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THE INFLUENCE OF CHATBOT AI ON COLLABORATIVE LEARNING AND PEER INTERACTIONS AMONG ENGINEERING STUDENTS

*** AR. MARLON S. MANABAT, ENGR. JASON F. RUFON, ENGR. BENITO F. SANTOS, ENGR. LADY P. SMITH, DR. JOVERTLEE C. PUDAN**

Philippine Christian University, Philippines.

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ABSTRACT

Aims: This study aims to investigate the influence of Chatbot AI on collaborative learning and peer interactions among engineering students. It focuses on understanding how Chatbot AI can enhance student engagement, communication, and collaborative problem-solving in engineering education. **Study design:** A quantitative, descriptive-correlational research design was employed. The study utilized a stratified random sampling technique to select 172 engineering students, gathering data through a self-administered questionnaire. The study assessed the frequency, functionality, and personalization of Chatbot AI and examined its impact on collaborative learning and peer interactions. **Methodology:** Data were analyzed using descriptive statistics and correlation analysis. Ethical considerations, including informed consent, anonymity, and confidentiality, were strictly adhered to. The study investigated three key areas: Chatbot AI integration, collaborative learning, and peer interactions. **Results:** Findings revealed that most students frequently used Chatbot AI for academic purposes, with a high level of agreement regarding its functionality and personalization. The study showed moderate levels of peer collaboration and student satisfaction with collaborative learning. Regression analysis indicated that while frequency and functionality of Chatbot AI positively influenced collaboration, its personalization feature was the most significant factor, accounting for 63% of the variance in collaborative learning and peer interactions. **Conclusion:** The study concludes that Chatbot AI significantly enhances collaborative learning and peer interactions, particularly through its personalized features. The integration of Chatbot AI is effective in supporting academic needs and promoting peer collaboration. However, there is still room for improvement in the frequency of collaboration and the quality of peer interactions. Future research should focus on further enhancing AI personalization and exploring its broader applications in collaborative learning across disciplines.

Keywords: AI, Chatbot, Collaborative, Engineering, Interactions.

INTRODUCTION

In the digital age, technological advancements have revolutionized education, with Artificial Intelligence (AI) emerging as a significant tool in enhancing learning experiences. Among the various AI applications, chatbots have gained prominence as educational tools, offering personalized learning experiences, immediate assistance, and fostering interaction between students and academic resources. Chatbot AI, specifically designed to simulate human-like interactions, provides an interactive interface that can support students' academic needs, answer queries, and offer tailored guidance (Alshammari & Alabdulrahman, 2021). Recent studies indicate that chatbots in education have significantly enhanced student engagement and satisfaction, with AI acting as a tool for improving both individual and collaborative learning experiences (Deng & Zhang, 2020).

Engineering education, characterized by its complexity and rigor, demands both independent and collaborative learning. The need for effective collaborative learning environments is becoming increasingly important as educational institutions strive to improve student engagement and academic performance. Peer interactions, particularly in group projects and discussions, are crucial for fostering critical thinking, teamwork, and problem-solving skills essential for success in the engineering field (Feng & Zhang, 2021). However, despite the significant role of collaboration in learning, many engineering students struggle to effectively collaborate due to large class sizes, diverse backgrounds, and limited time for direct peer interaction (Jain & Vohra, 2023). The challenge of overcoming these barriers has been highlighted in research that examines the role of AI technologies in fostering peer-to-peer engagement (García & López, 2022). While previous studies have explored the potential benefits of AI in education, the specific influence of Chatbot AI on collaborative learning and peer interactions within the context of engineering students has not been extensively researched. Existing literature tends to focus on isolated aspects such as individual learning support or the use of AI in administrative functions (Reed & Fischer, 2020). However, limited attention has been given to how Chatbot AI can enhance collaborative learning dynamics, promote peer interactions, and bridge gaps in communication among students in engineering courses (Li & Xie, 2021). Studies have suggested that the integration of chatbots in learning environments helps students solve academic problems collectively and improves the frequency and quality of peer collaboration (Zhang & Wang, 2021).

