

Artificial Intelligence Platform Integration Into Collaborative Learning Environments: Opportunities, Challenges and Educational Implications Among Undergraduates in Nigeria.

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Abstract

The integration of artificial intelligence (AI) into collaborative learning environments presents emerging opportunities for improving teaching and learning in Nigerian universities. This study examined the extent of AI-supported learning platform integration into collaborative learning and the associated opportunities, challenges and educational implications in Nigerian higher education. An explanatory sequential mixed-methods design was adopted. The study was conducted at the Air Force Institute of Technology, Kaduna State, Nigeria. A sample of 290 undergraduate students was selected from a target population of 1,254 using a multistage sampling procedure. Quantitative data were collected using a researcher-developed 4-point Likert-scale questionnaire, while qualitative data were obtained from a focus group discussion involving 10 purposively selected students. Quantitative data were analysed using mean and standard deviation, whereas qualitative data were analysed thematically. The findings indicated a moderate level of AI integration into collaborative learning environments (grand mean = 2.96), with notable opportunities for enhancing collaborative learning (grand mean = 2.92). However, several challenges hinder effective implementation, particularly inadequate internet connectivity, limited lecturer training, power outages, insufficient technical support, and large class sizes (grand mean = 2.59). The educational implications were generally positive (grand mean = 2.67), particularly for students' understanding, critical thinking, digital skills, engagement, and academic performance. Qualitative findings corroborated the quantitative results. The study concludes that AI-supported collaborative learning has considerable potential to enhance higher education in Nigeria, although infrastructural, capacity-building, and policy challenges require strategic attention.

INTRODUCTION

With the rapid advancement and integration of Artificial Intelligence (AI) into educational systems which lead to a significant transformation in the process of teaching and learning globally. AI-driven learning platforms such as intelligent tutoring systems, adaptive learning applications, learning analytics dashboards, and generative AI tools are continuously gaining popularity and making impact on students' learning outcomes (Li, 2026). AI collaborative learning enhances personalised learning, student's engagement, immediate feedback, learning assessment and improved learning outcomes. Globally, educational institutions are moving from conventional teaching to technology-enhanced collaborative learning, where AI supports peer interaction, group formation, collaborative problem solving, critical thinking and knowledge construction (Bo et al., 2026).

Collaborative learning, emphasises active learning where students actively participate and construct ideas, shared responsibility, and interaction becomes key to knowledge development (Ngoc and Thi, 2025). AI-driven learning platforms integrated into collaborative environments support learning by providing real-time feedback, adaptive resources, and structured peer engagement, which strengthen collaboration and improve learning outcomes (Sichterman et al., 2025). In developed countries, integration AI into collaborative learning has shown an improvement in students learning outcomes, learning engagement, and improved knowledge retention. However, in Nigeria, integrating AI-driving

learning platforms into learning pathway remains at an emerging stage. While using AI tools for research and assignments purposes among Nigerian students is moving at a higher speed. Learning institutional, curriculum developers and government are yet to formally accept the integration of AI-driving collaborative learning environments in to the educational system (Nnaji et al., 2025).

Nigerian educational system faces persistent challenges which includes overcrowded classrooms, limited instructional resources, inconsistent electricity supply, poor internet connectivity, inadequate funding, corruption, and inadequate teacher training in digital pedagogy (Mbaying et al., 2025). Additionally, data privacy, academic integrity, algorithmic bias, and over-reliance on AI-technology also raised a questioning statement. The above challenges persistently affecting the effective implementation of AI-driving collaborative learning structures in to Nigerian educational system.

Despite these challenges, there is ample opportunities for the implementation of AI-driving collaborative learning in to Nigerian educational system. The growing youth population, increasing smartphones penetration, expansion of EdTech startups, and government interest in digital transformation provide a foundation for innovation in collaborative learning environments in Nigeria (Eltaiba et al., 2025). Integrating AI-driving learning platforms into collaborative settings may help in bridging learning gaps, support different learning ability levels, enhance teacher productivity, and expand access to quality education across urban and rural communities.

However, limited empirical research examining how AI-driving learning platform integration influences collaborative learning in Nigerian educational institutions. Most existing studies focus broadly on ICT adoption rather than AI-driven collaborative systems. Consequently, there is a need to investigate the opportunities, challenges, and educational implications of AI platform integration within Nigeria's collaborative learning environments. This study therefore seeks to explore Artificial Intelligence Platform Integration into Collaborative Learning Environments: Opportunities, Challenges and Educational Implications in Nigeria.

Aim and Objectives

1. To examine the extent to which Artificial Intelligence are integrated into collaborative learning environments in Nigerian universities.
2. To identify the opportunities of integrating Artificial Intelligence into collaborative platform in enhancing learning outcomes.
3. To investigate the challenges hindering the effective integration of Artificial Intelligence in to collaborative learning environments in Nigerian universities.
4. To determine the educational implications of integrating Artificial Intelligence into collaborative learning environments in Nigerian universities.

Research Questions

1. To what extent does Artificial Intelligence are integrated into collaborative learning environments in Nigerian universities?
2. What opportunities does the integration of Artificial Intelligence into collaborative learning platforms provide for enhancing learning outcomes in Nigerian universities?
3. What challenges hinder the effective integration of Artificial Intelligence into collaborative learning environments in Nigerian universities?
4. What are the educational implications of integrating Artificial Intelligence into collaborative learning environments in Nigerian universities?

