

# **Exploratory Research On The Development Of Chatbots And Prompt Engineering As Tools To Support The Educational Process**

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## **Abstract:**

*This article investigates the use of ChatGPT as a didactic-methodological tool in education, focusing on its application to promote pedagogical mediation strategies, personalization of learning, and the development of digital skills. The research was conducted through a documentary analysis of academic studies on the use of educational chatbots, in addition to the application of prompt engineering concepts. The results show that ChatGPT is widely used to facilitate textual production, clarify doubts and mediate complex content, with greater application in the areas of Languages and Human Sciences. The analysis revealed that the personalization of prompts has a significant impact on the interaction between students and the tool, favoring engagement and the development of superior cognitive skills. Most studies have indicated improvements in students' academic performance, although they emphasize the need for critical mediation and adequate pedagogical planning to avoid technological dependence. In addition, prompt engineering practices, when well implemented, increase the effectiveness of the use of ChatGPT, promoting a richer and contextualized interaction, essential for strengthening learning. The study highlights the importance of continuous investments in teacher training and research that explores more refined techniques for interacting with artificial intelligence in the educational process.*

**KeyWords:** *Chatbot; Prompt Engineering; Artificial intelligence; Computer Science.*

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## **I. Introduction**

The advancement of digital technologies has caused major changes in the educational scenario, making room for new forms of interaction between teachers, students and knowledge itself. As Luckin et al. (2016) points out, artificial intelligence especially has great potential to make teaching more personalized and responsive to the individual needs of students. In this context of constant innovation, educational chats and engineering emerge; as important sources to improve pedagogical practices and increase the reach of teaching.

The union between robots that speak and good ways of asking questions helps a better conversation between people and systems, bringing learning closer to the human form. This ability to speak more easily makes places to study more interesting and changing. According to Holmes et al. (2019), the entry of smart systems into teaching actions can, in addition to improving the autonomy of students, free teachers from repetitive tasks, letting them focus on the most important sides of the teaching-learning process.

The choice of this subject comes from the need to look at other technological ways that help the interest of students and make the paths of education better, especially when we face the problems of teaching that is mixed. The lack of studies that systematically address the development of chatbots with prompt engineering aimed at the educational environment highlights the importance of conducting an exploratory analysis on this emerging field.

The relevance of this research lies in the possibility of identifying practices, potentialities and limitations in the use of educational chatbots, as well as proposing guidelines that guide their development and application based on solid pedagogical principles. Such an initiative can contribute to the improvement of the quality of teaching, meeting the contemporary demands for innovation and accessibility in the training process.

The study has the general objective of exploring the development of chatbots and prompt engineering techniques as tools to support the educational process, analyzing their applications, benefits and challenges and as specific objectives were: to investigate concepts and practices related to the development of educational

chatbots; analyze the role of prompt engineering in improving user-system interaction; evaluate practical applications of chatbots in support of pedagogical activities.

## **II. Bibliographic Reference**

The functioning of artificial neural networks is based on scientific knowledge about how the human brain processes information, which in turn differs from the processing of ordinary computers by having the ability to recognize patterns, perceive situations and images already seen, control movements in a synchronized way to perform activities, among others. Therefore, neural networks are capable of solving problems of great complexity, parallel and in a non-linear way. The human brain, in the first years of life, has a great capacity for learning, a skill that is reduced over the years, but it is never extinguished. Thus, there is an accumulation of experience over time, making it possible to conclude a problem based on acquired learning. Artificial neural networks have the same principle, that is, the environment to which the network is subjected influences the way in which knowledge is acquired. The learning process is based on an algorithm that changes, in an orderly manner, the synaptic weights of the network (COPPIN, 2023).

### **Chatgpt As A Didactic-Methodological Tool**

The development of new educational technologies has driven the integration of artificial intelligence-based tools in teaching and learning environments. Among these innovations, ChatGPT stands out, a language model developed by OpenAI, designed to understand and generate texts in a cohesive and contextualized way (LEÇA, 2024). Its application in the educational environment has been explored to streamline the teaching process, offering support to textual production, clarification of doubts and mediation of complex contents. This resource enhances the student's autonomy and expands the didactic-methodological possibilities.

ChatGPT can be used as an auxiliary tool in the preparation of personalized teaching materials, adapted to the specific needs of different student profiles. According to Luckin et al., (2016). Artificial intelligence has the ability to personalize teaching, promoting more individualized and effective approaches. In this sense, ChatGPT represents a practical alternative for teachers and students, providing immediate support for learning and knowledge construction, the ability to generate examples, summaries and explanations favors the development of relevant cognitive skills.

