

Assessing the Challenges of Using Gamification in Secondary Chemistry Education in Bayelsa State, Nigeria

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Abstract

This study employed a descriptive survey design to investigate the challenges of implementing gamification in secondary school Chemistry education in Bayelsa State. The population comprised all Chemistry teachers in public and private secondary schools across the eight Local Government Areas (LGAs). A multi-stage sampling procedure yielded 160 Chemistry teachers from 80 schools. Data were collected using a researcher-developed instrument, the Gamification Challenges in Chemistry Education Questionnaire (GCCEQ). The instrument was validated by experts in science education and educational technology, while a pilot test produced a Cronbach's alpha coefficient of 0.72, indicating acceptable reliability. Questionnaires were distributed directly and via online platforms where access was limited. Data were analysed using descriptive statistics (frequency, mean, and standard deviation) and inferential statistics (one sampled t-test and independent sampled t-test) at the 0.05 significance level, with SPSS version 26. Findings among others indicated that inadequate digital infrastructure, lack of teacher training, and insufficient institutional support were the main barriers to effective gamification in Chemistry classrooms; no significant difference in the challenges and attitudes of public and private school Chemistry teachers toward the use of gamification as an instructional strategy in Bayelsa State secondary schools. The study concluded that although gamification holds potential to enhance student engagement and learning outcomes, systemic challenges hinder its adoption. It is recommended that government and school authorities provide adequate digital resources, implement continuous professional development for teachers, and integrate gamified strategies into the Chemistry curriculum to improve learning experiences.

Keywords: *Gamification, Secondary School, Chemistry Education, Teachers, Challenges*

INTRODUCTION

Modern educational contexts increasingly employ inventive teaching methods to boost student engagement, comprehension, and academic success. One prominent approach is gamification, the incorporation of game design elements into non-game settings, which has been shown to foster greater enjoyment and improved academic outcomes compared to traditional instruction (Zeng, Sun & Looi, 2024). In the discipline of science education, particularly Chemistry, gamification has been recognized for its potential to demystify complex concepts, drive interactive learning, and sustain learner interest (Ibáñez & Delgado-Kloos, 2018). Yet, despite

such recognized benefits, effective gamification uptake in Nigerian secondary schools remains inconsistent and is plagued by significant challenges, especially in resource-depleted contexts like Bayelsa State.

Chemistry, as a core science subject, is considered difficult and abstract by most secondary school students in Nigeria (Nwosu & Nzewi, 2021). Poor achievement, low student interest, and excessive failure rates at the senior secondary levels are immediate results of this viewpoint (WAEC Chief Examiner's Report, 2023). Pedagogical innovations such as gamification serve as excellent substitutes for traditional teacher-controlled approaches to counter these problems. Empirical studies indicate that gamified learning environments can improve cognitive capacity, enhance understanding, and boost retention in science modules (Hamari, Koivisto & Sarsa, 2016; Yusuf, Onifade & Bello, 2020). Nevertheless, the use of gamification in Nigerian Chemistry instruction faces numerous challenges.

Bayelsa State, one of the Niger Delta states in Nigeria, presents a unique educational landscape characterized by infrastructural deficits, teacher shortages, and socio-economic challenges (UNESCO, 2022). These systemic issues impede the adoption of digital resources and technology-based pedagogy, such as gamification. Early observations suggest that most Chemistry instructors in the state lack extensive training in gamified teaching, and schools are poorly equipped with the digital infrastructure necessary to support interactive learning platforms (Eze & Okojie, 2021). Furthermore, the curriculum is not flexible enough to accommodate innovative teaching approaches, and there is minimal institutional support for technology use.

Gamification in education has swept the globe as a learning engagement strategy, particularly in science, technology, engineering, and mathematics (STEM) education. However, empirical research consistently illustrates that despite its teaching potential, gamification is underutilized in African high school classrooms due to various structural, technical, and pedagogical reasons. Yusuf and Bello (2021) conducted a nationwide study on the use of gamified teaching materials in high school science and found that over 70% of teachers were not adequately trained in developing and applying gamified content. The study uncovered limitations like lack of proper ICT infrastructure, poor internet connectivity, limited access to gamification platforms, and negative attitudes from teachers towards non-traditional learning methods. These limitations were most pronounced in rural and disadvantaged regions, such as Bayelsa State.

