

# ChatGPT and Moodle Walk into a Bar: Capabilities, Integration, Use Cases, and Challenges

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**Abstract**—Are you ready to explore the next frontier in e-learning with ChatGPT? This innovative artificial intelligence technology will revolutionize the way we teach and learn in Moodle, the world-renowned Learning Management System. This article draws attention to five powerful capabilities of ChatGPT: contextual conversing, feedback response, analytical power, adaptive tutoring, and multilingual capabilities. It explains a three-step technical procedure of integrating ChatGPT in Moodle using a publicly accessible Moodle instance at ResearchIC.com. A follow-up of eight use cases provides a user manual for the system, prompting for information, performing calculations on numerical data, interpreting data analysis results, generating data for educational purposes, supporting course design activities, providing emotional support, and supporting extended learning. The article concludes with a discussion of six challenges that may arise, but overall maintains an optimistic view of the future of applying ChatGPT to enhance teaching and learning. This research has the potential to inform and inspire multiple stakeholders in higher education institutions (e.g., students, teachers, system admins) to experiment with ChatGPT in their online teaching and learning environments.

**Keywords**— ChatGPT, generative AI, Moodle, e-learning

## I. INTRODUCTION

The student–faculty ratio is dividing the number of students by the number of teachers in the same institution. One undeniable pressure and deficit in our higher education system currently is the large student-faculty ratio [1]. It has significantly reduced the amount of guidance and supervision given by teachers to individual students. As a result, we have the increasing student disengagement, ineffective learning, and dropout rate [2]. Chatbots were introduced into the higher education sector as one promising solution and became widely used since 2018 [3]. A chatbot is a computer program that simulates and processes written or spoken human conversation. Some Chatbots that were reported in education settings included Lola, CourseQ, CEUBot, Differ, LTKABot, FAQs Chatbot, LISA, Syllabus Chatbot, LibBot, UCM3 Library chatbot, and FITEBot [4]. However, technologies of chatbots in education may be in the Innovation Trigger phase, where many expectations are placed on the technology, but the practical in-depth experience is still largely lacking [5]

Chatbot technologies continue to evolve rapidly. On November 30, 2022, ChatGPT, an artificial intelligence (AI) chatbot developed by OpenAI, was launched. Instantly, it attracted one million subscribers in one week [6] and became the most widely discussed technology in the world. In only two months, ChatGPT hit 100 million monthly active users (MAU), when TikTok achieved this user base in 9 months and Instagram in 30 months [7]. As of now, ChatGPT is

considered one of the most advanced language models in the world, and its capabilities are increasing constantly.

While many people are still trying to wrap their minds around this disruptive chatbot, some took quick actions to implement it to their practices. ChatGPT has been recognized by the researcher community, for instance, for its ability to act as a co-pilot to humans in scientific writing [8], data analysis [9], repetitive programming [10], picking up latest information [11], decision-making [12], and more. In the educator community, ChatGPT was applied in exam writing operation [13], creating prompts for formative assessment activities [14], and facilitating conversation among different stakeholders enabling processes of co-design and value co-creation [15]. There is also much discussion around the fear and criticism surrounding AI plagiarism [16]. After all, blinded human reviewers in the scientific publishing process can only detect 68% of ChatGPT-generated abstracts [17]. Not to mention that the updated GPT-4 (in March 2023) exhibits “human-level performance on various professional and academic benchmarks, including passing a simulated bar exam with a score around the top 10% of test takers.” [18] Plagiarism has been a daunting historical battle in schools, but AI can significantly elevate the issue. However, our goals as educators should focus on teaching students how to use technology ethically and effectively, instead of preventing them from using technology to cheat or take shortcuts.

Due in part to the ongoing debate surrounding AI ethics and the short time since ChatGPT’s launch, there is currently no literature available on how to integrate and use ChatGPT in learning management systems (LMS) such as Moodle. Given the significant role and global popularity of Moodle as LMS to support teaching and learning in higher education, it is essential to experiment with the possibilities and provide timely guidance to administrators, teachers, and students regarding adopting ChatGPT in higher education institutions.

This article provides a starting point by reporting a practical in-depth case study in which ChatGPT was implemented and explored on a Moodle instance accessible at <https://researchic.com>, which is a web platform that supports university students and researchers to host and attend online journal clubs. The article has three main objectives. Firstly, it aims to inform Moodle system administrators on the higher education level about the necessary steps to integrate ChatGPT, encouraging further experimentation. Secondly, it proposes a list of use cases that can help predict user prompts and improve the quality of feedback provided by ChatGPT in the context of Moodle. Finally, it aims to inspire further intelligent applications of ChatGPT in Moodle.

## II. CAPABILITIES OF CHATGPT

The human-ChatGPT interaction is a continuous series of operations that rely on human “Prompts” and machine “Feedback”. Clarifying the capabilities of this tool, such as remembering aspects, supportive communication, follow-up corrections [11], can help end-users better understand how to and where to apply the tool. In this article, I would like to focus and reflect on the following five capabilities of ChatGPT, which are relevant to the education and training sectors.

### A. Contextual Conversing Capability

Contextual conversing refers to its ability to provide an interactive conversing experience that keeps students engaged and motivated. It can understand the context of a conversation and respond accordingly, taking into account factors such as the student's previous questions, the topic being discussed, and the student's level of understanding. This ability to understand and respond to context is critical for providing effective feedback and personalized support to students in a learning management system.