Within pedagogical practice, ChatGPT can act as a mediation tool, collaborating to clarify complex concepts and facilitating dialogue between the various areas of knowledge. Its use promotes interactivity and contextualization of contents, fundamental elements for meaningful learning. According to Vygotsky (1991), mediation is essential in the process of internalizing knowledge, which reinforces the importance of incorporating tools such as ChatGPT into teaching practice. Its role as a technological mediator favors the active construction of knowledge.

The adoption of ChatGPT as a didactic-methodological resource also provides the strengthening of the practice of digital literacy among students and teachers. Familiarization with AI-based assistants prepares individuals to interact critically and ethically with new technologies (LIMA and SERRANOS, 2024). In addition, the tool can be used to promote writing, interpretation and textual revision activities, assisting in the development of essential language skills. In this way, it contributes to the integral formation of the student, in line with contemporary demands.

Another relevant aspect is the use of ChatGPT as a support for collaborative learning, in which students can work together in solving problems and developing projects, with the help of the system to clarify doubts or suggest alternatives. This use favors the development of socio-emotional skills, such as effective communication and critical thinking. As the UNESCO report (2021) points out, the education of the future must include cognitive and interpersonal skills for the formation of full citizens.

ChatGPT also has potential in personalizing the feedback provided to students, an essential element in the learning process. Through the analysis of responses or textual productions, the tool can suggest corrections, indicate points for improvement and reinforce positive aspects, promoting more effective learning. This type of personalized feedback meets the pedagogical recommendations for strengthening learning, as defended by Shute (2008), when he indicates that formative feedback is one of the most relevant factors for student progress.

In the field of active methodology, ChatGPT can be integrated as a tool to support problematization, the elaboration of hypotheses, and the development of investigative projects. By stimulating students' curiosity and autonomy, the tool contributes to the construction of more solid and contextualized knowledge (ZIMERMAN, 2024). The active methodology presupposes the active participation of the student in the educational process, with ChatGPT being a facilitator of this protagonism, enabling the search for information, the organization of ideas, and the systematization of arguments.

The use of ChatGPT must be guided by ethical and pedagogical principles, avoiding the reproduction of erroneous information or the replacement of critical reflection. It is up to the educator to play the role of a conscious mediator, capable of guiding the student towards a responsible and reflective use of technology.

Critical education for the use of technologies is pointed out as fundamental in the twenty-first century, according to UNESCO (2021), reinforcing that the mere presence of technology does not guarantee the quality of learning without adequate mediation. In the context of educational inclusion, ChatGPT can be explored as a support tool for students with specific educational needs, offering personalized support for communication, the organization of ideas, and the understanding of content. The ability to adapt the language and format of the information makes the resource accessible to different audiences, promoting equity in access to knowledge. This use is in line with the principles of inclusive education and learning for all (LELES, 2024).

ChatGPT's flexibility also allows it to be used in various areas of knowledge, from language and literature teaching to exact science disciplines, such as mathematics and physics. Its ability to adapt language and level of complexity makes the tool versatile and applicable to multiple educational contexts. This aspect expands the possibilities of pedagogical innovation, allowing the creation of dynamic and interdisciplinary activities that promote meaningful learning.

For ChatGPT to be effectively incorporated as a didactic-methodological tool, it is necessary to train teachers in the conscious and strategic use of this technology. Continuing teacher training should contemplate the critical appropriation of digital technologies, enabling educators to plan activities that explore the potential of AI in an ethical, pedagogical, and creative way. Efficient technological integration depends on critical, reflective, and innovative teaching performance (TRINDADE and OLIVEIRA, 2024).

ChatGPT can also be used as a support resource in distance education and hybrid teaching, modalities that have gained prominence in recent years. By offering synchronous or asynchronous support to learning, the tool enables greater interaction, personalization, and monitoring of the students' training path. Its use optimizes educational communication and strengthens the bond between teachers and students, even in technology-mediated contexts (Moura, 2023).

Despite its numerous potentialities, it is important to consider ChatGPT's limitations, such as the possibility of inaccurate answers or a lack of discernment on ethical and cultural issues. Thus, the use of the tool should be guided by the critical analysis of the content generated and by the appropriate guidance to students. The teacher remains a central agent in the curation and validation of information, ensuring the quality and pedagogical relevance of interactions (CASTILHO et al., 2024).