METHODOLOGY

The study adopted an explanatory sequential mixed-methods design to examine the integration of AI platforms into collaborative learning environments in Nigerian higher education. The design involved two sequential phases. The first phase was quantitative and was used to determine the extent of AI integration, perceived opportunities, implementation challenges, and educational implications of AI-supported collaborative learning. The second phase was qualitative and was conducted to provide contextual explanations for deeper insights into the patterns identified in the quantitative findings. Thus, the qualitative phase was connected directly to the quantitative results rather than functioning as an independent source of evidence.

The study was conducted at Air Force Institute of Technology (AFIT), Kaduna State, Nigeria. AFIT was purposively selected because of the availability of ICT infrastructure and students' exposure to digital learning environment. The target population comprised of all 300-level undergraduate students, with a total population of 1,254 students. A sample of 290 undergraduate students was determined from the target population using Krejcie and Morgan (1970) sample-size determination table. A multistage sampling procedure was used to select participants for the quantitative phase. The study site was purposively selected based on its relevance to the research focus and exposure to digital learning technologies, while simple random sampling was used to select students from the identified population.

For the qualitative phase, 10 undergraduate students were purposively selected from the participants who took part in the quantitative phase to participate in the focus group discussion (FGD). Connecting the qualitative sample to the quantitative sample enabled the researchers to obtain participants who had already responded to the questionnaire and could therefore provide further explanations of the quantitative patterns. The relatively small qualitative sample was considered appropriate for generating in-depth information within the focus group (Tracy, 2019).

Two instruments were used for data collection: a structured questionnaire and a semi-structured focus group discussion guide. The questionnaire was developed to obtain quantitative data on four dimensions: Extent of AI integration into collaborative learning environments, opportunities associated with AI-supported collaborative learning, challenges affecting AI integration and educational implications of AI integration. The questionnaire employed a four-point Likert scale. A decision mean of 2.50 was

adopted for interpreting the responses, mean scores of 2.50 and above indicated agreement, while mean scores below 2.50 indicated disagreement. The semi-structured FGD guide was developed using the same four measured in the questionnaire. The instruments were subjected to expert validation to establish their content and face validity. The experts examined the instruments for relevance, clarity, adequacy of coverage, and appropriateness of the items in relation to the objectives and research questions. Their observations were incorporated into the final versions of the instruments. A pilot study was conducted to determine the internal consistency of the questionnaire. Cronbach's alpha was used to analyse the data and a reliability coefficient of 0.70 was obtained.

Data collection was conducted sequentially. First, the questionnaire was administered to sampled undergraduate students. The quantitative data were subsequently analysed to establish the extent of AI integration, perceptions of the opportunities, challenges and educational implications associated with AI-supported collaborative learning. Following the quantitative analysis, a focus group discussion was conducted with 10 purposively selected undergraduate students. The qualitative phase was designed specifically to explain the quantitative findings. Participants were encouraged to discuss their actual experiences with AI-supported collaborative learning, including situations in which AI facilitated learning and circumstances that limited its effective use. Ethical procedures were observed throughout the study. Participants were informed about the purpose of the study, participation was voluntary, and confidentiality and anonymity were maintained during data collection and reporting.

Quantitative data were analysed using mean and standard deviation. The decision mean of 2.50 was used to determine whether respondents agreed or disagreed with each questionnaire statement. Qualitative data from the FGD were analysed thematically. The analysis involved familiarisation with the responses, identification of meaningful statements, coding of recurring ideas, grouping of related codes into categories, and development of themes corresponding to the four research questions. The qualitative findings were subsequently compared with the quantitative results to determine areas of convergence and explanation.

RESULTS

Result

The results were presented in the tables below based on the research questions.

Research Question One

To what extent does AI-driving learning platforms integrated into collaborative learning environments in the institution?

Table 1
Mean and Standard Deviation of the Extent of AI Integration in to Collaborative Learning

S/N	ITEMS	Mean	SD	Decision
1	AI tools are regularly used in my courses for group learning activities.	3.47	0.90	Agree
2	My university provides access to AI-based educational platforms (e.g., chatbots, intelligent tutoring systems).	3.57	0.77	Agree
3	Lecturers integrate AI tools into collaborative assignments.	3.45	0.63	Agree
4	Students use AI tools to support teamwork and peer learning.	2.16	1.08	Disagree
5	AI technologies are embedded in the university's learning management system (LMS).	2.96	1.07	Agree
6	AI platforms track student participation in collaborative tasks.	1.95	1.10	Disagree
7	AI supports online discussion forums for group learning.	3.38	0.87	Agree
8	AI platforms help assign and monitor group projects effectively.	2.29	1.06	Disagree
9	AI tools are used to facilitate peer review and feedback.	2.40	1.01	Agree
10	AI tools assist lecturers in evaluating collaborative learning outcomes.	1.95	0.89	Disagree
11	AI-based learning analytics are available to students and lecturers.	3.69	0.50	Agree
12	AI chatbots or assistants answer students' academic questions.	3.58	0.58	Agree
13	AI is integrated into lecture delivery for interactive learning.	3.17	0.89	Agree
14	The university provides resources to support AI use in collaborative activities.	3.68	0.50	Agree
15	Students frequently engage with AI-supported collaborative platforms outside class.	3.62	0.64	Agree
16	AI platforms enable collaborative document editing and file sharing.	3.56	0.67	Agree
17	AI allows real-time collaboration during online classes.	2.99	1.06	Agree
18	Lecturers receive institutional support to implement AI in collaborative tasks.	3.29	0.83	Agree
19	AI supports blended learning (online + face-to-face) for group projects.	1.96	0.88	Disagree
20	The university encourages the use of innovative AI applications for student group projects.	1.95	0.92	Disagree
Decision Mean = 2.50 Sources: Field Survey (2025)				

S/N	ITEMS	Mean	SD	Decision
Grand Mean = 2.96				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 1 present the mean and standard deviation of the extent of AI-integration in to collaborative learning. The result reveals a grand mean of 2.96 which is greater than the decision mean of 2.50. This indicates that, AI technology are integrated in to collaborative learning.

