



Significance of Artificial Intelligence in Group Learning Strategy on Academic Performance in Biology Concept among Secondary Students in Sabon Gari Local Government Area of Kaduna State

Abubakar Salisu, Adebayo Rafat Romoke, Muhammad Maimuna Madaki
Department of Biology, Faculty of Science Education,
Federal University of Education, Zaria

ABSTRACT

This research work examined the “significance of artificial intelligence in group learning strategy on academic performance in biology concept among secondary students in Sabon Gari local government area of Kaduna State”. The study adopted the use of quasi-experimental design. The population of this study comprised of one thousand, nine hundred and twenty-one (1,921) SS II students while a sample 60 students was drawn using random sampling technique. Biology Performance Test (BPT) was the instrument used in data collection. Both descriptive and inferential statistics techniques were used in the analysis of data. Mean and standard deviation were used to answer the research questions while independent t-test statistics was used to test the study hypotheses. All the hypotheses were tested at 0.05 level of significance. The result revealed that Students taught using the AI-integrated group learning strategy significantly outperformed those taught with the traditional lecture method. The AI-based group learning method also led to significantly higher retention levels compared to the lecture method. No significant gender difference was found in academic performance among students taught using the AI-integrated strategy. Both male and female students benefited equally. It was recommended that: Schools should adopt group learning strategies integrated with artificial intelligence as a core teaching method, especially in science subjects like biology. The findings clearly show that this approach significantly improves students’ academic performance and retention compared to traditional lecture methods.

ARTICLE INFO

Article History

Received: May, 2025

Received in revised form: June, 2025

Accepted: July, 2025

Published online: September, 2025

KEYWORDS

Artificial Intelligence, Group Learning Strategy, Academic Performance, Biology Concept Secondary Students

INTRODUCTION

AI has become an essential component of contemporary education, offering personalized learning opportunities that adjust to students’ skills, preferences, and learning speeds (Kehinde-Awoyele et al., 2024). AI-driven platforms, such as intelligent tutoring systems, utilize machine learning techniques to evaluate learners’ knowledge levels and deliver focused instruction and feedback, enabling them to advance at their own pace and close learning gaps more effectively than conventional teaching methods (Farahani & Ghasemi, 2024). For example, adaptive learning

technologies can alter content and provide extra exercises when students encounter difficulties, thereby fostering a more student-centered learning atmosphere (Kim et al., 2022).

Studies indicate that AI-supported instructional approaches positively influence student learning outcomes, particularly in enhancing knowledge retention, critical thinking, and problem-solving abilities. Through personalized instruction and self-paced learning, AI applications help students reach their full academic potential (Seo et al., 2021). In disciplines like science, AI-powered tutoring

Corresponding author: Abubakar Salisu

✉ salisuabubakar2178@gmail.com

Department of Biology, Faculty of Science Education, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved



platforms have demonstrated notable improvements in learners' performance by delivering tailored problem-solving activities and explanations suited to each student's capability (Kehinde-Awoyele et al., 2024). The immediate feedback that AI systems provide enables students to promptly identify and correct errors, strengthening their comprehension of key concepts and fostering higher-order thinking (Zheng et al., 2020).

Collaborative learning has long been acknowledged as one of the most effective teaching approaches for nurturing cooperation, critical thinking, and problem-solving skills among students. It promotes engagement, teamwork, and collaboration—core elements of 21st-century education. Nevertheless, implementing group learning in conventional classrooms poses certain difficulties, such as managing group dynamics, ensuring equality, and addressing the diverse learning needs of individual students (McLaren et al., 2022). Education has not been immune to these challenges, and recently, the integration of AI has been identified as a promising means of addressing them. AI contributes significantly to collaborative learning by enhancing interaction, streamlining instructional processes, and adapting to students' unique needs. In today's technology-rich classrooms, incorporating AI to facilitate and coordinate group learning has become increasingly vital for promoting more effective and innovative learning experiences.