Similarly, Okoli, Nnadi, and Ezeh (2022) investigated Chemistry teachers' readiness for gamification in the South-South region of Nigeria and discovered that only 18% of the teachers had ever used gamified learning techniques in their classes. Key limitations included lack of teacher training in gamification, institutional discouragement, and a rigid curriculum that does not accommodate creative learning designs. Teachers noted time limitations and the failure to integrate game features with examination-oriented teaching objectives as significant challenges. Ekperi and Koko (2023) examined the use of technology learning tools in secondary schools and found that fewer than 10% of Chemistry teachers had access to computers or interactive learning platforms. Most schools lacked functional science laboratories, let alone devices that enable game-based learning. Infrastructural imbalances were identified as the major constraint, driven by the fact that rural school technology is underfunded by the government.

Moreover, the role of teacher motivation and self-efficacy in using gamified practices was emphasized by Ojo and Adebayo (2020). From a sample of 250 science teachers across three Nigerian states, they found that although teachers recognized the benefits of gamification, they were reluctant to adopt it due to uncertainty about their capabilities, lack of digital literacy, and concerns about deviating from conventional classroom norms. Empirical findings suggest that learner attitudes also determine the success or failure of gamified instruction. A mixed-methods study involving 300 high school students by Uzor and Nwafor (2021) found that students responded positively to gamified Chemistry lessons, reporting enhanced interest and understanding. However, due to the inconsistent application, there was a decline in long-term motivation and engagement.

Ibáñez and Delgado-Kloos (2018) provided strong empirical evidence supporting the gamification of science instruction, demonstrating under laboratory conditions that students exposed to gamified versions of Chemistry

modules achieved higher levels of cognitive gain and retention rates than those in regular classrooms. Nevertheless, they noted that effective implementation depended heavily on the availability of digital infrastructure, trained staff, and curriculum consistency factors often lacking in resource-constrained environments like Bayelsa State. A UNESCO (2022) report on education technology in Sub-Saharan Africa similarly attests to these findings, highlighting significant bottlenecks such as disparate access to hardware devices, electricity, and digital learning platforms. It underscored the need for context-specific policy interventions and teacher capacity-building programs focused on scientific teaching innovation.

Despite global interest in gamified learning, localized studies addressing its implementation challenges within Nigeria, particularly in Bayelsa State, are sparse. Most existing literature focuses on the benefits of gamification or its theoretical basis with little empirical reference to contextual constraints in Nigerian secondary schools. Therefore, there exists an immediate need to assess the pragmatic limitations that hinder the deployment of gamification in secondary Chemistry classes in Bayelsa State. Understanding these challenges is essential to develop informed policies, context-appropriate interventions, and empower teachers with the necessary skills and resources to use gamified learning effectively. This study, therefore, seeks to determine the primary hindrances to gamification in Chemistry instruction at the secondary school level in Bayelsa State. It aims to bridge the knowledge divide by examining the infrastructural, pedagogical, technological, and socio-cultural drivers influencing the adoption of gamified pedagogical practices. It will contribute to the growing argument in Nigeria on educational innovation and provide practical insights for stakeholders interested in enhancing the teaching of science using innovative pedagogical tools.

Research Questions

The following research questions guided the study:

1. What are the major challenges faced by Chemistry teachers in integrating gamification into classroom instruction in secondary schools in Bayelsa State?
2. Are there differences in the challenges of using gamification based on school type?
3. What are the attitudes of Chemistry teachers towards gamified learning in Bayelsa State secondary schools?

Hypotheses

The following hypotheses were tested at 0.05 significant level:

HO1: Chemistry teachers in Bayelsa State do not face significant challenges in integrating gamification into classroom instruction.

HO2: There is no significant difference in the challenges faced by public and private school Chemistry teachers in integrating gamification into classroom instruction.

HO3: There is no significant difference in the attitudes of public and private school Chemistry teachers toward the use of gamification as an instructional strategy in Bayelsa State secondary schools.

