Impact of Game-Based Learning on Student's Engagement and Inclusiveness in Undergraduates Physics Classroom, in Abeokuta, Ogun State

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Abstract

Incorporating Game-Based Learning (GBL) into Physics education can revolutionize teaching-learning processes by providing interactive and participatory learning environments through the motivational spirit of gaming activity. This study examines the effect of GBL on students' inclusiveness and engagement in undergraduate Physics, based on Self-Determination Theory. A quasi-experimental design with a sample of 150 students divided into experimental (GBL Instruction) and control (Traditional Lecture, TL Instruction) groups was adopted. Data were collected using Student Engagement Scale (reliability coefficient 0.82) and Inclusiveness Perception Inventory (reliability coefficient 0.85); and analyzed using descriptive and Analysis of Covariace statistics at 0.05 significance level. Findings showed that students exposed to GBL recorded significantly higher mean scores in both engagement (**M = 67.80, SD = 6.11**) and inclusiveness (**M = 74.50, SD = 5.69**) compared to the TL group (**Engagement: M = 58.30, SD = 7.42**; **Inclusiveness: M = 61.70, SD = 8.06**). ANCOVA analysis indicated a **significant main effect** of teaching method on posttest engagement {$F(1, 147) = 47.44$, $p < 0.001$, **partial** $\eta^2 = 0.24$} and inclusiveness {$F(1, 147) = 79.26$, $p < 0.001$, **partial** $\eta^2 = 0.35$} scores between the experimental and control groups. The effect size of GBL on students' engagement (**Cohen's** $d = 1.40$) and inclusiveness (**Cohen's** $d = 1.83$) was observed to be very large. These findings indicated that GBL instruction had a substantial impact on students' engagement and inclusiveness compared to TL instruction. It is recommended that school authorities should organize training workshops for science teachers on GBL usage.

Keywords: Game-Based Learning, Physics, Inclusiveness, Engagement, Lecture Method.
Word Count: 248

Introduction

The integration of educational games into classroom teaching has emerged as an innovative strategy to enhance learning and student participation. Unlike traditional teacher-centered methods, educational games actively involve learners in problem-solving, collaboration, and decision-making processes, thereby transforming passive learning into an engaging experience. Research has shown that game-based learning (GBL) fosters motivation, sustains attention, and supports deeper conceptual understanding by combining instructional content with interactive, play-based elements (Khouna et al. 2019; Low et al. 2024; Plass & Kaplan, 2016; Qian & Clark, 2016). In addition, games can promote inclusiveness by providing differentiated roles, multimodal resources, and opportunities for every learner to contribute meaningfully, regardless of ability or background (Cezarotto et al. 2022; Honorato et al. 2024; Hung et al. 2018).

Several other studies have shown educational games to be associated with improved motivation, classroom climate, students' concept understanding, higher engagement and time-on-task, more peer discussion and contextualization among students, supporting deeper engagement beyond rote memorization, meaningful learning gains, deeper student inquiry, peer discussion and participation among students historically marginalized in class during game activities (Bjørner et al. 2023; Byusa et al. 2022; Galizia et al. 2025; Hodges et al. 2021; Rodríguez-Ferrer et al. 2023). In another study involving the use of Kahoot! games across educational levels and contexts, results showed that Kahoot! games produces consistent gains in affective engagement (enjoyment, interest) and behavioral indicators (participation, response rates) as well as large positive effects for short-term knowledge retention and moderate-to-large effects for achievement and motivation in classroom settings were also observed (Özdemir, 2024; Wang & Tahir, 2020). Aramillo-Alcázar et al. (2018) in their study observed that mobile games applied in lessons increased engagement, on-task behavior and inclusion in mainstream lessons. Wang et al. (2022) in their studies observed moderate positive effects of digital game-based on engagement and learning achievement of secondary students.

Several other studies that applied *game-based learning for learners with disabilities have reported that* GBL has the potential to improve academic skills, social participation and motivation among learners with disabilities; autonomy, and some domain-specific skills (attention, memory); improved task persistence and more peer-to-peer interaction (de la Torre & Livingston, 2020; Hersh & Leporini, 2018; Tlili, 2022). In another study by Bressler et al. (2021) serious game was observed to have created opportunities for authentic inquiry, motivated students, and supported collaboration, and gave students with diverse abilities multiple entry points to participate, especially those who might struggle with traditional lab-based inquiry, thereby enhancing inclusiveness. Papadopoulos et al (2024) in another study observed that gamification increased participation and self-reported inclusion indicators among students with diverse needs, in a way that adaptive badges and team scoring games helped scaffold participation for lower-confidence learners.

