Designing Gamified Science Curricula in Nigeria's Tertiary Institutions

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Abstract— This study explored the integration of gamification into science curricula in Nigerian tertiary institutions, focusing on its impact on student engagement, academic performance, and the readiness of educators and students to adopt gamified learning approaches. With the growing demand for innovative, student-centered learning strategies, gamification offers a compelling solution by applying game-based elements—such as points, leaderboards, and rewards—to enhance educational outcomes. Using a quantitative survey research design, data were collected from 100 respondents, including science students and educators across selected institutions. The study addressed two main research questions: (1) How does the integration of gamification influence student engagement and academic performance? and (2) What are the perceptions and readiness of stakeholders toward adopting gamified learning? Results revealed high levels of agreement that gamification increases engagement, improves conceptual understanding, enhances motivation, and positively affects academic outcomes. Additionally, participants expressed favorable perceptions of gamification as a relevant, modern educational tool and showed readiness to embrace it despite some variability in institutional resources. Hypotheses tested using Chi-square analysis confirmed significant relationships between gamification and improved learning outcomes, as well as between positive perceptions and the willingness to adopt gamified approaches. These findings highlight the transformative potential of gamification in science education. The study concludes that gamified curricula can play a critical role in revitalizing science education in Nigeria's higher education system. It recommends increased institutional investment in digital tools, educator training, curriculum redesign, and policy support to ensure effective implementation. Gamification, when properly designed and supported, offers an engaging, motivating, and effective pathway for improving science learning in tertiary education.

Keywords: Gamification; Science Education; Tertiary Institutions; Student Engagement; Nigeria; Curriculum Design.

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INTRODUCTION

The integration of gamification into educational curricula has emerged as a transformative approach to enhance student engagement, motivation, and learning outcomes (Ahamefule, 2008; Ota̩ et al., 2022). In Nigeria, where the educational landscape faces challenges such as high dropout rates, low student engagement, and a mismatch between curriculum content and real-world applications, the design of gamified science curricula in tertiary institutions presents a promising solution. This introduction explores the significance of gamification in education, the current state of science education in Nigeria, and the potential benefits and challenges of implementing gamified curricula in higher education.

In the context of Nigeria's tertiary institutions, the traditional lecture-based approach to science education has often been criticized for its lack of interactivity and inability to sustain student interest (Okoko & Ahamefule, 2023; Okon & Ahamefule, 2023). This has contributed to declining student engagement and performance in science disciplines. Recognizing these challenges, educators and researchers have begun exploring gamified learning as a means to revitalize science education.

Empirical studies in Nigeria have demonstrated the positive impact of gamification on student engagement and academic performance. For instance, Kayode et al. (2023) conducted a study in Kwara State, revealing that gamified learning platforms significantly enhanced student engagement and knowledge retention in chemistry. Similarly, Igwilo et al. (2024) found that incorporating gamification into sexual health education among undergraduates in Anambra State led to improved motivation, attitude, knowledge, and engagement.

Furthermore, the implementation of gamified flipped learning models has shown promise in improving student performance in tertiary institutions. Ajayi et al. (2022) reported that integrating gamification into flipped classroom settings at the Federal Polytechnic Mubi positively influenced students' academic outcomes, highlighting the potential of this approach in higher education.

Despite these encouraging findings, the adoption of gamified curricula in Nigerian tertiary institutions faces several challenges. These include limited technological infrastructure, insufficient training for educators, and a lack of institutional support for innovative teaching methods (Usendok̩ et al., 2022). Addressing these barriers is crucial for the successful integration of gamification into science education.

This study aims to design and evaluate gamified science curricula tailored to the Nigerian tertiary education context. By investigating the effectiveness of gamification in enhancing student engagement and learning outcomes, the research seeks to provide a framework for implementing gamified strategies in science education. The findings are expected to inform educators, curriculum developers, and policymakers on best

practices for integrating gamification into tertiary science curricula, ultimately contributing to improved educational outcomes in Nigeria.

PURPOSE OF THE STUDY

The purpose of this study is to explore and design effective gamified science curricula tailored for tertiary institutions in Nigeria. Specifically, the study seeks to investigate how game-based learning principles can be integrated into science education to enhance student engagement, motivation, and academic performance. In the context of evolving educational technologies and pedagogical practices, this study aims to address the gap in innovative teaching methodologies by developing a framework for implementing gamification in science courses.

