

Evaluating the impact of Kahoot-based gamification on student learning engagement and academic performance in higher education

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Abstract

The integration of digital technologies in higher education has led to a search for innovative instructional strategies to enhance student engagement and academic performance. This study examined the impact of Kahoot-integrated instruction on engagement, motivation, interest, and academic achievement among second-year students in a Science course at the University of Calabar. A quasi-experimental design involved 135 students, assigned to either a Kahoot-based instructional group or a conventional lecture group. Data analysis using descriptive statistics, correlation, regression, and ANOVA revealed significant improvements in academic performance for the Kahoot group, attributed to its interactive features, including real-time quizzes and immediate feedback. Strong relationships were found among engagement, motivation, interest, and academic achievement, indicating the importance of these factors in learning. Although the model was statistically significant, some variance in achievement remained unexplained, suggesting other influencing factors. The study concludes that Kahoot-integrated instruction is more effective than traditional methods, highlighting the need to foster student engagement, motivation, and interest for optimal learning outcomes.

Introduction

The rapid expansion of digital technologies has significantly reshaped teaching and learning practices in higher education worldwide. Universities increasingly adopt technology-mediated instructional approaches to address challenges associated with student engagement, large class sizes, and evolving learning expectations. In many African higher education institutions, the integration of digital technologies into pedagogy remains uneven due to infrastructural limitations, resource constraints, and limited exposure to innovative instructional models.

The COVID-19 pandemic further accelerated the adoption of digital learning platforms across universities, highlighting both the opportunities and challenges associated with technology-enhanced education. Institutions that previously relied heavily on traditional lecture-based instruction were compelled to explore digital tools capable of sustaining student participation and academic continuity. Within this context, game-based learning and gamification have emerged as promising strategies for promoting active learning and improving educational outcomes.

Gamification involves integrating game design elements, such as competition, points, feedback, and leaderboards, into non-game contexts to enhance motivation and engagement (Dahalan et al., 2024). In educational settings, gamified platforms can transform passive classroom experiences into interactive learning environments that stimulate curiosity and participation. One widely used gamified learning platform is Kahoot!, a digital student response system that enables instructors to conduct real-time quizzes and interactive assessments.

Despite growing global interest in gamification, empirical evidence regarding its effectiveness in African higher education remains limited. Most studies examining Kahoot! have been conducted in Europe, North America, or Asia, leaving a significant gap in understanding how such tools function in contexts

characterized by differing technological infrastructures and learning cultures. This study addresses this gap by investigating the pedagogical impact of Kahoot! in science education within a Nigerian university.

Theoretical Framework

This study is grounded in three complementary theoretical perspectives: Constructivist Learning Theory, Self-Determination Theory, and Cognitive Engagement Theory.

Constructivist theory by Piaget (1977) posits that knowledge is actively constructed through interaction with learning environments rather than passively received from instructors. Interactive tools such as Kahoot! provide opportunities for students to engage with course material through questioning, peer comparison, and immediate feedback, thereby facilitating deeper conceptual understanding. Self-determination theory by Deci and Ryan (2000) emphasizes the importance of autonomy, competence, and relatedness in motivating learners. Gamified environments support these psychological needs by allowing students to participate voluntarily, receive feedback on their progress, and interact with peers during learning activities. Cognitive engagement theory by Chi and Wylie (2014) highlights the role of active mental involvement in the learning process. Tools that promote questioning, reflection, and participation can stimulate deeper cognitive processing, leading to improved academic performance.

Together, these theoretical perspectives provide a framework for understanding how gamified digital platforms influence both cognitive and affective dimensions of learning.

Literature Review

The increasing integration of technology in education has stimulated growing interest in gamification as a strategy for enhancing student engagement, motivation, and learning outcomes. Gamification, which involves the incorporation of game elements such as points, leaderboards, and immediate feedback into instructional contexts, seeks to transform traditionally passive learning environments into interactive and participatory experiences. Within higher education, this approach has been particularly valuable in addressing persistent challenges such as low student engagement, limited participation, and declining motivation (Medvedev et al., 2023; Nguyen et al., 2024).