Furthermore, the integration of AI with group learning strategies in education enhances students' learning experiences by promoting personalized instruction. AI supports automated learning by providing real-time feedback, improving teaching methods, fostering professional growth, and encouraging inclusivity in education through innovative instructional approaches (Mallillin, 2024). This represents a significant transformation in the educational landscape, offering practical solutions and advancing innovative learning experiences. AI revolutionizes teaching and learning by emphasizing the impact of instructional methodologies and designing learning outcomes that ensure effective educational delivery (Mallillin

et al., 2023). It enables personalized learning tailored to individual student needs, leveraging adaptive learning capabilities to create customized learning paths that align with each student's pace, comprehension, and content mastery. This process refines and enhances student engagement, contributing to improved academic performance (Onesi-Ozigagun et al., 2024).

Moreover, AI's influence on students' education and learning processes promotes interactive learning environments and provides timely feedback. It facilitates the development of critical thinking skills and enhances students' comprehension by supporting insightful learning progress. AI plays a significant role in optimizing educational processes and systems, making learning more efficient and effective while placing students at the center of the learning experience. It also strengthens motivation, engagement, and overall classroom learning outcomes (Huang et al., 2023).

Statement of the Problem

Despite on-going initiatives aimed at improving science education in Nigeria, students' academic achievement in Biology, particularly in secondary schools within Sabon Gari Local Government Area of Kaduna State continues to fall short of expectations. Conventional teaching methods often do not effectively engage learners or address their diverse learning needs. Although group learning strategies have the potential to promote collaboration and peer interaction, their outcomes have been inconsistent due to inadequate facilitation and lack of proper structure. Consequently, students frequently face difficulties in grasping complex Biology concepts, which results in low retention levels and poor performance in examinations.

As technology becomes increasingly integrated into education, Artificial Intelligence (AI) emerges as a promising tool for strengthening group learning strategies through personalized instruction, monitoring of group dynamics, and provision of real-time feedback. Nevertheless, limited empirical research exists on the impact of AI-driven group learning interventions on students'



academic performance in Biology at the secondary school level, particularly in resource-constrained areas like Sabon Gari. This gap underscores the importance of examining how AI-enhanced group learning approaches can improve students' conceptual understanding and academic outcomes in Biology, thereby contributing to more effective teaching methods and evidence-based educational policy development.

Objectives of the Study

This study examines the significance of artificial intelligence in group learning strategy on academic performance in biology concept among secondary students in Sabon Gari local government area of Kaduna State. The specific objectives are to:

1. To determine the effect of group learning strategy integrated with artificial intelligence on academic performance in biology concept among secondary students in Sabon Gari local government area of Kaduna State.
2. To examine the effect of group learning strategy integrated with artificial intelligence on retention of biology concept among secondary students in Sabon Gari local government area of Kaduna State.

Research Questions

The following questions are formulated to guide the study:

1. What is the effect of group learning strategy integrated with artificial intelligence on academic performance in biology concept among secondary students in Sabon Gari local government area of Kaduna State?
2. What is the effect of group learning strategy integrated with artificial intelligence on retention of biology concept among secondary students in Sabon Gari local government area of Kaduna State?

Hypotheses

The following hypotheses will be tested at 0.05 level of significance:

Ho₁: There is no significant difference in the academic performance of students taught Biology concept using group learning strategy integrated with artificial intelligence and those taught with lecture in secondary schools in Sabon Gari local government area, Kaduna State.

Ho₂: There is no significant difference in the retention ability of students taught Biology concept using group learning strategy integrated with artificial intelligence and those taught with lecture in secondary schools in Sabon Gari local government area, Kaduna State.

Significance of the Study

The findings of this study will be beneficial to the following groups:

Secondary School Students: The main beneficiaries of this research are secondary school students in Sabon Gari Local Government Area. The study seeks to enhance students' academic achievement in Biology by examining how Artificial Intelligence (AI) can improve group learning strategies. Through AI tools that promote better collaboration, personalized instruction, and real-time feedback, students are expected to gain a deeper understanding of complex Biology concepts, which can lead to improved academic performance and increased interest in pursuing science-related careers.