Research Question Two

What opportunities does the integration of Artificial Intelligence into collaborative learning platforms provide for enhancing learning outcomes in Nigerian universities?

Table 2
Mean and Standard Deviation of AI Opportunities in Collaborative Learning

S/N	ITEMS	Mean	SD	Decision
1	AI tools improve communication among students during group work.	2.99	0.98	Agree
2	AI platforms provide personalized feedback that enhances learning outcomes.	2.54	0.94	Agree
3	AI increases students' engagement in group activities.	3.09	0.72	Agree
4	AI helps in organizing and managing collaborative tasks efficiently.	2.25	1.05	Disagree
5	AI-supported collaborative learning improves academic performance.	3.25	0.64	Agree
6	AI tools encourage participation from all group members.	2.79	1.05	Agree
7	AI promotes critical thinking in group discussions.	2.49	1.14	Disagree
8	AI platforms facilitate access to learning materials for collaborative tasks.	3.22	0.98	Agree
9	AI helps lecturers provide timely support to groups.	3.09	0.73	Agree
10	AI fosters creativity and problem-solving in collaborative assignments.	3.34	0.87	Agree
11	AI reduces time and effort required to manage group work.	2.97	0.91	Agree
12	AI tools enable students to work collaboratively beyond classroom constraints.	3.17	1.02	Agree
13	AI enhances digital literacy and technology skills among students.	3.16	0.91	Agree
14	AI platforms allow lecturers to monitor group progress in real time.	2.16	1.03	Disagree
15	AI integration prepares students for modern workplace collaboration.	2.95	1.02	Agree
16	AI increases students' motivation to participate in group projects.	3.03	1.02	Agree
17	AI platforms help reduce misunderstandings in group assignments.	3.09	0.90	Agree
18	AI assists in distributing tasks evenly among group members.	2.76	1.06	Agree
19	AI provides interactive simulations that enhance collaborative learning.	3.08	1.00	Agree
Decision Mean = 2.50 Sources: Field Survey (2025)				

S/N	ITEMS	Mean	SD	Decision
20	AI-supported learning leads to more equitable participation in group activities.	2.98	0.93	Agree
Cumulative Mean = 2.92				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 2 present the mean and standard deviation of the of AI opportunities in collaborative learning. From the table, a grand mean of 2.92 was obtained which is greater than the decision mean of 2.50. This indicates that, integrating AI in to collaborative learning provides opportunities for enhancing collaborative learning.

Research Question Three

What challenges hinder the effective integration of Artificial Intelligence into collaborative learning environments in Nigerian universities?

Table 3

Mean and Standard Deviation of the Challenges Affecting Implementation of AI in collaborative learning

S/N	ITEMS	Mean	SD	Decision
1	Inadequate internet connectivity limits effective use of AI in collaborative learning.	3.36	0.88	Agree
2	Lack of training affects lecturers' ability to use AI tools effectively.	2.69	1.05	Agree
3	Limited institutional funding hinders AI platform adoption.	2.03	0.96	Disagree
4	Students lack sufficient digital skills to utilize AI tools.	2.40	1.20	Disagree
5	Resistance to change among staff affects AI integration.	2.59	1.05	Agree
6	AI platforms are not user-friendly or accessible to all students.	2.00	0,93	Disagree
7	Power outages disrupt AI-supported collaborative learning.	3.04	0.91	Agree
8	Lack of institutional policy guidance affects AI adoption.	2.93	1.01	Agree
9	Insufficient technical support exists for AI platforms.	3.07	0.80	Agree
10	High cost of AI tools limits student access.	1.82	0.87	Disagree
11	Large class sizes make AI-supported collaboration difficult.	3.45	0.78	Agree
12	Some students prefer traditional learning methods over AI-assisted collaboration.	2.95	0.93	Agree
13	Limited awareness of AI tools reduces usage among students and lecturers.	2.81	1.11	Agree
14	Security and privacy concerns hinder AI platform adoption.	1.67	0.65	Disagree
15	Frequent software updates and technical issues disrupt collaborative activities.	2.22	1.08	Disagree
16	Inadequate AI infrastructure in laboratories and classrooms hinders learning.	1.84	0.93	Disagree
17	Time constraints prevent proper use of AI in group work.	2.35	1.11	Disagree
18	Low motivation among students affects engagement with AI platforms.	3.33	0.81	Agree
19	Lack of administrative support slows AI implementation.	2.73	1.17	Agree
20	Limited access to AI learning resources outside the classroom hinders collaborative learning.	2.52	1.14	Agree
Cumulative Mean = 2.59				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 3 present the mean and standard deviation of the challenges affecting the implementation of AI in collaborative learning. The result shows a cumulative mean of 2.59 which is greater than the decision mean of 2.50. This indicates that, several challenges hinder the effective implementation of AI technology in to collaborative learning environments.

