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GAMIFICATION AS INSTRUCTIONAL MEDIA: IMPACTS ON SECONDARY SCHOOL STUDENT'S ENGAGEMENT AND ACHIEVEMENT IN ENUGU STATE

OKEKE, PAULINE EGODI
Email: ogbuagupauline@gamil.com
&
UDENWAGU, PAULINUS AMOBI
Email: paulinusamobi19@gmail.com
&
IGBOAMALU, STEPHEN EZENNA
Email: stephenigboamalu@gmail.com

Department of Educational Foundations, Faculty of Education,
Enugu State University of Science and Technology (ESUT), Agbani, Nigeria

ABSTRACT

This study investigated the effects of gamification as instructional media on secondary school students' engagement and academic achievement in Enugu State. Four research questions guided the study. A quasi-experimental research design was adopted for this study. The population for the study comprised 251 Physics students in three public secondary schools in Agbani Education zone of Enugu State. There was no sample size because the population was manageable. The experimental group comprised 133 students, including 69 male and 64 female, while the control group consisted of 118 students. One instrument was used for data collection titled "Physics Achievement Test (PAT)". The validation of the instrument was done in two phases: face validation and content validation. During the face validation process, the items of Physics Achievement Test (PAT) were subjected to face validation by two experts. The instrument was subjected to a reliability test by administering it on an intact class of 40 students in public secondary schools in Enugu Education zone. Kuder-Richardson 21 (K-21) statistic was used to estimate the reliability of the instrument. The reliability index of the instrument was .80, which showed that the instrument was highly reliable. The PAT instrument was given to students in both the experimental and control groups by their class teachers as a pre-test before the treatment begins. Mean and standard deviations were used in answering the research questions. The findings of the study showed that students taught in the experimental group had enhanced engagement as well as achieved higher than those in the control group considering their higher mean achievement scores at posttest. Male students in the experimental group had enhanced engagement as well as achieved higher than their female counterparts considering their higher mean achievement score at post-test. In line with the findings, the researchers recommended that teachers should adopt the instructional approach used in the experimental group to enhance students' academic achievement and engagement. Teachers should consider implementing strategies to bridge the engagement and achievement gaps between male and female students in experimental learning environments among others.

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Keywords: Gamification, Instructional Media, Impacts, Student Engagement, Student Achievement, Secondary Education.

Introduction

Education is the most valuable resource society can offer to a child. It serves as a catalyst for transformation, essential for realizing the desired outcomes, which necessitates educational reform to meet specific goals, visions, and missions aimed at achieving academic excellence (Entoh & Abdullah, 2019). Obiakor and Oguejioffor (2020) asserted that quality education is crucial for global development and freedom. In its broadest sense, education encompasses any experience or activity that impacts an individual's mind, character, or physical abilities (Parvaiz & Khalid, 2021). The pursuit of enhanced educational quality is a global priority because education is believed to drive economic growth and development (Bentil, 2021). Nigeria's education system comprises various levels, including pre-primary, primary, secondary, and higher education (Federal Republic of Nigeria (FRN), 2013). This study will specifically focus on the secondary education level.

Secondary education is the stage of formal education that follows primary education and typically serves learners between the ages of 11 and 18. It prepares students for higher education, vocational training, or entry into the workforce. Secondary education occurs after primary education and before tertiary education. Fabunmi, as cited in Abdulrasheed and Bello (2015), describes it as the educational phase that follows primary education and precedes tertiary education. Okoza (2016) viewed secondary education as an investment and a tool for advancing economic, social, political, technological, scientific, and cultural development. It plays a crucial role in Nigeria, laying a strong foundation for higher education and effective living (Ogbu, 2014). The Federal Republic of Nigeria (FRN) (2013) defined secondary education as the education received after primary education and before tertiary education. The success of a state and its residents heavily relies on secondary education (Nyangarika & Kapinga, 2020). Secondary education plays a crucial role in laying the foundation for students to develop critical thinking and problem-solving skills through the study of science.