As classrooms become increasingly diverse, the dual potential of GBL to engage students and foster inclusiveness makes it a promising pedagogy. Its application in subjects like Physics, which students often perceive as abstract and difficult, may be particularly valuable in reducing barriers to participation while enhancing both learning outcomes and social equity.

Statement of the Problem

Traditional teacher-centered pedagogy have been shown to dissuade participation, marginalizes diverse learners and less effective in improving students' academic achievements in Physics, hampering students' deep learning and understanding of some Physics concepts especially in mathematically related Physics topics. On the other hand, Game-Based Learning (GBL) has emerged as a promising alternative pedagogy and has been shown to stimulate intrinsic motivation, sustain attention, boost cognitive engagement, and promote peer collaboration but still, there remains a relative dearth of research which focused specifically on student engagement and inclusiveness (i.e., sense of belonging, equal participation, access) within secondary school Physics.

This therefore necessitated the need to examine the possibility of GBL as a practical and innovative tool for teaching-learning of physics at an undergraduate level in a bid to making learning, both more engaging and inclusive for tertiary education students.

Aim and Objectives of the Study

The main aim of this study is to examine the impact of GBL on engagement and inclusiveness of students in undergraduate Physics classrooms. The objectives of this study are to compare the engagement and inclusiveness levels of students taught using the GBL Instruction and those taught using the Traditional Lecture Instruction.

Hypotheses

1. There is no significant difference in the academic engagement of physics students taught using GBL Instruction (experimental group) and those taught using the Traditional Lecture Instruction (control group).

2. There is no significant difference in the academic inclusiveness of physics students taught using GBL Instruction (experimental group) and those taught using the Traditional Lecture Instruction (control group).

Methodology

This study employs a quasi-experimental-descriptive research method. The target population for the study includes all Physics (100L - 300L) students in the school of Secondary Education (Sciences), Federal College of Education, Abeokuta, Ogun State, Nigeria. Through random sampling technique, 200L class consisting 150 physics students were selected as the sample size. The sample students were divided equally into experimental and control groups.

Data were collected with the aid of Student Engagement Scale (SES) and Inclusiveness Perception Inventory (IPI). The SES and IPI are questionnaires, self-developed by the researchers consisting of 20-items each. The SES are designed to measure students' engagement (behavioural, emotional and cognitive) in the classroom, while the IPI was designed to measure students' perception of belonging, equally involved, and adequately supported in learning activities. Responses to the SES and IPI were based on five-point Likert scale of Strongly Agree (SA = 5), Agree (A = 4), Undecided (UD = 3), Disagree (D = 2) and Strongly Disagree (SD = 1).

The SES and IPI were validated by expert colleagues in measurement and evaluation. The reliabilities of the instruments (SES and IPI) were determined using Cronbach's Alpha statistic to yield reliability coefficient values, α = 0.82 and 0.85, respectively.

An engagement and inclusiveness perception pre-test was administered on the two groups (experimental and control) to determine the students' entry behavior. Thereafter, the experimental group was taught using the GBL Instruction (GBLI), while the control group was taught using the Traditional Lecture Instruction (TLI). The teaching-learning activities for both groups took four weeks, after which a post-SES and post-IPI were administered to all students (experimental and control groups) under strict examination conditions to ensure students' total concentration and avoid communication of ideas among them. Collected data were analyzed using descriptive (mean, standard deviation) and inferential (t-test, Cohen's) statistics at 0.05 level of significance with the aid of SPSS statistical software.

Results and Discussion of Findings

Ho1: There is no significant difference in the academic engagement of physics students taught using GBL Instruction, GBLI (experimental group) and those taught using the Traditional Lecture Instruction, TLI (control group).

Table 1: Pretest and posttest academic engagement scores of physics students exposed to GBLI and TLI.

Treatment		**Students' Academic Engagement**						
		Pretest Score			**Posttest Score**			**Cohen's Stats**
Group	**N**	**Mean**	**S.D**	**MSD**	**Mean**	**S.D**	**MSD**	**d-value**
Experimental (GBLI)	75	57.86	10.26		67.80	6.11		
Control (TLI)	75	56.94	10.89	0.92	58.30	7.42	9.50	1.40

MS = Mean Score , SD = Standard Deviation, MSD = Mean Score Difference, Stats = Statistics

Source: Fieldwork, 2025

Table 1 revealed the pretest and posttest scores of students' academic engagement under GBL and TL instructions. As seen on the table, the pretest means were similar across groups (GBL = 57.86, *SD* = 10.26; TL = 56.94, *SD* = 10.89, MSD = 0.92). Table 1 also revealed that physics students taught using GBLI had a higher posttest mean engagement score (MS = 67.80, SD = 6.11) than those taught using TLI (MS = 58.30, SD = 7.42), with a mean score difference, MSD = 9.50. Cohen's analysis further revealed a d-value, d(148) = 1.40. This indicates that GBLI had a very large effect on students' engagement in the classroom. These results showed that students in GBLI classroom showed higher participation in learning activities, increased learning interest and stronger effort in deep learning than their colleagues taught using the conventional TLI.