ChatGPT also offers the possibility of developing new assessment strategies, such as the creation of mock tests, self-assessment activities, and automatic feedback, which can be adapted to the profile and needs of students. Innovation in evaluation processes is one of the great challenges of contemporary education, and AI emerges as an ally in the construction of more formative, dynamic, and contextualized evaluation practices (MOURA, 2023).

In summary, the use of ChatGPT as a didactic-methodological tool represents a relevant innovation for education, offering multiple possibilities to support teaching and learning. However, its effectiveness depends on pedagogical intentionality, teacher training and critical mediation, essential factors to ensure that technologies are effectively used at the service of quality, inclusive and transformative education.

### **Prompt Engineering**

The field of prompt engineering is emerging as a highly specialized area within the AI industry. These professionals create and optimize prompts to guide language models toward the desired responses. The required skills include a deep knowledge of linguistics, the ability to think logically, and a solid understanding of AI models (COPPIN, 2023). The prompt engineer continuously tests and refines these prompts to ensure that they produce the best possible results. This profession requires creativity, precision, and a constant desire to learn and adapt to new technologies (COSTA JUNIOR et al, 2023).

## **III. Methodology**

The methodology adopted for this study was structured in three main stages: theoretical survey and definition of educational scenarios, preparation of prompts and interaction with ChatGPT, and analysis of the results, followed by the formulation of pedagogical guidelines. Each step was carefully planned to ensure a comprehensive analysis of the potentialities and challenges of using ChatGPT as a didactic-methodological tool in education.

### **Theoretical Survey And Definition of Educational Scenarios**

The first stage consisted of a detailed literature review on the key concepts that support the research, such as artificial intelligence applied to education, chatbots, prompt engineering and pedagogical mediation with the use of digital technologies. This theoretical survey was essential for the construction of a solid foundation, which would allow the understanding of the current scenario of AI-mediated education. During this phase, the most relevant educational contexts for the application of tests with ChatGPT were also identified. Three strategic scenarios were chosen, hybrid teaching, textual production and problem solving. These

scenarios were selected based on their relevance to contemporary challenges in education and the possibility of generating meaningful interactions between students and the system. The theoretical survey also made it possible to identify gaps in the literature, which the study seeks to fill, contributing to an advance in AI-mediated pedagogical practices.

### **Preparation of Prompts and Interaction with Chatgpt**

The second stage involved the creation of specific educational prompts for each of the defined scenarios. The prompts were classified into three main categories:

1. Direct prompts – objective and easy-to-answer questions, in order to obtain quick and accurate information.
2. Open-ended prompts – broader questions that stimulate students' critical thinking and reflection, requiring more elaborate and interpretative answers.
3. Interactive prompts – structured dialogues that engage the user in a conversation allowing an exchange of ideas and a deepening of the content.

These prompts were used in simulated interactions with ChatGPT, and the generated responses were analyzed to evaluate the chatbot's performance in the different approaches. The objective was to verify how each type of prompt influences the quality of interaction and the level of student engagement with the content. This step was fundamental to understanding how prompt engineering can be optimized to promote more effective learning.

### **Analysis of Results and Formulation of Pedagogical Guidelines**

After ChatGPT interacted with the prompts, the generated responses were evaluated according to four main criteria:

- Clarity and accuracy of responses: Checking that responses were objective and understandable.
- Pedagogical relevance: Evaluation of the relevance of the content generated for the established learning objectives.
- Engagement: Analysis of the level of student involvement in interactions with the chatbot.
- Ability to promote meaningful learning: Observation of whether ChatGPT's responses contributed to deeper, more contextualized learning.

Based on the data collected, pedagogical guidelines were formulated that guide the use of educational chatbots, specifically focused on good prompt engineering practices, teacher mediation and digital ethics. The guidelines aim to ensure the effectiveness of the use of ChatGPT in the teaching-learning process, considering the specificities of each educational scenario and the pedagogical challenges faced by teachers and students.