Science is the systematic study of the structure and behaviour of the natural and physical world through observation and experimentation. It involves formulating hypotheses, testing them through controlled methods, and drawing conclusions based on empirical evidence. According to Ozoji (2013), science is both a body of knowledge and a way of thinking that helps individuals understand and interact with their environment logically and objectively. Science education is a structured and evolving discipline designed to meet the learning needs of 21st-century students. A key objective is to develop scientifically literate individuals who can think critically, engage emotionally and socially, and make informed decisions based on credible scientific information (Kaya et al., 2019; Chen & Xiao, 2021). It also aims to equip learners with strong conceptual understanding and relevant experiences that help them address real-world challenges (Purwaningsih et al., 2020). To achieve this, science education must adopt student-centered strategies that promote essential skills and prepare students for global competitiveness. Science provides the foundation for understanding natural phenomena through observation, experimentation, and reasoning. One of its core branches that explains the principles governing matter, energy, and motion is physics.

Physics is a core scientific discipline that explores the nature and behaviour of matter, energy, and the forces governing their interactions across space and time. It is widely regarded as a foundational subject within the sciences due to its role in explaining natural phenomena. The discipline has ancient roots, particularly because of its early connection with astronomy, making it one of the earliest formal sciences (Ogunleye & Aina, 2018). In the Nigerian senior secondary school curriculum, physics is categorized into major areas such as mechanics, properties of matter, waves and sound, optics, and nuclear physics (WAEC, 2020; NERDC, 2018). Physics focuses on the study of matter and energy, including how they interact within natural systems. Its applications cut across numerous fields such as electrical and mechanical engineering, electronics, telecommunications, architecture, construction, veterinary medicine, medicine, pharmacy, agriculture, meteorology, mining, astronomy, and even social sciences like psychology and economics (Oyelekan & Olorundare, 2020).

Almost every aspect of life whether living or non-living is influenced by physics, making it central to disciplines like biology, chemistry, and mathematics (Akinbobola & Afolabi, 2017). Without a solid foundation in physics, humanity would struggle to understand or explore the universe (Aliyu, 2019). A clear grasp of physics enhances comprehension of the universe's structure and mechanisms. For students, it cultivates skills such as observation, precision, critical thinking, and creativity (Usman, 2021). Therefore, acquiring knowledge in physics is increasingly essential and indispensable in today's scientific world (Adesoji & Olatunbosun, 2019). This study focused on a specific content area in Physics known as *Electricity and Circuits*, which involves the understanding of electric current, voltage, resistance, and the construction of electrical circuits.

Despite its importance, students' performance in Physics remains consistently low at both secondary and tertiary education levels in Nigeria (Achor & Anaso, 2019; Eze, 2020). This underperformance is linked to a range of internal and external factors affecting learners (Okonkwo & Olatunde, 2021). Internal factors include students' attitudes, motivation, interest, prior knowledge, learning goals, and self-perceptions. External factors involve the quality of the learning environment, teaching methods used by instructors, family background, and the availability of adequate learning facilities (Oyelekan & Olorundare, 2020; Usman, 2021). Among these, lack of interest stands out as a major internal factor negatively influencing achievement. When students are genuinely interested in a subject, they tend to perform better.

Conversely, low engagement often results in weak academic outcomes (Adesoji & Olatunbosun, 2019). Another persistent challenge is the widespread perception of Physics as a difficult subject, especially due to its heavy reliance on mathematical concepts and calculations (Akinbobola & Afolabi, 2017; Onah & Ugwuanyi, 2020). However, the researcher in this study considered one major problem affecting students' poor academic performance in physics as the inappropriate use of teaching approaches that fail to engage learners actively. Many teachers rely heavily on abstract, lecture-based instruction without incorporating practical demonstrations or interactive strategies. According to Olarinoye (2015), students often struggle to understand physics concepts due to the lack of effective, learner-centered teaching method.

Teaching methods refer to the strategies, techniques, and approaches that teachers use to deliver instruction and facilitate student learning. These methods are chosen based on the

learning objectives, student needs, subject matter, and available resources. According to Akpan and Undie (2016), effective teaching methods promote active engagement, critical thinking, and knowledge retention among students. Similarly, Alhassan and Habibu (2021) emphasize that varied teaching methods such as inquiry-based, cooperative, and technology-driven approaches enhance students' academic achievement and motivation. The selection of appropriate teaching methods is crucial for fostering meaningful learning experiences.

