

PERCEIVED IMPACT OF GAMIFICATION TEACHING STRATEGY ON SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN BIOLOGY

**Theresa Ukamaka Ugwu, Chidinma Blessing Anita Ugwu, Obiageli Lorreta Aniaku
& Anthonia Ngozi Ngwu**

Department of Science Education, Faculty of Education
University of Nigeria, Nsukka

Abstract

This study investigated perceived impact of gamification on senior secondary school students' academic achievement in Biology in Nsukka Local Government Area of Enugu State. The study adopted a descriptive survey research design. Three specific purposes and corresponding research questions guided the study. The population comprised of 2,686 senior secondary school (SS1) Biology students in Nsukka Local Government Area. A sample of 120 SS1 Biology students were selected using a multistage sampling procedure. Data were collected using a structured questionnaire titled, Perceived Impact of Gamification on Students' Academic Achievement in Biology (PIGSAAB), which was subjected to face validation. The instrument yielded a total reliability coefficient of 0.81 using Cronbach Alpha, for the entire instruments. Data collected were analyzed using mean and standard deviation. Findings revealed that gamification had positive impact on students' academic achievement in Biology. The study also identified factors influencing the use of gamification in schools and strategies for improving the use of gamification in Biology teaching were proffered. The study concluded that gamification is an effective teaching strategy for improving students' academic achievement in Biology. It was recommended that schools and education authorities provide necessary technological resources, organize regular teacher training among others to promote effective use of gamification in Biology classrooms.

Keywords: Biology, gamification teaching and learning strategy, achievement

Introduction

Teaching and learning of science especially Biology is often perceived as difficult, challenging and abstract by students. This is attributed to the use of teacher centered instructional approaches that provide limited opportunities for active students' engagement. Evidence from West African Examination Council (WAEC) Chief examiner's report (2023) indicated persistent low achievement in the subject. Due to the foregoing, This situation shows the need for teaching strategies that can increase students' engagement, motivation and understanding and ultimately improve their achievement. This study, therefore investigated the impact of gamification strategies on senior secondary students' achievement in biology.

Biology is a science subject that studies living organisms and their life processes. Biology is defined as a scientific study of life, including their structure, function, growth, interactions, Akinwumi (2023). Biology is also a branch of science structured to equip students with knowledge of relevant concepts and scientific skills (Oyovwi (2019). The study of Biology helps learners to understand life processes, develop scientific thinking and apply biological knowledge to everyday life. Biology as a branch of science is very broad, therefore discipline or areas of study in Biology is also very vast. The broad nature affects understanding of the concepts, influences interest and academic achievement in the subject,(Adewumi et al.,2024). Despite the importance of Biology, there have been reports on students' poor achievement in the subject WAEC Chief examiners' report (2023). Scholars are of the opinion that this is due to low motivation and interest, poor study habit,

anxiety towards science subjects and lack of engagement during lessons skinner et al. (2022); Okeke and Ugwuanyi, (2021). Ugwu et al., (2024) further explained that students who are not meaningfully engaged during lesson tends to be passive, leading to poor academic achievement. These findings underscore the urgent need for innovative, activity-based teaching strategies that can enhance conceptual understanding and long-term retention of biological concepts. So many researches have been carried out to enhance students' achievement in biology. Anazodo, (2023), suggested the use of scaffolding and other innovative strategies to enhance student achievement in biology. On the contrary Raeyegbemi et al. (2020) are of the view that poor achievement may be associated with weaknesses in in the teaching leaning process and the condition under which learning takes place. Safitri et al., (2025), emphasized inadequate learning support that engage students in teaching and learning process. Based on this backdrop, this study sets to determine percieved impact of gamification teaching strategy on students' achievement in biology

Achievement refers to how a learner performs or successfully attains learning objectives. Academic achievement also refers to the extent students achieve learning goals (Kassaw & Demareva (2023). Described academic achievement as a student's ability to reach set educational objectives, typically assessed through formal examinations and continuous evaluations, Achievement in biology refers to the level of knowledge, understanding skills and competencies a learner demonstrates in biology, usually measured through assessment. Due to the wrong usage of instructional strategy in the teaching of biology, students' attainment of the expected objectives has not been encouraging. Hence, this study tends to investigate the impact of gamification teaching strategy on students' academic achievement in biology.