Classroom dialogues between teachers and students, as well as among students, significantly contribute to intellectual development and educational attainment [19]. The increasing attention given to classroom talks is due to the growing popularity of sociocultural theory and research, which “treat communication, thinking, and learning as processes shaped by culture, whereby knowledge is shared and understandings are jointly constructed” (p.3). Paulo Freire, together with Ira Shor, developed the theory of dialogic pedagogy and recommended that the theory should be considered an epistemological position, which approaches knowing as a social activity instead of an individual activity [20]. Therefore, ChatGPT's conversational capability enables it to not only play an intermediate role but also act as an independent agent to engage in classroom dialogues with learners and teachers. What is more impressive is that the conversation with active users within a certain classroom context further become training data for ChatGPT, which allows it to grow accuracy and sensitivity in conversations by gaining a higher level of context-specific knowledge.

### B. Feedback Capability

ChatGPT can provide feedback that is both reflective and diagnostic, helping students to understand not only what they did wrong, but why it was wrong and how they can improve in the future. This type of feedback can be especially helpful for students who are struggling with a particular concept or skill, as it can help them to identify and address the root cause of the problem.

Feedback plays an integral part in the educational process by comparing learner performance to educational goals with the aim of helping them achieve or exceed such goals [21]. Feedback is given in the context of assessment, either formative or summative, often after students' attempts in these activities. Feedback can be verification or elaboration type, with the former identifying correct/incorrect responses and the latter further explaining why responses are correct or incorrect [22]. However, providing elaboration feedback often sacrifices timeliness, while providing verification feedback lacks tailored insight. With proper assessment design, ChatGPT can potentially offer a balanced middle ground, where students can receive both verification and elaboration feedback spontaneously. When combined with conversational

capability, it can provide feedback not as a one-time offering but as feedback dialogues, which has been shown to stimulate students' reflective thinking [23].

### C. Analytical Capability

The era of AI, or cognitive technologies, is known as Analytics 4.0, following Analytics 1.0 - the era of artisanal descriptive analytics, Analytics 2.0 - the era of big data analytics, and Analytics 3.0 - the era of data economy analytics [24]. Machine learning (ML) is a subset of AI that employs algorithms and statistical models to enable machines to learn from data without explicit programming. ML is the backbone of many AI approaches and is analytical at its core. Large language models (LLMs) are a specific type of ML model designed to generate human-like text by predicting the likelihood of a sequence of words given a certain input. ChatGPT benefits mainly from LLMs that train huge neural network models with large-scale data using language models. Since its focus is on natural language and it is trained on a massive amount of text data, it is not surprising to find that its current mathematical abilities are significantly below those of an average mathematics graduate student [25], or it provides incorrect answers to math or logic problems, which have definite, instead of probabilistic, solutions [26].

### D. Adaptive Tutoring Capability

Intelligent adaptive tutoring environments should take into account cognitive, metacognitive, and affective factors about the student before making teaching decisions [27]. ChatGPT is an example of such an environment that can adapt to the individuality of each user who sends prompts, satisfying all three factors. As mentioned, it can adjust its responses based on the user's previous questions, the topic being discussed, and the user's level of understanding. For instance, if a student asks a question about an unfamiliar topic, it can provide a simple and clear explanation to help them understand. Conversely, if a student asks a more advanced question, it can provide a more detailed and nuanced response. Moreover, a student can ask to raise or lower the difficulty of responses to their prompts. These abilities are incorporated in the tool as adaptive help scaffolds that can teach students how to effectively seek and utilize help and foster a positive attitude towards seeking help in general [28]. Scaffolds fill knowledge gaps and reduce cognitive load, enabling learners to pay attention to their learning styles and preferences. As a result, the possibility of becoming mentally frustrated or stressed during the learning process is greatly reduced, ultimately leading to better learning outcomes.

### E. Multilingual Capability

ChatGPT's multilingual capability can make it easier for students and educators to communicate across different languages and cultures, opening up new opportunities for global learning and collaboration. Its cross-lingual summarization (CLS) performance, which is to provide a target-language (e.g., Chinese) summary for a lengthy document in a different source of language (e.g., English), was tested and the result showed that the tool originally prefers to produce lengthy summaries with more detailed information but with the help of an interactive prompt, it can balance between informativeness and conciseness, and significantly improve its CLS performance [29]. One obvious implication of this capability is that it can help international students more efficiently understand instructional materials written in foreign languages.

Many e-learning experts will consensus on taking the evolution of the technologies used for teaching and learning into consideration when defining e-learning as a concept [30]. The multilingual capability of ChatGPT when applied to e-learning can potentially reform further research and practice on the topic of learner diversity and inclusion. This topic is a central focus of Sustainable Development Goal 4 [31] and has received much attention in higher education. However, when comparing e-learning and traditional learning, there is little evidence to suggest that e-learning is any more welcoming of diversity and inclusiveness [32]. A recent review of 87 inclusive virtual education (VLE) studies found that 42.7% of them addressed IVE educational designs for human differences such as age, race, religion, gender, ethnicity, culture, and social status [33]. Recognizing and characterizing student heterogeneity in more and more online courses offered to an international audience becomes a necessary mechanism to develop educational designs that help students meet their needs and reach their potential.

