including faculty reluctance, lack of resources, and concerns about the effectiveness of such systems. Researchers should explore the barriers to chatbot implementation in higher education and investigate the specific conditions under which chatbots can be most effective. This may include studying the impact of chatbots on different student populations, including those with diverse learning styles, and understanding how they can be integrated into curricula to support a variety of teaching methods. Further research on the efficacy of chatbot systems in educational contexts is critical for understanding their true potential and identifying best practices for their use in the classroom.

In conclusion, while chatbots have shown considerable promise in enhancing education, several areas still require further academic investigation. Technological advancements, the development of effective chatbot models, and the assessment of user experience are all critical areas that could greatly contribute to improving the implementation of chatbots in educational settings. By addressing these areas, researchers can help optimize chatbot technologies for broader educational use, ultimately supporting more personalized, efficient, and engaging learning experiences.

## CONCLUSION

The use of chatbots in education offers significant advantages, including quick access to learning materials, efficient content integration, and enhanced student motivation and engagement. Research indicates that chatbots can improve student satisfaction and learning outcomes, with quantitative data showing a 22% improvement in student performance after chatbot implementation. However, the introduction of chatbots also faces challenges such as ethical concerns, user attitudes, and the need for continuous oversight and maintenance of the system. Moving forward, the development of chatbot technology, creation of appropriate models, and assessment of user experience should be the focus of further research to fully realize the potential of chatbots in education.

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