Gamification refers to the use of game design elements in non-game contexts which is often implemented to motivate participation and enhance learning outcome and facilitate behaviour change. Sailer and Hommer (2020) defined gamification as the use of game mechanics, aesthetics and thinking to engage students. Kovisto and Hamari (2021) described it as the process of incorporating features of digital or physical games into instructions to make learning experience more interactive and enjoyable. Scholars classified gamification into mechanics (process and rules); dynamics (high level elements); and components (visible game elements) (Werbach and Hunter, (2019) & Kvisto and Hamari (2019). Mechanics (process and rules) are the system that drives players engagements. They include challenging task or problems to solve. It also involves Competition. cooperation, working together. Giving feedback, immediate response to action. rewards and incentives for completing tasks. The dynamic (high level elements) are the big picture aspects that shape the overall experience such as narrative/story telling- a story that guides learners through activities. Emotions, excitement, curiosity competition, Progression - movement from beginner to advanced levels, relationships- interaction with peers. Components (specific visible elements) these are the concrete ventures learner see and interact with they include Points- scores earned for tasks. Badges – symbols of achievement, leaderboards ranking of players. Levels stages of progression, avatars player representation, among others. Biology contains concepts that are difficult to visualize or understand through verbal explanations alone. Students in Nsukka local Government area may loose interest when lessons are predominantly lecture based. Gamified activities that introduces challenges, can provide interactive experiences that help students connect abstracts concepts with meaningful learning tasks. This study,

therefore investigated the perceived impact of gamification teaching strategy on students' academic achievement in biology.

Statement of the Problem

Biology investigates life at multiple levels of organization from the molecular and cellular level, through tissues and organs, to the entire ecosystem: It helps in understanding Life and Its Processes, it has led to tremendous breakthroughs in medicine and public health among others. Despite the importance of biology, there have been persistent students' poor achievement in biology according to WAEC chief examiner's report. This poor achievement of students in biology can be attributed to many factors such as poor method of teaching, inadequate use of innovative teaching strategy, lack of instructional materials, poor infrastructural facilities. Many studies have introduced various innovative strategies such as scaffolding, virtual classrooms, simulations among others, yet students' achievement in the subject have not been encouraging. This may be as a result of non use of achievable goals, challenges and progress indicators that can encourage students to participate and persist with learning tasks. Therefore, there is a need to explore other game - based that can be utilized in biology classroom instruction. Hence, this study therefore investigated the impact of gamification teaching strategy on students' academic achievement in biology.

Purpose of the Study

The main purpose of the study is to investigate perceived impact of gamification on Biology students' academic achievement in Nsukka Local Government Area. Specifically, it investigated:

1. The impact of gamification on students' academic achievement in Biology.
2. The factors that militate students' use of the gamification in biology classroom.
3. The strategies that enhance students' use of the gamification in biology classroom.

Research Questions

The following research questions guided the study;

1. What is the impact of gamification on students' academic achievement in Biology?
2. What are the factors that militate students' use of gamification in biology classroom?
2. What are the strategies that enhance students' use of the gamifications in biology classroom?