Research Question Four

What are the educational implications of integrating Artificial Intelligence into collaborative learning environments in Nigerian universities.

Table 4
Mean and Standard Deviation of Educational Implications of AI Integration in to Collaborative Learning Environment

S/N	ITEMS	Mean	SD	Decision
1	Integration of AI in to collaborative learning platforms improves students' understanding of learning content.	3.04	0.91	Agree
2	AI platforms promote communication among students during group learning activities.	2.81	1.11	Agree
3	AI-supported collaborative learning enhances students' critical thinking skills.	3.33	0.81	Agree
4	The use of AI platforms improves students' problem-solving abilities in group assignment.	2.99	0.98	Agree
5	AI integration helps students access different learning resources that support collaborative learning.	3.17	1.02	Agree
6	AI platforms encourage active participation of students in group learning activities.	2.22	1.08	Disagree
7	The integration of AI tools enhances students' digital skills.	3.22	0.98	Agree
8	AI-supported collaborative learning improves students' academic performance.	2.99	1.06	Agree
9	AI-supported collaborative learning enhances students' engagement during classroom activities.	3.09	0.90	Agree
10	AI platforms help students develop independent learning skills within collaborative environments.	2.79	1.05	Agree
11	AI platforms enhance knowledge sharing among students.	2.16	1.03	Disagree
12	AI platforms support personalized learning within collaborative learning environments.	2.18	0.98	Disagree
13	The integration of AI platforms promotes innovative teaching and learning practices in educational institutions.	2.25	1.05	Disagree
14	AI integration improves students' ability to work effectively	1.83	0.86	Disagree
15	AI platforms contribute to improving the overall quality of teaching and learning in Nigerian educational institutions.	2.40	1.20	Disagree
16	The use of AI in collaborative learning prepares students for technology-driven workplaces.	3.04	0.91	Agree
17	The integration of AI tools increases students' motivation to participate in collaborative learning.	2.73	1.17	Agree
18	AI platforms help students receive timely feedback during collaborative tasks.	2.69	1.05	Agree
Decision Mean = 2.50 Sources: Field Survey (2025)				

S/N	ITEMS	Mean	SD	Decision
19	AI integration helps lecturers facilitate collaborative learning more effectively.	2.79	1.05	Agree
20	The use of AI in collaborative learning promotes creativity among students.	1.67	0.65	Disagree
Cumulative Mean = 2.67				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 4 present the mean and standard deviation of the educational implication of AI integration in to collaborative learning environment. The result recorded a grand mean of 2.67 is greater than the decision mean of 2.50. This indicates that, AI integration in to collaborative learning environment has positive educational implications for teaching and learning. The results were presented in the tables below based on the research questions.

Research Question One

To what extent does AI-driving learning platforms integrated into collaborative learning environments in the institution?

Table 1
Mean and Standard Deviation of the Extent of AI Integration in to Collaborative Learning

S/N	ITEMS	Mean	SD	Decision
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2	My university provides access to AI-based educational platforms (e.g., chatbots, intelligent tutoring systems).	3.57	0.77	Agree
3	Lecturers integrate AI tools into collaborative assignments.	3.45	0.63	Agree
4	Students use AI tools to support teamwork and peer learning.	2.16	1.08	Disagree
5	AI technologies are embedded in the university's learning management system (LMS).	2.96	1.07	Agree
6	AI platforms track student participation in collaborative tasks.	1.95	1.10	Disagree
7	AI supports online discussion forums for group learning.	3.38	0.87	Agree
8	AI platforms help assign and monitor group projects effectively.	2.29	1.06	Disagree
9	AI tools are used to facilitate peer review and feedback.	2.40	1.01	Agree
10	AI tools assist lecturers in evaluating collaborative learning outcomes.	1.95	0.89	Disagree
11	AI-based learning analytics are available to students and lecturers.	3.69	0.50	Agree
12	AI chatbots or assistants answer students' academic questions.	3.58	0.58	Agree
13	AI is integrated into lecture delivery for interactive learning.	3.17	0.89	Agree
14	The university provides resources to support AI use in collaborative activities.	3.68	0.50	Agree
15	Students frequently engage with AI-supported collaborative platforms outside class.	3.62	0.64	Agree
16	AI platforms enable collaborative document editing and file sharing.	3.56	0.67	Agree
17	AI allows real-time collaboration during online classes.	2.99	1.06	Agree
18	Lecturers receive institutional support to implement AI in collaborative tasks.	3.29	0.83	Agree
19	AI supports blended learning (online + face-to-face) for group projects.	1.96	0.88	Disagree
20	The university encourages the use of innovative AI applications for student group projects.	1.95	0.92	Disagree
Decision Mean = 2.50 Sources: Field Survey (2025)				

S/N	ITEMS	Mean	SD	Decision
Grand Mean = 2.96				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 1 present the mean and standard deviation of the extent of AI-integration in to collaborative learning. The result reveals a grand mean of 2.96 which is greater than the decision mean of 2.50. This indicates that, AI technology are integrated in to collaborative learning.

Research Question Two

What opportunities does the integration of Artificial Intelligence into collaborative learning platforms provide for enhancing learning outcomes in Nigerian universities?