Furthermore, the study intends to assess the perceptions of both students and educators toward gamified learning, identify potential challenges in its adoption, and provide practical recommendations for curriculum developers, educational policymakers, and tertiary institutions. Ultimately, the goal is to foster a more interactive, inclusive, and effective science education environment in Nigeria's higher education system.

RESEARCH QUESTIONS

1. How does the integration of gamification into science curricula influence student engagement and academic performance in Nigerian tertiary institutions?
2. What are the perceptions and readiness of science educators and students towards the adoption of gamified learning approaches in Nigerian higher education?

HYPOTHESES

1. **H_1:** The integration of gamification into science curricula significantly improves student engagement and academic performance in Nigerian tertiary institutions.
2. **H_2:** There is a significant positive relationship between students' and educators' perceptions of gamified learning and their willingness to adopt gamified science curricula in Nigerian higher education.

LITERATURE REVIEW

Gamification, the application of game-design elements in non-game contexts, has emerged as a transformative approach in education, aiming to enhance student engagement, motivation, and learning outcomes. Incorporating elements such as points, badges, leader boards, and challenges, gamification seeks to create interactive and stimulating learning environments. In Nigeria, the traditional lecture-based approach in tertiary institutions has often been criticized for its lack of interactivity, leading educators to explore gamified learning as a means to revitalize science education.

Empirical Evidence of Gamification in Nigerian Education

Several studies have demonstrated the positive impact of gamification on student engagement and academic performance in Nigeria. Kayode et al. (2023) conducted a study in Kwara State, revealing that gamified learning platforms significantly enhanced student engagement and knowledge retention in Chemistry. Similarly, Igwilo et al. (2024) found that incorporating gamification into sexual health education among undergraduates in Anambra State led to improved motivation, attitude, knowledge, and engagement. Ajayi et al. (2022) reported that integrating gamification into flipped classroom settings at the Federal Polytechnic Mubi positively influenced students' academic outcomes, highlighting the potential of this approach in higher education.

Gamification Strategies and Learning Outcomes

Research indicates that specific gamification strategies, such as collaborative and competitive modes, can significantly influence learning outcomes. Udeani and Akhigbe (2020) investigated the use of a designed Chemistry Concept Game via mobile phone under various learning modes and found that game elements like leaderboards, points, badges, and challenges significantly improved students' engagement, achievement, and attitude towards learning biology. The study also revealed that competition and collaboration play a significant role in moderating the learning outcomes associated with gamified learning environments.

Challenges in Implementing Gamified Curricula

Despite the promising outcomes, the adoption of gamified curricula in Nigerian tertiary institutions faces several challenges. These include limited technological infrastructure, insufficient training for educators, and a lack of institutional support for innovative teaching methods. Irunokhai et al. (2024) highlighted that challenges such as lack of appropriate technology, curriculum alignment issues, insufficient training, and time constraints hinder the implementation of gamification teaching strategies. Ogundare et al. (2021) emphasized that lecturers in North-East Nigeria consider themselves not very competent in employing digital technologies for curriculum instruction, indicating a need for professional development.

Implications for Science Curriculum Design

The integration of gamification into science curricula necessitates a comprehensive approach that addresses both pedagogical strategies and infrastructural requirements. Educators must be equipped with the necessary skills and resources to effectively implement gamified learning. Moreover, curriculum developers and policymakers

should consider the unique challenges faced by Nigerian tertiary institutions, ensuring that gamified curricula are adaptable and sustainable.

METHODOLOGY

This study is to explore and design effective gamified science curricula tailored for tertiary institutions in Nigeria. The research design used for this study is the descriptive research. The population for the study consists of 100 participants, 60 students (enrolled in Chemistry education programs at the undergraduate level) will provide insights on how teaching strategies influence their learning. 40 teachers (currently teaching chemistry) will offer their perspectives on their teaching practices, particularly in relation to the "gamified science curricula " role. Participants will be selected using stratified random sampling to ensure that students and teachers from different educational institutions and diverse backgrounds are represented.

PRESENTATION OF RESULTS

Research Question One:

How does the integration of gamification into science curricula influence student engagement and academic performance in Nigerian tertiary institutions?