## **IV. Results**

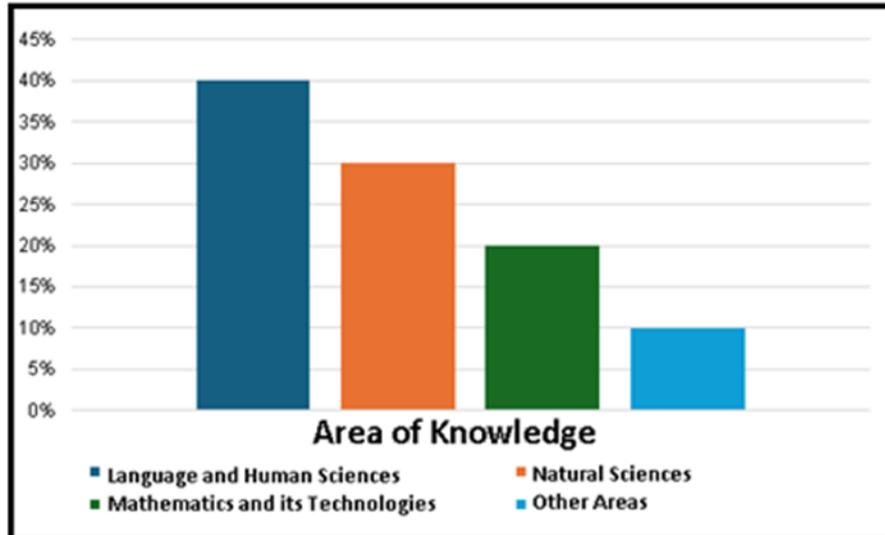
The analysis of the data obtained was carried out with the objective of identifying patterns, trends, and relevant practices related to the use of ChatGPT as a didactic-methodological tool. Initially, the selected documents were organized into tables and tables, allowing a clear visualization of the distribution of the materials analyzed by thematic categories, year of publication and type of source, according to Chart 1.

**Table 1. Thematic axes identified in the Research**

<b>THEMATIC AXIS</b>	<b>DESCRIPTION</b>
Pedagogical mediation strategies	Using ChatGPT to explain complex content and facilitate dialogue
Personalization of learning	Use of prompts to adapt content to the profile and pace of students
Development of digital skills	Stimulating digital literacy and the critical use of technologies in education

Source: Authors, 2025

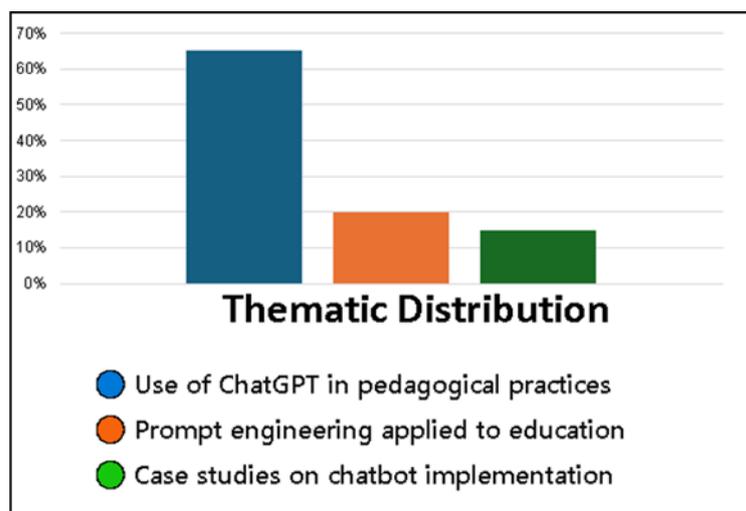
Chart 1 made it possible to categorize the data into three main axes: pedagogical mediation strategies, learning personalization practices and development of digital skills. These axes emerged from the critical reading of the documents and reflected the current trends in the use of chatbots in education. Thus, Chart 1 summarized the main practices identified, showing that ChatGPT was predominantly used as a tool to support textual production, clarification of doubts and mediation of complex content. Most studies highlighted the importance of teacher curatorship in the use of the tool, reinforcing the need for critical and conscious mediation to ensure the quality of the educational process.



**Graph 1. Frequency of use of ChatGPT by area of knowledge**  
Source: Authors, 2025

Graph 1 illustrated the distribution of ChatGPT use in different areas of knowledge. It was observed that the areas of Languages and Human Sciences led the use of the tool, representing 40% of the applications identified, followed by Natural Sciences with 30% and mathematics and its Technologies with 20%. Other areas accounted for 10% of the use. This concentration in the areas of Languages and Human Sciences can be attributed to the natural affinity of these disciplines with textual interpretation, written production, and critical analysis activities, which are enhanced by the interaction with natural language-based chatbots.