Methods

The study adopted descriptive survey research design. Descriptive survey design is concerned with describing, recording, analyzing, and interpreting conditions that exist or have existed because it does not involve manipulation of variables but aims at determining the nature of a situation as it exists at the time of the study" (Kothari, 2019). The population of the study comprised 2686 of all senior secondary (SS1) Biology students in Nsukka Local Government area of Enugu state. A sample of 120 SS1 Biology students were selected using a multistage sampling procedure. Firstly, purposive sampling technique was used to select two secondary schools out of the 30 secondary schools in the local government Area so as to select schools with sufficient game tools. Also, the selected schools have specific characteristics, qualities and knowledge needed for the study. Secondly, a simple random sampling technique was used to select Biology students from the two schools. Lastly simple random sampling technique was used to select one teacher with good knowledge of gamification from each of the two selected school, who acted as a research assistant. The instrument that was used for data collection include a

structured questionnaire titled Perceived Impact of Gamification on Students' Academic Achievement in Biology (PIGSAAB) The questionnaire has two sections A and B. Section A elicited response from demographic information of the respondents. While, section B has three clusters which answered the three research questions. The questionnaire consisted of a four-point scale of Strongly Agreed (SA), Agreed (A), Disagreed (D), and Strongly Disagreed (SD). The instruments were subjected to face validation. Also, the reliability of the questionnaire was established through pilot study involving 20 SS1 students from community secondary school Aku in Igbo – Etit local Government area which is outside the study area. Cronbach's Alpha coefficient was calculated to measure internal consistency, that yielded internal consistency of 70, 71 and 80 for clusters A, B and C, respectively. And an overall reliability index of 0.81 indicating that the instruments are reliable for the study. Mean and standard deviation was used to answer the three research questions.

Results

Research Question One: What is the impact of gamification on students' academic achievement in Biology?

Table 1: Mean and standard deviation of the impact of gamification on students' academic achievement in Biology.

S/ N	Item Statement	Mean	SD	Decision
1.	Gamification helps me understand Biology concepts better	3.80	0.40	Agree
2.	My test scores in Biology decrease when gamified activities are used	2.15	0.57	Disagree
3.	Gamification does not help me remember Biology concepts for a longer time	1.20	0.51	Disagree
4.	Game-based activities help me apply Biology knowledge more effectively	3.40	0.97	Agree
5.	Gamification makes difficult Biology topics easier to learn	3.65	0.66	Agree
Cluster Mean		2.84	0.62	Agree

$N = 120$; $X < 2.50 = Disagree$; $X \geq 2.50 = Agree$

The result of table 1 shows that items 1, 4 and 5 had mean responses of 3.80, 3.40 and 3.65 respectively. This shows that the statements represented by those items are the impact of gamification on students' academic achievement in Biology. Respondents, however, disagreed to items 2 and 3 with mean response of 2.15 and 1.20 respectively. This shows that the statement represented by these items are not the impact of gamification on students' academic achievement in Biology. The cluster mean of 2.84 which is greater than the benchmark mean of 2.50 for "agree" indicates that overall, gamification impacts the academic achievement in Biology because it helps students understand biology concepts better, helps students apply Biology knowledge better, and makes difficult Biology concepts easy to learn. The cluster standard deviation of 0.62 indicates similarity in the responses provided by the respondents.

Research Question Two: What are the factors militating students' use of gamification in biology classroom?

Table 2: Mean and standard deviation of the factors militating the use of gamification in Biology.

S/ N	Item Statement	Mean	SD	Decision
1.	Availability of digital devices influences students' use of gamification elements	3.50	0.67	Agree
2.	Teachers' knowledge of technology affects students' use of gamification elements	3.55	0.74	Agree
3.	Large class size reduces students' access to gamification elements	3.25	0.89	Agree
4.	Insufficient internet access limits gamified activities	3.40	0.86	Agree
5.	Support from school administration encourages students' use of gamification elements.	3.50	0.81	Agree
Cluster Mean		3.44	0.80	Agree

$N = 120; X < 2.50 = \text{Disagree}; X \geq 2.50 = \text{Agree}$

The result in table 2 shows that respondents agreed to all items on the cluster, with mean responses ranging from 3.25 – 3.55. This shows that the statements represented by those items are the factors impacting the use of gamification in Schools. The cluster mean of 3.44 which is greater than the benchmark mean of 2.50 for “agree” indicates that the factors impacting the use of gamification in schools include: availability of digital devices influences the use of gamification, teachers' knowledge of technology affects the use of gamification, large class size makes it difficult to implement gamification, insufficient internet access limits gamified activities, support from school administration encourages gamification. The cluster standard deviation of 0.80 shows that the respondents provided varied by 0.80 from the group mean.

