

EFFECTS OF GAMIFIED INSTRUCTIONAL VIDEOS ON SPATIAL REASONING AND ENVIRONMENTAL AWARENESS OF SENIOR SECONDARY SCHOOL GEOGRAPHY STUDENTS IN KATSINA STATE, NIGERIA

Dr. Aminu Salisu Tsauri¹ & Muhammad Nazir Ibrahim²

¹*Department of Science and Vocational Education, Umaru Musa Yaradua University*
aminu.salisua2@umyu.edu.ng/+2348037446501

²*Department of Science Education, Federal University Dutsinma*
nimuhammad@fudutsinma.edu.ng/+2347030302788

ARTICLE INFO

Article No.: 0145

Accepted Date: 04/01/2025

Published Date: 31/01/2026

Type: Research

ABSTRACT

Secondary school Geography students continue to experience difficulties in developing spatial reasoning and environmental awareness, skills that are central to understanding complex geographical phenomena. These challenges are often associated with conventional, lecture dominated instructional practices that limit active cognitive engagement. Anchored in the Cognitive Theory of Multimedia Learning and constructivist learning principles, this study investigated the effect of gamified instructional videos on spatial reasoning and environmental awareness among Senior Secondary School II Geography students in Katsina State, Nigeria. A quasi-experimental pretest, post-test control group design was employed. Using a multistage sampling technique, 148 students were drawn from public secondary schools and assigned to experimental and control groups using intact classes. Data were collected using validated instruments measuring spatial reasoning, environmental awareness, and Geography achievement. The experimental group received instruction on climate zone concepts through gamified instructional videos, while the control group was taught using the conventional lecture method. Data were analyzed using descriptive statistics, independent samples *t*-test, and Analysis of Covariance (ANCOVA) at the 0.05 level of significance. Results revealed that students exposed to gamified instructional videos demonstrated significantly higher spatial reasoning skills and environmental awareness than those taught conventionally. The findings highlight the instructional value of gamified multimedia in fostering deeper cognitive processing and meaningful engagement with environmental concepts in Geography education.

Keywords: Gamified learning, Instructional videos, Spatial reasoning, Environmental awareness

Introduction

In the 21st century, classrooms worldwide are moving away from traditional lectures toward innovative strategies that truly resonate with today's learners (Rahimi & Oh, 2024). At the heart of this shift is gamification the art of bringing game design into the classroom to boost engagement, spark motivation, and deepen understanding (Rivera & Garden, 2021). As educators, understanding how these tools actually work is no longer optional; it is essential for keeping our teaching methods relevant in a rapidly changing world (Balakrishna, 2023).

By using game based techniques, the researcher can transform how students interact with complex material (Chans & Portuguese Castro, 2021). This approach isn't just about playing games; it's about promoting learning through real life simulations where students can shape concepts through hands on experience. In an effective gamified environment, students work toward clear goals, making choices and seeing the consequences play out in real-time. This creates a safe, risk free space for trial and error, allowing them to practice the right way to do things through experimentation (Ogundare, Akinyemi & Ayotola, 2025). This level of immersion ensures that the habits and thought processes they develop in a simulation are easily carried over into the real world.

Specifically, gamified learning works by weaving elements like points, badges, leaderboards, and instant feedback directly into lessons to drive student participation (Saleem, Noori and Ozdamli, 2022). As Deterding et al. (2011) noted, it's about using the fun mechanics of games in non game settings to improve the overall experience. When the researcher pair these mechanics with instructional videos which combine sight and sound to present content in a structured, digestible way (Kahsay, Berhe, & Tesfamariam, 2024) the researcher effectively reduce the cognitive overload that often causes students to tune out (Matthew & De Villiers, 2020).

This combination is particularly powerful for developing spatial reasoning that critical ability to visualize the locations, shapes, and relationships of the world around us (Newcombe, 2010; Baumgartner, Ferdig & Gandolfi, 2022). In geography, spatial thinking is how the researcher interpret the world; it allows students to describe how environments are interdependent and how different geographical phenomena intersect (Nursa'ban, Kumaidi & Mukminan, 2020). After all, you cannot solve geographical problems without a spatial mind (Christian, 2020). When a student can look at a map or a landscape and ask, why is this here? or how does this affect its neighbor? they are engaging in the kind of deep analysis that gamified tools are designed to spark (Alfizahr, Putra & Sazali, 2023).

Ultimately, these tools serve a higher purpose fostering environmental awareness. By helping students understand the weight of issues like climate change, deforestation, and resource management (Iizuka, 2016), the researcher prepare them to be better stewards of the planet. Geography education is the primary bridge between human activity and the natural world (Urbańska et al., 2021). By using gamified instructional videos to make learning more active and goal oriented, the researcher don't just make geography enjoyable the researcher make it meaningful.