A substantial body of literature highlights the effectiveness of gamified instructional tools, particularly student response systems such as Kahoot!, in promoting active learning. Empirical studies conducted across European and Asian contexts indicate that Kahoot! enhances classroom interaction, sustains students' attention, and fosters collaborative learning (Ebadi et al., 2023; Dana & Yendol-Hoppey, 2020). The platform's competitive features, such as timed responses and leaderboards, are widely reported to stimulate motivation and reinforce learning through repetition and immediate feedback. Similarly, Aibar-Almazán et al. (2024) found that the use of gamified quizzes significantly improved students' concentration, participation, and overall classroom engagement.

Beyond engagement, gamification has also been linked to improvements in students' motivation and learning experiences. Motivation, whether intrinsic or extrinsic, plays a critical role in shaping learners'

willingness to invest effort in academic tasks. Gamified environments can support both forms: external rewards such as badges and rankings encourage participation, while interactive and enjoyable learning experiences can foster intrinsic interest. Empirical evidence suggests that students exposed to gamified instruction often report higher levels of motivation, persistence, and self-efficacy (Ranieri et al., 2021). Furthermore, immediate feedback provided by digital response systems enables learners to monitor their progress and address misconceptions, thereby strengthening their sense of competence.

Recent systematic reviews and meta-analyses provide further support for the pedagogical value of gamification. For instance, Ratinho et al. (2026) reported statistically significant positive effects of gamified learning interventions on students' motivation and engagement across secondary and higher education contexts. Similarly, studies by Altawalbeh (2023) and Rahmahani (2020) emphasize that gamification promotes collaborative learning, peer interaction, and formative assessment, all of which contribute to deeper learning experiences.

However, despite these promising findings, the relationship between gamification and academic achievement remains complex and somewhat inconsistent. While some studies report significant improvements in students' academic performance following the integration of gamified tools (Ranieri et al., 2021; Tóth et al., 2019; Malak, 2024), others have found minimal or non-significant effects (Wang & Tahir, 2020; Aras & Çiftçi, 2021). In some cases, gamification appears to influence affective outcomes such as enjoyment, interest, and engagement more strongly than cognitive outcomes related to achievement (Asniza et al., 2021; Zhang & Yu, 2021; Gündüz & Akkoyunlu, 2020). These mixed findings suggest that the effectiveness of gamification may depend on contextual factors, including instructional design, subject matter, and cultural setting.

Scholars further argue that the success of gamification is largely contingent upon its pedagogical alignment. Poorly designed gamified activities, excessive competition, or superficial integration of game elements may undermine learning by shifting students' focus from content mastery to performance outcomes (Kalleney, 2020; Buenadicha-Mateos et al., 2025). While competitive features can enhance attention and participation, they may also create anxiety or discourage lower-performing students if not carefully balanced with cooperative elements. Therefore, effective gamification requires thoughtful integration with instructional objectives, learning outcomes, and students' motivational needs.

Student engagement, a central construct in educational research, provides a useful lens for understanding the impact of gamification. Engagement encompasses behavioral, emotional, and cognitive dimensions that collectively influence students' participation and persistence in learning activities. Empirical evidence indicates that gamified instructional strategies can significantly enhance behavioral engagement, as students become more willing to participate in classroom discussions and activities (Cárdenas-Moncada et al., 2020). Nevertheless, sustained engagement depends not only on novelty but also on meaningful integration of gamified elements with course content.