Research Question Three: What are the strategies that enhance students' use of the gamifications in biology classroom?

Table 3: Mean and standard deviation of the strategies that enhance students' use of gamification in biology teaching.

S/ N	Item Statement	Mean	SD	Decision
1.	Earning points during Biology activities encourages me to participate actively	3.60	0.49	Agree
2.	Receiving rewards motivates me to compete biology learning tasks	3.85	0.66	Agree
3.	Points makes biology lessons more interesting to me	3.90	0.44	Agree
4.	Leaderboards encourage me to improve my biology performance	3.70	0.56	Agree
5.	Gamified quizzes make biology lessons more interesting.	3.85	0.36	Agree
Cluster Mean		3.78	0.50	Agree

$N = 120; X < 2.50 = \text{Disagree}; X \geq 2.50 = \text{Agree}$

The result in table 3 shows that respondents agreed to all items on the cluster, with mean responses ranging from 3.60 – 3.90. This shows that the statements represented by those items are the strategies that students' use of gamification in biology classroom. The cluster mean of 3.78 which is greater than the benchmark mean of 2.50 for "agree" indicates that the strategies that impact students' use of gamification in biology classroom include: Earning points during biology activities encourage students to participate actively during lesson process; points makes biology lessons more interesting; leaderboards encourage students to improve biology performance; and gamified quizzes make biology lessons more interesting. The cluster standard deviation of 0.50 shows that the respondents provided varied by 0.50 from the group mean.

Discussion

The study revealed that students perceived gamification as beneficial to their learning and achievement in biology. Students reported that gamification helps them understand biology concepts better, apply biology knowledge more effectively, and learn difficult concepts with ease. This finding shows that gamification turns abstract and complex biology content into engaging learning experiences. Through game based elements such as points, challenges, quizzes, and rewards, students interact more actively with biology lessons. This active engagement improves comprehension and supports better application of learned concepts during class activities and assessments. As a result, students achieve better academic outcomes in Biology. This finding aligns with some existing studies. Adeyemi and Yusuf (2021) found that game based learning strategies improved students' understanding and achievement in Biology. Similarly, Chukwu and Eze (2020) reported that interactive learning activities enhanced students' ability to apply scientific concepts effectively. In contrast, Okafor and Nnamani (2019) observed minimal impact of gamification in classrooms where teachers lacked adequate training. Musa and Lawal (2022) also noted that the effectiveness of gamification depends on proper integration into lesson objectives. These differences suggest that while gamification supports academic achievement, its impact depends on how well it is implemented in biology instruction.

The findings of this study revealed that several interrelated factors impact the use of gamification in schools. These factors include availability of digital devices, teachers' knowledge of technology, class size, internet access, and support from school administration. This finding shows that gamification does not operate in isolation but depends on the broader teaching and learning environment. Availability of digital devices determines whether students and teachers can participate in game-based activities at all. Teachers' knowledge of technology influences how well gamified lessons are designed, delivered, and managed in the classroom. Large class size limits effective supervision and reduces students' active participation during gamified tasks. Insufficient internet access disrupts online platforms and weakens real time interaction. Support from school administration provides motivation, resources, and policy backing that encourages students to adopt and sustain gamification practices.