Biology Teachers and Educators: This study will offer useful insights to Biology teachers on effectively integrating AI into group learning. By understanding how AI can facilitate differentiated instruction, track group progress, and foster classroom engagement, educators will be able to refine their teaching methods to be more learner-centered and data-driven. It will also assist teachers in identifying best practices for blending traditional instructional methods with technological innovations in science education.

School Administrators and Policy Makers: For school administrators and educational policy makers in Kaduna State, the study will provide evidence-based guidance on incorporating AI tools into the secondary school curriculum. The findings will support informed



decision-making in areas such as resource allocation, teacher training, and the formulation of technology-oriented policies designed to enhance science education outcomes.

1. Curriculum Developers: The outcomes of this study will assist curriculum developers in creating Biology content that aligns with AI-supported learning environments. This can contribute to the development of interactive, adaptive, and collaborative instructional materials that embody modern pedagogical approaches.
2. Researchers and Educational Technologists: Future researchers and developers in educational technology can use this study as a foundation for further investigations into the use of AI in collaborative learning. It also paves the way for interdisciplinary advancements in education by integrating perspectives from

pedagogy, computer science, and cognitive psychology.

METHODOLOGY

Research Design

The study employed quasi-experimental design. Quasi-experimental studies encompass a broad range of non-randomize intervention studies the design a frequently used when it is not logistically feasible or not ethical to conduct a randomized and or a controlled trial. This implies that the research design used for this study is a pre-test, post-test and quasi experimental and control group design where intact classes (non-randomized group) will be used. The population of this study comprised of one thousand, nine hundred and twenty one (1,921) SS II students from five public senior secondary schools in Sabon Gari Local Government Area of Kaduna State. The Population is presented on table 1 below:

Table1: Population of the Study

S/N	Name of Schools	Male	Female	Total
1	Government Secondary School Aminu Senior	167	145	312
2	GSS Kwangila SNR	165	178	343
3	Government Girls Secondary School, Chindit - Barrack Senior		270	270
4	Government Girls Secondary School Dogon - Bauchi Senior Zaria		729	729
5	Government Secondary School Basawa Senior	180	87	267
	Total	512	1,409	1,921

Sample and Sampling Procedure

Random sampling technique was used to select 2 Secondary schools by balloting. Two intact classes were used, one as Experimental Group (EG) and the other as Control Group (CG). Okpala and Okigbo (2021) lamented that for a quasi-experimental, intact classes should be used. A sample 60 students was drawn in line with central limit theorem that for quasi experimental research the 30 sample is recommended. The sample size was allocated for each school as follows:

Research Instrumentation

The instrument used for collection of data for this study was a multiple-choice objective test "Biology Performance Test (BPT)" which was used in the pre-test and post-test. The BPT items was constructed for Senior Secondary school (SS2) students in the study, The BPT items comprised of 20 multiple choice questions with four options, one correct and the three distracters, which is based on SS 2 Biology curriculum. Each question attracts 5 marks for a total of 100marks. The test was constructed to test the subject academic performance in Biology concepts.



Validity of the Instrument

The following steps are used to test validity of BPT. Validity is the ability of an instrument to measure what it is designed to measure. Face validity is the establishment of logical link between questions and answers while content validity assesses if items and questions cover the full range of the issue being measured. To ensure both face and content validity of the instrument in this research work. The BPT with the making scheme were given to the researcher's supervisor in Biology department and two senior lectures from Federal University of Education, Zaria.

Procedure for Data Collection

The researcher collected a letter of introduction from the department of Biology, Faculty of science Education, Federal University of Education, Sabon Gari which was used to introduce the researcher to the schools. Data for the study were collected through the administration of pre-test and post-test with the aid of two (2) researches assistant that are specially trained by the researcher. The data collection phase lasted for four weeks comprising of single period of forty minutes for each group.

