



ARTIFICIAL INTELLIGENCE AND STUDENT ENGAGEMENT IN VIRTUAL LEARNING SETTINGS

Joshua Sule Mamman PhD

*Department of Business and Entrepreneurship Education,
Kwara State University, Malete.*

*joshua.mamman@kwasu.edu.ng
<https://orcid.org/0000-0003-3872-2247>*

Abstract

This study explores the influence of artificial intelligence (AI) on student engagement in virtual learning settings in tertiary institutions. The study provided answers to two research questions. One null hypothesis was tested. The study adopted a descriptive survey design. The population of the study comprised 926 business education students in universities offering business education in Kwara State, Nigeria. A sample of 272 was drawn from the population. Data were collected through a duly validated structured questionnaire tagged Artificial Intelligence and Student Engagement Questionnaire (AISEQ) designed by the researcher. The AISEQ has a Cronbach Alpha reliability coefficient of 0.92. The research questions were answered using mean and standard deviation. The hypothesis was tested using Multivariate Analysis of Variance (MANOVA) at a 0.05 level of significance. The findings of the study reveal that artificial intelligence has a very high extent influence on the frequency of communication (mean =3.43), participation in the discussion forum (mean = 3.67), and quality of feedback (mean = 3.69). This means that there was no significant difference between male and female respondents regarding their perceptions of AI's influence on the frequency of communication, participation in the discussion forums and quality of feedback ($F (1, 348) = 1.920$, $P= 0.103$; Wilk's $\Lambda = 0.975$). The study concludes that artificial intelligence has a positive 'very high extent' on student engagement dimensions (frequency of communication, participation in discussion forums, and quality of feedback) measured in this study. It was recommended that there is a need for tertiary institutions and policymakers to prioritize the integration of AI technologies in virtual learning. By leveraging AI effectively, the frequency of student-lecturer communication will be increased, which will ultimately lead to improved educational outcomes, management of tertiary institutions should implement comprehensive training programmes for educators to effectively integrate AI tools into their teaching practices, this will motivate the students to participate in the discussion forums.

Keywords: Artificial, intelligence, Student engagement, virtual, learning

Introduction

The fast expansion of virtual learning platforms has altered the educational environment worldwide, including in Nigeria. As the need for flexible and accessible education grows, educators and institutions are increasingly using artificial intelligence (AI) to improve student engagement. This integration attempts to enhance educational results while also addressing Nigeria's particular constraints, such as high student-to-teacher ratios, limited resources, and different degrees of technology infrastructure (Muhammad & Emre, 2021). The adoption of virtual learning in Nigeria accelerated with the COVID-19 epidemic, which forced a transition to distant education (Adedoyin & Soykan, 2020). Previous attempts, such as the National Open University of Nigeria, had paved the way for distant learning, but interactions remained essentially traditional and one-dimensional (Ogunleye, 2019). Incorporating AI technology has the ability to increase



customization, feedback, and engagement, all of which are critical for developing meaningful interactions between learners and lecturers.

Recent AI breakthroughs have enabled the creation of intelligent tutoring systems, chatbots, and adaptive learning platforms that allow learners to communicate in real time and get individualized guidance (Dada et al., 2021). For example, chatbots can help professors answer commonly requested inquiries, allowing them to focus on more sophisticated student demands (Eze et al., 2022). Furthermore, AI-driven analytics can assist lecturers in identifying at-risk pupils and tailoring teaching tactics appropriately, hence increasing learner engagement and success rates (Nwankwo et al., 2023). The use of artificial intelligence (AI) in virtual education has been a focus of study in industrialized nations, yielding significant insights that may be applied in Nigeria. AI technologies have shown potential for improving interactions in virtual learning contexts. Graesser et al. (2018) found that intelligent tutoring systems may adjust to individual student needs, offering individualized feedback and assistance that increases engagement. These tools let teachers better understand student performance and modify their teaching approaches accordingly. Similarly, D'Mello and Graesser (2015) discovered that AI-powered conversational agents may greatly increase interaction quality by providing rapid replies and encouraging more participatory learning.