The continued low engagement and low academic achievement of secondary school students in Physics are closely tied to the use of outdated teaching methods. To address this challenge, educators must adopt more interactive and student-centered strategies that enhance engagement and conceptual understanding. Research shows that learning becomes more effective when game elements are used to increase motivation (Deterding et al., 2015) and when learners are immersed in realistic simulations that aid comprehension (Merchant et al., 2014). Such innovative transformations in teaching methods can be achieved through the integration of **gamification**.

Gamification involves applying game design elements to non-game settings to enhance user participation, improve knowledge retention, and drive performance by tapping into players' natural instincts (Adeoye, 2023). According to Attah, Ogunlade, and Otemuyiwa (2024), gamification is an innovative teaching strategy used to influence students' behaviour, boost motivation, and improve academic outcomes especially in challenging subjects like mathematics where failure is common. Rao (2022) explained that gamification-based instruction uses features such as levels, quests, storylines, progress indicators, and achievement badges to actively involve learners in the educational process, promoting engagement and encouraging critical thinking. Similarly, Forndran and Zacharias (2019) and Segura-Robles et al. (2020) noted that gamified teaching focuses on infusing fun into learning by using specific tools and strategies to keep students actively involved in their studies. Gamification encourages active participation and motivation through game-like elements in learning, which can boost students' interest and engagement. When combined with immersive simulations, it serves as an effective instructional strategy to improve students' engagement and academic achievement in Physics.

Students' engagement refers to the level of attention, interest, motivation, and active participation that learners exhibit in the learning process. It encompasses behavioral, emotional, and cognitive dimensions, including involvement in classroom activities, emotional investment in learning, and the application of effort to understand and master content (Fredricks, Blumenfeld, & Paris, 2014). High student engagement is associated with better retention, higher academic achievement, and positive attitudes toward learning (Reeve, 2013). In essence, engaged students are more likely to participate actively, persist in challenging tasks, and achieve meaningful learning outcomes. Higher levels of student engagement, characterized by active participation, sustained attention, and motivation, have been shown to directly contribute to improved academic achievement.

Academic achievement refers to the measurable performance outcomes of students in formal education, typically assessed through tests, assignments, and examinations (Okeke & Opara, 2020). It reflects how well students understand and apply knowledge and skills taught in the classroom. In Physics education, academic achievement indicates the level of mastery

students have over fundamental concepts like motion, energy, and electricity. When gamification and virtual reality are integrated into Physics instruction, they create engaging and practical learning environments that improve students' comprehension and retention (Merchant et al., 2014). Studies show that such innovative strategies significantly enhance students' academic achievement in Physics by making abstract concepts more concrete (Barma, Daniel, & Desjardins, 2016). These technologies also promote active participation, which leads to higher interest levels and better academic outcomes. However, disparities exist in the academic achievement and interest levels of male and female students in Physics, often influenced by sociocultural and instructional factors (Ezeudu & Obi, 2013). Research reveals that these differences tend to favour male students, leading to persistent gaps in performance and perception based on gender.

Gender refers to the socially constructed roles, behaviours, activities, and attributes that a given society considers appropriate for males and females. It differs from biological sex, as it is shaped by cultural, historical, and social contexts. In educational settings, gender influences students' participation, interest, and achievement in various subjects, including Physics. According to Offorma (2016), gender roles and expectations can affect how students perceive their abilities and engage with academic content. In the context of **gamification as instructional media, understanding gender differences is crucial to examining its impacts on secondary school students' engagement and achievement in Enugu State.**

Statement of the Problem

In an ideal secondary school learning environment, students are actively engaged, motivated, and consistently achieve high academic performance. Teachers employ diverse instructional strategies that make learning interactive, enjoyable, and relevant, fostering both cognitive and emotional development. Instructional media are effectively integrated into lessons to enhance understanding and stimulate interest, ensuring that students grasp complex concepts with ease. Such an environment promotes creativity, critical thinking, and collaboration among learners, preparing them for higher education and future challenges. However, in many secondary schools in Enugu State, traditional teaching methods still dominate, often relying on rote learning and lecture-based approaches. This has resulted in decreased student engagement, limited participation, and underwhelming academic achievement.