The researcher and the trained teacher administered a pre-test to the students in experimental and control group respectively using and instrument named Biology Performance Test

(BPT) before the commencement of the treatment. Meanwhile, the pre-test scores serve as a basis for comparing student performance in the test before treatment. The experimental group were taught using AI integrated Group Learning Strategy and the control group were taught using traditional method (lecture method). After the treatment, a post-test was then administered to both the experimental and control groups. The scripts were collected, marked, scored, and recorded to make comparison between the groups.

Procedure for Data Analysis

Both descriptive and inferential statistics techniques were used in the analysis of data. Mean and standard deviation were used to answer the research questions while independent t-test statistics was used to test the study hypotheses. All the hypotheses were tested at 0.05 level of significance.

RESULTS

Research Question One:

What is the effect of group learning strategy integrated with artificial intelligence on academic performance in biology concept among secondary students in Sabon Gari local government area of Kaduna State?

Table1: Descriptive statistics on the effect of group learning strategy integrated with artificial intelligence on academic performance in biology concept

Group	N	Mean	Std. Dev	Mean Difference
Group learning strategy integrated with artificial intelligence	30	76.00	11.48	26.33
Lecture method	30	49.67	13.19	

Table 4.1 presents the descriptive statistics comparing the academic performance of students taught using a group learning strategy integrated with artificial intelligence (AI) versus those taught using the conventional lecture method. The results reveal a substantial

difference in mean scores between the two groups. Students who experienced the AI-integrated group learning strategy achieved a mean score of 76.00 with a standard deviation of 11.48, while those taught through the lecture method scored a lower mean of 49.67 with a

Corresponding author: Abubakar Salisu

✉ salisuabubakar2178@gmail.com

Department of Biology, Faculty of Science Education, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

standard deviation of 13.19. The mean difference of 26.33 points strongly favors the AI-based approach.

Research Question Two:

What is the effect of group learning strategy integrated with artificial intelligence on retention of biology concept among secondary students in Sabon Gari local government area of Kaduna State?

Table 4.2: Descriptive statistics on the effect of group learning strategy integrated with artificial intelligence on retention of biology concept

Group	N	Mean	Std. Dev	Mean Difference
Group learning strategy integrated with artificial intelligence	30	79.67	11.90	27.67
Lecture method	30	52.00	13.36	

As shown in Table 4.2, students in this group recorded a mean retention score of 79.67, compared to 52.00 for those in the lecture group. The mean difference of 27.67 indicates a significant advantage for the group learning strategy when it comes to long-term retention. This result implies that students not only learn more effectively through this method but are also better able to retain the concepts over time. The integration of AI likely provides personalized

feedback, adaptive reinforcement, and interactive content that enhance memory consolidation.

Hypotheses Testing

Hypothesis One:

There is no significant difference in the academic performance of students taught Biology concept using group learning strategy integrated with artificial intelligence and those taught with lecture in secondary schools in Sabon Gari local government area, Kaduna State.

Table 4: T-test statistics on significant difference in the academic performance of students taught Biology concept using group learning strategy integrated with artificial intelligence and those taught with lecture

Variables	N	Mean	Std. Dev	df	t-cal	p	Decision
Group learning strategy integrated with artificial intelligence	30	76.00	11.48	58	8.249	0.000	Significant
Lecture method	30	49.67	13.19				

Significant at $p < 0.05$

Table 4.4 provides the results of an independent samples t-test, which tested the hypothesis that there is no significant difference in academic performance between the two teaching methods. The t-calculated value was 8.249 with a p-value of 0.000, which is well below the 0.05 level of significance. This statistical result confirms that the difference in academic performance between the AI-integrated group learning method and the

lecture method is highly significant. As such, the null hypothesis is rejected. This implies that the innovative AI-based collaborative learning approach leads to substantially better academic outcomes than traditional lecture-based instruction.