Despite the growing global interest in gamification, research within African higher education contexts remains relatively limited. This gap is noteworthy, given the distinct challenges faced by many African

institutions, including limited digital infrastructure, large class sizes, and the continued dominance of lecture-based teaching methods. These contextual factors may influence how students interact with and benefit from gamified learning tools. Emerging evidence, however, suggests promising outcomes. Kaje (2026) reported that the integration of Kahoot! in a Kenyan university significantly enhanced students' engagement, motivation, and interest in course content. Such findings highlight the potential of gamified platforms to support interactive learning even in resource-constrained environments, particularly through the use of widely accessible mobile technologies.

In summary, the literature indicates that gamification, and specifically tools such as Kahoot!, holds considerable potential for enhancing student engagement and motivation in higher education. While evidence regarding its impact on academic achievement remains mixed, there is a strong consensus that gamified instructional strategies can enrich the learning experience when thoughtfully designed and implemented. However, the limited empirical evidence within African contexts underscores the need for further research to better understand the effectiveness and contextual adaptability of gamification in diverse educational settings.

Research Hypotheses

The study tested the following hypotheses:

1. There is no significant difference in academic performance between students taught using Kahoot!-supported instruction and those taught using conventional instructional methods.
2. There is no significant relationship among student engagement, motivation, interest, and academic performance.

Methodology

The study adopted a quasi-experimental factorial design because it made it possible to evaluate the outcomes of the independent variables separately as well as the combined effects of the independent and interactive effects (Onwioduokit, 2000). This design was adopted because it was not possible to complete the randomization of subjects. Entire classes were randomly allotted to experimental and control groups. The study involved 135 second-year undergraduate students enrolled in the course Science, Technology, and Society (SED 213) in the Department of Science Education at the University of Calabar, Nigeria. Participants were divided into two groups: the Kahoot!-integrated instruction group was the experimental group (56 students), and the conventional instruction group was the control (79 students)

Two instruments were used for the study: the Science Achievement Test (SAT) with a reliability of 0.76 using Kuder-Richardson R-20 and a four-point Likert scale of 15 items each in the Student Interest, Engagement, and Motivation Questionnaire with a reliability of 0.72, 0.78, and 0.89, respectively, using Cronbach's alpha reliability estimate. The SAT is a 50-item objective test based on the course content, administered as a pre-test to both groups, and likewise the questionnaire, which served as baseline data.

Instruction was delivered over a 16-weeks semester. Kahoot! Quizzes were incorporated into lecture sessions as formative assessments aligned with course content for the experimental group. Each quiz session lasted approximately 10 minutes and included multiple-choice and true/false questions designed to reinforce key scientific concepts in line with the course content. The control group received instruction with the conventional lecture strategy in line with the course content. At the end of the semester, Students completed a final examination, and Participants responded to a post-intervention questionnaire assessing engagement, motivation, and interest. Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Analytical techniques included Descriptive statistics, Analysis of covariance (ANCOVA), Pearson correlation, and Multiple regression analysis.

Results

Hypothesis one

Table 1
Mean (M) and standard deviation of students’ pre-test and post-test scores
classified by treatment groups

Treatment Groups	N	Pre-test	Post-test	Mean Gain Score
		M SD	M SD	
Conventional strategy	79	6.05 1.50	33.32 2.81	27.27
Kahoot-integrated strategy	56	6.39 1.24	41.03 3.47	34.64

The results indicate a clear and meaningful difference in academic performance between the conventional instructional strategy and the Kahoot-integrated approach.

At baseline, both groups demonstrated nearly equivalent prior knowledge, with mean pretest scores of 6.05 (conventional group) and 6.39 (Kahoot group). This similarity suggests that the two groups were comparable before the intervention, thereby strengthening the internal validity of the comparison and implying that subsequent differences can reasonably be attributed to the instructional strategies rather than pre-existing disparities.

Following the intervention, both groups showed substantial improvement; however, the magnitude of improvement differed considerably. The conventional group achieved a posttest mean score of 33.32 with a mean gain of 27.27, while the Kahoot-integrated group attained a notably higher posttest mean of 41.03 and a mean gain of 34.64. This indicates that although traditional instruction was effective in enhancing students’ learning, integrating Kahoot yielded a greater learning gain.