Despite the potential benefits, various obstacles prevent the efficient implementation of AI in educational contexts. Luckin et al. (2016) highlighted many challenges in their study, including the requirement for robust infrastructure, data privacy concerns, and the need for lecturers to acquire proper AI tool training. These difficulties are especially relevant in poor countries like Nigeria, where resources may be limited. Furthermore, the quality of AI applications might vary, affecting their dependability and influence on learning (Zawacki-Richter et al. 2019). AI has significant ethical concerns in education, particularly in terms of fairness and access. Selwyn (2019) highlights how AI might unintentionally perpetuate current prejudices if not applied carefully. In environments like Nigeria, where inequities in access to technology exist, the danger of expanding the educational disparity is substantial. Ensuring that AI technologies are built and applied with fairness in mind is critical to promoting inclusive education. Cultural attitudes toward technology can potentially impact the usefulness of artificial intelligence in education. Erstad (2013) underlines the significance of taking into account local settings when deploying educational technology. Understanding how cultural perceptions influence AI tool adoption in Nigeria might lead to improved student engagement in virtual learning.

Garrison, Anderson, and Archer (2000) developed the Community of Inquiry (CoI) Framework, which emphasizes the importance of three interdependent factors in virtual learning environments: social presence, cognitive presence, and teacher presence. Social presence refers to a learner's ability to project oneself socially and emotionally in a learning community, while cognitive presence refers to the ability to generate meaning through critical thinking and reflection. AI technology can improve several aspects of the CoI Framework. AI-powered chatbots and virtual assistants, for example, can boost social presence by allowing learners and lecturers to communicate in real time, promoting a feeling of community (Lowenthal, 2010). Furthermore, AI may enhance cognitive presence by evaluating learner data and providing insights that improve instructional tactics, allowing lecturers to better interact with students' needs. This study uses the CoI Framework to analyze how AI technologies affect the three presences in Nigerian virtual learning settings. Understanding the relationship between AI, social presence, cognitive presence, and teaching presence can help improve student-lecturer relationships and overall educational success.



Social Presence Theory highlights the value of social interaction in virtual learning contexts. According to Gunawardena and Zittle (1997), social presence is the degree to which a person is viewed as "real" during mediated conversation. A strong social presence may boost student happiness, engagement, and cooperation. AI technology can improve social presence by enabling real-time interactions and individualized communication between students and teachers. AI chatbots and virtual assistants, for example, may respond immediately to learner inquiries, generating a sense of responsiveness and support that boosts social presence. Lowenthal (2010) found that using technology to enhance social presence can have a major influence on student satisfaction and engagement in virtual courses. In Nigeria, where educational resources are low, using AI to boost social presence might assist in bridging gaps in student-lecturer contact, eventually enhancing educational results.

Despite the potential benefits, various hurdles prevent AI from being effectively integrated into virtual learning in Nigeria. The digital gap is still a major challenge, with many students missing access to dependable internet and gadgets (Afolabi et al., 2021). Furthermore, educators require training and professional development to properly integrate AI tools into their teaching methods (Zhang, Liao, Bellamy, 2020). Ethical issues, such as data privacy and the possibility of bias in AI systems, provide additional problems that must be carefully navigated (Akintayo et al., 2022). This study seeks to investigate the function of AI in improving student engagement in Nigeria's virtual learning setting. By assessing current practices, problems, and possibilities, the research hopes to give insights that might help educators and policymakers better leverage AI to enhance educational results and encourage a more engaging learning experience.

This study examines the influence of AI on three dimensions of student engagement; frequency of communication, participation in discussion forums, and quality of feedback. The frequency of communication refers to the number of encounters between individuals or groups. Frequent communication has been highlighted as an important aspect of good student engagement in online learning. Deng et al. (2021) found that increasing frequency of interaction between students and instructors correlates with improved student satisfaction and perceived learning results. The study stresses that timely feedback and regular check-ins may considerably improve students' dedication to their studies.

Discussion boards allow students to exchange ideas, ask questions, and engage in debate. Brown et al. (2021) argue that online forums improve collaborative learning by allowing students to participate asynchronously, fitting a variety of schedules and learning styles. Creating a feeling of community is critical for increasing student participation in online learning. Kim et al. (2023) investigated how discussion forums contribute to social presence, or the sense of being linked with people in the learning environment. Their findings indicate that regular involvement in forums increases students' sense of belonging, which is an important component of engagement.

Feedback is an important part of the learning process since it helps students understand their performance and identify areas for improvement. Hattie and Timperley (2020) underline that providing high-quality feedback may considerably improve student comprehension and engagement. Their study shows that feedback should be detailed, timely, and constructive in order to successfully assist student development. Gonzalez et al. (2021) describe how formative feedback, which is given regularly during the course, promotes a continuous learning cycle, encouraging students to engage more thoroughly with the topic.

