



ADVANCED TOOLS FOR EDUCATION: ChatGPT-BASED LEARNING PREPARATIONS

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Abstract

Artificial intelligence (AI) is increasingly permeating our daily lives, and the field of education is no exception. Technology already plays a significant role in education, and AI is rapidly advancing. Chatbots, for instance, have been used as a valuable tool in schools for decades. With the emergence of tools like ChatGPT, their usage has expanded even further. The presence of such tools can be highly beneficial for teachers in the educational setting. The study focused on the fact that ChatGPT can serve as an excellent support for teachers in lesson planning. The usefulness of the tool and the challenges that teachers may encounter when using it to create lesson plans were explored. The results of the study, based on the analysis of 58 lesson plans created using ChatGPT, revealed certain limitations. Therefore, it is crucial to empower teachers to make prudent use of this tool.

Keywords: *artificial intelligence, chatbots in education, learning preparation, technology and engineering, STEM, natural science*

Introduction

Artificial Intelligence (AI) is increasingly being integrated into our everyday lives in various ways and forms. The way individuals live in society is changing because of AI. AI-powered new technologies have been used in a variety of sectors, and the educational setting is no exception (Durso & Arruda, 2022). One of the most well-known forms of AI that is becoming a part of our daily lives is intelligent agents, which are created through the development and analysis of intelligent software and hardware. Their advantage lies in their ability to perform various tasks in a very short period of time (Adamopoulou & Moussiades, 2020). However, the ChatGPT tool, released in late November 2022, is not the first tool of its kind. The first chatbot, named ELIZA, was developed by Weizenbaum in 1966, but it was not widely known to the general public (Adamopoulou & Moussiades, 2020; Bradeško & Mladenčić, 2012). Chatbot assistants, such as Amazon's Alexa, Apple's Siri, and Google Assistant, have gained somewhat more recognition, allowing users to freely communicate with them in various languages. Despite the existence of such tools earlier, ChatGPT has gained tremendous popularity worldwide. ChatGPT is a generative AI tool that is capable of solving and executing highly complex tasks within a short span of time (Baidoo-Anu & Owusu, 2023). It represents the most advanced language model designed to generate text that is exceedingly challenging, and in some cases practically indistinguishable from text written by a human (Halaweh, 2023; Pericles 'asher' Rospigliosi, 2023; Rudolph et al., 2023).

Over the past few decades, both learning environments and teaching strategies have undergone steady change (Kerneža & Kordigel Aberšek, 2022). The ChatGPT tool has gained immense popularity among users, including the area of education (and teachers), due to its usefulness in performing complex tasks directly or indirectly related to education. In their research, Clarizia et al. (2018) highlighted that chatbots can be a highly useful technology that supports education, particularly by significantly improving personalized learning and reducing the administrative workload of teachers. The potential

usefulness of such tools in education has also been highlighted by Cunningham-Nelson et al. (2019). They stated that chatbots represent a promising area for potential use in education as they can streamline and personalize educational components. Additionally, chatbots prove to be valuable in various areas of education, such as teaching and learning, administration, assessment, as well as research and development. Utilizing the ChatGPT tool enables users to enhance their writing skills, summarize information effectively, and format their content, leading to substantial time savings in their work. One notable advantage of ChatGPT is its ability to detect grammatical and stylistic errors, thereby providing valuable assistance and education to students and users of the tool in general (Atlas, 2023a; Atlas, 2023b). The utility of the ChatGPT tool extends beyond education and finds application in various other fields. In the realm of research, it proves beneficial to students by offering a wealth of information related to their chosen topics, thereby aiding in the development of their research skills. Moreover, the tool has the capacity to propose unexplored aspects, fostering students' curiosity and prompting them to delve into new research areas (Kasneci et al., 2023). Despite the potential positive aspects of using chatbots in education, it is important to acknowledge that there will be some scepticism. As demonstrated by the study conducted by Baidoo-Anu and Owusu (2023), the ChatGPT tool has evoked mixed feelings among teachers. The main concern lies in the fact that this AI-based tool brings about significant changes to existing educational practices. While the ChatGPT tool is relatively new, several studies have addressed the issue of text plagiarism when utilizing it. Khalil and Er (2023) conducted a study revealing that 80 % of essays written using the ChatGPT tool had a similarity score of 20 % or less compared to other texts. Susnjak (2022) also explored the capabilities of the ChatGPT tool and found that it exhibits a certain degree of critical thinking. Indeed, considering these developments, it is reasonable to question where such technological advancements will lead us in the future. It is crucial to contemplate how we will adapt to new tools that leverage AI. Furthermore, it is of utmost importance to harness the potential offered by such tools and utilize them to our advantage. There are undoubtedly numerous possibilities for teachers to incorporate tools like ChatGPT into their work in a meaningful manner. In our research, we primarily focused on exploring how teachers could effectively utilize the ChatGPT tool for preparing lesson plans.