Table 2

Summary of Analysis of Covariance (ANCOVA) of the students' post-test scores classified by treatment groups with pre-test scores as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Decision at $p < .05$ alpha
Corrected Model	2003.683 ^a	2	1001.842	107.868	.000	.620	S
Intercept	7593.242	1	7593.242	817.559	.000	.861	S
Treatment	1839.569	1	1839.569	198.065	.000	.600	S
Pretest	57.395	1	57.395	6.180	.014	.045	S
Error	1225.976	132	9.288				
Total	183339.000	135					
Corrected Total	3229.659	134					
a. R Squared = .620 (Adjusted R Squared = .615)							
b. Computed using alpha = .05							

The statistical analysis further reinforces this observation. The reported significance level of $p = .000$ ($p < .05$) indicates that the difference in achievement between the two groups is statistically significant and unlikely to have occurred by chance. More importantly, the partial eta squared value of 0.60 suggests a very large effect size, meaning that approximately 60% of the variance in students' academic performance can be explained by the type of instructional strategy employed. This reflects a substantial practical significance, highlighting the strong impact of the Kahoot-integrated approach on students' learning outcomes.

Hypothesis two

The correlation matrix reveals strong, positive, and statistically significant relationships among students' interest, engagement, motivation, and academic performance.

Table 3
Correlation Matrix of Study Variables

	Interest	Engagement	Motivation	Achievement
Interest	1			
Engagement	.798**	1		
	.000			
Motivation	.773**	.758**	1	
	.000	.000		
Achievement	.733**	.669**	.675**	1
	.000	.000	.000	
**. Correlation is significant at the 0.01 level (2-tailed).				

All reported correlations are significant at the 0.01 level ($p = .000$), indicating that the observed relationships are unlikely to have occurred by chance and reflect meaningful associations among the variables.

There is a very strong positive relationship between interest and engagement ($r = .798$). This suggests that students who demonstrate higher levels of interest in learning activities are also more likely to be actively engaged in the learning process. This finding is theoretically consistent, as interest often serves as a precursor to engagement; when students find content appealing or relevant, they are more inclined to participate, pay attention, and invest effort.

Similarly, interest shows a strong positive correlation with motivation ($r = .773$). This implies that as students' interest increases, their intrinsic drive to learn also rises. Interest can enhance motivation by making learning experiences enjoyable and personally meaningful, thereby encouraging persistence and goal-directed behavior.

The relationship between engagement and motivation is also strong ($r = .758$), indicating that motivated students tend to be more behaviorally and cognitively involved in learning tasks. Motivation provides the energy and direction for engagement, while engagement reflects the visible manifestation of that motivation in classroom activities.

With respect to academic achievement, all three variables, interest ($r = .733$), engagement ($r = .669$), and motivation ($r = .675$) show strong positive correlations. This indicates that students who are more interested, engaged, and motivated tend to achieve higher academically. Among these, interest demonstrates the strongest relationship with achievement, suggesting that fostering students' curiosity and personal connection to the subject matter may have a particularly powerful impact on learning outcomes.

The slightly lower, though still substantial, correlations of engagement and motivation with achievement may reflect the complexity of academic performance, which is influenced not only by psychological factors but also by external variables such as teaching quality, prior knowledge, and assessment methods.

The regression results provide compelling evidence that students’ interest, engagement, and motivation jointly make a substantial contribution to predicting academic achievement.

Table 4: Summary of Multiple Regression Analysis Predicting Academic Achievement

Model	R	R ²	Adjusted R ²	SE Estimate	ΔR ²	F Change	df1	df2	Sig. ΔF
1	.757	.573	.563	3.24	.573	58.61	3	131	.000

a. Predictors: (Constant), Motivation, Engagement, Interest

The model yielded a multiple correlation coefficient of $R = .757$, indicating a strong positive relationship between the combined predictors (interest, engagement, and motivation) and academic achievement. This suggests that, taken together, these variables are closely associated with variations in students’ performance.