Table 2: Summary of ANCOVA Analysis result for students' academic engagement under GBL and TL Instructions

Dependent Variable: Engagement (Posttest)

Source	Type III Sum of Squares	df	Mean square	F	Sig	Partial Eta Squared
Corrected Model	2355.18	2	1177.59	27.41	0.000	0.27
Intercept	1210.63	1	1210.63	28.16	0.000	0.16
Pretest (Covariate)	315.72	1	315.72	7.35	0.008	0.05
Teaching Method (Independent Variable)	2039.46	1	2039.46	**47.44**	**0.000**	**0.24**
Error	6363.52	147	43.30			
Total	60355.00	150				
Corrected Total	8718.70	149				

Independent variable: Teaching methods (GBLI, TLI), **Covariate: pretest engagement score**
Source: Fieldwork, 2025

Table 2 showed the results of analysis of covariance (ANCOVA) conducted to examine the effect of the teaching methods (*GBLI* and *TLI*) on students' engagement scores. These results showed that there was a **significant main effect** of teaching methods on posttest engagement, $F(1, 147) = 47.44$, $p < 0.001$, partial $\eta^2 = 0.24$. This result indicated that approximately 24% of the variance in the posttest engagement scores was attributable to differences in teaching method, after controlling for pretest engagement. The covariate (pretest engagement) was also statistically significant, $F(1, 147) = 7.35$, $p = 0.008$, partial $\eta^2 = 0.05$, suggesting that initial engagement levels had a little influence of approximately 5% on students' posttest engagement. These results demonstrated that, even after accounting for pretest differences, **GBL Instruction significantly enhanced students' engagement levels** compared with the Traditional Lecture Instruction. This finding underscores the effectiveness of game-based pedagogies in fostering active student participation and sustained learning engagement in physics classrooms.

These findings support previous studies such as that of Barata et al. (2017), **Kalleny (2020),** Li et al. (2023), Rodríguez-Ferrer et al. (2023), **Wang & Tahir (2020),** Wulaningrum & Novitasari (2024), among others. Research studies like that of Barata et al. (2017) and Li et al. (2023) found that gamified media supported differentiated pacing and increased engagement for students requiring extra supports, such that teachers also reported easier formative differentiation. Rodríguez-Ferrer et al. (2023) *in a* quasi-experimental study found GBL to significantly improved classroom climate, engagement measures, motivation and participation among historically marginalized students, with teachers observed that GBL activities **reduced disruptive behaviors** and fostered **a sense of belonging** among students in socially deprived contexts. Wulaningrum & Novitasari (2024) in their study of how Quizizz as a gamified practice tool supported vocabulary enrichment observed increased students' motivation, enjoyment, and willingness to practice vocabulary; classroom observations also showed higher voluntary participation during Quizizz activities and richer discussion about word usage. In other related studies, Kahoot! (a gaming tool) was observed to correlated positively with multiple engagement indicators (attention, participation, enjoyment) and modestly with short-term academic outcomes (**Kalleny, 2020; Wang & Tahir, 2020**).

Ho2: There is no significant difference in the academic inclusiveness of physics students taught using GBL Instruction, GBLI (experimental group) and those taught using the Traditional Lecture Instruction, TLI (control group).

Table 3: Pretest and posttest academic inclusiveness scores of physics students exposed to GBLI and TLI.