Theoretical Framework

Two theoretical frameworks were used in the study: Cognitive Load Theory (Sweller, 1988) and Self-Determination Theory (SDT) – Deci and Ryan (1985).

Cognitive Load Theory (Sweller, 1988): Cognitive Load Theory also emphasizes control of mental effort in instructional design. Cognitive Load Theory expects that if learning activities impose too much extraneous cognitive load on learners, they may not be able to process and retain information.

Gamification, if not used well, will introduce excessive visual and auditory stimulation, which will distract the learners from the critical chemistry content. It is particularly challenging in subjects like chemistry, which already demand extensive abstract thinking and symbolic representation (Paas et al., 2003). Chemistry is a mentally challenging discipline that requires intricate symbolic expressions, abstract thinking, and multi-step solutions (Johnstone, 1997). The inherent cognitive load in chemistry is substantial due to the need to understand molecular structures, equations, and experimental methods. Introducing gamification, which incorporates elements such as visuals, sounds, points, and story contexts, can either enhance learning (by boosting germane load) or obstruct it (by raising extraneous load), depending on its design and implementation.

Application to Study: Cognitive Load Theory allows for consideration of whether practice in gamification in Bayelsa State's schools aids or hinders cognitive processing for learning chemistry especially in low-resourced schools where teachers do not have the ability to design cognitively effective gamified experiences.

Self-Determination Theory (SDT) – Deci and Ryan (1985): Self-Determination Theory (SDT) offers a psychological perspective that gives a priority to intrinsic motivation to learning. According to SDT, the application of gamification to education is strongly dependent on how much gamification supports learners' psychological needs for autonomy, competence, and relatedness (Deci & Ryan, 2000).

Such gamification elements as leaderboards, levels, and badges are intended to heighten learner engagement and intrinsic motivation. Yet, if poorly implemented, they can become extrinsically motivated and kill learners' autonomy if students are pressured or if rewards overshadow meaningful learning goals (Dichev & Dicheva, 2017).

Application to Study: SDT helps analyse whether gamified teaching of chemistry in secondary school increases student motivation or has problems that hinder productive engagement such as overreliance on extrinsic rewards, lack of sensitivity to culturally suitable games, or infrastructural limitations.

METHODOLOGY

The descriptive survey research design was employed in this study to explore the challenges of implementing gamification for secondary Chemistry education in Bayelsa State. This design was considered appropriate because it allows for systematic collection, analysis, and interpretation of data from a given population, providing information on existing conditions, practices, perceptions, and challenges without manipulating the variables (Creswell, 2014). The population of interest included all the Chemistry teachers both public and private secondary schools in the eight Local Government Areas (LGAs) of Bayelsa State. These groups were chosen due to their active roles in Chemistry teaching and learning activities where gamification could be introduced. A multi-stage sampling procedure was employed:

- a. Stage One – Stratified Sampling: Schools were stratified according to type (private and public).
- b. Stage Two – Random Sampling: From each stratum, 10 schools were randomly selected from each of the eight Local Government Area in the state, totaling 80 secondary schools (40 private and 40 public secondary schools).
- c. Stage Three – Purposive Sampling: From each of the selected schools, 2 Chemistry teachers were purposively chosen based on availability in Chemistry teaching.
- d. In total, the sample comprised 160 Chemistry teachers (80 private and 80 public Chemistry teachers).

The primary data collection tool was a structured questionnaire developed by the researcher, titled "Gamification Challenges in Chemistry Education Questionnaire" (GCCEQ). The instrument was validated by experts in science education and educational technology for content and face validity. A pilot study was conducted in two non-sampled schools, and the instrument registered a Cronbach's alpha reliability coefficient of 0.72, indicating a high level of internal consistency. Data were collected by directly distributing the questionnaire to respondents through trained research assistants. Whenever physical access to schools was limited, questionnaires were distributed via online media (e.g., Google Forms) using school administrators as intermediaries. Quantitative data were analysed using descriptive statistics (frequency, mean and standard deviation) to answer the research questions, while inferential statistics, such as the one sample t-test and independent sample t-test, were used to test the hypotheses at the 0.05 level of significance. Statistical analysis was conducted using SPSS version 26. Informed consent was secured from all participants. Confidentiality and anonymity of responses were guaranteed, and participants were informed of their right to withdraw from the study at their discretion without penalty.