Despite advances in educational technology, the integration of gamification as an instructional media remains minimal, leaving students less motivated and less involved in classroom activities. Many learners perceive lessons as monotonous, leading to low concentration, poor retention, and diminished performance in examinations. Teachers often lack adequate training or resources to implement gamified learning effectively, and schools rarely provide the necessary support systems. Consequently, students miss opportunities to develop problem-solving skills and practical knowledge that gamification can facilitate. The gap between ideal engagement-driven learning and the current passive learning environment poses a significant challenge to educational outcomes. This raises a critical question: **To what extent can gamification as instructional media enhance secondary school students' engagement and academic achievement in Enugu State?**

Purpose of the Study

The main purpose of this study was to investigate the effect of gamification as instructional media on secondary school student's engagement and achievement in Enugu State. Specifically, the study sought to investigate the:

1. mean engagement scores of students taught *electricity and circuits* with gamification and those taught using the lecture method;
2. influence of gender (male and female) on students' engagement in Physics when taught *electricity and circuits* using gamification;
3. mean academic achievement scores of students taught *electricity and circuits* with gamification and those taught using the lecture method;
4. influence of gender (male and female) on students' academic achievement in Physics when taught *electricity and circuits* using gamification.

Research Questions

The following research questions guided the study:

1. What is the difference in mean engagement scores between students taught electricity and circuits using gamification and those taught using the lecture method?
2. How does gender (male and female) influence students' engagement in Physics when taught electricity and circuits using gamification?
3. What is the difference in mean academic achievement scores between students taught electricity and circuits using gamification and those taught using the lecture method?
4. How does gender (male and female) influence students' academic achievement in Physics when taught electricity and circuits using gamification?

Research Method

A quasi-experimental research design was adopted for this study. According to Nworgu (2018), a **quasi-experimental research design** is a type of research in which the researcher manipulates an independent variable to determine its effect on a dependent variable but does not use random assignment of participants to groups. It is often used in educational settings where randomization is impractical or impossible, allowing the researcher to study causal relationships while controlling for some, but not all, extraneous variables. The population for the study comprised 251 Physics students in three public secondary schools in Agbani Education zone of Enugu State. There was no sample size because the population was manageable. The experimental group comprised 133 students, including 69 male and 64 female, while the control group consisted of 118 students. One instrument was used for data collection titled "Physics Achievement Test (PAT)". The validation of the instrument was done in two phases: face validation and content validation. During the face validation process, the items of Physics Achievement Test (PAT) were subjected to face validation by two experts. The instrument was subjected to a reliability test by administering it on an intact class of 40 students in public secondary schools in Enugu Education zone. Kuder-Richardson 21 (K-21) statistic was used to estimate the reliability of the instrument. The reliability index of the instrument was .80, which showed that the instrument was highly reliable. The PAT instrument was given to students in both the experimental and control groups by their class teachers as a pre-test before the treatment begins. Mean and standard deviations were used in answering the research questions.

Results Presentation

Research Question 1: What is the difference in mean engagement scores between students taught electricity and circuits using gamification and those taught using the lecture method?

Table 1: Mean Engagement Scores and Standard Deviations of students in the experimental and control groups in both Pre-test and Post-test

Groups	Number	Pre-test		Post-test	
		Mean ($\bar{x}$)	Standard Deviation (s)	Mean ($\bar{x}$)	Standard Deviation (s)
Experimental	133	24.13	4.69	28.43	5.09
Control	118	22.10	4.12	24.06	4.55

The table presents the pre-test and post-test mean engagement scores and standard deviations for students in the experimental group (taught using gamification) and the control group (taught using the lecture method). Initially, both groups had similar pre-test engagement scores, with the experimental group at 24.13 and the control group at 22.10, showing comparable levels of baseline engagement. At post-test, the experimental group's mean engagement increased to 28.43, while the control group's mean rose slightly to 24.06, indicating a greater improvement for students exposed to gamified instruction. Students taught electricity and circuits using gamification demonstrated higher engagement than those taught using the lecture method.

Research Question 2: How does gender (male and female) influence students' engagement in Physics when taught electricity and circuits using gamification?