### III. INTEGRATING CHATGPT IN MOODLE

#### A. Install the Plugin

The easiest way to install ChatGPT on Moodle is by installing the “OpenAI Chat Block” plugin ([https://moodle.org/plugins/block\\_openai\\_chat](https://moodle.org/plugins/block_openai_chat)), which was developed and is maintained by Bryce Yoder. Once installed on your Moodle, the plugin will enable you to add a new block called “OpenAI Chat” to the site’s block drawer.

#### B. Obtain the OpenAI API Key

To use the plugin, you need to obtain an OpenAI API key. Visit <https://platform.openai.com> and sign up for a new account to get the key. To view your API keys, log in to the system and click on your account. From the dropdown list, select “View API keys”. Clicking “Create new secret key” will generate an OpenAI API key. You can then copy and paste this key into your Moodle site.

#### C. Contextualize the Bot

When configuring the OpenAI Chat Block on your Moodle, it’s important to feed some questions and answers into the “Source of truth” field as the process of supervised training (Fig. 1). This trains the chatbot in the context of your LMS. In this case, a set of 23 questions and answers (<https://t.ly/vOZHh>) was used to train the chatbot for ResearchIC.com, a platform for hosting and joining Online Journal Club (OJC) events. As a result, when users ask questions using the ChatGPT window on ResearchIC.com, they will receive answers that are contextualized to the platform, unless they specify otherwise.

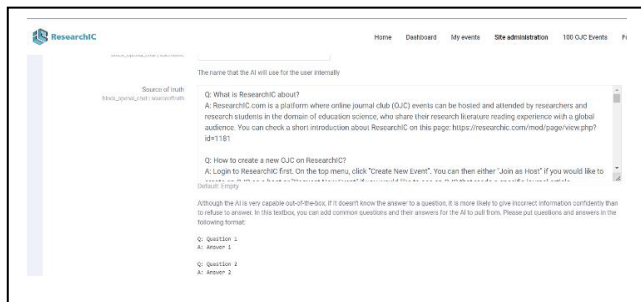


Fig. 1. “Source of truth” to provide supervised training to your ChatGPT in Moodle.

Identify applicable funding agency here. If none, delete this text box.

After completing these steps and saving all changes, ChatGPT will be integrated into your Moodle system and available for use by your students and instructors.

### IV. POTENTIAL USE CASES OF CHATGPT IN MOODLE

#### A. Act as User Manual for the System

One potential use case is to request guidance on specific operations that a user wants to achieve on the platform. For example, a user might send the same prompt in English and Japanese asking for guidance on how to add a video to a course, as shown in the following screenshot (Fig. 2). Although the prompt does not provide any context about Moodle, the bot is able to understand it and provide the correct instructions for adding a video to a course in the Moodle environment.

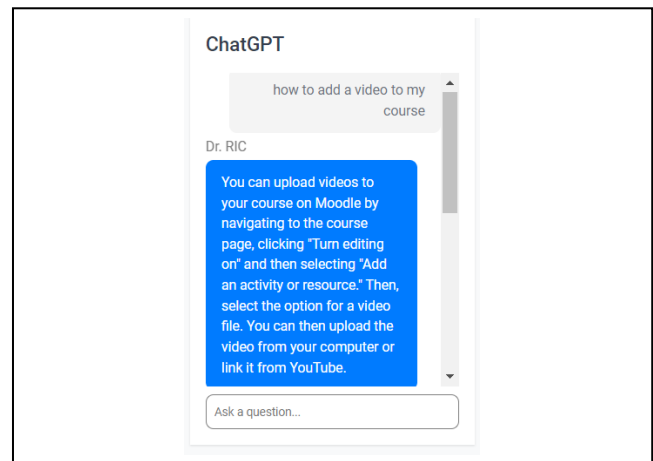


Fig. 2. User case 1: consulting how to use the system.

To tailor feedback more closely to your Moodle system, which likely already has a deck of previously developed user manuals, you can add more Q&A sets to the “Source of truth” field. In the case of ResearchIC, some user manuals are available in the system in the form of forum posts: <https://researchic.com/course/view.php?id=28>.

I added a Q&A set as follows:

Q: How do I embed a YouTube video on the event page?

A: It’s easy! We have created a list of user tutorials at <https://researchic.com/course/view.php?id=28>. Depending on your user role, you can search for answers in one of the three forums on the page. If you can’t find the answer you’re looking for, please email us at [hi@researchic.com](mailto:hi@researchic.com).

If you provide the prompt “How to embed a video on my OJC”, it will give a more customized answer based on the information you input into its “Source of truth” (Fig. 3). The answer may not use the same words as your input in the Q&A set, but it will be rephrased in a new way.

Feeding only one question from the user manual into ChatGPT cannot ensure the accuracy of other unlisted questions. To address this issue, it is recommended to list other frequently asked questions. I suggest leaving the Moodle system-related user manual to the official Moodle documentation and asking users to add the context of Moodle to their prompts when consulting about how to use Moodle. However, if there are any special functions that are not well documented by the Moodle community, you can add them as a Q&A set to the “Source of truth.”