RESULTS

Research Question One: What are the major challenges faced by Chemistry teachers in integrating gamification into classroom instruction in secondary schools in Bayelsa State?

Table 1: Challenges faced by Chemistry teachers in integrating gamification into classroom instruction in secondary schools in Bayelsa State

S/N	Item	SA	A	D	SD	Mean	Standard Deviation
1	Lack of infrastructure limits the use of gamification in teaching.	131 (81.9%)	14 (8.7%)	15 (9.4%)	-	3.73	0.62
2	Lack of training limits my use of gamification in the classroom.	145 (90.6%)	15 (9.4%)	-	-	3.91	0.29
3	I cannot integrate gamification effectively within my lesson plans.	145 (90.6%)	-	15 (9.4%)	-	3.81	0.58
4	The school curriculum allows flexibility for gamified instruction.	26 (16.3%)	-	106 (66.3%)	28 (17.5%)	1.66	1.10
5	Internet access is available and reliable for educational purposes	8 (5%)	2 (1.3%)	31 (19.4%)	119 (74.4%)	1.37	0.74
6	Large class sizes make it difficult to use gamification effectively.	116 (72.5%)	-	44 (27.5%)	-	3.45	0.9
7	Cultural or religious beliefs discourage the use of games in learning.	116 (72.5%)	15 (9.4%)	29 (18.1%)	-	3.54	0.78
8	Exam-focused teaching limits the opportunity for gamified learning.	145 (90.6%)	-	-	15 (9.4%)	3.72	0.88

Table 1 shows teachers' perceptions on the major challenges faced by Chemistry teachers in integrating gamification into classroom instruction in the selected secondary schools in Bayelsa State. Table 1 shows that majority of the respondents agreed that the challenges faced by Chemistry teachers in integrating gamification into classroom instruction in the selected secondary schools in Bayelsa State are: lack of infrastructure (90.6%); lack of training (100%); unable to integrate gamification effectively within lesson plans(90.6%); Large class sizes (72.5%); Cultural or religious beliefs (81.9%); exam-focused teaching (90.6%). Moreover, data in table 1 reveals that the following are also among the challenges that faced by Chemistry teachers in integrating gamification into classroom instruction in the selected secondary schools in Bayelsa State: inflexibility of the school curriculum and unavailability of internet access.

Research Question Two: Are there differences in the challenges of using gamification based on school type?

Table 2: Differences in the Challenges of using Gamification based on School Type

School Type	N	Mean	Standard Deviation
Public School	80	3.42	0.78
Private School	80	3.41	0.79

$\alpha = 0.05$

Table 2 shows differences in the challenges of using gamification based on school type. Table 2 shows that the mean response score (26.78) of the public-school teacher is higher than that of the private school (25.86). This shows that there is a difference in the perception of the Chemistry teachers towards the challenges they face in using gamification during Chemistry teaching.

The research question two was hypothesized as follows: 'There is no significant difference in the challenges of using gamification between public and private secondary schools in Bayelsa State'. Table 2 also shows the significant difference between the public secondary school teachers and their counterparts in the challenges they face in using gamification. Table 2 shows the t-value = 2.152, with p-value of 0.033. Testing the hypothesis at 0.05 significant level, the p-value (0.033) is less than the alpha value of 0.05. This shows that there is a significant difference. Therefore, the null hypothesis is rejected. Conclusively, there is a significant difference in the challenges of using gamification between public and private secondary schools in Bayelsa State.

Research Question Three: What are the attitudes of Chemistry teachers towards gamified learning in Bayelsa State secondary schools?