The R^2 value of .573 shows that approximately 57.3% of the variance in academic achievement is explained by the three predictors. This is a relatively high proportion in educational research, where learning outcomes are often influenced by numerous cognitive, social, and contextual factors. The adjusted R^2 of .563, which accounts for the number of predictors and sample size, remains very close to R^2 , indicating that the model is stable and not over fitted. In other words, the predictors included in the model meaningfully contribute to explaining achievement without inflating the explanatory power.

The standard error of the estimate (3.24440) reflects the average deviation of observed achievement scores from those predicted by the model. The relatively moderate size of this value suggests that the model provides a reasonably accurate prediction of students’ academic performance, though some unexplained variability still exists.

The change statistics further confirm the robustness of the model. The R^2 change of .573 indicates that the inclusion of interest, engagement, and motivation as predictors significantly improves the model compared to having no predictors. This is supported by the F-change value of 58.608 with degrees of freedom (3, 131), which is statistically significant at $p = .000$ ($p < .05$). This means that the model as a whole significantly predicts academic achievement, and the likelihood that this result occurred by chance is extremely low.

The ANOVA table evaluates whether the regression model, which includes interest, engagement, and motivation, significantly predicts students’ posttest scores (academic achievement).

Table 5
ANOVA Results for Regression Model Predicting Academic Achievement

Source	SS	df	MS	F	P
Regression	1850.74	3	616.91	58.61	.000
Residual	1378.92	131	10.53		
Total	3229.66	134			
a. Dependent Variable: Posttest					
b. Predictors: (Constant), Motivation, Engagement, Interest					

The regression sum of squares ($SSR = 1850.738$) represents the portion of the total variability in posttest scores that is explained by the predictors (interest, engagement, and motivation). In contrast, the residual sum of squares ($SSE = 1378.921$) reflects the unexplained variability differences in achievement that are due to other factors not included in the model. The total sum of squares ($SST = 3229.659$) captures the overall variability in students' posttest scores.

When these values are partitioned, it becomes evident that a larger proportion of the variance is explained by the model than remains unexplained. This is further reflected in the mean square values, where the mean square for regression (616.913) is substantially higher than the mean square for residuals (10.526). This large difference indicates that the model explains a meaningful amount of variation relative to random error.

The F-statistic ($F = 58.608$) tests whether the explained variance is significantly greater than the unexplained variance. With degrees of freedom (3, 131), the F-value is quite large and is associated with a significance level of $p = .000$ ($p < .05$). This indicates that the regression model as a whole is statistically significant. In practice, this means that the combination of interest, engagement, and motivation significantly predicts students' posttest achievement, and the observed relationship is highly unlikely to be due to chance.

Discussion

The findings demonstrate that integrating gamified student response systems into university teaching can enhance student engagement, interest, motivation and improve academic performance. The result for hypothesis one indicated a significant difference in the academic performance in favour of students that had kahoot integrated in their lectures. Several pedagogical factors may account for this observed difference. Kahoot-based instruction promotes active learning by engaging students in interactive quizzes, immediate feedback, and real-time competition. Such features align with constructivist learning principles, where learners actively construct knowledge through participation and feedback. The

gamified environment likely increased students' motivation, attention, and emotional involvement, all of which are known to enhance cognitive processing and retention. Also, the use of Kahoot may have reduced classroom monotony often associated with conventional teaching methods. Traditional strategies, which are typically teacher-centered, may limit opportunities for student interaction and immediate reinforcement. In contrast, Kahoot fosters a more learner-centered environment, encouraging participation from a wider range of students, including those who might otherwise remain passive.