Table 2
Mean and Standard Deviation of AI Opportunities in Collaborative Learning

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1	AI tools improve communication among students during group work.	2.99	0.98	Agree
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7	AI promotes critical thinking in group discussions.	2.49	1.14	Disagree
8	AI platforms facilitate access to learning materials for collaborative tasks.	3.22	0.98	Agree
9	AI helps lecturers provide timely support to groups.	3.09	0.73	Agree
10	AI fosters creativity and problem-solving in collaborative assignments.	3.34	0.87	Agree
11	AI reduces time and effort required to manage group work.	2.97	0.91	Agree
12	AI tools enable students to work collaboratively beyond classroom constraints.	3.17	1.02	Agree
13	AI enhances digital literacy and technology skills among students.	3.16	0.91	Agree
14	AI platforms allow lecturers to monitor group progress in real time.	2.16	1.03	Disagree
15	AI integration prepares students for modern workplace collaboration.	2.95	1.02	Agree
16	AI increases students' motivation to participate in group projects.	3.03	1.02	Agree
17	AI platforms help reduce misunderstandings in group assignments.	3.09	0.90	Agree
18	AI assists in distributing tasks evenly among group members.	2.76	1.06	Agree
19	AI provides interactive simulations that enhance collaborative learning.	3.08	1.00	Agree
Decision Mean = 2.50 Sources: Field Survey (2025)				

S/N	ITEMS	Mean	SD	Decision
20	AI-supported learning leads to more equitable participation in group activities.	2.98	0.93	Agree
Cumulative Mean = 2.92				
Decision Mean = 2.50 Sources: Field Survey (2025)				

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Research Question Three

What challenges hinder the effective integration of Artificial Intelligence into collaborative learning environments in Nigerian universities?

Table 3

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3	Limited institutional funding hinders AI platform adoption.	2.03	0.96	Disagree
4	Students lack sufficient digital skills to utilize AI tools.	2.40	1.20	Disagree
5	Resistance to change among staff affects AI integration.	2.59	1.05	Agree
6	AI platforms are not user-friendly or accessible to all students.	2.00	0,93	Disagree
7	Power outages disrupt AI-supported collaborative learning.	3.04	0.91	Agree
8	Lack of institutional policy guidance affects AI adoption.	2.93	1.01	Agree
9	Insufficient technical support exists for AI platforms.	3.07	0.80	Agree
10	High cost of AI tools limits student access.	1.82	0.87	Disagree
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13	Limited awareness of AI tools reduces usage among students and lecturers.	2.81	1.11	Agree
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18	Low motivation among students affects engagement with AI platforms.	3.33	0.81	Agree
19	Lack of administrative support slows AI implementation.	2.73	1.17	Agree
20	Limited access to AI learning resources outside the classroom hinders collaborative learning.	2.52	1.14	Agree
Cumulative Mean = 2.59				
Decision Mean = 2.50 Sources: Field Survey (2025)				

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Research Question Four

What are the educational implications of integrating Artificial Intelligence into collaborative learning environments in Nigerian universities.

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3	AI-supported collaborative learning enhances students' critical thinking skills.	3.33	0.81	Agree
4	The use of AI platforms improves students' problem-solving abilities in group assignment.	2.99	0.98	Agree
5	AI integration helps students access different learning resources that support collaborative learning.	3.17	1.02	Agree
6	AI platforms encourage active participation of students in group learning activities.	2.22	1.08	Disagree
7	The integration of AI tools enhances students' digital skills.	3.22	0.98	Agree
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Decision Mean = 2.50 Sources: Field Survey (2025)				

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19	AI integration helps lecturers facilitate collaborative learning more effectively.	2.79	1.05	Agree
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Cumulative Mean = 2.67				
Decision Mean = 2.50 Sources: Field Survey (2025)				

Table 4 present the mean and standard deviation of the educational implication of AI integration in to collaborative learning environment. The result recorded a grand mean of 2.67 is greater than the decision mean of 2.50. This indicates that, AI integration in to collaborative learning environment has positive educational implications for teaching and learning.

Analysis of the Qualitative Finding from the Focus Group (FGD)

To support the quantitative findings, a focus group of ten (10) undergraduate students was interviewed to explore their perceptions and experiences regarding the integration of AI into collaborative leaning environment. The responses were analysed using thematic analysis, which give room for the identification of key themes that correspond to the research questions. Below is the thematic analysis table of the focus group;

Table 5

Thematic Analysis Table of the Focus Group Discussion on AI Integration in to Collaborative learning Environment

Theme	Codes Identification	Sample Participant Statement
Extent of AI integration	Use of AI for assignment, idea generation, and explanation of complex concepts	We use AI tools to ourselves or group members to understand difficult topics during collaborative learning.
Opportunities of AI in collaborative learning environment	Faster access to information, improving teamwork, and enhancing understanding	AI help us to get answers very easy and quickly during collaborative learning.
Challenges of AI integration	Poor internet connectivity, limited digital skills, and fear of misuse	Sometime, network issues make it difficult to use AI during collaborative learning.
Educational implications	Interactive learning, independent research, and improved academic performance	AI encourages us to discover a good research topic before discussing them during collaboration.
Sources: Focus Group Interview (2026)		

Integration of Quantitative and Qualitative Findings Based on Research Questions

The integration of quantitative and qualitative findings was undertaken in accordance with the explanatory sequential mixed-methods design. The quantitative results established the overall patterns, while the qualitative findings provide a contextual explanation of those patterns. The integrated findings are presented according to the four research questions.