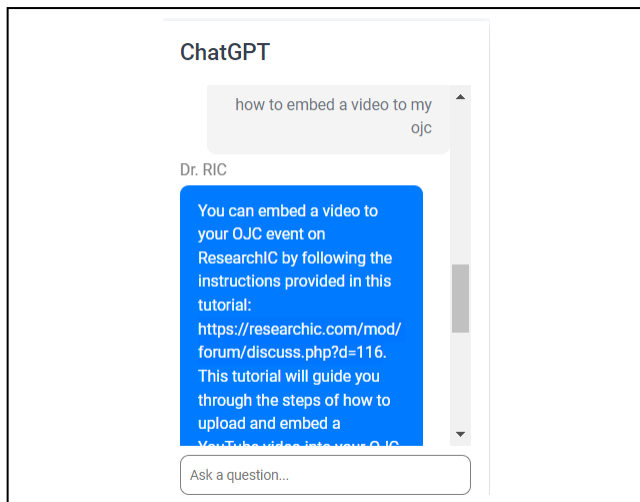


Fig. 3. User case 2: improved performance.

### B. Prompt for Information

When students interact with a given material, such as a PDF file in the following example of a PDF annotation activity on ResearchIC (Fig. 4), they may encounter difficult terminologies that require prompt explanation. ChatGPT can act like a dictionary or Wikipedia to offer explanations for concepts and terms so that students can focus on the overall meaning presented in the materials.

Teachers can also encourage students to paste the GPT generated responses to a public thread in forums. This way, other students will not need to repeat the operation of consulting when they face the same mental block while reading. It provides an opportunity for other students to build upon what is made available and reach out to search for more extended meaning. This action transforms human-agent interaction into human-human interaction and extends the engagement lifespan of one operation.

Prompt and feedback in the screenshot:

Q: Define readiness.

A: Readiness is the ability to take action or respond to a situation. It can refer to physical, mental, emotional, or educational preparedness for a task or activity. For example, in education science readiness could refer to having the necessary skills and knowledge required for successful learning outcomes.

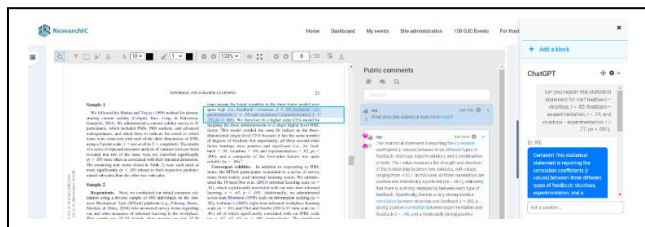


Fig. 4. User case 3: prompt for information.

### C. Calculations on Numerical Data

To enable ChatGPT's mathematical calculation capability on Moodle, you need to input at least one mathematical calculation Q&A set into the "Source of truth." Otherwise, your LMS's ChatGPT will return incorrect answers consistently. Generating Q&A is not necessary; simply visit

<https://chat.openai.com/chat> and prompt "provide a mathematical question and answer it."

I have previously mentioned the context sensitivity of ChatGPT. The following statement still surprised me the first time I saw it after prompting a mathematical statement such as "sin(8)" to ResearchIC's ChatGPT (Fig. 5). It instantly reminded me of the context and attempted to bring me back to it. This is because I had mainly input Moodle support type of Q&A sets into the "Source of truth" thus far. If the dominant type of Q&A sets is related to mathematics, I expect the reminder message to be quite distinct from the current one.

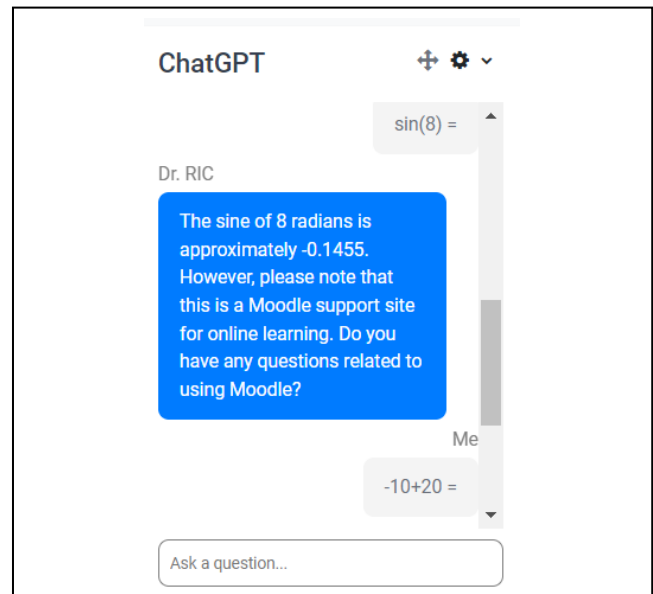


Fig. 5. User case 4: calculations on numerical data.

### D. Interpret Data Analysis Results

ChatGPT can be used to interpret data analysis results. For instance, when students are reading an educational journal article on survey design (Fig. 6), they may face difficulties in understanding statistical results. It can act as a virtual tutor and provide explanations for these results, which can help students comprehend the underlying concepts better and enhance their scientific literature reading competencies.

Prompt and feedback in the screenshot:

Q: Can you explain this statistical statement for me? feedback—vicarious,  $r = .85$ ; feedback—experimentation,  $r = .74$ ; and vicarious—experimentation,  $r = .77$ ,  $ps < .001$ .