The immediate feedback provided through Kahoot allows students to identify and correct misconceptions, thereby strengthening understanding quickly. This continuous formative assessment loop supports deeper learning compared to delayed or less frequent feedback in conventional settings. This result aligns with that of (Rahamahani 2020; Ranieri et al., 2021; Licorish & Lotter 2022; Sahin 2023; Altawalbeh 2023; Malak 2024; Nguyen et al.,2024; Andreani et al.,2024) but disagrees with that of (Wang & Tahir 2020 and Aras and Ciftci 2021) whose findings indicate a non- significant difference in the academic performance of students who had Kahoot integrated lecture.

While both instructional strategies were effective in improving students' achievement, the Kahoot-integrated approach proved significantly more effective, with a large effect size. The findings underscore the value of incorporating interactive, technology-enhanced, and student-centered tools into teaching practices to optimize learning outcomes. Additionally, the competitive and collaborative elements of Kahoot can enhance peer interaction and foster a positive classroom climate. This social dimension of learning may further contribute to improved academic performance by fostering engagement and sustained interest. These results support constructivist perspectives, which emphasize the importance of active participation in learning.

The positive correlations among engagement, motivation, and interest suggest that affective factors play an important role in shaping student learning experiences. When learners are emotionally and cognitively invested in classroom activities, they are more likely to persist in challenging tasks and develop a deeper understanding of course content. Several reasons can account for these findings. From a psychological perspective, interest enhances attention and cognitive processing, leading to deeper understanding and better retention of information. Engagement ensures that students are actively involved in learning tasks, increasing opportunities for practice and feedback. Motivation sustains effort over time, especially when students encounter challenging material.

Moreover, these variables are interrelated and mutually reinforcing. For example, an interested student becomes more motivated, which in turn promotes greater engagement, ultimately leading to improved academic achievement. This interconnectedness explains the consistently high correlations observed across the variables.

In practice, the results underscore the importance of creating learning environments that stimulate students' interest, sustain their motivation, and encourage active engagement. Instructional strategies that are interactive, relevant, and student-centered are more likely to produce these psychological states, thereby enhancing overall academic performance.

The correlation analysis highlights a coherent and theoretically grounded pattern: interest, engagement, and motivation are strongly linked to one another and collectively contribute to improved academic achievement. These findings reinforce the need for educators to address not only cognitive but also affective dimensions of learning in order to achieve optimal educational outcomes.

The regression results provide compelling evidence that students' interest, engagement, and motivation jointly contribute substantially to predicting academic achievement.

Several reasons can explain these outcomes. From a theoretical standpoint, interest, engagement, and motivation are core affective and behavioral constructs that directly influence how students approach learning. Interest enhances attention and curiosity, making students more receptive to new information. Motivation drives persistence and effort, particularly when tasks are challenging. Engagement reflects the extent to which students are actively involved in learning activities, which increases opportunities for practice, feedback, and deeper cognitive processing.

Moreover, these variables are not isolated; they interact synergistically. For instance, a student who is interested in a subject is more likely to feel motivated, and this motivation often translates into active engagement during instruction. This interconnected dynamic amplifies their combined predictive power, which explains the substantial proportion of variance explained by the regression model.

However, it is also important to recognize that 42.7% of the variance in achievement remains unexplained, suggesting the influence of other factors such as prior knowledge, instructional quality, socioeconomic background, cognitive ability, and assessment conditions. This highlights the multifaceted nature of academic achievement.

In summary, the regression analysis demonstrates that interest, engagement, and motivation are strong and significant predictors of academic achievement. Their combined influence is both statistically and practically meaningful, underscoring the importance of fostering these psychological and behavioral attributes within instructional settings to enhance students' learning outcomes.