Moreover, the gap in the literature lies in understanding how Chatbot AI can be utilized to foster collaborative learning and improve peer interactions specifically in the context of engineering education. While research on AI-driven learning tools is abundant, there is insufficient exploration into the direct relationship between Chatbot AI and its influence on the quality and frequency of peer collaboration in technical fields like engineering (Hassan & Shah, 2020). Furthermore, existing studies do not comprehensively examine how such AI tools can tailor interactions based on individual student needs and group dynamics, which is critical for enhancing teamwork and knowledge sharing in an engineering setting (Sahin & Yildirim, 2022).

Also, this research aims to bridge this gap by investigating the influence of Chatbot AI on collaborative learning and peer interactions among engineering students in a university setting. By focusing on

***Corresponding Author: AR. MARLON S. MANABAT,**
Philippine Christian University, Philippines.

how these technologies can improve student engagement, communication, and collaborative problem-solving, the study will contribute to the understanding of AI's role in shaping the future of engineering education.

THEORETICAL FRAMEWORK

This study was anchored in Bandura's Social Learning Theory and Vygotsky's Sociocultural Theory of learning, both of which emphasized the social aspects of learning and collaboration in educational settings. These theories provided a strong foundation for understanding the relationship between Chatbot AI Integration (independent variable) and Collaborative Learning and Peer Interactions (dependent variable).

Bandura's Social Learning Theory (1977) suggested that learning occurred within a social context and was facilitated through observation, imitation, and modeling. This theory emphasized the importance of peer interactions in the learning process. In the context of Chatbot AI, the AI functioned as a tool that could stimulate peer interaction by providing real-time answers to questions and encouraging discussion among students. By assisting students in academic tasks, Chatbot AI enhanced peer-to-peer learning and collaborative problem-solving, leading to more meaningful group interactions.

Vygotsky's Sociocultural Theory (1978), which focused on the role of social interactions and cultural context in learning, posited that cognitive development occurred through interactions within a social environment. Vygotsky's concept of the Zone of Proximal Development (ZPD) suggested that learning was most effective when students engaged in tasks just beyond their current capabilities, but with the help of more knowledgeable peers or tools. Chatbot AI, as an adaptive learning tool, provided support within this ZPD, helping students solve problems, share knowledge, and collaborate more effectively. The AI tool bridged gaps in knowledge, fostering collaborative interactions that improved both individual and group learning outcomes.

The conceptual framework of this study explored how Chatbot AI Integration influenced Collaborative Learning and Peer Interactions among engineering students. The independent variable, Chatbot AI Integration, was characterized by three sub-dimensions: Frequency of Chatbot AI usage, Functionality of Chatbot AI, and Personalization of Chatbot AI. These aspects of AI integration were expected to influence various dimensions of collaborative learning and peer interactions, which were broken down into Peer Collaboration Frequency, Quality of Peer Interactions, and Student Satisfaction with Collaborative Learning. The frequency of Chatbot AI usage was anticipated to increase the likelihood of students engaging in collaborative learning activities. As students used the chatbot more frequently, they had consistent access to academic support, fostering more frequent group discussions, study sessions, and collaborative projects. The functionality of Chatbot AI played a critical role by providing essential support such as answering questions, assisting with assignments, and offering academic resources, thereby facilitating deeper and more productive peer interactions. When the AI tool was highly functional, students could resolve doubts quickly, access relevant resources, and contribute effectively to group discussions, ultimately enhancing the quality of their peer interactions. Additionally, personalization of Chatbot AI ensured that students received tailored responses based on their individual needs and learning progress. This personalized assistance promoted better collaboration as students felt more confident and supported, which led to more meaningful contributions in group work. Consequently, these factors contributed to higher peer collaboration frequency, better quality of peer interactions, and greater student satisfaction with collaborative learning, as students experienced more engaging, efficient, and rewarding collaborative efforts with their peers.

The objectives of this study were to determine the profile of the respondents, including their age distribution, gender, year level, and usage of Chatbot AI for academic purposes, as well as the frequency of Chatbot AI usage. Additionally, the study aimed to assess the level of Chatbot AI integration among the respondents by examining the frequency of usage, the effectiveness of its functionality in assisting with academic needs, and the extent to which Chatbot AI was personalized to meet individual student needs. Finally, the study sought to evaluate the level of collaborative learning and peer interactions, focusing on the frequency of peer collaboration activities, the quality of peer interactions during group work, and the students' satisfaction with their collaborative learning experiences.