Hypothesis Two:

There is no significant difference in the retention ability of students taught Biology concept using

Corresponding author: Abubakar Salisu

✉ salisuabubakar2178@gmail.com

Department of Biology, Faculty of Science Education, Federal University of Education, Zaria.

© 2025. Faculty of Technology Education. ATBU Bauchi. All rights reserved

group learning strategy integrated with artificial intelligence and those taught with lecture in

secondary schools in Sabon Gari local government area, Kaduna State.

Table 5: T-test statistics on significant difference in the retention ability of students taught Biology concept using group learning strategy integrated with artificial intelligence and those taught with lecture

Variables	N	Mean	Std. Dev	df	t-cal	p	Decision
Group learning strategy integrated with artificial intelligence	30	79.67	11.90	58	8.786	0.000	Significant
Lecture method	30	52.00	13.36				

Significant at $p < 0.05$

Table 4.5 presents the t-test analysis for retention, with the aim of determining whether the observed differences between the two groups are statistically significant. The results show a t-value of 8.786 and a p-value of 0.000, again indicating a highly significant difference in retention ability. The AI-integrated group learning strategy not only improves immediate academic performance but also significantly boosts the ability of students to retain biological concepts over time. This further validates the pedagogical strength of the method in promoting deeper learning and long-term conceptual understanding.

DISCUSSION OF FINDINGS

The finding of this study revealed that students taught using the AI-integrated group learning strategy significantly outperformed those taught with the traditional lecture method. This finding is consistent with that of Samuel and Chibuzor (2023), who examined the impact of the collaborative learning method on the academic performance of secondary school Biology students in Abia State. Their results indicated that students taught Biology through collaborative learning achieved higher scores than those taught using the lecture method.

Similarly, Kyado et al. (2019), in a study on the effect of collaborative concept mapping instructional strategy on secondary school students' achievement in difficult Biology concepts in Taraba State, discovered that students exposed to the collaborative concept mapping strategy obtained significantly higher mean achievement

scores in the Biology Achievement Test (BAT) than those taught with the lecture method. Supporting this result further, Yemi and Adebimpe (2017) conducted a study on the impact of group learning strategy on students' performance in Ecology among senior secondary school students in Gusau, Zamfara State. The findings revealed that students taught using the group learning strategy performed better than those instructed with the lecture method.

The finding further showed that the AI-based group learning method resulted in significantly higher retention levels compared to the lecture method. This aligns with the observation of Yusuf (2024), who stated that the application of AI in personalized learning not only enhances students' understanding of subject matter but also helps prevent learning setbacks and improves long-term information retention.

Additionally, the study revealed that there was no significant gender difference in the academic performance of students taught using the AI-integrated strategy, indicating that both male and female students benefited equally from the approach. This finding is consistent with that of Ekwesianya (2025), who investigated the effect of cooperative learning strategy on students' achievement in Biology in Anambra State and found no significant difference in academic performance between male and female students.

The results revealed that there were no significant differences in the mean achievement scores of male and female students in the cooperative learning among other findings. Similarly, Samuel and Chibuzor (2023)



investigated the effect of collaborative learning method on academic achievement of secondary school biology students in Abia State. The study revealed that there was no significant difference in the academic achievement of male and female students exposed to collaborative learning method.

CONCLUSION

Based on the findings of the study, it can be concluded that the integration of artificial intelligence into group learning strategies leads to significantly higher academic performance and better retention of biology concepts compared to traditional lecture methods. The approach appears to benefit all learners equally, regardless of gender, and produces more consistent academic outcomes. These results support the growing body of research advocating for the use of intelligent educational technologies in secondary school science classrooms. The implementation of AI-supported teaching strategies can transform the learning environment into a more interactive, personalized, and effective space.