Table 2: Mean Engagement Scores and Standard Deviations of male and female students in the experimental group

Groups	N	Pre-test		Post-test	
		($\bar{x}$)	(s)	($\bar{x}$)	(s)
Male	69	25.16	4.80	28.46	5.03
Female	64	23.59	4.61	24.93	4.90

The table shows the pre-test and post-test mean engagement scores and standard deviations of male and female students in the experimental group taught electricity and circuits using gamification. Initially, male students had a slightly higher pre-test mean engagement score (25.16) than female students (23.59), indicating a small difference in baseline engagement. At post-test, male students' mean engagement increased to 28.46, while female students' mean rose to 24.93, showing that male students experienced greater improvement in engagement. Male students in the experimental group demonstrated higher engagement than their female counterparts when taught using gamification.

Research Question 3: What is the difference in mean academic achievement scores between students taught electricity and circuits using gamification and those taught using the lecture method?

Table 3: Mean Achievement Scores and Standard Deviations of students in the experimental and control groups

Groups	N	Pre-test		Post-test	
		$(\bar{x})$	(s)	$(\bar{x})$	(s)
Experimental	133	28.43	5.09	32.79	5.84
Control	118	24.06	4.55	26.11	4.90

The table presents the pre-test and post-test mean academic achievement scores and standard deviations for students in the experimental group (taught using gamification) and the control group (taught using the lecture method). At the pre-test stage, the experimental group had a mean score of 28.43, slightly higher than the control group's 24.06, indicating some initial difference in performance. By the post-test, the experimental group's mean increased to 32.79, while the control group's mean rose to 26.11, showing a greater improvement among students exposed to gamified instruction. Students taught electricity and circuits using gamification achieved higher academic performance than those taught using the lecture method.

Research Question 4: How does gender (male and female) influence students' academic achievement in Physics when taught electricity and circuits using gamification?

Table 4: Mean Achievement Scores and Standard Deviations of male and female students in the experimental group

Groups	n	Pre-test		Post-test	
		$(\bar{x})$	(s)	$(\bar{x})$	(s)
Male	69	28.46	5.03	30.68	5.54
Female	64	24.93	4.90	25.16	5.15

The table presents the pre-test and post-test mean academic achievement scores and standard deviations of male and female students in the experimental group taught electricity and circuits using gamification. Initially, male students had a slightly higher pre-test mean score (28.46) compared to female students (24.93), indicating a small difference in baseline academic performance. At post-test, male students' mean score increased to 30.68, while female students' mean rose to 25.16, showing that male students achieved greater improvement in academic performance. Male students in the experimental group demonstrated higher academic achievement than their female counterparts when taught using gamification.

Discussion of Findings

The findings of the study showed that students taught in the experimental group using gamification demonstrated significantly higher levels of engagement compared to their peers in the control group. This increased engagement was reflected in their active participation, sustained attention, and enthusiasm during lessons. Furthermore, the experimental group achieved higher academic performance, as evidenced by their superior mean achievement scores at the post-test, indicating that gamification positively influenced both learning interest and understanding of the concepts. Several studies support these findings. For instance, Hamari, Koivisto, and Sarsa (2014) found that gamification in educational settings significantly increased student engagement and motivation, leading to improved learning outcomes. Similarly, Dichev and Dicheva (2017) reported that incorporating gamified elements in classroom instruction enhanced both participation and academic performance, confirming the positive impact of gamification on students' learning experiences.

Male students in the experimental group exhibited higher levels of engagement compared to their female counterparts, actively participating and showing greater interest during lessons. This increased engagement translated into better academic performance, as reflected in their higher mean achievement scores at the post-test. The findings suggest that male students responded more positively to gamification as an instructional media, benefiting both their involvement in class activities and their understanding of the subject matter. This finding aligns with previous research on gender differences in response to gamified learning. For example, Barata, Gama, Jorge, and Gonçalves (2013) found that male students often show higher engagement and motivation in gamified educational environments compared to female students. Similarly, Mekler, Brühlmann, Tuch, and Opwis (2017) reported that gamification can differentially affect students based on gender, with males generally achieving higher performance and demonstrating greater participation when gamified elements are incorporated.