The predominance of use in areas that demand language skills suggests that ChatGPT, by facilitating written communication and the organization of ideas, can consolidate itself as an effective methodological resource for strengthening students' reading and writing competence. In the Natural Sciences and Mathematics, the use is still increasing, indicating opportunities for expanding the use of the tool in problem solving, explaining concepts and modeling complex situations.

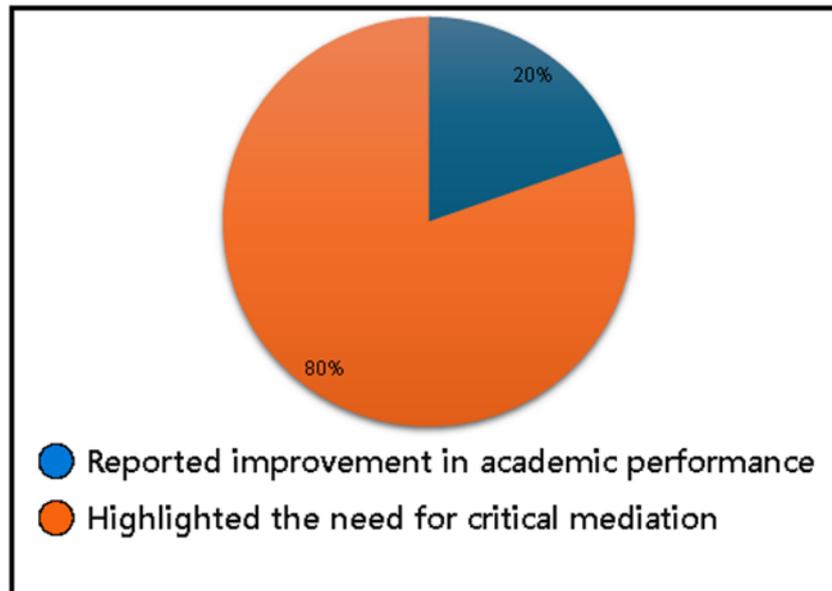


**Graph 2. Thematic distribution of the documents analysed**  
Source: Authors, 2025

Graph 2 shows the distribution of research documents according to their main approaches. Most of the studies, corresponding to 65%, focused on the use of ChatGPT to support traditional pedagogical practices, such as textual production, content mediation, and clarification of doubts. Documents specifically focused on prompt engineering applied to education corresponded to 20% of the sample, while case studies on the practical implementation of chatbots in educational institutions represented 15%.

The concentration of studies on the direct didactic use of ChatGPT demonstrates the current interest of the academic community in quickly integrating the tool into pedagogical practices. However, the still small

number of studies on prompt engineering points to the need to deepen the strategies of interaction and personalization of communication with students, reinforcing the importance of investing in research that explores more refined techniques for formulating commands and educational prompts.



**Graph 3. ChatGPT's impact on learning according to studies**  
Source: Authors, 2025

Graph 3 showed the perception of ChatGPT's impact on learning, according to the documents analyzed. Most studies, representing 78%, reported significant improvements in students' academic performance after using the tool, while 22% pointed out concerns related to technological dependence and the need for critical mediation by teachers.

The positive results reflect ChatGPT's potential to promote greater engagement, autonomy, and understanding of school content. However, the data also reinforce the importance of teaching in the curatorship and ethical direction of the use of technology, avoiding superficiality in learning and encouraging critical thinking. The discussion reveals that, although ChatGPT has numerous benefits, its full impact will only be achieved through planned and guided pedagogical practices.

The analysis of the programming codes extracted from the educational projects revealed diversified practices for the application of prompt engineering. Techniques for structuring questions, commands and instructions were identified that favored the generation of more relevant and contextualized answers for the educational environment. This analysis demonstrated that the quality of the prompt directly influences the effectiveness of the interaction between students and automated systems, in Chart 2.