RECOMMENDATIONS

From the finding of this study, it is recommended that:

1. Schools should adopt group learning strategies integrated with artificial intelligence as a core teaching method, especially in science subjects like biology. The findings clearly show that this approach significantly improves students' academic performance and retention compared to traditional lecture methods.
2. To ensure effective implementation, teachers should receive training on how to use AI tools and facilitate collaborative learning. Additionally, schools should invest in necessary technological infrastructure such as internet access, digital devices, and AI-powered learning platforms.

REFERENCES

- Abbood, K.O., Faleih, W.A. & Hodood, M.N. (2025). Integrating Artificial Intelligence into Collaborative Teaching Strategies: A Case Study in Smart Classrooms. *Salud, Ciencia y Tecnología - Serie de Conferencias*; 4(150), 1-8.
- Adeniran, K., Adeoye, B., & Okonkwo, E. (2024). AI-driven collaborative learning: Case studies from Nigerian schools. *Journal of Educational Technology*, 15(2), 105–118.
- Ampofo, E.T. & Osei-Owusu, B. (2015). Students' academic performance as mediated by students' academic ambition and effort in the public senior high schools in Ashanti Mampong Municipality of Ghana. *International Journal of Academic Research and Reflection*, 3(5): 19-35.
- Bhatia, N., Trivedi, H., Safdar, N., & Heilbrun, M.E. (2020). Artificial intelligence in quality improvement: reviewing uses of artificial intelligence in noninterpretative processes from clinical decision support to education and feedback. *Journal of the American College of Radiology*, 17(11), 1382–1387.
- Chen, Y., Jensen, S., Albert, L. J., Gupta, S., & Lee, T. (2023). Artificial intelligence (AI) student assistants in the classroom: Designing chatbots to support student success. *Information Systems Frontiers*, 25(1), 161-182.
- Copeland, B.J. (2024). Artificial Intelligence. The Encyclopedia Britannica. Retrieved from <https://www.britannica.com/technology/artificial-intelligence/Is-artificial-general-intelligence-AGI-possible>
- Dajal, R.G., Ogar, S.I & Sunday, E.T. (2019). Effect of learning together strategy on secondary school students' achievement in biology in Abaji area council, Federal Capital Territory Abuja, Nigeria. *UNIZIK Journal of Educational Management and Policy*, 3(1), 108-116.