A: Certainly! This statistical statement is reporting the correlation coefficients ( $r$  values) between three different types of feedback: vicarious, experimentation, and a combination of both. The  $r$  value measures the strength and direction of the relationship between two variables, with values ranging from -1 to 1. In this case, all three correlations are positive and statistically significant ( $ps < .001$ ), indicating that there is a strong relationship between each type of feedback. Specifically, there is a very strong positive correlation between vicarious and feedback ( $r = .85$ ), a strong positive correlation between experimentation and feedback ( $r$

= .74), and a moderately strong positive correlation between vicarious and experimentation ( $r = .77$ ).

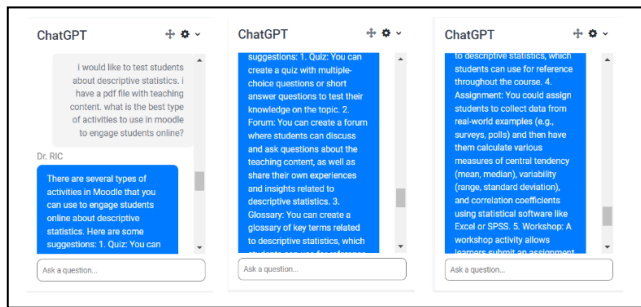


Fig. 6. User case 5: interpret data analysis results.

### E. Generate Data for Educational Purposes

Teachers can use ChatGPT to generate new dataset as educational artefacts by using carefully written prompts (Fig. 7). This can support the process of preparing teaching content on Moodle, especially in disciplines like statistics and machine learning. Having access to large amounts of high-quality data for practices or demonstration purposes is critical for effective learning and practice in these fields.

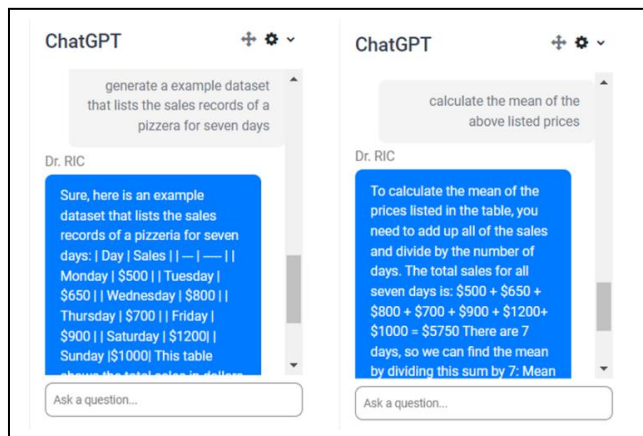


Fig. 7. User case 6: generate data for educational purposes.

### F. Support Course Design Activities

ChatGPT can support teachers in creating formative assessment activities, such as quizzes and assignments, by using the learning objectives and outcomes of the course as prompts (Fig. 8). It can also suggest ways to match a teacher's course content with different types of Moodle resources and activities (e.g., files, forums, workshops, chats, and books) that can engage students in various ways.

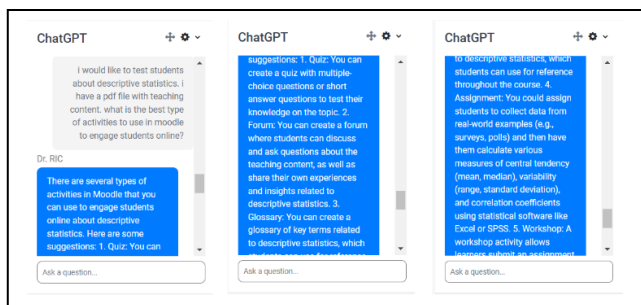


Fig. 8. User case 7: support course design activities.

Prompt used in the screenshot:

Q: I would like to test students about descriptive statistics. I have a PDF file with teaching content. What is the best type of activities to use in Moodle to engage students online?

### G. Emotional Support

ChatGPT can provide emotional support to students who may be struggling with stress, anxiety, loneliness, or other mental health issues when they use Moodle (Fig. 9). By offering a safe and confidential space for students to discuss their feelings and concerns, it can help to promote a positive and supportive learning environment. Additionally, it can provide resources and referrals to students who may need additional support or assistance.

Prompts used in the screenshots:

Q: I feel quite disengaged in this course. What can I do?

Q: Can you tell me a joke to cheer me up?

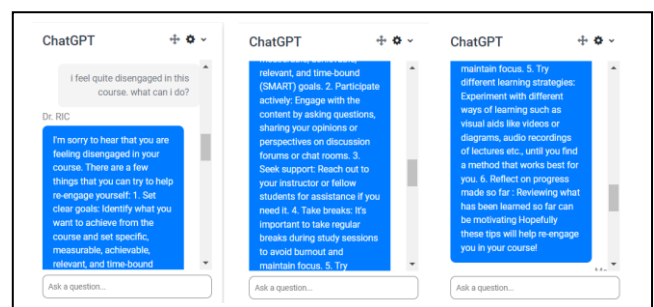


Fig. 9. User case 8: emotional support.