Conclusion

The findings of this study clearly indicate that the use of gamification as an instructional media positively impacts students' engagement and academic achievement in Physics. Students in the experimental group demonstrated higher participation, interest, and motivation compared to those taught using the traditional lecture method. Their superior post-test mean scores confirm that gamified learning enhances understanding and retention of concepts in electricity and circuits. Additionally, male students in the experimental group showed higher engagement and achievement than their female counterparts, suggesting that gender may interact with the effectiveness of gamification. These results highlight the potential of gamification to transform teaching and learning in secondary schools. Incorporating gamified instructional strategies can significantly improve both student engagement and academic performance.

Recommendations

Based on the findings, the study recommended that:

1. Teachers should adopt the instructional approach used in the experimental group to enhance students' academic achievement and engagement.

2. Teachers should consider implementing strategies to bridge the engagement and achievement gaps between male and female students in experimental learning environments among others.

REFERENCES

Abdulrasheed, O. & Bello, A. S. (2015). Challenges to secondary school principals' leadership in northern region of Nigeria. *British Journal of Education,* 3(3), 1-5.

Achor, E. E., & Anaso, U. M. (2019). Influence of students' interest on academic performance in senior secondary school physics. *Nigerian Journal of Science and Educational Research*, 5(2), 44–52.

Adeoye, M. A. (2023). Influence of gamification elements on students' academic performance. *Indonesian Journal of Teaching in Science 3*(2), 105-112.

Adesoji, F. A., & Olatunbosun, S. M. (2019). Challenges and significance of teaching physics in Nigerian secondary schools. *African Journal of Educational Research and Development*, 12(1), 88–97.

Akinbobola, A. O., & Afolabi, F. (2017). Analysis of science students' performance in physics: Implications for teaching and learning. *Journal of Science, Technology, Mathematics and Education*, 13(2), 146–154.

Akpan, B. B., & Undie, M. E. (2016). Effective teaching strategies in science education: A necessity for students' academic performance. *Global Journal of Educational Research, 15*(2), 85–92.

Alhassan, A. R. K., & Habibu, T. (2021). Impact of innovative teaching strategies on students' academic performance in Nigerian secondary schools. *African Educational Research Journal, 9*(3), 672–678.

Aliyu, M. M. (2019). *Fundamentals of Physics for Tertiary Institutions*. Zaria: Samaru Academic Press.

Attah, J. O., Ogunlade, O. O. & Otemuyiwa, B. I. (2024). Effect of gamification-based teaching on Junior secondary school student's academic performance in Mathematics in Kwara State. *Andragogi Jurnal Pendidikan dan Pembelajaran*, 4(2), 153-165

Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013). *Engaging engineering students with gamification. Proceedings of the 5th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games), 1–8.*

Barma, S., Daniel, S., & Desjardins, G. (2016). Using a serious game to teach scientific inquiry: Effects on motivation and learning. *Journal of Science Education and Technology*, 25(3), 435–449.

Chen, L., & Xiao, S. (2021). Perceptions, challenges and coping strategies of science teachers in teaching socioscientific issues: A systematic review. *Educational Research Review, 32*, 100377.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2015). *From game design elements to gamefulness: Defining "gamification". Proceedings of the 15th International Academic MindTrek Conference*, 9–15.

Dichev, C., & Dicheva, D. (2017). *Gamifying education: What is known, what is believed, and what remains uncertain: A critical review. International Journal of Educational Technology in Higher Education, 14*(9), 1–36.

Entoh, M., & Abdullah, R. (2019). *The impact of technology integration on students' academic performance in secondary schools*. *International Journal of Educational Technology*, 10(2), 45–58.

Eze, C. N. (2020). Students' interest and attitude as predictors of academic achievement in science subjects in secondary schools. *African Journal of Educational Studies*, 16(1), 91–101.

Ezeudu, F. O., & Obi, T. U. (2013). Effects of Concept Mapping on Students' Achievement in Physics. *Journal of Science Teachers Association of Nigeria*, 48(1), 32–41.

Federal Republic of Nigeria (2013). *National policy on education* (4th Eds). Lagos: NERDC Press.

Forndran, F., & Zacharias, C. R. (2019). Gamified experimental physics classes: A promising active learning methodology for higher education. *European Journal of Physcology, 40*(1), 17-22.