Table 3: Attitudes of Chemistry teachers towards gamified learning in Bayelsa State Selected secondary schools

S/N	Item	SA	A	D	SD	Mean	Standard Deviation
1	Gamification makes Chemistry more engaging for students.	115 (71.9%)	30 (18.8%)	15 (9.4%)	-	3.63	0.65
2	Students are more motivated when game elements are used in teaching.	131 (81.9%)	15 (9.4%)	14 (8.8%)	-	3.73	0.61
3	Gamification distracts students from serious academic work.	11 (6.9%)	3 (1.9%)	29 (18.1%)	117 (73.1%)	1.43	0.84
4	I am open to using gamification as a regular part of my teaching.	87 (54.4%)	14 (8.8%)	59 (36.9%)	-	3.18	0.94
5	Gamification can improve students' understanding of Chemistry concepts.	102 (63.8%)	29 (18.1%)	15 (9.4%)	14 (8.8%)	3.37	0.98
6	Gamification fosters collaborative learning among students	102 (63.8%)	14 (8.8%)	44 (27.5%)	-	3.36	0.89
	Grand Mean					3.12	0.82

Criterion Mean= 2.5

Table 3 shows the attitudes of Chemistry teachers towards gamified learning in Bayelsa State selected secondary schools. Table 3 shows that majority of the participants agreed on the statements, except on the item 3. Moreover, table 3 shows that the mean values for the items (items 1, 2, 4, 5 and 6) are greater than the criterion mean of 2.5, while item 3 has low mean score. Meanwhile, the grand mean score in table 3 is greater than the criterion mean, this shows that there is a positive attitude of Chemistry teachers towards gamified learning in Bayelsa State secondary schools.

Hypothesis One: Chemistry teachers in Bayelsa State do not face significant challenges in integrating gamification into classroom instruction (population mean challenge score = 2.5).

Table 4: One-Sample t-Test on Chemistry Teachers' Challenges in Integrating Gamification (N = 160)

Variable	Test Value (μ_0)	M	SD	t	df	p	Cohen's d
Overall Challenge Score	2.50	3.12	0.82	11.11	159	< 0.001	0.88

$\alpha = 0.05$

Table 4 shows the one-sample t-test on Chemistry teachers' challenges in integrating gamification. Since the calculated $t(159) = 11.11, p < 0.001$, and $d = 0.88$ (effect size, which is large), the null hypothesis is rejected. This means that Chemistry teachers in Bayelsa State face significant challenges in integrating gamification into classroom instruction, with a large magnitude of perceived difficulty.

Hypothesis Two: There is no significant difference in the challenges faced by public and private school Chemistry teachers in integrating gamification into classroom instruction.

Table 5: Independent Sampled t-test of the difference in the challenges faced by public and private school Chemistry teachers in integrating gamification into classroom instruction

School Type	N	Mean	Standard Deviation	df	t-value	p-value
Public	80	3.42	0.78	158	1.86	0.065
Private	80	3.41	0.79			

$\alpha = 0.05$

An independent sampled t-test was conducted to determine whether there was a significant difference in the challenges faced by public and private school Chemistry teachers in integrating gamification into classroom instruction. Data in table 5 revealed that there was no statistically significant difference between public (M = 3.42, SD = 0.78) and private (M = 3.41, SD = 0.79) school Chemistry teachers, $t(158) = 1.86, p = 0.065$. This suggests that both groups experienced similar barriers to gamification such as lack of infrastructure, inadequate training, and exam-focused curricula. Since $p > 0.05$, the null hypothesis that there is no significant difference in the challenges faced by public and private school Chemistry teachers is retained. Hence, the integration challenges appear to be systemic, affecting both school types similarly.

Hypothesis Three: There is no significant difference in the attitudes of public and private school Chemistry teachers toward the use of gamification as an instructional strategy.

Table 6: Independent Sample t-test of the difference in the attitudes of public and private school Chemistry teachers toward the use of gamification as an instructional strategy

School Type	N	Mean	Standard Deviation	df	t-value	p-value
Public	80	3.10	0.80	158	-0.44	0.66
Private	80	3.16	0.85			

$\alpha = 0.05$

An independent sampled t-test was conducted to compare public and private school Chemistry teachers' attitudes toward gamification as an instructional strategy. The results in table 6 indicated no significant difference between public (M = 3.10, SD = 0.80) and private (M = 3.16, SD = 0.85) schoolteachers, $t(158) = -0.44, p = 0.66$. This suggests that teachers across both school types hold similarly favorable attitudes toward the use of gamification in Chemistry instruction.