METHODOLOGY

This study was conducted at a university in Odiongan, Romblon, focusing on engineering students to explore the influence of Chatbot AI on collaborative learning and peer interactions. A quantitative research design using a descriptive-correlational approach was employed to assess the frequency, functionality, and personalization of Chatbot AI, and how these factors influence peer collaboration, interaction quality, and student satisfaction. A stratified random sampling technique was used to select 172 engineering students from various year levels. Data were collected through a self-administered questionnaire with sections on demographic profile, Chatbot AI integration, and collaborative learning experiences. Descriptive statistics and correlation analysis were applied to analyze the data. Ethical considerations, including informed consent, anonymity, and confidentiality, were strictly followed throughout the study. The research aimed to provide insights into how Chatbot AI enhances collaborative learning among engineering students in a university setting.

RESULTS AND DISCUSSIONS

1. What is the profile of the respondents?

The survey results provided valuable insights into the demographic profile and usage patterns of Chatbot AI among engineering students. The majority of respondents were aged 21-23 years (75.6%), with a near-equal gender distribution of 48.8% male and 51.2% female students. A significant portion of participants were in their 4th year (53.5%), followed by 3rd-year students (26.7%), while freshmen were notably underrepresented. These results align with studies indicating that students in higher years tend to engage more with educational tools as they progress through their academic journey (Jain & Vohra, 2023). Furthermore, nearly all respondents (97.1%) reported using Chatbot AI for academic purposes, demonstrating a high level of familiarity with the technology. This usage rate mirrors findings from recent literature, which emphasizes that AI-powered tools, including chatbots, have become widely adopted by students in various fields due to their ability to provide personalized learning experiences (Feng & Zhang, 2021).

Regarding the frequency of use, more than half of the students (55.8%) indicated they used Chatbot AI occasionally, while smaller portions used it weekly (22.7%) or rarely (13.4%). A small group (8.1%) used the technology on a daily basis, highlighting that while Chatbot AI is frequently used, it is not always a daily tool for students. This finding is consistent with recent studies that suggest while AI

tools like chatbots are effective in providing on-demand support, students may not always use them daily, especially when they do not require immediate academic assistance (Li & Xie, 2021). Research by García and López (2022) further supports this by showing that while AI integration in educational settings is beneficial, students often engage with these tools in a more sporadic manner depending on their academic needs.

Additionally, the data reflect the varying reliance on Chatbot AI for academic purposes, with students using it more frequently for assistance in tasks like answering queries and accessing resources, as noted in studies on AI in collaborative learning environments (Zhang & Wang, 2021). The sporadic yet consistent use of AI tools like Chatbot AI can be seen as a reflection of their support role rather than a central part of students' daily academic routines. This usage pattern could be further explored in future studies to determine how frequent engagement with AI chatbots could influence learning outcomes and collaborative interactions over time.

In conclusion, while Chatbot AI is a commonly utilized tool among engineering students, its use remains occasional rather than constant. The results align with current literature, which suggests that while AI tools are highly valued in educational contexts, students may engage with them primarily when needed, such as during collaborative learning or when immediate academic support is required (Hassan & Shah, 2020). Future studies should examine how increasing the frequency of AI usage might improve collaborative learning outcomes, particularly in peer interactions and academic engagement.

2. What is the level of Chatbot AI Integration among the respondents?

The level of Chatbot AI integration among the respondents was assessed with strong overall agreement. The mean scores for all three items—Frequency of Chatbot AI Usage (3.30), Functionality of Chatbot AI (3.28), and Personalization of Chatbot AI (3.31)—fell within the "Strongly Agree" range (3.26–4.00). This indicates that respondents strongly agreed that Chatbot AI was frequently used, highly functional, and offered personalized features that catered to their academic needs. The overall mean of 3.29, with a standard deviation of 0.52, further reinforced that students perceived Chatbot AI to be well-integrated into their academic routines, providing a high level of support. These results suggest that the integration of Chatbot AI is robust and highly effective in addressing students' learning needs.