### H. Support Extended Learning

ChatGPT is an incredibly versatile tool that can be used to support extended learning beyond the classroom. By providing additional resources and opportunities for practice and exploration, students have the chance to delve deeper into the topics they are learning about. For example, it can suggest possible sources online that students can visit for more learning materials, such as videos, articles, and interactive activities (Fig. 10). This means that students have access to a wide range of materials that can support their learning journey. However, it is also worth noting that the accuracy of such suggestions is sometimes questionable. Thus, teachers need to remind students of such a problem.

Furthermore, it can provide personalized quizzes and feedback to students, which can help them identify areas where they excel and areas where they may need more practice (Fig. 10). This individualized approach ensures that students receive the support they need to succeed, while also allowing them to explore and learn at their own pace.



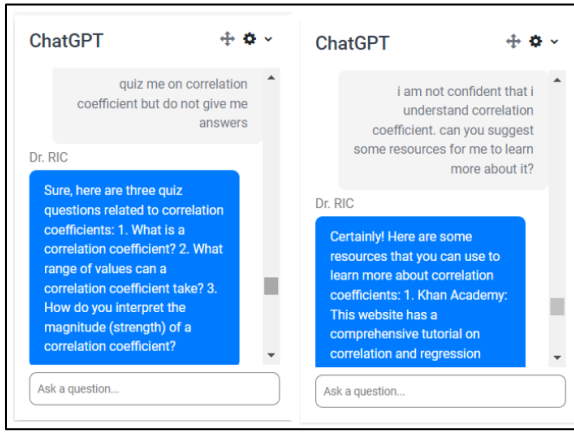


Fig. 10. User case 9: support extended learning.

## V. CHALLENGES IN SIGHT

Overall, ChatGPT offers many exciting possibilities for enhancing teaching and learning activities in Moodle. By understanding its capabilities and use cases, educators and administrators can better integrate this tool into their LMS and provide a more effective and personalized learning experience for students. Meanwhile, students can utilize it as a study companion to enhance their understanding of the material covered in class, provide additional practices, help them prepare for exams, create shared notes and insights, and support extended learning outside of the course curriculum. However, we cannot overlook some important challenges, which will be discussed as follows.

### A. Copyright Issues

One of the challenges of its implementation in LMS is the issue of copyright [34]. The use of ChatGPT may raise questions about intellectual property rights and ownership of the content produced by the chatbot. For example, if it is used to generate content for a course, who owns the copyright for that content? Additionally, there may be concerns about the use of copyrighted materials within the chatbot's responses.

### B. Over Dependency

Students may rely too heavily on ChatGPT for help, which could ultimately hinder their learning process such as having negative impact on the development of their critical thinking and problem-solving skills [34]. Therefore, it is important to provide guidance to students on how to use it effectively and in conjunction with other learning resources. Teachers can also encourage students to seek help from their peers and instructors, in addition to using ChatGPT. By promoting a balanced approach to learning, students can benefit from the advantages of this AI tool without becoming overly reliant on it.

### C. Feedback Accuracy and Response Time

ChatGPT, while a powerful tool, is not immune to inaccuracies, and there may be instances where the feedback provided is not entirely correct. For instance, the pre-print by Baidoo-Anu and Owusu Ansah [6] is a co-authored synthesis, between the two authors and ChatGPT. Since its publication online on 27 January 2023 on SSRN.com, the pre-print has been cited for 14 times by other scholars despite its obvious deficits. The article summarized its five benefits in promoting teaching and learning, which include personalized tutoring, automated essay grading, language translation, interactive learning, and adaptive learning. For each benefit, the authors

quoted a research to support their argument; however, out of five quoted studies, four are non-existing and for the only one that exists, the authorship is wrongly placed. It is a good example of using ChatGPT without a proper human supervision and revision can spread unreal or inaccurate information to the public.

Response time is an important factor that can influence the user experience. If the chatbot takes too long to respond to user queries, it can lead to frustration and a negative overall experience. Users may also lose interest and motivation to continue engaging with the chatbot if they have to wait too long for a response. Therefore, it is important to ensure that ChatGPT is able to respond to user queries in a timely and helpful manner.

### D. Demand of New E-Assessment

As ChatGPT becomes more integrated into educational practices, it is possible that traditional assessment methods such as multiple choice tests may become less effective. This is because it has the potential to provide students with personalized feedback and support that goes beyond simple question and answer formats. Therefore, educators may need to develop new e-assessment methods that are better suited to the capabilities of AI technologies. These could include more complex problem-solving tasks, essay-based assessments, or interactive simulations that allow students to apply their knowledge in a more realistic context. By embracing new e-assessment methods, educators can help to ensure that students are able to fully benefit from the capabilities of AI technologies in their learning journey.

### E. Need of Training for Teachers and Students

Many educators and educational institutions may not have the knowledge or expertise to effectively integrate new technologies into their teaching [35]. It is important to provide training for faculty and students to ensure that they can effectively use the chatbot. This can include providing resources such as user manuals and training sessions, as well as having dedicated support staff available to assist with any issues or questions.

### F. User Privacy and Data Security

ChatGPT relies on machine learning algorithms that require access to large amounts of data in order to improve their performance. When a vast amount of user data is involved, discussions of user privacy and data security become paramount [15], [36], [37]. As a result, there is a risk that the data collected, stored, and analyzed may be misused or stolen. Additionally, there may be concerns about the user privacy and data security of students regarding their personal data of grades, performance, and bibliographic information.