Extent of AI Integration into Collaborative Learning

The quantitative findings indicated that AI was moderately integrated into the collaborative learning environment, with a grand mean of 2.96, which was above the decision mean of 2.50. Several indicators reflected relatively high levels of AI usage, including the availability of AI-based educational platforms ($M = 3.57$), use of AI chatbots or assistants for academic questions ($M = 3.58$), availability of AI-based learning analytics ($M = 3.69$), provision of institutional resources supporting AI use ($M = 3.68$), and students' engagement with AI-supported platforms outside the classroom ($M = 3.62$). However, some institutional and collaborative functions recorded lower mean scores, including AI-supported monitoring of student participation ($M = 1.95$), evaluation of collaborative learning outcomes ($M = 1.95$), support for blended group projects ($M = 1.96$), and institutional encouragement of innovative AI applications for group projects ($M = 1.95$).

The qualitative findings help explain this mixed pattern. Participants reported that they already used AI tools for assignments, idea generation, and clarification of difficult concepts during collaborative learning. One participant explained that AI tools were used to help group members understand difficult topics. These accounts indicate that AI usage has become part of students' academic practices even though its institutional integration is not yet comprehensive. The convergence between the two phases therefore suggests that AI integration is developing primarily through students' and lecturers' use of accessible AI tools rather than through full institutionalization of AI across all collaborative learning processes. The qualitative evidence consequently explains why the quantitative findings indicate moderate rather than extensive integration.

Opportunities Provided by AI-Supported Collaborative Learning

The quantitative findings revealed that respondents generally perceived AI-supported collaborative learning as providing substantial opportunities, with a cumulative mean of 2.92. The strongest perceived opportunities included fostering creativity and problem-solving ($M = 3.34$), improving academic performance ($M = 3.25$), facilitating access to learning materials ($M = 3.22$), enabling collaboration beyond classroom constraints ($M = 3.17$), enhancing digital literacy and technology skills ($M = 3.16$), and increasing student engagement in group activities ($M = 3.09$).

The qualitative findings reinforced these results. Participants identified faster access to information, improved teamwork, and enhanced understanding of difficult concepts as important benefits of AI-

supported collaborative learning. Students explained that AI enabled them to obtain information quickly and use the information during group discussions and collaborative assignments. The qualitative evidence therefore provides an experiential explanation for the positive quantitative ratings. While the questionnaire established that students generally perceived AI as creating opportunities for collaborative learning, the FGD revealed the mechanisms through which these opportunities were experienced, particularly rapid information access, clarification of difficult concepts, and support for group discussions. The combined findings suggest that AI can complement collaborative learning by providing immediate informational and cognitive support during group tasks.

Challenges Hindering AI Integration

The quantitative findings showed that several challenges hinder AI integration, with a cumulative mean of 2.59, which was above the decision mean of 2.50. The most prominent challenges included large class sizes ($M = 3.45$), inadequate internet connectivity ($M = 3.36$), low student motivation ($M = 3.33$), insufficient technical support ($M = 3.07$), power outages ($M = 3.04$), lack of institutional policy guidance ($M = 2.93$), limited awareness of AI tools ($M = 2.81$), inadequate lecturer training ($M = 2.69$), and lack of administrative support ($M = 2.73$).

The FGD findings provided further explanation of these barriers. Participants specifically identified poor internet connectivity and limited digital skills as obstacles to effective AI use. They also expressed concerns about the misuse of AI for academic tasks. These qualitative accounts complement the quantitative evidence by demonstrating how infrastructural and human-capacity challenges are experienced during actual learning activities. The integrated findings indicate that the challenges associated with AI integration are not limited to the availability of AI technologies. Rather, effective implementation depends on reliable connectivity, digital and AI literacy, institutional support, and responsible-use practices. The qualitative findings also extend the quantitative results by drawing attention to misuse of AI as an academic concern.

Educational Implications of AI Integration

The quantitative findings indicated generally positive educational implications, with a cumulative mean of 2.67. Respondents agreed that AI integration could improve understanding of learning content ($M = 3.04$), enhance critical thinking ($M = 3.33$), improve access to learning resources ($M = 3.17$), enhance digital skills ($M = 3.22$), improve academic performance ($M = 2.99$), enhance engagement ($M = 3.09$), and prepare students for technology-driven workplaces ($M = 3.04$).

The qualitative findings supported these perceptions. Participants described AI-supported collaborative learning as promoting interactive learning and independent research. They also indicated that AI could assist them in identifying and exploring relevant research topics before engaging in group discussions. These experiences provide a practical explanation for the quantitative perception that AI has positive implications for teaching and learning. Generally, the quantitative and qualitative findings suggest that AI-supported collaborative learning may contribute to student-centred learning by providing access to

information, supporting independent inquiry, facilitating interaction, and enriching group discussions. However, these potential benefits depend on appropriate institutional support and responsible use.