The findings reflect recent studies that highlight the importance of well-integrated AI tools in educational settings, demonstrating their positive impact on student engagement and learning outcomes (Feng & Zhang, 2021; Zhang & Wang, 2021). Moreover, the results align with findings from previous research, which showed that personalized AI systems are highly valued by students for offering tailored support and enhancing their overall learning experience (García & López, 2022).

Table 1. The summary on the level of Chatbot AI Integration among the respondents

Items	Mean	SD	Description
Frequency of Chatbot AI Usage	3.30	0.52	*Strongly Agree*
Functionality of Chatbot AI	3.28	0.54	*Strongly Agree*
Personalization of Chatbot AI	3.31	0.51	*Strongly Agree*
Overall Mean	**3.29**	**0.52**	***Strongly Agree***

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

These results suggest that students perceive Chatbot AI as an essential tool that plays a significant role in enhancing their academic experience through frequent use, functionality, and personalized support, which corresponds with findings in recent literature emphasizing the effectiveness of AI tools in education (Deng & Zhang, 2020; Li & Xie, 2021).

3. What is the level of Collaborative Learning and Peer Interactions among the respondents?

The level of collaborative learning and peer interactions among the respondents was evaluated positively, though with moderate agreement. The mean score for Peer Collaboration Frequency was 3.00 (Agree), suggesting that students engaged in collaboration with their peers on a regular basis, though the frequency and depth of collaboration varied. This aligns with recent studies that found collaborative learning environments are frequently utilized in higher education, but the extent of peer interaction can differ based on course structure and class dynamics (Sahin & Yildirim, 2022).

The Quality of Peer Interactions had a mean of 2.55 (Agree), indicating that while students perceived their peer interactions as effective, there was still room for improvement in terms of depth and quality. This result echoes findings from García and López (2022), which highlight that while AI tools like Chatbot AI facilitate collaboration, the richness of the interactions still depends on various factors such as task design and the active participation of all group members.

Student Satisfaction with Collaborative Learning also had a mean score of 3.00 (Agree), showing that students were generally satisfied with their collaborative experiences. However, there remains potential for further enhancement. Research by Feng and Zhang (2021) suggests that AI tools can improve both the quality and frequency of peer interactions, but the overall student satisfaction with collaboration often requires a holistic approach that includes not just AI tools, but also effective group management and instructor support.

The overall mean of 2.85 (Agree) indicated that, on the whole, students agreed that collaborative learning and peer interactions were occurring at a satisfactory level. However, the data also revealed areas for potential improvement, particularly in the quality of interactions and the frequency of collaboration. As highlighted in the literature, the use of AI in collaborative settings often leads to positive outcomes, but for these benefits to be maximized, additional strategies may be necessary, such as encouraging consistent use of AI tools and fostering deeper engagement in collaborative tasks (Jain & Vohra, 2023).

Table 2. The summary on the level of Collaborative Learning and Peer Interactions among the respondents

Items	Mean	SD	Description
Peer collaboration frequency	3.00	0.56	*Agree*
Quality of peer interactions	2.55	0.45	*Agree*
Student satisfaction with collaborative learning	3.00	0.87	*Agree*
Overall Mean	**2.85**	**0.62**	***Agree***

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

These results suggest that while collaborative learning and peer interactions were generally satisfactory, opportunities exist for further enhancement, particularly in terms of increasing the quality of peer

interactions and encouraging more frequent collaboration. Studies have shown that the integration of AI in collaborative learning can improve these areas by facilitating real-time communication and personalized support (Zhang & Wang, 2021).

4. How does Chatbot AI Integration influence Collaborative Learning and Peer Interactions among the respondents?

The regression analysis in Table 3 indicates that the integration of Chatbot AI significantly influences collaborative learning and peer interactions. Although the frequency of Chatbot AI usage showed a positive impact on collaboration, it was not statistically significant (t = 1.30, p = 0.196). This suggests that while students may use Chatbot AI frequently, the mere frequency of its use does not directly translate into increased collaboration. This finding aligns with studies that suggest that while AI tools are valuable, their frequent use alone does not always result in enhanced learning outcomes unless they are utilized effectively (Feng & Zhang, 2021; Li & Xie, 2021).