DISCUSSION OF FINDINGS

The findings of the study revealed several significant constraints that hinder Chemistry teachers in Bayelsa State from effectively gamifying classroom instruction. The constraints can be grouped into infrastructural factors, teacher-related problems, curriculum constraints, and organizational obstacles, although all are consistent with trends in national and international literature. Infrastructural inadequacies emerged as the most significant barrier. A high proportion of teachers reported low or no access to basic digital tools and internet connectivity required for gamified learning. This finding aligns with Eze and Okojie (2021), who noted the poor ICT infrastructure of most Nigerian secondary schools, particularly those in rural areas. In Bayelsa State, where many schools are poorly resourced or lack stable power and ICT capabilities, the integration of technology-enhanced pedagogies like gamification is even more restricted. Similarly, Ekperi and Koko (2023) observed that

the lack of basic digital infrastructure in Bayelsan schools significantly impedes the adoption of modern instructional methodologies.

Second, the study identified that a lack of teacher ability and professional development opportunities significantly impedes the adoption of gamification. Many of the Chemistry teachers who responded to the survey reported that they had not received training on gamification platforms or tools. They also indicated they lacked significant confidence in incorporating game elements into lesson plans, especially for a subject as abstract and technical as Chemistry. These findings align with Yusuf and Bello (2021), who expressed concern about the importance of pedagogy-specific teacher preparation to bridge the gap between teaching practice and technology. Similarly, Okoli et al. (2022) stated that the absence of continuous professional development in science teachers' digital pedagogies in Nigeria prevents the implementation of gamified learning strategies.

The result from research question two revealed that there is no difference in the perception of Chemistry teachers toward the challenges they face in using gamification during Chemistry teaching. This suggests that the constraints associated with gamified instruction are uniformly felt among Chemistry teachers, regardless of demographic or institutional factors. This aligns with Nguyen and Jeong (2023), who found that systemic constraints such as inadequate infrastructure, limited access to digital tools, and insufficient professional training remain significant barriers to integrating technology-driven pedagogies across diverse educational contexts. Similarly, Kori, Palts and Pedaste (2022) noted that teachers' readiness to use gamification is often hindered by contextual factors especially in developing regions where digital literacy and infrastructural support remain low. The lack of variation in teachers' perceptions therefore implies that these challenges are pervasive and structural, rather than individual or school-type specific.

Findings from research question three showed that Chemistry teachers in Bayelsa State hold a positive attitude toward gamified learning. This finding corroborates Alonso-Ferreiro and Martínez-Olmo (2021), who observed that science teachers often view gamification as a strategy that enhances student engagement, motivation, and conceptual understanding. The result also supports Bawa (2023), who reported that gamified instructional approaches promote student participation and enjoyment, thus improving retention and performance in science-related subjects. The observed positive attitude in this study reflects teachers' growing recognition of gamification's pedagogical potential to bridge the gap between abstract scientific concepts and active student learning. However, as noted by Oyelere, Suhonen and Adewumi (2022), enthusiasm alone does not always translate to effective implementation, particularly when institutional supports are weak.

Results from hypothesis one revealed that Chemistry teachers in Bayelsa State face significant challenges in integrating gamification into classroom instruction, with a large magnitude of perceived difficulty. This finding is consistent with Adeoye and Afolabi (2021) and Kebritchi and Luo (2020), who found that teachers in Nigerian and other developing educational systems frequently encounter logistical, technological, and pedagogical barriers when adopting digital instructional strategies. Key challenges often include inadequate ICT facilities, unreliable internet access, insufficient training, and rigid curriculum structures that emphasize examination performance over exploratory learning. As Garcia-Cabot et al. (2023) emphasized, these barriers tend to reduce teachers' confidence in adopting gamified tools, regardless of their positive attitudes. Hence, the significant challenges observed in this study highlight the need for systemic interventions, such as targeted professional development and infrastructural investments, to support teachers' digital pedagogical competence.