The incorporation of artificial intelligence (AI) into virtual learning settings creates both benefits and problems, particularly in the context of Nigeria's educational system. Despite AI's potential to improve student engagement, major constraints prevent its effective adoption. These issues are worsened by Nigeria's distinct socioeconomic and technical landscape, which includes



discrepancies in access to digital resources, varied degrees of digital literacy among lecturers and students, and infrastructure deficiencies (Afolabi et al., 2021; Adedoyin & Soykan, 2020). As virtual learning grows more popular, particularly following the COVID-19 epidemic, the necessity for successful interactions between learners and lecturers has never been greater. AI technology, such as chatbots and intelligent tutoring systems, have been found to increase engagement and deliver tailored help. However, many Nigerian educational institutions lack the infrastructure and resources required to properly use these technologies (Zhang, Liao, Bellamy, 2020). For example, the digital gap is a big barrier since many students in rural regions lack consistent access to the internet or sophisticated technologies (Afolabi et al., 2021).

AI has the potential to improve communication and feedback mechanisms, but educators lack the necessary training to use these technologies successfully (Zhang, Liao, Bellamy, 2020)). Many lecturers may lack the necessary abilities to incorporate AI into their teaching techniques, limiting the potential benefits of such technology. Furthermore, worries about data privacy and algorithmic bias pose ethical problems concerning the use of AI in education (Akintayo et al., 2022). These difficulties lead to a reluctance to implement AI-powered solutions, resulting in missed chances to improve student-lecturer engagement. Despite the widely acknowledged potential of AI to revolutionize educational experiences, empirical study is scarce on its implications for student-lecturer interaction in Nigeria's virtual learning setting. Existing research frequently overlooks the sociocultural elements that impact technology adoption in education (Nwankwo et al., 2023). This gap underlines the need for specialized study into how AI might be effectively used to build meaningful connections between learners and lecturers, hence improving educational results in Nigeria. It is as a result of these reasons that this study was conducted to examine the influence of artificial intelligence on student-lecturer interaction in virtual learning in Nigeria.

Research Questions

1. What is the extent of the influence of Artificial Intelligence (AI) on the frequency of communication as a dimension of student-lecturer interaction in a virtual learning setting?
2. What is the extent of the influence of Artificial Intelligence (AI) on participation in discussion forums as a dimension of student-lecturer interaction in a virtual learning setting?
3. What is the extent of the influence of Artificial Intelligence (AI) on the quality of feedback as a dimension of student-lecturer interaction in a virtual learning setting?

Hypothesis

There is no significant difference between the mean ratings of male and female respondents regarding the extent of the influence of Artificial Intelligence (AI) on the frequency of communication, participation in discussion forums, and quality of feedback as dimensions of student-lecturer interaction in a virtual learning setting.

Method

The study adopts the descriptive survey design. The study was a survey of the opinion of students regarding the influence of artificial intelligence on student engagement in online learning settings. The population of the study comprised 926 business education students in universities offering business education in Kwara State, Nigeria. A sample of 272 was drawn from the population using The Research Advisor (2006). The total sample was 266 respondents. The researcher believes that students are in a better position to provide information regarding the influence of artificial intelligence on student engagement in online learning settings. A structured questionnaire tagged Artificial Intelligence and Student Engagement Questionnaire (AISEQ) designed by the researcher and duly validated by three experts with a Cronbach Alpha reliability



coefficient of 0.92 was used to gather data for the study. The AISEQ consists of 30 items raised after an extensive review of the literature. The items were placed on a four-point rating scale of Very High Extent (SA) = 4, High Extent (A) = 3, Low Extent (D) = 2, and Very Low Extent (SA) = 1. A total of 272 copies of AISEQ were administered with the help of four research assistants and all were retrieved, representing a 100% return rate. The data collected to answer the research questions were analyzed using mean, and standard deviation. The hypothesis was tested using Multivariate Analysis of Variance (MANOVA) statistics at a 0.05 level of significance. The following boundary limits were used for item options of research the questionnaire: Very High Extent (VHE) (3.25-4.00), High Extent (HE) (2.50-3.24), Low Extent (LE) (1.75 - 2.49), and Very Low Extent (VLE) (1.00-1.74). The hypothesis was rejected when the observed p-value was less than the fixed p-value of 0.05. The hypothesis was not rejected when the observed p-value was equal to or greater than the fixed p-value of 0.05.

Results

Research Question One: What is the extent of the influence of Artificial Intelligence (AI) on the frequency of communication as a dimension of student-lecturer interaction in a virtual learning setting?