Research Problem

The emergence of new tools that are becoming part of our daily lives presents opportunities and advantages in their usage. However, it is important to be aware of the potential pitfalls that we may encounter while using them. Nevertheless, these tools can be versatile and provide excellent support to teachers in their work, particularly in lesson planning and preparation. The use of new tools like ChatGPT also requires certain skills from the users. Most of the existing research primarily focuses on the opportunities that AI-supported tools like ChatGPT offer to teachers. However, only a few studies highlight the specific skills that teachers would need to utilize such tools effectively and efficiently in their work and derive support from them. The same holds true for the area of lesson planning. It is crucial to identify the skills that teachers require to become competent and discerning users of chatbots for teaching purposes and related administrative tasks.

Research Focus

The aim of the research was to explore the feasibility of using the ChatGPT tool in the creation of an appropriate lesson plan in the areas of technology, science, and nature (STEM), while also exploring the basic skills required to create lesson plans in these subject areas. However, the objective was not to develop a complete lesson plan but rather to identify and outline the necessary steps that could serve as a solid framework for teachers to subsequently construct an appropriate lesson plan. Therefore, the hypothesis was formulated as follows: *“With the assistance of the ChatGPT tool, it is feasible to generate suitable starting points that can serve as a solid foundation for creating an appropriate lesson plan”*.

Research Methodology

General Background

Since its release in November 2022, the ChatGPT tool quickly gained immense popularity among the broader educational community, as well as among students from various fields. Even students studying in pedagogical programs (pre-service teachers) who will become teachers upon completion of their studies were not an exception. In practice, it has been observed that students utilize this tool; however, they often struggle to critically assess and evaluate the content generated using the ChatGPT tool. In order to examine and explore whether the ChatGPT tool is suitable for designing educational lessons in the fields of technology, science, and nature, a study was conducted in March 2023. Pre-service teachers were tasked with using the ChatGPT tool to attempt to write a pedagogically grounded lesson plan for teaching the subject of Science and Technology (i.e., the realm of technology, science, engineering, and natural sciences - STEM). The data collection or preparation of lesson plans was conducted in a way that pre-service teachers had two different subject areas available, and they had to achieve three different learning objectives.

Table 1

Contents That the Students Considered When Creating a Lesson Plan Using ChatGPT

Class		4th grade	
Learning unit	Substance flow	Changing the properties of substances	
Learning objective	to use basic processing techniques for paper and wood materials, synthetic substances, thin sheet metal	to make useful items from different types of paper materials by using various methods of joining materials	using wooden materials in making models and mock-ups; reading a plan and realizing it

The pre-service teachers were given the freedom to choose the field, unit, and learning objective based on their own interests. However, they were required to consider the condition that they had already written a lesson plan in the same subject area in the past. This requirement ensured that their work in this research study was based on the

knowledge and experience they had gained during the preparation of a traditional lesson plan. Their task was to ask the first question or command to the ChatGPT tool, which was “*Write a lesson plan for educational work in 4th grade for the objective _____*” (insert the learning objective chosen by the pre-service teachers). Once the ChatGPT tool generated the first response and thus the basic lesson plan, pre-service teachers were allowed to ask further questions and write desired commands to the tool until they felt that the starting points of the lesson plan were appropriate. When they felt that the lesson plan was appropriate, they took a screenshot and uploaded it to a shared through the Ika.si web application, which allows for anonymous submission.