DISCUSSION OF FINDINGS

The study found that artificial intelligence (AI) technologies were moderately integrated into collaborative learning within the study setting, as reflected by a grand mean of 2.96, which was above the decision mean of 2.50. However, the item-level findings indicated that the pattern of integration was uneven. AI-based educational platforms, chatbots, learning analytics, and access to AI resources received relatively high ratings, whereas institutional monitoring of collaborative activities, AI-assisted evaluation, support for blended group projects, and institutional encouragement of innovative AI applications received comparatively lower ratings. The qualitative findings provide an important explanation for this pattern. Participants reported that they used AI tools for assignments, idea generation, and clarification of difficult concepts during collaborative learning. This suggests that AI adoption is occurring more strongly through students' individual and group academic practices than through comprehensive institutional integration. The finding is consistent with Chen et al. (2024), who reported that AI technologies, including intelligent tutoring systems, machine learning models, and educational analytics, are increasingly integrated into computer-assisted collaborative learning to monitor group activities, evaluate interactions, and provide immediate feedback. Similarly, Kovari (2025) observed that AI resources are gradually being incorporated into collaborative learning tasks and teaching methodologies in higher education. Wei et al. (2025) further reported that students' use of generative AI during collaborative tasks can support critical thinking, teamwork, and problem-solving. Taken together, these findings suggest that the moderate level of AI integration observed in the present study reflects an emerging stage of adoption in which students are actively incorporating AI into learning activities, while institution-wide structures and pedagogical mechanisms for systematic integration remain comparatively underdeveloped.

The study further revealed that integrating AI into collaborative learning provides considerable opportunities for enhancing students' learning experiences. The quantitative findings produced a cumulative mean of 2.92, indicating that respondents generally perceived AI as providing opportunities for collaborative learning. Particularly strong perceptions were recorded for AI's ability to foster creativity and problem-solving, improve academic performance, facilitate access to learning materials, enable collaboration beyond classroom constraints, enhance digital literacy and technology skills, increase participation in group projects, and provide interactive support during collaborative activities. The qualitative findings reinforced these quantitative results. Participants reported that AI provides faster access to information, improves teamwork, enhances understanding of difficult concepts, and assists students during group discussions and assignments. The convergence of these findings indicates that the perceived value of AI in collaborative learning extends beyond simple information retrieval. AI appears to function as an additional cognitive and informational resource that students can draw upon while negotiating ideas and completing group tasks. This interpretation is supported by Vieriu (2025), who found that AI-driven tools can provide personalised feedback, increase student engagement, and

facilitate effective teamwork, thereby supporting academic performance. Similarly, Wang et al. (2025) reported that students participating in AI-supported collaborative learning environments demonstrated higher academic performance, motivation, and self-efficacy than students taught through traditional approaches. Siamika (2025) also identified personalised learning, improved assessment efficiency, data-driven decision-making, and improved educational management as important opportunities associated with AI implementation in education. In addition, Younas et al. (2025) reported that AI-supported learning platforms can strengthen student interaction, knowledge development, and participation during knowledge construction. The agreement between these previous findings, the quantitative evidence, and the students' qualitative experiences strengthens the interpretation that AI can serve as a useful support mechanism for collaborative learning when appropriately integrated into learning activities.

Despite these opportunities, the findings demonstrate that several challenges constrain the effective integration of AI into collaborative learning environments. The quantitative results produced a cumulative mean of 2.59, which was above the decision mean of 2.50, indicating that respondents generally recognised the presence of implementation challenges. The most prominent challenges included large class sizes, inadequate internet connectivity, low student motivation, insufficient technical support, power interruptions, lack of institutional policy guidance, limited awareness of AI tools, inadequate lecturer training, and limited administrative support. The qualitative findings closely reinforced these quantitative results. Participants specifically identified poor internet connectivity and limited digital skills as barriers to using AI during collaborative learning activities and also expressed concerns about the misuse of AI for academic tasks. The convergence of the two phases suggests that AI implementation challenges are multidimensional, extending beyond technological availability to include infrastructural, human-capacity, institutional, and academic-integrity concerns.

The finding regarding inadequate internet connectivity is consistent with Almusaed et al. (2024), who identified poor internet connectivity, insufficient staff training, and inadequate technological infrastructure as continuing barriers to students' access to and participation in AI-supported learning. Similarly, Reina et al. (2025) noted that limited digital skills and AI literacy among teachers and students can reduce the effectiveness of AI utilisation in contemporary collaborative learning environments. The qualitative evidence in the present study gives contextual meaning to these observations by showing that network problems can directly interrupt students' attempts to use AI during collaborative activities. Furthermore, the participants' concerns about the misuse of AI for academic tasks are consistent with Vieriu and Petrea (2025), who highlighted the risks associated with misuse of AI-generated information and over-reliance on AI-generated content, particularly in relation to academic integrity and meaningful student engagement. Wiese (2025) similarly identified institutional policy gaps, data privacy, transparency, and algorithmic bias as important ethical issues surrounding AI use in education. Siamika (2025) also identified ethical and data-privacy concerns, algorithmic bias, teacher readiness, infrastructural inequality, and weak policy as significant challenges to AI implementation. Thus, the integrated findings indicate that successful AI adoption requires more than providing students with access to AI tools. It requires reliable digital infrastructure, adequate AI and digital literacy, technical

support, institutional guidance, and mechanisms for promoting responsible and academically appropriate use.