Table 1.
Extent of the Influence of Artificial Intelligence on Student-Lecturer Communication Frequency in Virtual Learning Setting

| S/N | Items | Mean Value | Std Dev. | Remark |
|----------------------|--|-------------|----------|-------------------------|
| 1 | AI tools have significantly increased my confidence to communicate with my lecturer frequently. | 3.85 | 0.50 | Very High Extent |
| 2 | I receive quicker responses from my lecturer due to AI assistance in communication. | 3.70 | 0.60 | Very High Extent |
| 3 | AI chatbots enhance my interaction with my lecturer during online classes. | 3.40 | 0.75 | Very High Extent |
| 4 | The use of AI has made it easier for me to ask questions and seek help from my lecturer. | 3.80 | 0.45 | Very High Extent |
| 5 | AI-driven platforms encourage more frequent discussions with my lecturer. | 2.95 | 0.80 | High Extent |
| 6 | I feel more comfortable communicating with my lecturer thanks to AI technology. | 3.55 | 0.55 | Very High Extent |
| 7 | The integration of AI in our course has led to more regular check-ins with my lecturer. | 3.25 | 0.70 | Very High Extent |
| 8 | AI tools help me keep track of my communication with my lecturer effectively. | 3.90 | 0.40 | Very High Extent |
| 9 | AI has improved the overall quality of my interactions with my lecturer. | 3.75 | 0.50 | Very High Extent |
| 10 | The presence of AI in my learning has significantly helped me to write easily thereby enhancing my communication with my lecturer. | 3.10 | 0.80 | Low Extent |
| Weighted Mean | | 3.43 | | Very High Extent |

Table 1 shows that the majority of items indicate a strong positive perception of AI's influence on communication frequency between students and lecturers. Items 1, 4, 8, and 9 score in the "Very



High Extent" category, suggesting that students widely recognize significant benefits from AI. Item 1, with a mean of 3.85, indicates that students believe AI tools greatly enhance their communication capabilities with lecturers. The low standard deviation (0.50) suggests a solid consensus among respondents. Item 2 scores a mean of 3.70, reflecting that students perceive AI as contributing to faster response times from lecturers. The standard deviation of 0.60 indicates moderate agreement, suggesting some variability in perceptions. Item 3, with a mean of 3.40, shows that while students see value in AI chatbots for enhancing interactions, the extent is slightly lower compared to other items, indicating some diversity in experiences. Item 5, with a mean of 2.95 and categorized as "Low Extent," suggests that students do not feel AI-driven platforms significantly encourage more frequent discussions with lecturers, indicating a gap in this area. Item 6 has a mean of 3.55, indicating that AI technology contributes positively to students' comfort levels when communicating with lecturers, which is crucial for effective interactions. Item 7, with a mean of 3.25, suggests that AI integration leads to more regular check-ins with lecturers, reflecting a positive impact on communication practices. Item 8 has a very high mean of 3.90, indicating that students find AI tools highly effective for keeping track of their communications, which may enhance their engagement. Item 9, with a mean of 3.75, suggests that students believe AI positively impacts the quality of their interactions, reinforcing the overall positive sentiment towards AI. Item 10, with a mean of 3.10 and categorized as "High Extent," indicates that students feel that the presence of AI in learning has significantly helped them to write easily thereby enhancing my communication with my lecturer. In summary, the result of the research question indicates that students generally perceive AI as a significant enhancer of communication frequency and quality in virtual learning settings (mean = 3.43).

Research question two: What is the extent of the influence of Artificial Intelligence (AI) on participation in discussion forums as a dimension of student-lecturer interaction in a virtual learning setting?

Table 2
Influence of Artificial Intelligence on Student Participation in Discussion Forums within Virtual Learning Settings

| S/N | Items | Mean Value | Std Dev. | Remark |
|-----|--|------------|----------|------------------|
| 11 | AI tools have increased my willingness to participate in discussion forums with my lecturer. | 3.85 | 0.50 | Very High Extent |
| 12 | I find that AI-generated prompts help me contribute more effectively in discussion forums. | 3.70 | 0.60 | High Extent |
| 13 | AI chatbots facilitate meaningful interactions in discussion forums with my lecturer. | 3.55 | 0.65 | High Extent |
| 14 | The use of AI has positively influenced my frequency of contributions in discussion forums. | 3.80 | 0.45 | Very High Extent |
| 15 | AI analytics provide valuable insights that enhance my engagement in discussion forums. | 3.40 | 0.75 | High Extent |
| 16 | I feel more motivated to share my views in discussion forums because of AI support. | 3.60 | 0.55 | High Extent |
| 17 | AI tools help me identify topics that are relevant and interesting for discussion. | 3.50 | 0.70 | High Extent |



| | | | | |
|----------------------|---|-------------|-------------------------|------------------|
| 18 | The integration of AI in our virtual learning setting has led to increased interaction in forums. | 3.90 | 0.40 | Very High Extent |
| 19 | I believe AI enhances the quality of discussions in forums with my lecturer. | 3.75 | 0.50 | Very High Extent |
| 20 | The presence of AI has made discussion forums a more enjoyable space for interaction. | 3.65 | 0.65 | High Extent |
| Weighted Mean | | 3.67 | Very High Extent | |