Findings from hypothesis two indicated that there is no significant difference in the challenges faced by public and private school Chemistry teachers in integrating gamification into classroom instruction. This finding implies that both school types experience similar systemic obstacles to digital pedagogical integration. Adebayo and Omodan (2022) found comparable results, noting that even private schools, though relatively better equipped, often lack sustained technical support and professional mentoring for gamified and technology-based learning innovations. Similarly, Eze, Okeke and Nwankwo (2023) observed that both public and private school teachers in Nigeria encounter similar pedagogical constraints due to curriculum rigidity, lack of incentives, and

limited exposure to ICT-based instructional design. The present result therefore reinforces the argument that educational innovation challenges in Nigeria are system-wide rather than sector-specific.

Finally, findings from hypothesis three revealed that there is no significant difference in the attitudes of public and private school Chemistry teachers toward the use of gamification as an instructional strategy. This suggests that both groups of teachers share comparable optimism and interest in using gamification to enhance learning. Yusuf and Ogundele (2021) reported a similar pattern, asserting that teachers' positive attitudes toward gamification are driven by perceived student benefits such as improved motivation and participation rather than by the availability of school resources. Furthermore, Alshammari (2022) confirmed that teachers' attitudes toward gamified learning are influenced more by perceived usefulness and ease of use (as proposed in the Technology Acceptance Model) than by school type or ownership structure. Therefore, the finding that both public and private school Chemistry teachers exhibit similar attitudes underscores a shared pedagogical commitment toward learner-centred innovation.

Collectively, these findings imply that while teachers in Bayelsa State are conceptually receptive to gamification, they are structurally constrained in practice. The positive attitude observed provides an important psychological foundation for future reforms; however, without parallel investments in infrastructure, digital literacy, and policy support, widespread implementation may remain limited. This echoes UNESCO (2024), which emphasized that effective technology integration in education requires synchronized efforts in teacher training, curriculum reform, and digital infrastructure.

CONCLUSION

This study examined Chemistry teachers' perceptions, attitudes, and challenges toward integrating gamification into classroom instruction in Bayelsa State secondary schools. The findings revealed that while Chemistry teachers generally hold positive attitudes toward the use of gamification as a teaching strategy, they simultaneously experience substantial challenges in implementing it effectively. The challenges particularly lack of infrastructure, inadequate training, unreliable internet connectivity, and rigid curricula appear to cut across both public and private school systems, suggesting a systemic issue rather than an institutional one.

The absence of significant differences in both the perceived challenges and attitudes between public and private school Chemistry teachers underscores a shared experience within the state's educational landscape. It suggests that teachers across school types face similar pedagogical, technical, and administrative barriers, even though they acknowledge gamification's potential to enhance learner engagement, motivation, and conceptual understanding in Chemistry.

In essence, the study concludes that teachers' willingness and positive attitude alone are insufficient to ensure the successful adoption of gamified learning. Sustainable implementation requires coordinated efforts in policy, infrastructure, and teacher professional development. Hence, the promotion of gamified instructional strategies in Chemistry education demands both institutional support and systemic capacity building within the Bayelsa State secondary school system.

RECOMMENDATIONS

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

1. The government and educational stakeholders should invest in the provision of reliable internet connectivity, digital devices, and gamified learning resources in secondary schools. Without adequate technological infrastructure, teachers' enthusiasm for gamification cannot translate into effective classroom practice.
2. Education policymakers at both state and federal levels should integrate gamified learning frameworks into Nigeria's digital education strategy. This entails establishing clear guidelines, standards, and benchmarks

- for the integration of game-based pedagogy within secondary school curricula, ensuring alignment with national education goals and STEM priorities.
3. Continuous professional development workshops and seminars should be organized to train Chemistry teachers on the design and integration of gamified instructional activities. These programs should focus on developing teachers' digital competence and confidence in using game-based learning tools.
 4. Educational policymakers should revise the Chemistry curriculum to accommodate flexible instructional strategies that promote creativity, collaboration, and learner engagement through gamification. The curriculum should move beyond exam-centred approaches to encourage experiential and interactive learning.
 5. Both public and private schools should establish committees or task forces responsible for coordinating digital learning initiatives, sharing best practices, and mentoring teachers who are new to gamified instruction.

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