The study also found that AI integration has positive perceived educational implications for teaching and learning, with a cumulative mean of 2.67, which exceeded the decision mean of 2.50. Respondents particularly recognised the potential of AI to improve understanding of learning content, critical thinking, access to learning resources, digital skills, academic performance, engagement, and preparation for technology-driven workplaces. The qualitative findings complemented these results by indicating that AI promotes interactive learning, supports independent research, and helps students explore relevant research topics and materials before participating in collaborative discussions. Participants therefore viewed AI not only as a source of information but also as a tool that could facilitate preparation, inquiry, interaction, and knowledge construction. These findings are consistent with Ruiz-Rojas et al. (2024), who found that AI-supported cooperative learning can enhance critical thinking and collaborative problem-solving abilities. Similarly, Kong et al. (2025) reported that AI-enhanced collaborative learning environments have the potential to create conditions that support knowledge creation and improve students' understanding. He et al. (2025) further reported that AI-supported learning environments can stimulate creativity and self-reflection, while Wu et al. (2025) found improvements in academic performance and engagement associated with AI-supported learning, particularly in virtually oriented collaborative environments. Msambwa et al. (2025) also indicated that AI tools can encourage active participation, social interaction, collaborative problem-solving, and instructional effectiveness. The convergence of these studies with the quantitative and qualitative findings of the present study suggests that AI-supported collaborative learning has the potential to enrich student-centred learning by providing additional resources for inquiry, interaction, problem-solving, and academic engagement.

However, the positive educational implications identified in this study should be interpreted as perceived implications rather than demonstrated causal effects. The study employed an explanatory sequential mixed-methods design in which the quantitative phase measured students' perceptions and the qualitative phase provided contextual explanations of those perceptions. Therefore, the findings do not establish that AI integration directly caused improvements in academic performance, critical thinking, engagement, or other educational outcomes. Rather, they indicate that students perceive AI-supported collaborative learning as having the potential to contribute positively to these areas. This distinction is important because it places the findings within the evidential limits of the research design while still demonstrating their relevance to the growing literature on AI-supported learning.

CONCLUSION

The study concludes that AI is moderately integrated into collaborative learning within the study setting, although the pattern of integration remains uneven across different academic and institutional functions. Students are already using AI tools to support group assignments, generate ideas, obtain information, and clarify difficult concepts, suggesting that AI-supported learning practices are emerging within higher education.

The findings further indicate that AI-supported collaborative learning offers several perceived opportunities, including improved access to information, enhanced engagement, support for problem-solving, development of digital skills, and facilitation of collaborative academic activities. At the same time, effective integration is constrained by infrastructural and institutional challenges, particularly inadequate internet connectivity, large class sizes, power interruptions, limited technical support, insufficient AI literacy, and the absence of sufficiently developed institutional guidance on responsible AI use.

The convergence of quantitative and qualitative evidence suggests that the educational value of AI-supported collaborative learning is closely associated with the conditions under which the technology is implemented. AI should therefore not be viewed as a stand-alone solution to educational challenges. Rather, its effective integration requires reliable infrastructure, continuous AI and digital-literacy development, institutional support, and clear policies addressing responsible use, academic integrity, and appropriate engagement with AI-generated information.

Within the context of Nigerian higher education, the findings suggest that AI-supported collaborative learning represents an emerging opportunity for strengthening student-centred and digitally supported learning. However, further empirical research involving multiple institutions and more rigorous designs is required to establish the effectiveness of specific AI-supported collaborative learning interventions and to determine how institutional and learner characteristics influence their outcomes.

Recommendations

1. Government and school administrators should provide a reliable internet connection, improve electricity supply, provide AI-enabling systems, and ensuring equitable access to AI tools for all students.
2. School administrators should organize continuous training for lecturers and students to strengthen AI literacy, digital pedagogy, and effective use of AI in collaborative learning environment.
3. Schools should develop clear institutional policies and ethical guidelines on the use of AI that focuses on academic integrity, data privacy, and responsible AI adoption.
4. Government should integrate AI-supported collaborative learning platforms in to school curriculum and establish technical support units to maintain platforms and assist users.
5. School administrators should encourage further research on AI in education and encourage collaboration between universities, government, and EdTech organizations to motivate innovation.

Declarations

Ethics approval and consent to participate

This study involving human participants was reviewed and approved by the Research Ethics Committee of Air force Institute of Technology (AFIT), Kaduna State. The Research Ethics Committee operates as the institutional based ethics review body responsible for reviewing and approving studies involving

human participants. All procedures were conducted in accordance with relevant institutional guidelines, applicable ethical standards, and the principles of the Declaration of Helsinki.

Informed consent

Informed consent was obtained from all participants prior to data collection. Participants were informed about the purpose of the study, the voluntary nature of their participation, the procedures involved, and the use of their assessment for research purposes. Only participants who provided informed consent were included in the study.

Data availability

The datasets generated and analysed during the current study are not publicly available due to participant confidentiality and ethical restrictions, but are available from the corresponding author on reasonable request.

Consent to Publish

Not applicable.

Conflict of Interest

The author(s) declare that they have no competing interests or conflicts of interest related to the publication of this study.

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Author Contribution

Abubakar Mallam Aliyu conceived and designed the study, collected and analysed the data, and drafted the manuscript. Amosu Isiaka Gambari contributed to the study design, methodology, supervision, and critical revision of the manuscript. Ismail Muhammad Bello contributed to data interpretation and manuscript review. Taliha Abiodun Folorunso contributed to data analysis, interpretation, and critical revision. All authors reviewed and approved the final manuscript.

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