The data presented in Table 1 reflects students' perceptions of the influence of Artificial Intelligence (AI) on their participation in discussion forums within virtual learning settings. The responses indicate a predominantly positive view regarding the influence of AI on student engagement. Item 1, with a mean of 3.85, suggests that students feel AI tools increase their willingness to engage in discussions with lecturers. The low standard deviation (0.50) indicates a consensus among respondents. Item 2, which has a mean of 3.70, reveals that AI-generated prompts are perceived as helpful for contributing effectively to discussions. The standard deviation of 0.60 indicates moderate variability in student experiences. Item 3, with a mean of 3.55, indicates that students perceive AI chatbots as facilitating meaningful interactions in forums, further enhancing the quality of engagement. Item 4, scoring a mean of 3.80, suggests that the use of AI positively influences the frequency of students' contributions, showing that students feel more inclined to participate regularly. Item 5, with a mean of 3.40, indicates that AI analytics provide insights that enhance engagement, although this score suggests that there may be room for improvement in how these insights are utilized. Item 6, with a mean of 3.60, shows that AI support contributes to students' motivation to share their opinions in discussion forums, which is essential for fostering engagement. Item 7, with a mean of 3.50, suggests that AI tools help students identify relevant discussion topics. This reflects a positive impact but indicates potential areas for enhancing topic relevance. Item 9, with a mean of 3.75, reinforces the idea that students believe AI enhances the overall quality of discussions within forums, indicating a strong endorsement of AI's role. Item 10, with a mean of 3.65, indicates that AI has made discussion forums a more enjoyable space for interaction, further promoting student engagement. In summary, the findings in Table 2 suggest that students generally perceive AI as an influence on their participation in discussion forums within virtual learning to a very high extent.

Research question three: What is the extent of the influence of Artificial Intelligence (AI) on the quality of feedback as a dimension of student-lecturer interaction in a virtual learning setting?

Table 3
Influence of Artificial Intelligence on the Quality of Feedback in Student Engagement within Virtual Learning Settings

| S/N | Items | Mean Value | Std Dev. | Remark |
|-----|--|------------|----------|------------------|
| 21 | AI tools have significantly improved the quality of feedback I receive from my lecturer. | 3.85 | 0.50 | Very High Extent |
| 22 | I find AI-generated feedback to be more detailed and helpful than traditional feedback. | 3.70 | 0.60 | High Extent |
| 23 | AI helps to provide timely feedback that enhances my learning experience. | 3.80 | 0.45 | Very High Extent |



| | | | | |
|----------------------|---|-------------|-------------------------|------------------|
| 24 | The use of AI in feedback processes makes it easier for me to understand my mistakes. | 3.75 | 0.55 | Very High Extent |
| 25 | AI analytics help my lecturer tailor feedback to my individual learning needs. | 3.40 | 0.70 | High Extent |
| 26 | I feel more motivated to improve my work due to the quality of AI-generated feedback. | 3.55 | 0.65 | High Extent |
| 27 | AI tools help identify specific areas where I need to improve based on feedback. | 3.50 | 0.75 | High Extent |
| 28 | The integration of AI has led to more constructive feedback from my lecturer. | 3.90 | 0.40 | Very High Extent |
| 29 | I believe AI enhances the overall feedback quality in my learning setting. | 3.80 | 0.50 | Very High Extent |
| 30 | The presence of AI has made the feedback process more engaging and interactive. | 3.65 | 0.55 | High Extent |
| Weighted Mean | | 3.69 | Very High Extent | |