Sample

The research was conducted in March 2022. The study employed a purposive non-random sampling method, involving 58 third-year students (pre-service teachers) from the Faculty of Education in Slovenia (Elementary Education program). The pre-service teachers' ages ranged from 20 to 22 years, with 87.94% female participants and 12.06% male participants. The pre-service teachers' group was selected based on their prior experience using ChatGPT, as they had already utilized the tool in previous academic assignments. Additionally, the selected pre-service teachers had previous teaching experience, which means they had practical classroom exposure and, consequently, practical experience in using lesson plans as teachers. This implies that they were familiar with the process of creating lesson plans from their previous studies, including the elements and content required. This prior knowledge was significant, as it enabled the pre-service teachers to understand the necessary information for a lesson plan and focus on how to obtain that information using the ChatGPT tool. The pre-service teachers participated in the study voluntarily, and they were provided with information regarding the research procedures and objectives.

Instrument and Procedures

Before conducting the main study, a pilot study was carried out, involving 9 participants consisting of 3 students, 3 teachers, and 3 university professors. The purpose of the pilot study was for the participants to create lesson plans in the areas of literature, science, and technology using the ChatGPT tool. Based on their work, fundamental skills required for successful lesson plan creation using the ChatGPT tool in the fields of science, technology, and nature were analysed and identified. These skills were as follows:

1. *The ability to recognize and troubleshoot issues*: it should be noted that the chatbot occasionally offers incorrect answers since the question is not comprehensible to it. The problem must be acknowledged by the individual in this role, and workable solutions need to be devised.
2. *Abstract thinking*: the ability to think in an abstract manner, to recognize distinct content-related concepts, to link ideas, to uncover patterns, and to engage in analytical thought processes.
3. *Awareness that chatbots are capable of learning*: knowing that chatbots may be trained to learn and polish their skills over time implies that the chatbot learns from its queries, behaviours, and actions, which can increase (or degrade) its performance.

4. *Incorporating knowledge from diverse fields*: the ability to distinguish and recognize the chatbot's generated content, as it may deal with content from multiple thematic areas, resulting in inadequate answers for the specific subject.
5. *Understanding concepts*: being aware of the context of the created information, comprehending it, and comprehending the content that the chatbot transmits, while also identifying the chatbot's objective and distinguishing between different answer alternatives.
6. *Understanding the logic and programming of chatbots*: understanding that chatbots are built on certain logic and programming to better grasp how the chatbot operates and what is expected of it.

The analysis of the lesson plans represented an important step as it revealed which skills were crucial for the successful writing of lesson plans using the ChatGPT tool. This served as a basis for selecting appropriate learning units and learning objectives.

Data Analysis

A case study was conducted, focusing on the analysis of 58 lesson plans to examine how the use of ChatGPT technology affects their quality and effectiveness. Qualitative methods were used for the analysis, with the latter being particularly conducted through text analysis techniques. After obtaining all the data, all lesson plans were reviewed and analysed. The analysis was conducted by three randomly selected teachers who evaluated the lesson plans created with the help of the ChatGPT tool. A short evaluation was written from which the key findings were extracted and presented below. In the analysis, teachers had to focus mainly on:

- recording learning objectives and their correctness in relation to the written learning objectives in the curriculum,
- appropriate choice of methods and forms of teaching and learning,
- is there a list of relevant materials and tools that are key to conducting the lesson,
- timeliness of implementation and
- general lesson plan.

Teachers who analysed the lesson plans were required to provide their own opinions and feedback on the lesson plans created using the ChatGPT tool. No specific format or structure was prescribed for their analyses. Teachers were asked to suggest, among the core skills given, which are the essential skills that teachers would need in order to be able to successfully prepare lessons using the ChatGPT tool.

Research Results

The analysis of the lesson plans revealed that they were partially prepared correctly and partially inappropriately (the analysis was based on the comments made about the preparations by the instructors who assessed the preparations). The results are presented in Table 2.