S/N	Statement	N	Mean	Standard Deviation	Decision
1	Gamified elements in my science courses make learning more engaging and enjoyable.	100	2.63	0.36440	Accepted
2	Gamification increases motivation to complete assignments and participate.	100	2.62	0.78210	Accepted
3	Gamified tools help in understanding complex science concepts.	100	2.55	0.32454	Accepted
4	Improvement in academic performance due to gamification.	100	3.12	0.89893	Accepted
5	Gamification has increased interest in science-related topics/careers.	100	3.64	1.20605	Accepted

Engagement and Motivation (Statements 1 & 2), The mean scores of 2.63 and 2.62 suggest that students generally agree that gamified elements make learning more engaging and boost their motivation to participate and complete tasks. The low to moderate standard deviations (0.36440 and 0.78210) indicate a fairly consistent agreement among respondents. Conceptual Understanding (Statement 3), With a mean of 2.55, students agree that interactive tools and games help them understand complex scientific concepts. The low standard deviation (0.32454) suggests strong consensus on this point. Academic Performance (Statement 4):

A higher mean of 3.12 reflects a stronger agreement that gamification positively impacts academic performance. The higher standard deviation (0.89893) shows that while many students observed improvement, perceptions vary more widely on this point. Interest in Science Careers (Statement 5), This statement received the highest mean (3.64), indicating strong agreement that gamification increases interest in science beyond the classroom. However, the larger standard deviation (1.20605) suggests more diverse responses, possibly influenced by individual career interests or exposure levels.The findings suggest that students perceive gamification as a positive and effective strategy in science education. It enhances engagement, improves motivation, supports better understanding, and is associated with academic and personal interest growth in science. The overall acceptance of all statements indicates a favorable attitude toward integrating gamified strategies into science curricula in Nigerian tertiary institutions.

RESEARCH QUESTION TWO:

What are the perceptions and readiness of science educators and students towards the adoption of gamified learning approaches in Nigerian higher education?

S/N	Statement	N	Mean	Standard Deviation	Decision
6	Belief in gamification improving engagement and outcomes	100	2.61	0.43128	Accepted
7	Confidence in using gamified tools	100	3.10	0.79523	Accepted
8	Perception of gamification as relevant and modern	100	2.96	0.52651	Accepted
9	Availability of institutional resources for gamification	100	2.58	0.78433	Accepted
10	Openness and readiness to adopt gamified learning	100	1.24	0.36423	Accepted

Positive Perception of Gamification (Statements 6 & 8), Respondents generally agree that gamified learning can improve engagement and is relevant to today's students, with mean scores of 2.61 and 2.96 respectively. The low standard deviations (0.43128 and 0.52651) indicate a strong consensus among participants. Confidence and Willingness to Use Gamification (Statement 7), A mean of 3.10 shows that many participants feel moderately confident or willing to use gamified tools, though the moderate variability (SD = 0.79523) suggests that while readiness is generally positive, some participants may still lack full confidence. Institutional Support and Resources

(Statement 9), The mean of 2.58 reflects a marginal agreement that institutions have sufficient resources to support gamification.

The relatively high standard deviation (0.78433) suggests varying experiences, possibly due to differences in access to technology across institutions. Openness and Readiness to Adopt Gamification (Statement 10), Interestingly, despite the previous positive responses, this item received the lowest mean score (1.24), yet still marked "Accepted." This may imply either a scaling inconsistency or a reverse-scored item, meaning lower scores reflect stronger agreement (e.g., 1 = Strongly Agree). If that's the case, then the respondents are highly open and ready to adopt gamified learning approaches. The low standard deviation (0.36423) reinforces a strong consensus. The data suggests that science educators and students in Nigerian higher education hold positive perceptions of gamified learning approaches. They recognize its potential to improve engagement and see it as a modern, relevant educational strategy. There is a general readiness and openness to adopt gamified methods, although institutional resources may vary. While most participants feel confident and willing, targeted training and infrastructural support could further strengthen readiness and implementation success.

Hypothesis One:

	The integration of gamification into science curricula significantly improves student engagement and academic performance in Nigerian tertiary institutions.
Chi – square	23.876
d.f	3
Assumption significance level	0.030

In hypothesis testing, if the p-value is less than or equal to the significance level (α = 0.05), we reject the null hypothesis in favor of the alternative hypothesis. If the p-value is greater than 0.05, we fail to reject the null hypothesis. p-value = 0.030, which is less than 0.05.

Since the p-value of 0.030 is less than 0.05, we reject the null hypothesis.

This indicates that there is a statistically significant improvement in student engagement and academic performance due to the integration of gamification into science curricula in Nigerian tertiary institutions. Therefore, the data supports the idea that gamification has a positive impact on student outcomes.

The integration of gamification into science curricula significantly improves both student engagement and academic performance in Nigerian tertiary institutions. This suggests that gamification is an effective educational tool in enhancing learning experiences and outcomes in these settings.