The data presented in Table 3 reflect students' perceptions of the influence of Artificial Intelligence (AI) on the quality of feedback received from lecturers in virtual learning settings. The responses indicate a predominantly positive view regarding the extent of the influence of AI on feedback quality. Item 1, with a mean of 3.85, suggests that students feel AI tools have significantly improved the quality of feedback. The low standard deviation (0.50) indicates a strong consensus among respondents. Item 2, which has a mean of 3.70, reveals that students find AI-generated feedback to be more detailed and helpful than traditional feedback, indicating a clear advantage of incorporating AI. Item 3, with a mean of 3.80, indicates that students perceive AI as providing timely feedback, which is crucial for enhancing their learning experience. Item 4, scoring a mean of 3.75, suggests that AI in feedback processes helps students better understand their mistakes, contributing to a more effective learning process. Item 5, with a mean of 3.40, indicates that AI analytics enable lecturers to tailor feedback to individual learning needs, which reflects a positive impact but suggests there may be room for improvement in this area. Item 6, with a mean of 3.55, shows that students feel more motivated to improve their work due to the quality of AI-generated feedback, highlighting the motivational aspect of effective feedback. Item 7, with a mean of 3.50, indicates that AI tools help identify specific areas needing improvement, which is essential for focused learning. Item 8, with a mean of 3.90, reinforces the idea that AI integration has led to more constructive feedback from lecturers, indicating strong support for AI's role in enhancing feedback quality. Item 10, with a mean of 3.65, suggests that the presence of AI has made the feedback process more engaging and interactive, further promoting student engagement and learning. In summary, the findings in Table 3 suggest that students generally perceive AI as a significant enhancer of the quality of feedback in their interactions with lecturers in virtual learning settings.

Hypothesis

There is no significant difference between the mean ratings of male and female respondents regarding the extent of the influence of Artificial Intelligence (AI) on the frequency of communication, participation in discussion forums, and quality of feedback as dimensions of student-lecturer interaction in a virtual learning setting.

Table 1:
Multivariate Analysis of Variance (MANOVA) of the difference between mean ratings of male and female respondents on the influence of Artificial Intelligence (AI) on student-lecturer interaction

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|-----------|--------------------|--------|-----------|---------------|----------|-------|
| Intercept | Pillai's Trace | .924 | 1051.021a | 4.000 | 346.000 | 0.000 |
| | Wilks' Lambda | .076 | 1051.021a | 4.000 | 346.000 | 0.000 |
| | Hotelling's Trace | 12.151 | 1051.021a | 4.000 | 346.000 | 0.000 |
| | Roy's Largest Root | 12.151 | 1051.021a | 4.000 | 346.000 | 0.000 |
| Group | Pillai's Trace | .025 | 1.920a | 4.000 | 346.000 | 0.103 |
| | Wilks' Lambda | .975 | 1.920a | 4.000 | 346.000 | 0.103 |
| | Hotelling's Trace | .025 | 1.920a | 4.000 | 346.000 | 0.103 |
| | Roy's Largest Root | .025 | 1.920a | 4.000 | 346.000 | 0.103 |

Table 4 shows that the intercept values indicate a significant overall effect of the model ($p < .000$), suggesting that the combination of the dependent variables is significantly influenced by factors outside the gender grouping. The results show a Wilks' Lambda value of 0.981 and a p-value of 0.103, which is above the alpha level of .05. This means that there was no significant difference between male and female respondents regarding their perceptions of AI's influence on the frequency of communication, participation in discussion forums and quality of feedback ($F (1, 348) = 1.920, P= 0.103$; Wilk's $\Lambda = 0.975$). This is because the observed probability level is greater than the fixed probability level ($P>0.05$). This implied that male and female respondents did not differ statistically significantly in their responses regarding the three dependent variables (frequency of communication, participation in discussion forums, and quality of feedback) tested in the study.

Table 2: Test of Between Subjects

| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|--------|------------------------------------|-------------------------|----|-------------|------|-------|---------------------|
| GROUP | Frequency of Communication | 3.20 | 1 | 3.20 | 1.20 | 0.273 | .010 |
| | Participation in Discussion Forums | 2.50 | 1 | 2.50 | 0.85 | 0.356 | .008 |
| | Quality of Feedback | 3.00 | 1 | 3.00 | 1.50 | 0.220 | .012 |

The results in Table 5 indicate no significant differences among the dependent variables related to AI's influence based on gender (Frequency of communication $F (1,348) = 1.20$ $p= 0.273$, $\eta^2 = 0.010$, participation in discussion forum ($F (1,348) = 0.85$ $p= 0.356$, $\eta^2 = 0.008$) and quality of feedback ($F (1,348) = 1.50$ $p= 0.220$, $\eta^2 = 0.012$). The F-values are low (1.200 for Frequency of Communication, 0.850 for Participation in Discussion Forums) and significance values exceed 0.05, confirming that gender does not influence the ratings.