## VI. CONCLUSION

The integration and usage of ChatGPT in Moodle offers a range of exciting possibilities for enhancing teaching and learning activities. It can provide personalized and adaptive feedback to students, act as a virtual tutor, and support extended learning beyond the classroom. Despite several challenges associated with implementation, its potential benefits are significant. As AI technologies continue to develop and evolve, it is likely that they will play an increasingly important role in education, and ChatGPT represents an important step forward in this direction.

Looking to the future, the OpenAI team emphasized in their technical report on GPT-4 the importance of building evaluations, mitigations, and approaches with real-world usage in mind [18]. It is crucial to consider various factors such as the user, the specific use case, and the deployment location to mitigate potential harms associated with the model's deployment. Therefore, more research and detailed use cases in the Moodle environment and LMS in general should be conducted soon.

Overall, the future looks bright for ChatGPT in LMS, with a wide range of possibilities for innovation and improvement. As natural language processing technology continues to advance, we can expect to see even more exciting developments in the years to come.

#### ACKNOWLEDGMENT

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#### REFERENCES

- [1] D. J. Nicol and D. Macfarlane-Dick, "Formative assessment and self-regulated learning: A model and seven principles of good feedback practice," *Stud. High. Educ.*, vol. 31, no. 2, pp. 199–218, 2006.
- [2] S. B. Eom, H. J. Wen, and N. Ashill, "The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation," *Decis. Sci. J. Innov. Educ.*, vol. 4, no. 2, pp. 215–235, 2006.
- [3] H. T. Hien, P.-N. Cuong, L. N. H. Nam, H. L. T. K. Nhung, and L. D. Thang, "Intelligent Assistants in Higher-Education Environments: The FIT-EBot, a Chatbot for Administrative and Learning Support," *Proc. Ninth Int. Symp. Inf. Commun. Technol. - SoICT 2018*, pp. 69–76, 2018, doi: 10.1145/3287921.3287937.
- [4] J. Q. Pérez, T. Daradoumis, and J. M. M. Puig, "Rediscovering the use of chatbots in education: A systematic literature review," *Comput. Appl. Eng. Educ.*, vol. 28, no. 6, pp. 1549–1565, 2020, doi: 10.1002/cae.22326.
- [5] S. Wollny, J. Schneider, D. Di Mitri, J. Weidlich, M. Rittberger, and H. Drachsler, "Are We There Yet? - A Systematic Literature Review on Chatbots in Education," *Front. Artif. Intell.*, vol. 4, 2021, Accessed: Mar. 19, 2023. [Online]. Available: <https://www.frontiersin.org/articles/10.3389/frai.2021.654924>
- [6] 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," Rochester, NY, Jan. 25, 2023. doi: 10.2139/ssrn.4337484.
- [7] A. Garfinkle, "ChatGPT's on track to surpass 100 million monthly users faster than TikTok or Instagram: UBS," *Yahoo Finance*, Feb. 02, 2023. <https://finance.yahoo.com/news/chatgpt-on-track-to-surpass-100-million-users-faster-than-tiktok-or-instagram-ubs-214423357.html> (accessed Mar. 18, 2023).
- [8] X. Zhai, "ChatGPT user experience: Implications for education," *Available SSRN 4312418*, 2022.
- [9] C. Macdonald, D. Adeloye, A. Sheikh, and I. Rudan, "Can ChatGPT draft a research article? An example of population-level vaccine effectiveness analysis," *J. Glob. Health*, vol. 13, p. 01003, 2023, doi: 10.7189/jogh.13.01003.
- [10] M. Hutson, "Could AI help you to write your next paper?," *Nature*, vol. 611, no. 7934, pp. 192–193, Oct. 2022, doi: 10.1038/d41586-022-03479-w.
- [11] A. Haleem, M. Javaid, and R. P. Singh, "An era of ChatGPT as a significant futuristic support tool: A study on features, abilities, and challenges," *BenchCouncil Trans. Benchmarks Stand. Eval.*, vol. 2, no. 4, p. 100089, Oct. 2022, doi: 10.1016/j.tbench.2023.100089.
- [12] M. Salvagno, ChatGPT, F. S. Taccone, and A. G. Gerli, "Can artificial intelligence help for scientific writing?," *Crit. Care*, vol. 27, p. 75, Feb. 2023, doi: 10.1186/s13054-023-04380-2.
- [13] C. Terwiesch, "Would Chat GPT3 Get a Wharton MBA? A Prediction Based on Its Performance in the Operations Management Course," *Mack Inst. Innov. Manag. Whart. Sch. Univ. Pa.* Retrieved <https://mackinstitute.whart.upenn.eduwpccontentuploads202301/Christian-Terwiesch-Chat-GTP-124-Pdf-Date-Accessed-Feb-6th-2023-2023.pdf>