Table 2

Analysis of the Overview of the Lesson Plans Annotated with ChatGPT tool by Different Domains

Domain	Negative Findings	Positive Findings
Learning Objectives and Methods	<p>Most problems were encountered in determining the learning objectives, which were not always properly formulated according to the learning objectives stated in the curriculum. Pre-service teachers sometimes paid little attention to the learning objectives, resulting in superficial and sometimes completely inappropriate writing. There were some lesson plans that did not have any learning objectives written at all, making them completely inappropriate. As a result, inappropriate teaching methods and forms of work were also proposed, which contributed to completely inadequate teaching preparation.</p>	<p>Some pre-service teachers managed to translate learning objectives into a learning plan in a very clear and understandable way. Learning objectives were thus set correctly and appropriately. Learning objectives largely corresponded with the learning objectives in the curriculum. Teachers who reviewed and analysed the teaching preparation also pointed out that, in cases where the learning objectives were set appropriately, appropriate forms of work were overwhelmingly suggested.</p>
Relevant Materials	<p>It was found that the list of necessary materials for the lessons was often incomplete or inadequate. For example, in some lesson plans, incorrect or unsuitable tools were listed for a particular activity (for example, using scissors when working with wood). Similarly, during the analysis of lesson plans, it was also observed that the material list was partially or even completely unsuitable. Among the materials, there were materials listed that were not related to the intended content of the lesson.</p>	<p>In some lesson plans, well-written lists of materials and tools for work were observed and were consistent with the planned activities. The listed tools were appropriate, as were the materials.</p>
Timeframe	<p>The analysis of the lesson plans revealed that some of them had only a superficial description of the content and activities, making it unclear what the lesson would entail. As a result, the duration of the lesson was often inappropriate, either too short to cover the content adequately or too long to be completed within a 45-minute timeframe.</p>	<p>The scheduling of the lesson plans varies in a similar manner. While some pre-service teachers adhere to the timeline well, others do not. One of the lesson plans was very well structured in terms of timing and was planned down to the minute. This lesson plan also had a note added that it would be good to have an assistant present during the lesson to ensure that the work is carried out smoothly and safely.</p>

From the analysis of the lessons, the teachers who reviewed and analysed all the lesson plans highlighted the following core skills as essential for a teacher to develop a

relevant curriculum using ChatGPT in the areas of technology, science and technology education: *The ability to recognize and troubleshoot issues, Abstract thinking, Awareness that chatbots are capable of learning, Incorporating knowledge from diverse fields, Understanding concepts and Understanding the logic and programming of chatbots.*

Discussion

An increasing number of studies (Georgescu, 2018; Hew et al., 2023; Molnár & Szűts, 2018; Wollny, 2021) highlight the use of chatbots in education, with their popularity on the rise. As stated by Studente et al. (2020), chatbots can have a positive impact on both teachers and students. Through our conducted study, it was also found that chatbots, particularly ChatGPT, are a useful tool, especially in lesson plan preparation.

Based on the analysis conducted by the teachers, it was determined that more attention needs to be given to the identification of learning objectives and their translation into the curriculum. As Chatterjee and Corral (2017) state, the cornerstone of instructional alignment lies in the utilization of learning objectives, which facilitate the desired learning outcomes by aligning with assessment tools, instructional techniques, and learning activities. In some cases, learning objectives were not properly defined, which is likely due to inadequate prompts provided to the pre-service teachers in the ChatGPT tool. The goal of using the tool was, among other things, to guide pre-service teachers in properly communicating with ChatGPT so that the tool can formulate appropriate objectives and content. Therefore, it would be advisable to carefully study the learning objectives before starting to write the lesson plan and then provide ChatGPT with appropriate prompts. At this point, it is believed it is important for the teacher to formulate the learning objectives with the help of the curriculum, while ChatGPT can provide suggestions and improvements. However, ultimately, the teacher is the one who will make the final decision and determine the learning objectives of the lesson. Incorrect or inadequate lists of supplies can also present a significant challenge for teachers in preparing and executing lesson plans. With inadequate lists, there may be a wrong choice of tools or materials, which can affect the quality of the lesson plan and reduce the effectiveness of education. This can also lead to wasting time and money on obtaining appropriate materials or correcting mistakes that result from the use of inappropriate tools or materials. Lesson planning requires precision and attention, especially when it comes to tools and materials lists. If the listed tools and materials are correct and appropriate, they can improve the quality of education and the execution of the lesson plan. Proper tools and materials are essential for the successful implementation of a lesson and help reduce complications or complexity. It is believed that at this point, it is also necessary for the teacher to assess whether the listed supply lists are correct for the proper implementation of the planned content of the lesson. Certainly, the same applies to the content and timing of the lesson plan. With the appropriate sub-questions and successful guidance of the ChatGPT tool, the teacher can provide suitable prompts that can be a good basis for preparing an appropriate lesson plan. With minor adjustments and adaptations of the text generated by ChatGPT, it is possible to prepare an appropriate lesson plan. Based on all the above, we can confirm the hypothesis that *“With the help of the ChatGPT tool, it is possible to write suitable prompts that can be a good basis for an appropriate lesson plan”*. The analysis of lesson plans created with the help of the ChatGPT tool can provide very good prompts that can be translated into an appropriate lesson plan with some adjustments and adaptations.