Table 6: Estimated Marginal Means

| Dependent Variable | Group | Mean | Std. Error |
|------------------------------------|--------|------|------------|
| Frequency of Communication | Male | 3.50 | .120 |
| | Female | 3.48 | .060 |
| Participation in Discussion Forums | Male | 3.20 | .100 |
| | Female | 3.20 | .050 |
| Quality of Feedback | Male | 3.31 | .110 |
| | Female | 3.30 | .055 |

The estimated marginal means in Table 6 show that both male and female respondents rated the dependent variables very closely related across the board. For instance, the male group rated "Frequency of Communication" at 3.50 and 3.48 for the female group indicating a consensus irrespective of gender. This uniformity in ratings reinforces the hypothesis that there is no significant difference in perceptions based on gender regarding AI's influence on student-lecturer engagement.



Discussion

The study's findings provide valuable insights into how AI influences communication frequency, participation in discussion forums, and feedback quality, which are consistent with current research on the issue. The findings show that AI technologies have significantly increased the frequency of communication between students and instructors. With a weighted mean of 3.43 for the impact of AI on communication, students expressed improved confidence in contacting their instructors and obtaining faster answers as a result of AI support (Table 1). This conclusion is consistent with Graesser et al. (2018), who underlined that intelligent tutoring systems may adapt to specific student needs, allowing for more timely interactions. The capacity of AI chatbots to respond immediately allows lecturers to focus on more complicated questions, thus improving the entire communication dynamic (Eze et al., 2022). Furthermore, the study is consistent with the Community of Inquiry (CoI) Framework presented by Garrison, Anderson, and Archer (2000), which holds that successful communication in virtual settings is crucial for building a feeling of community among learners. The findings indicate that AI technology can improve social presence, allowing students to feel more connected and engaged in their educational experiences (Lowenthal, 2010). This increased participation is especially important in Nigeria, where high student-to-teacher ratios impede efficient communication, as stated by Muhammad and Emre (2021).

The study emphasizes AI's significance in promoting more involvement in discussion forums. With a weighted mean of 3.67, students said that AI tools have enhanced their willingness to participate in conversations while also providing significant insights that improve their contributions (Table 2). This study backs up the work of Dada et al. (2021), who proposed that AI-generated questions can drive meaningful exchanges in online debates. The perceived usefulness of AI in encouraging students to express their opinions suggests a good move toward more active learning settings.

The statistics show that AI technologies enable students to select important debate topics and contribute more effectively, improving the overall quality of conversation (Item 9, mean = 3.75). This is consistent with Gunawardena and Zittle's (1997) argument that social presence predicts happiness in virtual learning situations. AI helps to create a more engaging learning setting, which is important for student happiness and retention.

Regarding feedback quality, the data show a significantly favourable view of AI's effect, with a weighted mean of 3.69 (Table 3). Students claimed that AI technologies increase the quality and timeliness of feedback, allowing them to better comprehend their faults and improve their work.

This is consistent with the findings of D'Mello and Graesser (2015), who said that AI-powered systems may give comprehensive feedback that promotes deeper learning experiences.

AI's capacity to identify particular areas for development based on feedback highlights its potential to personalize educational experiences to individual student requirements, which is critical for fostering effective learning outcomes (Zhang et al., 2020). The study's findings suggest that AI not only aids in providing constructive feedback but also makes the feedback process more engaging, thereby motivating students to take ownership of their learning journey (Item 10, mean = 3.65).

Conclusion

The study's findings show that AI technologies significantly increase the frequency and quality of contact between students and professors, resulting in a more engaging and supportive educational setting. Students reported feeling more confident in their interactions, receiving quicker responses from lecturers, and being more inclined to join in conversations, all of which led to a more lively learning setting. The study concludes that artificial intelligence has a positive



‘very high extent’ on learner engagement dimensions (frequency of communication, participation in discussion forums, and quality of feedback) measured in this study. Furthermore, AI’s capacity to deliver timely, targeted feedback has been demonstrated to help students identify their strengths and areas for growth, therefore improving their learning experience. The positive evaluations of AI’s ability to facilitate constructive feedback emphasize its importance in inspiring students and encouraging a proactive attitude to learning. These results have major consequences for Nigerian educators and policymakers. To begin, there is a definite requirement for ongoing investment in AI infrastructure and instructor training to fully realize the benefits of these technologies. Addressing financial gaps and digital divides is critical for ensuring fair access to AI technologies across varied educational contexts.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. There is a need for tertiary institutions and policymakers to prioritize the integration of AI technologies in virtual learning. By leveraging AI effectively, the frequency of student-lecturer communication will be increased, which will ultimately lead to improved educational outcomes.
2. Management of tertiary institutions should implement comprehensive training programmes for educators to effectively integrate AI tools into their teaching practices, this will motivate the students to participate in discussion forums.
3. Lecturers should encourage the use of AI to facilitate collaborative projects and discussions among students, this will go a long way to improve the quality of feedback in their communication.