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2014). *School engagement: Potential of the concept, state of the evidence.* Review of Educational Research, 74(1), 59–109.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does gamification work? — A literature review of empirical studies on gamification. Proceedings of the 47th Hawaii International Conference on System Sciences, 3025–3034.*

Kaya, E., Erduran, S., Aksoz, B., & Akgun, S. (2019). Reconceptualised family resemblance approach to nature of science in pre-service science teacher education. *International Journal of Science Education, 41*(1), 21–47.

Mekler, E. D., Brühlmann, F., Tuch, A. N., & Opwis, K. (2017). *Towards understanding the effects of individual gamification elements on intrinsic motivation and performance. Computers in Human Behaviour, 71*, 525–534.

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2013). *Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis*. *Computers & Education, 70*, 29–40.

NERDC. (2018). *Senior Secondary Education Curriculum: Physics for SS1–3*. Nigerian Educational Research and Development Council.

Nworgu, B. G. (2018). *Educational Research: Basic Issues and Methodology* (3rd ed.). Nsukka: University Trust Publishers.

Nyangarika, A. & Kapinga, B. B. (2020). Influence of heads of school's leadership practices on teachers' job performance in secondary schools. *International Journal of Advance Research and Innovative Ideas in Education*, 6(5), 1826-1838.

Obiakor, M. I., & Oguejioffor, C. N. (2020). *Impact of classroom size on academic performance of secondary school students in Enugu North Local Government Area of Enugu State, Nigeria*. *African Journal of Educational Management, Teaching and Entrepreneurship Studies, 1*(1), 51–59.

Offorma, G. C. (2016). Gender and education: A sociological perspective. *Journal of the Nigerian Academy of Education*, 12(2), 1–14.

Ogbu, J. O. (2014). Principals' motivational strategies and teacher job satisfaction in Benue State. *Unpublished thesis. Department of Educational Foundations University of Nigeria, Nsukka.*

Ogunleye, A. O., & Aina, J. K. (2018). *Teaching and learning of physics in Nigerian secondary schools: The curriculum implementation bottlenecks*. *Journal of Education and Practice, 9*(12), 88–93.

Okeke, S. O., & Opara, J. A. (2020). Assessment of academic achievement of senior secondary school students in Physics using ICT-Based instructional strategies. *International Journal of Education and Evaluation*, 6(3), 11–19.

Okonkwo, E. C., & Olatunde, A. M. (2021). Emotional and cognitive factors influencing student engagement in physics. *Journal of Educational Psychology and Pedagogy*, 12(1), 67–74.

Okoza, J. (2016). Secondary school pupils' perception of environmental variables influencing academic performance in Edo State, Nigeria, *Bangladesh e-Journal of Sociology.* 9(2), 84-94.

Olarinoye, R. (2015). Enhancing science education through effective teaching strategies. *Journal of Science Teachers Association of Nigeria (STAN), 45*(1), 56–62.

Onah, E. U., & Ugwuanyi, C. S. (2020). The role of mathematics anxiety in students' achievement in physics. *International Journal of Educational Research*, 23(2), 59–68.

Oyelekan, O. S., & Olorundare, A. S. (2020). Physics education and national development: Issues and prospects. *Journal of Science Education and Innovation*, 8(1), 25–34.

Parvaiz, O. & Khalid, I. (2021). School climate: Research, policy, practice, and teacher education. *Teachers College Record, 111*(1), 180–213.

Purwaningsih, E., Sari, S. P., Sari, A. M., & Suryadi, A. (2020). The effect of STEM-PjBL and discovery learning on improving students' problem-solving skills of impulse and momentum topic. *JPII (Jurnal Pendidikan IPA Indonesia), 9*(4), 465–476.

Reeve, J. (2013). *How students create motivationally supportive learning environments for themselves: The concept of agentic engagement. Journal of Educational Psychology, 105*(3), 579–595.

Segura-Robles, A., Fuentes-Cabrera, A., Parra-González, M. E., & López-Belmonte, J. (2020). Effects on personal factors through flipped learning and gamification as combined methodologies in secondary education. *Frontier Psychology, 1*(1), 1103-1111.

Usman, I. A. (2021). Promoting students' scientific creativity through effective physics instruction. *Nigerian Journal of Science Education*, 10(1), 55–63.

WAEC. (2020). *West African Senior School Certificate Examination Syllabus for Physics*. West African Examinations Council.