Treatment		**Students' Academic Engagement**						
		Pretest Score			**Posttest Score**			**Cohen's Stats**
Group	**N**	**Mean**	**S.D**	**MSD**	**Mean**	**S.D**	**MSD**	**d-value**
Experimental (GBLI)	75	55.78	11.64		74.50	5.69		
Control (TLI)	75	55.36	11.12	0.42	61.70	8.06	12.8	1.83

MS = Mean Score , SD = Standard Deviation, MSD = Mean Score Difference, Stats = Statistics
Source: Fieldwork, 2025

Table 3 showed the pretest and posttest scores of students' academic inclusiveness under GBL and TL instructions. As revealed by the table, the pretest means were relatively similar across groups (GBLI group = 55.78, *SD* = 11.64; TLI = 55.36, *SD* = 11.12, MSD = 0.42). Table 3 also showed that those students exposed to GBLI had a higher posttest mean inclusiveness score (MS = 74.50, SD = 5.69) than those exposed to TLI (MS = 61.70, SD = 8.06), with a mean score difference, MSD = 12.80. Cohen's analysis conducted also revealed a d-value, d(148) = 1.83, indicating a very large effect of GBLI on students' academic inclusiveness in the classroom. Overall, these results showed that students in GBLI supported classrooms demonstrated more equal involvement and adequate access support than their colleagues taught using the conventional TLI.

Table 4: Summary of ANCOVA Analysis result for students' inclusiveness when subjected to GBL and TL Instructions

Dependent Variable: Inclusiveness (Posttest)

Source	Type III Sum of Squares	df	Mean square	F	Sig	Partial Eta Squared
Corrected Model	3820.64	2	1910.32	42.88	0.000	0.37
Intercept	2178.45	1	2178.45	48.88	0.000	0.25
Pretest (Covariate)	275.63	1	275.63	6.19	0.014	0.04
Teaching Method (Independent Variable)	3530.02	1	3530.02	**79.26**	**0.000**	**0.35**
Error	6546.77	147	44.54			
Total	74155.00	150				
Corrected Total	10367.41	149				

Independent variable: Teaching methods (GBLI, TLI), **Covariate: pretest engagement score**
Source: Fieldwork, 2025

Table 4 showed the results of analysis of covariance (ANCOVA) conducted to examine the effect of the teaching methods (*GBL* and *TL Instructions*) on students' inclusiveness in class. These results showed that there was a **significant main effect** of teaching method on posttest inclusiveness, $F(1,\ 147) = 79.26$, $p < 0.001$, partial $\eta^2 = 0.35$. This result indicates that approximately 35% of the variance in the posttest inclusiveness scores was attributable to differences in teaching method, after controlling for pretest inclusiveness. The pretest inclusiveness (covariate) was statistically significant, $F(1, 147) = 6.19$, $p = 0.014$, partial $\eta^2 = 0.04$, even though it had a little influence of approximately 4% on the posttest inclusiveness. These results indicate that, **GBL Instruction significantly enhanced students' inclusiveness levels** compared with the Traditional Lecture *Instruction*, thus, emphasizing the pedagogical strength of GBL instruction to foster equitable involvement and participatory classroom learning experiences.

The findings from this study are in line with previous research works of Avdiu (2022), Papadopoulos et al. (2024), Peterson (2019), Quintero & Silva (2022), Tsai, Huang, and Chen (2022), among others. Avdiu (2022) found GBLI to increased social participation, peer collaboration, and voluntary engagement for students with diverse learning needs, with teachers reporting easier differentiation and more natural peer supports during game play. Papadopoulos et al. (2024) in their study of team-based gamification *observed that* gamification increased participation and self-reported inclusion indicators among students with diverse needs; adaptive badges and team scoring helped scaffold participation for lower-confidence learners. Several studies such as that of Peterson (2019) showed that digital game-based tools supported inclusiveness by providing multiple entry points for diverse learners, encouraging peer collaboration and differentiated, and enabling students with varied skills to engage meaningfully. Tsai, Huang, and Chen (2022) found that gamified formative assessment not only enhanced students' motivation and performance but also fostered inclusiveness in classrooms by providing accessible entry points, sustained engagement and positive reinforcement that encouraged learners with different ability levels to participate equitably.

Conclusion

The study concludes that Game-Based Learning Instruction (GBLI) supported higher levels of students' engagement and inclusiveness compared to the traditional lecture *Instruction*. The interactive and participatory nature of game-based learning created an enjoyable learning environment that encouraged students' collaboration, active participation, and equal involvement. These results suggest that GBL effectively promotes students' interest, teamwork, and sense of belonging, leading to a more inclusive classroom experience. Therefore, GBL when properly applied in classroom teaching-learning processes can foster more active motivation, and participation, and consequently improved intellectual engagement and inclusiveness among students irrespective of their level and learning capabilities.

Recommendations

Based on the findings obtained from this study, it is recommended that school authorities and other education stakeholders should (i) organize training workshops and seminars for science teachers on the use of GBL in science teaching and learning processes, (ii) encourage and ensure science teachers integrate GBL in their teaching-learning activities, (iii) support science teachers with all necessary learning materials needed for effective implementation of GBL in classrooms.

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