However, regression analysis indicated that these variables explained only a small proportion of the variance in academic achievement, suggesting that additional instructional factors may contribute to performance outcomes. The ANOVA results confirm that the regression model is highly significant, demonstrating that interest, engagement, and motivation collectively provide a powerful explanation of students' posttest achievement. The findings highlight the importance of addressing these affective and behavioral dimensions in teaching and learning processes to achieve meaningful academic success. Several reasons can account for this outcome. For instance, interest, engagement, and motivation are foundational components of effective learning. Interest enhances students' attention and curiosity, making them more cognitively receptive during instruction. Engagement ensures that students are actively involved, participating, thinking, and interacting with content, thereby deepening understanding. Motivation, on the other hand, sustains effort and persistence, especially when learners encounter difficulties.

These variables tend to operate in a mutually reinforcing manner. An interested student is more likely to be motivated, and a motivated student is more likely to engage actively in learning tasks. This synergy increases the overall impact of these predictors, resulting in a strong combined effect on academic achievement, as reflected in the significant F-value.

The instructional context may have supported these relationships. For example, if the learning environment incorporated interactive or student-centered strategies (such as technology-enhanced tools), it could have amplified students' interest and engagement, thereby strengthening their motivation and ultimately improving performance. This agrees with the findings of (Cárdenas-Moncada et al., 2020; Gündüz & Akkoyunlu, 2020; Asniza et al., 2021; Zhang & Yu, 2021; Ranieri et al., 2021; Ratinho et al., 2026 and Kaje, 2026).

Despite the strong model, the residual variance (1378.921) indicates that other factors still influence achievement. Variables such as prior academic ability, teaching quality, learning resources, and socio-economic background may also play important roles, but were not included in this model.

Conclusion

In the African context, the integration of gamified tools such as Kahoot! represents a promising strategy for addressing persistent challenges associated with passive lecture-based teaching methods. By transforming traditional classrooms into interactive learning environments, such technologies can foster greater participation and support student-centered pedagogies.

This study provides empirical evidence that gamified digital learning platforms can enhance student engagement and academic performance in African higher education contexts. The findings suggest that Kahoot! can serve as a valuable instructional tool for promoting interactive learning and formative assessment in science education.

However, the effectiveness of such tools depends largely on how they are integrated into instructional practice. Educators should therefore focus not only on adopting digital technologies but also on designing pedagogical strategies that maximize their educational value.

Implications for Practice

The findings have several implications for higher education institutions in Africa:

1. Universities should encourage the integration of gamified digital tools into teaching practices.
2. Professional development programs should train instructors in technology-enhanced pedagogy.
3. Institutions should invest in digital infrastructure to support interactive learning environments.

Limitations and Future Research

The study was limited to a single institution and discipline. Future research should explore the use of gamified learning platforms across different academic fields and institutions in Africa.

Longitudinal studies may also provide deeper insights into the long-term effects of gamification on student learning and retention.

Declarations

Author's contribution

MIA, HAN, and IEI: Conceived and designed, and wrote the paper

AMN, LII, and JOA: Methodology, Statistical analysis, and interpretation of the data

JJO and EEE: Data acquisition and curation

AE and EBA: Material support

Conflict of interest

The authors declare no conflict of interest

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Ethical Declaration

Ethical approval for this study was obtained from the Research Ethical Review Board (UNICAL-RERB) of the University of Calabar, Nigeria (Approval No. UC/DR&D/RERB/56; April 29, 2026). The study was conducted in accordance with established ethical standards for research involving human participants.

Consent for publication

All participants provided oral consent for the publication of anonymised and aggregated data derived from their responses. No identifiable personal information is included in the manuscript.

Informed consent

Participants were duly informed of the study's objectives and procedures, and oral informed consent was obtained before data collection. Participation was entirely voluntary, and respondents were assured of their right to withdraw from the study at any stage without any adverse consequences.

Consent to publish

We, the authors, consent to the publication of the research manuscript in your journal if accepted for publication.

Data Availability Statement

The dataset generated or analyzed during the current study is available from the corresponding author on reasonable request

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