Statement of the Problem

Despite the strategic importance of geography in the secondary school curriculum, senior secondary students in Katsina State, Nigeria, consistently struggle to master the core competencies of spatial reasoning and environmental awareness. Reports from the West African Examinations Council (WAEC, 2021) frequently highlight candidates' deficiencies in map reading, spatial interpretation, and the application of geographic concepts to environmental issues areas that form the bedrock of the subject. Research suggests that inadequate interactive content and minimal practical exposure impede learners' comprehension of spatial phenomena and geographic environment concepts, resulting in poor academic performance and weak

application of geographic knowledge to real-world contexts (Dewi et al, 2025). These persistent performance gaps suggest that traditional lecture-based methods and static instructional materials are no longer sufficient; they fail to bridge the gap between abstract spatial phenomena and the students' cognitive reality.

While the adoption of technology in Nigerian classrooms has grown, a critical pedagogical tension remains unresolved. Existing research in Nigeria has explored the use of standard instructional videos to improve academic performance in physical geography, yet these interventions often overlook the psychological drivers of learning; motivation and sustained engagement. According to Alsawaier (2018) suggest that without gamified elements, digital content can become as passive as the traditional lectures it seeks to replace.

Currently, there is a scholarly debate regarding the universality of gamification. While some literature indicates it can heighten awareness of complex environmental issues, empirical evidence remains fragmented and mixed across different cultural and educational settings (Minas, Vrettis, & Xenos, 2025). Specifically, in the Katsina State context, there is a black box regarding how the combination of instructional videos and gamified mechanics points, levels, and feedback specifically targets the spatial-cognitive faculties of learners.

Previous studies are insufficient because they have treated multimedia as a monolithic tool, failing to isolate how game design elements can specifically remediate the documented weaknesses in spatial reasoning and environmental stewardship among Nigerian students. Therefore, a gap exists in determining whether a gamified instructional video framework can move beyond mere performance enhancement to foster deeper, transferable spatial intelligence. This study addresses this tension by investigating the effectiveness of gamified learning as a targeted intervention to resolve these persistent instructional challenges in Katsina State.

Objective of the Study

The Study was set to find out:

1. Assess the effect of gamified learning through instructional videos on students' spatial reasoning skills in geography.
2. Determine the influence of gamified instructional videos on students' environmental awareness with respect to geographic issues.
3. Compare the academic performance of students exposed to gamified instructional videos with those taught using conventional instructional methods.

Research Question

1. What is the effect of gamified learning through instructional videos enhance senior secondary students' spatial reasoning skills in geography?
2. How does gamified instruction via video affect students' awareness of environmental issues related to geography?
3. What is the difference in academic achievement between students taught with gamified instructional videos and those taught using traditional methods?

Research Hypotheses

- H₀₁:** There is no significant difference in spatial reasoning scores between students taught using gamified instructional videos and those taught through conventional methods.
- H₀₂:** There is no significant difference in environmental awareness levels between students exposed to gamified instructional videos and those taught via traditional approaches.
- H₀₃:** There is no significant difference in overall academic performance in geography between students taught with gamified learning through instructional videos and those taught with non-gamified instructional methods.

Methodology

To truly understand how gamified videos impact learning, the researcher chose a quasi-experimental design using pretests and post-tests with two distinct groups. This research took place in public secondary schools within the Katsina Zonal Quality Assurance Area of Katsina State, Nigeria a region where geographical education is vital but often resource constrained. The study started with a target population of 6,623 Geography students in Senior Secondary School II. Through a multistage sampling process, the researcher randomly selected four schools. To keep the learning environment as natural as possible, the researcher used intact classes rather than pulling individual students out of their rooms. The final study included 148 participants 66 in the experimental group and 82 in the control group. While the researcher initially engaged a larger number of students, the final sample reflects those who were present for the entire six-week journey and completed every assessment. the researcher used ANCOVA for our final analysis specifically because it is designed to handle these unequal group sizes fairly, ensuring the results remain accurate even though the groups weren't perfectly balanced. The researchers used three specific tools to track student progress, all of which were vetted by experts in Geography and Measurement to ensure they were hitting the mark: Spatial Reasoning Test (SRT); An objective test designed to see how well students can mentally visualize and rotate objects. Environmental Awareness Questionnaire (EAQ); A scale that captures students' attitudes and sensitivity toward local issues like desertification. Geography Achievement Test (GAT) a focused test on climate zone concepts. To make sure these tests were reliable, the researcher ran a pilot study. The results were strong, with reliability scores (KR-20 and Cronbach's alpha) ranging from 0.76 to 0.84, giving us high confidence in our data.