On the other hand, the functionality of Chatbot AI had a statistically significant effect on collaborative learning (t = 2.30, p = 0.023), indicating that its ability to provide academic support plays an important role in enhancing collaboration among students. This supports research by García and López (2022), who found that the functionality of AI tools, such as providing real-time academic assistance, significantly contributes to students' academic success and collaboration.

However, the most significant influence came from the personalization of Chatbot AI (t = 6.14, p < 0.001), indicating that tailored responses to individual student needs greatly improve peer interactions and collaborative learning. This result aligns with the findings of Zhang and Wang (2021), who emphasized the importance of personalized AI interactions in fostering deeper engagement and more effective collaboration. Personalization allows students to receive targeted support that enhances their confidence and promotes meaningful contributions during collaborative activities.

The overall model, with an adjusted R2 of 0.63, shows that Chatbot AI, particularly its personalized features, accounts for 63% of the variance in collaborative learning and peer interactions. This highlights the significant role of personalized AI tools in fostering effective academic collaboration, a conclusion that is consistent with the conclusions of recent studies on AI-driven learning systems (Sahin & Yildirim, 2022).

Table 3 Regression Analysis of AI Integration Influences Collaborative Learning and Peer Interactions among the Respondents

Predictor	Estimate	SE	t	p
Intercept	-0.693	0.225	-3.08	0.002
X_1:Frequency of Chatbot AI Usage	0.148	0.114	1.30	0.196
X_2: Functionality of Chatbot AI	0.247	0.108	2.30	0.023
X_3:Personalization of Chatbot AI	0.750	0.122	6.14	<.001

Note: Adjusted R^2=0.63 p=0.000

The regression analysis clearly indicates that personalized features of Chatbot AI are the most significant factor influencing collaborative learning and peer interactions, underscoring the potential of AI tools to enhance academic collaboration when they are tailored to meet individual student needs. This highlights the importance of continuing to refine and develop AI systems that can provide personalized, dynamic support for students.

CONCLUSION

The study provides valuable insights into the integration of Chatbot AI and its impact on collaborative learning and peer interactions among engineering students. The findings reveal that Chatbot AI is highly integrated into the academic routines of students, with strong agreement regarding its frequency of use, functionality, and personalization. This integration appears to be effective in assisting students with their academic needs, contributing positively to their learning experiences. However, while students engage in collaborative learning activities regularly and are generally satisfied with their peer interactions, there remains room for improvement in the quality of interactions and the frequency of collaboration. Regression analysis further indicates that Chatbot AI's personalization feature is the most significant predictor of improved collaborative learning and peer interactions, accounting for a substantial portion of the variance in these outcomes. This highlights the importance of tailored AI responses in enhancing teamwork and peer collaboration.

Recommendations

Based on the findings, the following recommendations are proposed:

1. **Enhance Chatbot AI Personalization:** Given that the personalization of Chatbot AI was found to have the most significant impact on collaborative learning and peer interactions, further development of its adaptive features should be prioritized. Tailoring responses more effectively to individual student needs could further enhance engagement and support academic success.
2. **Increase Frequency of Chatbot AI Usage**: Although Chatbot AI is frequently used by students, efforts to encourage more consistent daily usage could further strengthen its role in supporting collaborative learning. Providing incentives or integrating AI usage into daily academic routines may encourage more frequent interaction.
3. **Improve Peer Interaction Quality:** While students are generally satisfied with their collaborative learning experiences, there is room for improvement in the depth and quality of peer interactions. Educators could incorporate activities or tools that encourage deeper engagement, critical thinking, and more meaningful collaboration among students.
4. **Further Research on AI's Role in Collaboration:** Future studies should explore the broader applications of AI in education, particularly in how it can support collaborative learning in different disciplines. Examining other types of AI tools and their impact on learning outcomes could provide further insights into optimizing the use of technology in higher education.

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