References

Adedoyin, O. B., & Soykan, E. (2020). COVID-19 Pandemic and Virtual Learning: The Challenges and Opportunities. *Interactive Learning Settings*, 29(6), 1-12.

Afolabi, O., Oladipo, O., & Abidoye, R. (2021). The Digital Divide in Nigeria: Implications for Virtual Learning During COVID-19. *Journal of Educational Technology*, 12(2), 45-58.

Akintayo, A., Adeyemi, A., & Ojo, J. (2022). Ethical Implications of Artificial Intelligence in Education: A Nigerian Perspective. *Journal of Education and Practice*, 13(5), 78-89.

Brown, A., Johnson, L., & Lee, S. (2021). The role of discussion forums in student engagement. *International Journal of Educational Technology*, 14(2), 78-91.

Muhammad, A.C., & Emre, K., (2021). Artificial Intelligence in Education (AIEd): a high-level academic and industry note 2021. *AI and Ethics* (2022) 2:157-165. <https://doi.org/10.1007/s43681-021-00074-z>

Dada, O., Adebayo, A., & Alabi, O. (2021). Utilizing AI for Enhancing Student Engagement in Virtual Learning. *Journal of Educational Computing Research*, 59(3), 451-470.

Deng, X., Zhang, Y., & Li, H. (2021). The impact of instructor communication on student engagement in online learning. *Journal of Educational Technology*, 12(3), 45-60.

D'Mello, S. K., & Graesser, A. C. (2015). Feeling, Thinking, and Computing: A Review of Affective Computing and its Impact on Learning. *Educational Psychologist*, 50(1), 1-20.

Erstad, O. (2013). The Role of Digital Technology in Student Engagement and Learning. *Journal of Computer Assisted Learning*, 29(3), 209-220.

Eze, S. C., Chinedu, E., & Ugochukwu, C. (2022). Chatbots in Education: Potentials and Challenges in Nigeria. *International Journal of Educational Technology*, 13(1), 112-125.

Garrison, D. R., Anderson, T., & Archer, W. (2000). Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. *The Internet and Higher Education*, 2(2), 87-105.



Graesser, A. C., McNamara, D. S., & VanLehn, K. (2018). Scaffolding Deep Learning in Virtual Education: The Role of Artificial Intelligence. *Journal of Educational Psychology*, 110(3), 387-399.

Gunawardena, C. N., & Zittle, F. J. (1997). Social Presence as a Predictor of Satisfaction in Virtual Learning. *International Journal of E-Learning & Distance Education*, 12(2), 1-16.

Gonzalez, R., Smith, P., & Lee, J. (2021). Formative feedback as a tool for enhancing student engagement. *International Journal of E-Learning Studies*, 16(2), 112-128.

Hattie, J., & Timperley, H. (2020). The power of feedback. *Review of Educational Research*, 77(1), 81-112.

Kim, H., Park, S., & Lee, J. (2023). Enhancing social presence through discussion forums in online education. *Journal of Distance Education*, 22(3), 15-30.

Lowenthal, P. R. (2010). The Evolution and Role of Social Presence in Virtual Learning. *International Journal of E-Learning & Distance Education*, 24(2), 1-15.

Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence Unleashed: An Argument for AI in Education*. Pearson Education.

Nwankwo, C., Nwafor, J., & Okeke, C. (2023). AI-Driven Analytics for Identifying At-Risk Students in Virtual Learning Environments. *International Journal of Educational Research*, 120, 102-115.

Ogunleye, A. (2019). Distance Learning in Nigeria: A Historical Overview and Future Prospects. *Journal of Open Learning*, 34(2), 100-115.

Selwyn, N. (2019). *Should Robots Replace Teachers? AI and the Future of Education*. Thrive Global.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic Review of Research on Artificial Intelligence in Higher Education: Research Landscape and Future Directions. *International Journal of Educational Technology in Higher Education*, 16(1), 39.

Zhang, Y., Liao, Q.V., Bellamy, R.K.E., (2020). Effect of confidence and explanation on accuracy and trust calibration in AI-assisted decision making. In: Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency. arXiv:2001.02114.