The skills listed in the results section represent only the foundational skills, and we believe that further research in this area will uncover additional skills necessary. However, we acknowledge that there is still much work to be done in this field. As Kooli (2023) also suggests, it is essential to raise awareness among users, establish appropriate legislation, and adopt ethical guidelines. This can be achieved more effectively once the field is thoroughly researched.

Conclusions and Implications

The discussion about the analysis of lesson plans prepared using the Chat GPT tool is crucial for improving the quality of education and learning, as well as for the use of AI and Chat GPT for educational support purposes. As the results of the conducted research show, there are some issues that need to be addressed for the lesson plans to be more effective and appropriate for the educational goals. Firstly, it would be necessary to focus on improving the prompts that users input when preparing their lesson plans using the Chat GPT tool. If the prompts were of higher quality, the resulting lesson plans would presumably be more appropriate. This is evidenced by those lesson plans that the pre-service teachers upgraded multiple times by adding new tasks and instructions to the ChatGPT tool, resulting in more precise guidance and better adherence to the content. The appropriate refinement of key prompts in lesson plan preparation would lead to more content-appropriate lesson plans. Furthermore, more attention needs to be paid to designing learning objectives, as they are crucial for achieving appropriate levels of knowledge. A Chat GPT tool user who uses the tool for the purpose of preparing lesson plans may understand that learning objectives are essential and may need to guide the ChatGPT tool accordingly or independently refine or develop the objectives as needed, independent of the ChatGPT tool. The same applies to defining tools and materials and the remaining parts of the lesson plan. Before using the ChatGPT tool for the purpose of writing lesson plans, it would be necessary to provide more support and education to users, so that they understand how to effectively use the ChatGPT tool. Since the ChatGPT tool is still relatively new and therefore not fully tested, providing education is currently quite challenging. Therefore, it would make sense for teachers and other ChatGPT users to come together in a community where they can exchange best practices, good examples, and any findings with each other. This would create a community that could contribute to the appropriate use of the ChatGPT tool for the purpose of writing lesson plans.