- [14] A. Herft, "A Teacher's Prompt Guide to ChatGPT aligned with 'What Works Best' Guide," *Retrieved January*, vol. 23, p. 2023, 2023.
- [15] H. Khosravi *et al.*, "Explainable Artificial Intelligence in education," *Comput. Educ. Artif. Intell.*, vol. 3, p. 100074, 2022, doi: 10.1016/j.caeai.2022.100074.
- [16] A. Thurzo, M. Strunga, R. Urban, J. Surovková, and K. I. Afrashtehfar, "Impact of Artificial Intelligence on Dental Education: A Review and Guide for Curriculum Update," *Educ. Sci.*, vol. 13, no. 2, Art. no. 2, Feb. 2023, doi: 10.3390/educsci13020150.
- [17] C. A. Gao *et al.*, "Comparing scientific abstracts generated by ChatGPT to original abstracts using an artificial intelligence output detector, plagiarism detector, and blinded human reviewers," *bioRxiv*, pp. 2022–12, 2022.
- [18] OpenAI, "GPT-4 Technical Report." arXiv, Mar. 16, 2023. doi: 10.48550/arXiv.2303.08774.
- [19] D. Skidmore and K. Murakami, *Dialogic pedagogy: The importance of dialogue in teaching and learning*, vol. 51. Multilingual matters, 2016.
- [20] I. Shor and P. Freire, *A pedagogy for liberation: Dialogues on transforming education*. Greenwood Publishing Group, 1987.
- [21] S. A. Schartel, "Giving feedback – An integral part of education," *Best Pract. Res. Clin. Anaesthesiol.*, vol. 26, no. 1, pp. 77–87, Mar. 2012, doi: 10.1016/j.bpa.2012.02.003.
- [22] V. J. Shute, "Focus on formative feedback," *Rev. Educ. Res.*, vol. 78, no. 1, pp. 153–189, 2008.
- [23] M. Van der Schaaf, L. Baartman, F. Prins, A. Oosterbaan, and H. Schaap, "Feedback Dialogues That Stimulate Students' Reflective Thinking," *Scand. J. Educ. Res.*, vol. 57, no. 3, pp. 227–245, Jun. 2013, doi: 10.1080/00313831.2011.628693.
- [24] T. H. Davenport, "From analytics to artificial intelligence," *J. Bus. Anal.*, Nov. 2018, doi: <https://doi.org/10.1080/2573234X.2018.1543535>.
- [25] S. Frieder *et al.*, "Mathematical Capabilities of ChatGPT." arXiv, Jan. 31, 2023. doi: 10.48550/arXiv.2301.13867.
- [26] J. Zhou, P. Ke, X. Qiu, M. Huang, and J. Zhang, "ChatGPT: potential, prospects, and limitations," *Front. Inf. Technol. Electron. Eng.*, pp. 1–6, 2023.
- [27] I. Arroyo, B. P. Woolf, W. Burelson, K. Muldner, D. Rai, and M. Tai, "A Multimedia Adaptive Tutoring System for Mathematics that Addresses Cognition, Metacognition and Affect," *Int. J. Artif. Intell. Educ.*, vol. 24, no. 4, pp. 387–426, Dec. 2014, doi: 10.1007/s40593-014-0023-y.
- [28] V. Aleven, B. McLaren, I. Roll, and K. Koedinger, "Toward meta-cognitive tutoring: A model of help seeking with a Cognitive Tutor," *Int. J. Artif. Intell. Educ.*, vol. 16, no. 2, pp. 101–128, 2006.
- [29] J. Wang, Y. Liang, F. Meng, Z. Li, J. Qu, and J. Zhou, "Cross-Lingual Summarization via ChatGPT," *ArXiv Prepr. ArXiv230214229*, 2023.
- [30] A. Sangrà, D. Vlachopoulos, and N. Cabrera, "Building an inclusive definition of e-learning: An approach to the conceptual framework," *Int. Rev. Res. Open Distrib. Learn.*, vol. 13, no. 2, pp. 145–159, 2012.
- [31] J. Biemann and L. Pfahl, "A Global Monitoring Practice in the Making: Disability Measurement for UN Sustainable Development Goal 4 on Inclusive Education," *Österr. Z. Für Geschichtswissenschaften*, vol. 31, no. 3, pp. 192–213, 2020.
- [32] G. Hughes, "Diversity, identity and belonging in e-learning communities: Some theories and paradoxes," *Teach. High. Educ.*, vol. 12, no. 5–6, pp. 709–720, 2007.
- [33] M. Fermín-González, "Research on virtual education, inclusion, and diversity: A systematic review of scientific publications (2007–2017)," *Int. Rev. Res. Open Distrib. Learn.*, vol. 20, no. 5, pp. 146–167, 2019.
- [34] E. Kasneci *et al.*, "ChatGPT for good? On opportunities and challenges of large language models for education," *Learn. Individ. Differ.*, vol. 103, p. 102274, 2023.
- [35] C. Redecker, "European Framework for the Digital Competence of Educators: DigCompEdu," Joint Research Centre (Seville site), JRC Research Reports JRC107466, Nov. 2017. [Online]. Available: <https://ideas.repec.org/p/ipt/iptwpa/jrc107466.html>
- [36] D. Long and B. Magerko, "What is AI Literacy? Competencies and Design Considerations," in *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, in CHI '20. New York, NY, USA: Association for Computing Machinery, Apr. 2020, pp. 1–16. doi: 10.1145/3313831.3376727.

- [37] A. Tlili *et al.*, “What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education,” *Smart Learn. Environ.*, vol. 10, no. 1, 2023, doi: 10.1186/s40561-023-00237-x.