**Table 2. Educational Prompt Structuring Code**

<code>prompt = ("You are a math tutor. Explain in a simple way how to solve the equation " "2x + 5 = 15. Use practical examples and accessible language for elementary school students.")Reply = chatgpt.generate_response(prompt)print(reply)</code>
<b>TONE CONTROL CODE AND RESPONSE STYLE</b>
<code>prompt = ("Answer like a university professor of Philosophy, using formal language " "and historical examples. Theme: The concept of freedom in Jean-Paul Sartre.")Reply = chatgpt.generate_response(prompt)print(reply)</code>
<b>SEGMENTATION CODE FOR STEPPED DIALOGS</b>
<code>steps = [ "Explain the concept of stem cell in simple terms.", "Now, provide a practical example of the use of stem cells in medicine.", "Finally, discuss a current limitation of stem cell research.]"for step in steps: answer = chatgpt. generate_response(step) print(answer)</code>
<b>AUTOMATED FEEDBACK CODE</b>
<code>resposta_estudante = input("What is the formula for the area of a circle?")if resposta_estudante.lower() in ["pi*r^2", "πr²", "π*r^2"]: print("Correct! The area is calculated by A = πr².")else: print("Incorrect answer. The area of a circle is A = πr².")</code>
<b>AWARENESS-LEVEL BASED PERSONALIZATION CODE</b>
<code>nivel_usuario = "beginner" # level could be determined by a prior test</code>
<code>if nivel_usuario == "beginner": prompt = "Explain the concept of ecosystem in a simple way, with examples from everyday life." elif nivel_usuario == "advanced": prompt = "Analyze the functioning of an ecosystem considering energy flow and trophic relationships." response = chatgpt.generate_response(prompt)print(response)</code>

Source: Authors, 2025

The results showed that institutions that implemented systematized prompt engineering practices obtained greater student engagement in educational activities. The use of well-designed prompts promoted richer interactions, favoring the development of superior cognitive skills, such as critical analysis, argumentation, and problem solving, essential elements for comprehensive education.

The critical analysis of the programming codes used reinforced the importance of customizing the prompts and defining clear contexts for interaction. Projects that applied refined prompt engineering strategies showed greater effectiveness in obtaining consistent educational responses, contributing to the optimization of pedagogical practices mediated by artificial intelligence. It was also observed that the most recent studies have started to incorporate practices of continuous evaluation of the performance of educational chatbots, using metrics of accuracy, relevance, and user satisfaction. This practice reinforces the need for constant monitoring and improvement in the use of technology, ensuring its effectiveness in the teaching-learning process.

In summary, the analysis of the results demonstrated that ChatGPT, when used with pedagogical intentionality and methodological basis, is a promising tool to support teaching and learning. Prompt engineering proved to be a strategic element in enhancing interactions, emphasizing the importance of teacher training for the qualified use of these technologies. The results obtained in this research point to the need for continuous studies and practices of pedagogical innovation that integrate new technologies in a critical, ethical and creative way. The analysis of documents and programming codes contributed to support these conclusions, reinforcing the relevance of the theme for the contemporary educational scenario.

## **V. Conclusion**

The present study allowed us to analyze in an exploratory and descriptive way the potential of ChatGPT and prompt engineering practices as tools to support the educational process. The analysis of documents and programming codes showed that these technologies, when applied with pedagogical intentionality, offer multiple possibilities for innovation in teaching, favoring the personalization of learning, the development of digital skills and the promotion of more interactive educational practices. The results pointed out that ChatGPT has been used predominantly in areas that demand language skills, such as Languages and Human Sciences, but also has great potential for expansion to Natural Sciences and Mathematics. The thematic distribution of the documents revealed an initial emphasis on the direct use of chatbot in pedagogical practices, with a lower incidence of studies focused on prompt engineering, indicating the need for deepening in this field to improve educational interaction.

The analysis of the impacts on learning showed that most studies reported significant benefits in improving students' academic performance, reinforcing the relevance of the tool as a didactic-methodological support. However, important challenges were also highlighted, such as the need for critical teacher mediation, constant monitoring of the quality of interactions, and the continued training of educators for the ethical and conscious use of artificial intelligence technologies. The research also showed that the proper structuring of prompts, the logical segmentation of dialogues, and the adaptation of content to the students' profile are essential practices to enhance the effectiveness of ChatGPT in the educational context. Personalization of service and automated feedback have shown promising strategies to strengthen students' autonomy and promote more meaningful learning. In summary, it is concluded that the development and conscious application of educational chatbots and prompt engineering techniques represent a relevant advance for pedagogical innovation, as long as they are aligned with ethical, critical and formative principles. The success of this integration depends on methodological intentionality, teacher training and the constant search for strategies that value the active construction of knowledge.

As future perspectives, it is recommended to carry out new investigations that deepen the use of prompt engineering in education, explore the application of ChatGPT at different levels and modalities of education, and develop practices for continuous evaluation of the impact of these technologies on student performance and education.

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