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References

- Adamopoulou, E. & Moussiades, L. (2020). An overview of Chatbot technology. In Maglogiannis, I., Iliadis, L., & Pimenidis, E. (Eds.), *Artificial intelligence applications and innovations. AIAI 2020. IFIP Advances in Information and Communication Technology*, 584. Springer. https://doi.org/10.1007/978-3-030-49186-4_31
- Atlas, S. (2023a). *ChatGPT for higher education and professional development: A guide to conversational AI*. https://digitalcommons.uri.edu/cba_facpubs/548
- Atlas, S. (2023b). *Chatbot prompting: A guide for students, educators, and AI-augmented workforce*. University of Rhode Island.
- Bradeško, L., & Mladenčić, D. (2012). A survey of chatbot systems through a Loebner Prize competition. In Erjavec, T., & Žganec Gros, J. (Eds.), *Proceedings of the eighth language technologies conference, October 8th-12th, 2012, Ljubljana, Slovenia: Proceedings of the 15th International Multiconference Information Society - IS 2012* (Vol. C, pp. 34-37). Institut Jožef Štefan. <http://nl.ijs.si/isjt12/JezikovneTehnologije2012.pdf>
- Baidoo-Anu, D., & Owusu, A. L. (2023). *Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning*. SSRN: <https://ssrn.com/abstract=4337484>
- Chatterjee, D., & Corral, J. (2017). How to write well-defined learning objectives. *The Journal of Education in Perioperative Medicine*, 19(4), 1-4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5944406/pdf/i2333-0406-19-4-1a.pdf>
- Clarizia, F., Colace, F., Lombardi, M., Pascale, F., & Santaniello, D. (2018). Chatbot: An education support system for students. In Castiglione, A., Pop, F., Ficco, M., & Palmieri, F. (Eds.), *Cyberspace Safety and Security* (pp. 291-302). Springer. https://doi.org/10.1007/978-3-030-01689-0_23
- Cunningham, N., Boles, W., Trouton, L., & Margerison, E. (2019). A review of chatbots in education: Practical steps forward. In *30th Annual Conference for the Australasian Association for Engineering Education (AAEE 2019): Educators becoming agents of change: Innovate, integrate, motivate* (pp. 299-306). Engineers Australia. <https://eprints.qut.edu.au/134323/>
- Durso, S. D. O., & Arruda, E. P. (2022). Artificial intelligence in distance education: A systematic literature review of Brazilian studies. *Problems of Education in the 21st Century*, 80(5), 679-692. <https://doi.org/10.33225/pec/22.80.679>
- Georgescu, A. A. (2018). Chatbots for education—trends, benefits and challenges. In *Conference proceedings of “eLearning and Software for Education (eLSE)”*, 14(2), 195-200, Carol I National Defence University Publishing House.
- Halaweh, M. (2023). ChatGPT in education: Strategies for responsible implementation. *Contemporary Educational Technology*, 15(2), Article ep421. <https://doi.org/10.30935/cedtech/13036>
- Hew, K. F., Huang, W., Du, J., & Jia, C. (2023). Using chatbots to support student goal setting and social presence in fully online activities: Learner engagement and perceptions. *Journal of Computing in Higher Education*, 35(1), 40-68. <http://dx.doi.org/10.1007/s12528-022-09338-x>
- Kasneći, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., Stadler, M., Weller, J., Kuhn, J. & Kasneći, G. (2023). *ChatGPT for good? On opportunities and challenges of large language models for education*. <https://doi.org/10.35542/osf.io/5er8f>
- Kerneža, M., & Kordigel Aberšek, M. (2022). Online reading in digital learning environments for primary school students. *Problems of Education in the 21st Century*, 80(6), 836-850. <https://doi.org/10.33225/pec/22.80.836>
- Khalil, M., & Er, E. (2023). Will ChatGPT get you caught? Rethinking of plagiarism detection. *arXiv*. <https://doi.org/10.35542/osf.io/fnh48>
- Kooli, C. (2023). Chatbots in education and research: A critical examination of ethical implications and solutions. *Sustainability*, 15(7). <http://dx.doi.org/10.3390/su15075614>

- Molnár, G., & Szüts, Z. (2018). The Role of Chatbots in formal education. In 2018 IEEE 16th International Symposium on Intelligent Systems and Informatics (SISY), (pp. 197-202). <https://doi.org/10.1109/SISY.2018.8524609>
- Pericles 'asher' Rospigliosi (2023). Artificial intelligence in teaching and learning: What questions should we ask of ChatGPT? *Interactive Learning Environments*, 31(1), 1-3. <https://doi.org/10.1080/10494820.2023.2180191>
- Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Ed-tech Reviews*, 6(1), 342-363. <https://doi.org/10.37074/jalt.2023.6.1.9>
- Studente, S., Ellis, S., & Garivaldis, S. F. (2020). Exploring the potential of chatbots in higher education: A preliminary study. *International Journal of Educational and Pedagogical Sciences*, 14(9), 768-771.
- Susnjak, T. (2022). ChatGPT: The end of online exam integrity? *arXiv preprint*. <https://doi.org/10.48550/arXiv.2212.09292>
- Wollny, S., Schneider, J., Di Mitri, D., Weidlich, J., Rittberger, M., & Drachsler, H. (2021). Are we there yet? A systematic literature review on chatbots in education. *Frontiers in Artificial Intelligence*, 4. <https://doi.org/10.3389/frai.2021.654924>

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