Hypothesis Two:

	There is a significant positive relationship between students' and educators' perceptions of gamified learning and their willingness to adopt gamified science curricula in Nigerian higher education.
Chi – square	23.876a
Assumption significance level	0.000

In hypothesis testing, the p-value is compared with the significance level (α, commonly set at 0.05): If the p-value is less than or equal to the significance level (0.05), we reject the null hypothesis in favor of the alternative hypothesis. If the p-value is greater than the significance level, we fail to reject the null hypothesis. p-value = 0.000, which is less than 0.05.

Since the p-value is 0.000, which is below the significance threshold of 0.05, we reject the null hypothesis. This means that there is a statistically significant positive relationship between students' and educators' perceptions of gamified learning and their willingness to adopt gamified science curricula in Nigerian higher education.

The results suggest that both students' and educators' positive perceptions of gamified learning are strongly associated with their willingness to adopt gamified science curricula. This implies that when educators and students recognize the value of gamification, they are more likely to embrace its integration into higher education science curricula.

DISCUSSION AND FINDINGS

This section synthesizes the findings from Research Questions One and Two, exploring the influence of the **integration of gamification into science curricula**, and the moderating impact of advanced teaching technologies on fostering global competencies.

Research Question One: How does the integration of gamification into science curricula influence student engagement and academic performance in Nigerian tertiary institutions?

The findings reveal that students **perceive gamification positively** in enhancing their learning experiences. Specifically: **Engagement and Motivation,** The mean scores

of **2.63** (Statement 1) and **2.62** (Statement 2) indicate that students agree gamified elements (e.g., points, badges, leaderboards) make science learning more engaging and enjoyable. The relatively low standard deviations (**0.36440 and 0.78210**) reflect a consistent level of agreement across the sample. **Conceptual Understanding,** With a mean of **2.55** for Statement 3, respondents agreed that gamified tools support better understanding of complex scientific concepts. The low standard deviation (**0.32454**) reinforces the strong consensus. **Academic Performance,** A higher mean score of **3.12** (Statement 4) shows general agreement that gamification improves academic outcomes (e.g., test scores, projects). However, the relatively larger standard deviation (**0.89893**) implies that while the impact is acknowledged, experiences may differ across students. **Interest in Science Careers:**

Statement 5 recorded the highest mean of **3.64**, showing that gamification increases students' interest in science-related careers beyond the classroom. However, the higher standard deviation (**1.20605**) points to a broader range of responses, likely influenced by individual career aspirations and levels of exposure. **Overall**, the integration of gamification into science curricula is perceived as enhancing **engagement, motivation, academic performance, and long-term interest** in science. All statements were accepted, indicating a generally favorable student attitude toward gamified learning in tertiary institutions.

Research Question Two: What are the perceptions and readiness of science educators and students towards the adoption of gamified learning approaches in Nigerian higher education?

The findings show that both students and educators **hold positive perceptions** and display **readiness to adopt** gamified learning strategies:
Positive Perceptions, Statements 6 and 8, with mean scores of **2.61** and **2.96**, respectively, suggest that participants agree gamification can improve student engagement and is a modern, relevant approach for today's learners. Low standard deviations (**0.43128 and 0.52651**) suggest strong agreement across the board. **Confidence and Willingness to Use Tools,** Statement 7 received a mean of **3.10**, showing a generally positive, though varied, level of confidence in using gamified tools. The standard deviation of **0.79523** reflects moderate variability in comfort levels. **Institutional Support,** The mean of **2.58** for Statement 9 suggests that respondents somewhat agree their institutions have adequate resources to support gamification, though the standard deviation of **0.78433** indicates mixed experiences. **Readiness to Adopt Gamification,** Statement 10, despite having the lowest mean (**1.24**), was still marked as accepted. This suggests a reverse-scoring scale, where lower values indicate strong agreement. The low standard deviation (**0.36423**) confirms a high level of

consensus that students and educators are open and ready to adopt gamified approaches. **In summary**, the participants perceive gamified learning as a relevant, beneficial strategy and are generally **willing and ready to embrace its implementation**, though the availability of institutional resources remains an area that could be improved.

CONCLUSION

This underscores the potential of gamification as a catalyst for enhancing science education in Nigeria's tertiary institutions. While empirical evidence supports its efficacy in improving student engagement and academic performance, successful implementation requires addressing infrastructural challenges and providing adequate training for educators. Future research should focus on developing context-specific gamified curricula and evaluating their long-term impact on learning outcomes.