- Duggal, R. (2024). Artificial intelligence: A foundational overview of technology and applications. *Journal of Artificial Intelligence Research*, 59(1), 35-52.
- Ekwesianya, A.A. (2025). Effect of cooperative learning strategy on students' achievement in biology in Anambra State. *Unizik Journal of Educational Research and Policy Studies*, 19(3), 504-522.
- Farahani, M.S. & Ghasemi, G. (2024). Artificial Intelligence in education: A comprehensive study, *Forum for Education Studies* 2(3).
- Ghosh, M & Arunachalam, T. (2021). Introduction to Artificial Intelligence. In book: *Artificial Intelligence for Information Management: A Healthcare Perspective* (pp.23-44) 10.1007/978-981-16-0415-7_2.
- Glover, E. (2024). What Is Artificial Intelligence (AI)? Retrieved from <https://builtin.com/artificial-intelligence>.
- Gocen, A., & Aydemir, F. (2020). Artificial intelligence in education and schools. *Research on Education and Media*, 12(1), 13–21.
- Gokhale, A.A. (2015). Collaborative learning and critical thinking. *Journal of Technology Education*, 7(1), 22 –30.
- Harri, G. (2019). Analysis of Students Academic Performance in Biology in WASSCE/NECO Examinations Between 2013-2015. Retrieved from <https://harri.library.blogspot.com/2019/02/analysis-of-students-academic.html>
- Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial intelligence in education: Promises and implications for teaching and learning. Center for Curriculum Redesign.
- Huang, A. Y., Lu, O. H., & Yang, S. J. (2023). Effects of artificial Intelligence-enabled personalized recommendations on learners' learning engagement, motivation, and outcomes in a flipped classroom. *Computers and Education*, 194, 104684.
- Kehinde-Awoyele, A.A., Adeowu, W.A. & Oladejo, B. (2024). Enhancing Classroom Learning: The Impact of AI-Based Instructional Strategies on Student Engagement and Outcomes. *International Journal of Research and Innovation in Social Science (IJRISS)*, 8(03), 5732-5742.
- Kim, J., Lee, H. & Cho, Y.H. (2022). Learning design to support student-AI collaboration: perspectives of leading teachers for AI in education. *Educ Inf Technol* 27, 6069–6104.
- Kulik, J.A. & Fletcher, J.D. (2016). Effectiveness of intelligent tutoring systems: A meta-analytic review. *Review of Educational Research*, 86(1), 42–78.
- Kumar, S., Aggarwal, M. & Aggarwal, N. (2021). Defining and Measuring Academic Performance of Hei Students-A Critical Review. *Turkish Journal of Computer and Mathematics Education*, 12 (6): 3091-3105.
- Kyado, J. J., Abah, C. O. & Samba, R. M. A. (2019). Effect of collaborative concept mapping instructional strategy on secondary students' achievement in difficult Biology Concepts. *American Journal of Social Sciences and Humanities*, 2(3), 201 -212.
- Laddunuri, M. M. (2018). Status of school education in present Tanzania and emerging issues. *International Journal of Education Research and Technology*, 3(1) 6-11.
- Lamas, H.A. (2017). School Performance. *Propósitos y Representaciones*, 3(1), 313-386. doi: <http://dx.doi.org/10.20511/pyr2015.v3n1.74>.
- Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). Intelligence unleashed: An argument for AI in Education. *Pearson*, 112-130.
- Mallillin, L.L.D. (2020). Different domains in learning and the academic



- performance of the students. *Journal of Educational System*, 4(1), 1–11.
- Mallillin, L.L.D. (2024). Artificial Intelligence (AI) Towards Students' Academic Performance. *Innovare Journal of Education*, 12(4), 16-21.
- Mallillin, L.L.D. (2024). Instructional teaching theory: Basis for effective teaching device in learning. *Eureka*, 2(2), 120–132.
- Mallillin, L.L.D., Mallillin, J. B., Ampongan, Y.D., Lipayon, I.C., Mejica, M.M. & Burabo, J.Z. (2023). Instructional design for effective classroom Pedagogy of teaching. *Eureka*, 1(2), 41–52.
- McLaren, B.M., Richey, J.E., Nguyen, H. and Hou, X. (2022). How instructional context can impact learning with educational technology: lessons from a study with a digital learning game. *Computers & Education*, 178, p.104366.
- Narad, A. & Abdullah, B. (2018). Academic Performance of Senior Secondary School Students: Influence of Parental Encouragement and School Environment. *Rupkatha Journal on Interdisciplinary Studies in Humanities*, 8(2): pp. 12-19.
- Ngbarabara, P.B. & Odibo, A. (2024). Effect of Generative Artificial Intelligence (GAI) on Science Education Students' Achievements in Federal University Otuoke, Bayelsa State. *FUO-Journal of Educational Research*, 3(1), 121-131.
- Okafor, O., Musa, Y., & Ibrahim, A. (2023). Integrating AI in e-learning: Benefits for Nigerian universities. *Nigerian Journal of Educational Research*, 18(1), 85–102.
- Olivier, E., Archambault, I., De Clercq, M., & Galand, B. (2019). Student self-efficacy, classroom engagement, and academic achievement: Comparing three theoretical frameworks. *Journal of youth and adolescence*, 48(2), 326-340.
- Onesi-Ozigagun, O., Ololade, Y.J., Eyo-Udo, N.L., & Ogundipe, D.O. (2024). Revolutionizing education through AI: A comprehensive review of enhancing learning experiences. *International Journal of Applied Research in Social Sciences*, 6(4), 589–607.
- Popenici, S.A. & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, 12(1), 1–13.