Several reasons may explain why these factors influence the use of gamification. Gamification relies heavily on digital tools such as computers, tablets, and mobile devices, which makes access to devices essential. Teachers with limited technological skills may avoid gamified strategies due to fear of failure or poor classroom control. Large class sizes make it difficult for students to have access to game-based activities and active individual participation. Poor internet access affects the smooth use of online games and instant feedback systems. Administrative support also plays a vital role by approving innovations,

funding resources, and organizing workshop for students on effective use of game elements. These conditions collectively shape how often and how well gamification is used in schools. This finding agrees with some empirical studies. Yusuf and Bala (2020) reported that access to digital facilities and administrative support significantly influence the use of innovative teaching strategies. Similarly, Ibrahim and Olanrewaju (2023) found that teachers' digital competence and internet access predicted the adoption of technology-based instruction. In contrast, Adekunle and Aremu (2019) observed limited use of gamification in overcrowded classrooms despite availability of devices. Okeke and Ugwuanyi (2021) further noted that without strong institutional support, students and teachers were less able to utilize gamified approaches. These studies confirm that effective use of gamification depends on adequate resources, teacher capacity teacher to integrate gamification approach, and supportive school leadership.

The study also revealed strategies that can improve the students' use of gamification in Biology classroom. These strategies include training teachers on the use of gamification tools to enhance students understanding of the concept, provision of digital devices by schools, incorporation of more practical and interactive game activities, development of Biology games aligned with the curriculum, and collaboration among students. This finding shows that effective gamification requires deliberate planning and sustained support. Training equips teachers with the skills needed to design and manage gamified lessons. Provision of digital devices creates access for both teachers and students. Practical and interactive game activities promote active participation and deeper understanding of biology concepts. Curriculum aligned Biology games ensure that learning objectives remain central. Collaboration among students supports sharing of ideas and continuous improvement of gamification practices.

Several reasons may explain why these strategies influence gamification in Biology teaching. Teachers often avoid gamification when they lack the technical skills to use digital tools confidently. Training reduces this gap and builds confidence. Availability of digital devices removes access barriers and allows gamified activities to run smoothly. Practical game activities encourage learning by doing, which suits the nature of Biology. Curriculum based games help teachers integrate gamification without losing focus on syllabus coverage. Collaboration among students creates a support system where challenges are discussed and solutions shared. These strategies work together to strengthen the adoption and sustainability of gamification in Biology classrooms. This finding aligns with some empirical studies. Kehinde et al.,(2024) reported that professional training improved teachers' effective use of gamified and interactive teaching tools. Similarly, Ezeoguine & Eteng Uket, (2023). found that curriculum aligned digital learning tools enhanced student engagement and achievement in science subjects. In contrast, Salami and Bello (2020) observed limited impact of gamification in schools where students worked in isolation without collaboration. Okafor and Obi (2022) further noted that provision of devices alone did not improve gamification without proper teacher training. These studies suggest that combining training, resources, and collaboration is essential for successful gamification in Biology classrooms

Conclusion

The study concludes that the use of gamification enhance students engagement in the biology classroom. Students perceived gamification as helpful for understanding, applying and learning biology concepts. Practical and interactive game activities, curriculum-based Biology games, and collaboration among students are necessary to improve the use of

gamification in Biology classroom. When these conditions are in place, schools can sustain the use of gamification for effective Biology learning.

Educational implication of the study.

Findings of this study reveal that gamification can increase students participation in classroom activities making teaching more interactive. It provides immediate feedback helping teachers identify students strengths and learning difficulties. It help schools move beyond exclusively conventional instructional approaches. It help educational authorities to develop policies that encourage innovative instructional practices. Education authorities should organize training programs to improve teachers' knowledge of technology. Schools should also address large class size and strengthen administrative support to create conditions that support the use of gamification in Biology classroom

Recommendations

Based on the findings of the study, the following recommendations were made;

1. This study recommends provision of adequate digital devices and reliable internet access.
2. Train biology teachers on effective gamification.
3. Develop curriculum- aligned biology gamification activities.
4. Encourage practical and interactive gamified activities.
5. Provide administrative support for implementating gamification and finally address large class challenges where possible.

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