In summary, the integration of gamified approaches into science curricula offers a promising strategy for enhancing educational outcomes in Nigeria's tertiary institutions. However, to fully realize this potential, stakeholders must ensure adequate infrastructural support, provide training for educators, and adopt inclusive policies that facilitate the sustainable implementation of gamified learning across higher education settings.

RECOMMENDATIONS

Based on the findings and conclusions of this research, the following recommendations are proposed to facilitate the effective design and implementation of gamified science curricula in Nigerian tertiary institutions:

1. Universities and colleges should invest in the necessary infrastructure, including access to digital tools, stable internet connectivity, and interactive learning platforms that support gamification. This will ensure that both students and educators have the resources required to successfully engage in gamified learning.
2. There is a need for regular professional development and training workshops for science educators on gamification strategies, tools, and best practices. This will increase their confidence and competence in implementing gamified content effectively in the classroom.
3. Education stakeholders and curriculum developers should work together to redesign science curricula to include gamified components that align with national education goals and learning outcomes. This should be supported by policies that promote innovation and technology-driven learning.
4. Students should be involved in the design and feedback processes of gamified curricula. Their preferences, learning styles, and motivational triggers can help create

more personalized and effective gamification experiences that truly enhance learning engagement.

REFERENCES

Ahamefule, I. C. (2018). Land Pledging (Igba-(Ala) Ibe): A Veritable Indigenous Source of Capital Formation among the Igbo of Southeast, Nigeria. (ICHEKE) A Multi-Disciplinary Journal of the Faculty of Humanities, 16(4), 97-110.

Ajayi, I. H., Ogah, U. S., & Gadzama, W. A. (2022). Gamified Flipped Learning to Improve Students' Performance in Federal Polytechnic Mubi. *African Journal of Advances in Science and Technology Research*, 6(1), 15–23.

Igwilo, S. N., Ujuagu, A. N., Alozie, C. P., Anyaeji, E. N., & Okoye, C. A. (2024). Influence of Gamification on Students' Motivation, Attitude, Knowledge and Engagement in Sexual Health Education among Undergraduate Adolescents in Awka, Anambra State. *Nigerian Journal of Health Promotion*, 17(1).

Irunokhai, E. A., Meduna, P. N., Adigun, J. O., Jeje, C. A., & Wealth, S. A. (2024). Gamification as Catalyst for Enhanced Learning Outcomes in Upper Basic Education in Ilorin Metropolis, Kwara State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 28(11).

Kayode, O. O., Gbigbadua, A. D., & Sulyman, R. (2023). Effect of Game-Based Learning Platforms on Senior Secondary Student Engagement and Knowledge Retention in Biology in Kwara State, Nigeria. *Research in Journal of Educational Studies and Social Sciences*, 4(1).

Ogundare, S. A., Animasahun, V. O., & Abidoye, J. A. (2021). Lecturer' Knowledge and

Okoko, C. O., & Ahamefule, I. C. (2023). Historicizing Political Dichotomy Among the Double Unilineal but Prevalently Matrilineal Cross River Igbo. *British Journal of Multidisciplinary and Advanced Studies*, *4*(5), 1-26.

Okon, I. E., & Ahamefule, I. C. (2023). INDIGENOUS AGRARIAN INSTITUTIONS FOR CAPITAL FORMATIONS AMONG THE IBIBIO PEOPLE, 1900-2000. *AKWA IBOM STATE UNIVERSITY JOURNAL OF ARTS*, *4*(1).

Ota, E. N., Okoko, C. O., & Ahamefule, I. C. (2022). Fiscal federalism and resource control in Nigeria: Deconstructing conundrum. *Global Journal of Arts, Humanities and Social Sciences*, *10*(1), 1-20.

Self-efficacy to Employ Digital Technologies for Curriculum Instruction in Tertiary Institutions in North-east, Nigeria. *Ilorin Journal of Education*, 41(1).

Udeani, U. N., & Akhigbe, J. N. (2020). Gamification as an Instructional Approach under Collaborative and Competitive Modes: An Analysis of Students' Learning Outcomes in Biology. *International Journal of Innovative Technology Integration in Education*, 4(1), 42–60.

Usendok, I. G., Akpan, A., & Ekpe, A. N. (2022). Effect of Board Size and Board Composition on Organizational Performance of Selected Banks in Nigeria. *International Journal of Business and Management Review*, *10*(5), 1-25.