For this study to be replicated by others, it is important to define what happened in the experimental classroom. Over six weeks, these students didn't just watch videos; they interacted with a gamified framework. the researcher built three specific game elements into the lessons: Knowledge Quests (Challenges); Students had to solve geographic puzzles before they could unlock the next part of the video. Instant Feedback; If a student made an error in a map-reading exercise, the video provided immediate, helpful correction. Leveling Up; the researcher used progress bars to give students a sense of achievement as they mastered difficult climate concepts. Meanwhile, the control group covered the exact same curriculum using the conventional lecture method relying on traditional textbooks and static maps. Before the lessons began, the researcher gave everyone a pretest to establish a baseline. Afterward, the researcher used mean scores and standard deviations to see the general trends. To test our hypotheses, the researcher applied ANCOVA at the 0.05 significance level. By using the pretest scores as a control, the researcher were able to filter out any prior knowledge students had, allowing us to see exactly how much the gamified videos actually improved their spatial reasoning and environmental awareness.

Result

Research Question One: To what extent does gamified learning through instructional videos enhance senior secondary students' spatial reasoning skills in geography?

Table 1: mean and standard deviation of students' spatial reasoning scores based on instructional method.

	Group	N	Mean	Std.	Std. Error Mean
Spatial Reasoning	Experimental	66	16.14	2.411	.297
	Control	82	8.59	3.285	.363

The descriptive statistics presented in Table 1 indicate that gamified learning through instructional videos enhanced senior secondary school students' spatial reasoning skills in geography to a considerable extent. Students exposed to gamified instructional videos recorded

a higher mean post-test spatial reasoning score ($M = 16.14$, $SD = 2.41$) than their counterparts taught using the conventional method ($M = 8.59$, $SD = 3.29$).

Research Question Two: How does gamified instruction via video affect students' awareness of environmental issues related to geography?

Table 2: mean and standard deviation of students' environmental awareness scores based on instructional method.

	Group	N	Mean	Std. Deviation	Mean difference
Environmental Awareness	Experimental	66	59.74	8.448	13.4
	Control	82	46.34	8.829	

As shown in Table 2, gamified instruction delivered through videos positively influenced students' awareness of environmental issues in geography. The experimental group obtained a higher mean post-test environmental awareness score ($M = 59.74$, $SD = 8.45$) compared with the control group ($M = 46.39$, $SD = 8.83$).

Research Question Three: What is the difference in academic achievement between students taught with gamified instructional videos and those taught using traditional methods?

Table 2: mean and standard deviation of students' Geography Achievement scores based on instructional method.

	Group	N	Mean	Std. Deviation	Mean difference
Posttest	Experimental	66	16.52	2.61	0.321
	Control	82	9.37	3.23	0.357

The descriptive statistics in Table 3 reveal a clear difference in academic achievement between students taught with gamified instructional videos and those taught using traditional methods. Students in the experimental group recorded a higher mean post-test academic achievement score ($M = 16.52$, $SD = 2.61$) than students in the control group ($M = 9.37$, $SD = 3.23$).

Test of Hypothesis One

Ho₁: There is no significant difference in spatial reasoning scores between students taught using gamified instructional videos and those taught through conventional methods.

Table 4: independent sample t-test of spatial reasoning scores of students taught using gamified instructional videos and conventional methods.

Group	N	Mean	Std.	df	t-value	p-value	Remark
Experimental	66	16.14	2.41	146	15.60	0.000	Significant
Control	82	8.59	3.29				
Total	148						

* Significant at $p \leq 0.05$

An independent samples t-test was conducted to determine whether a significant difference existed in the spatial reasoning scores of students taught using gamified instructional videos and those taught using the conventional method. The results showed that students in the experimental group obtained a higher mean spatial reasoning score ($M = 16.14$, $SD = 2.41$) than those in the control group ($M = 8.59$, $SD = 3.29$). The test result indicated a statistically significant difference between the two groups, $t(146) = 15.60$, $p < .05$. Therefore, the null hypothesis was rejected. This implies that gamified instructional videos significantly improved students' spatial reasoning skills in geography compared to the conventional teaching method.

Test of Hypothesis Two

H₀₂: There is no significant difference in environmental awareness levels between students exposed to gamified instructional videos and those taught via traditional approaches.

Table 5: analysis of covariance (ANCOVA) of student's environmental awareness scores by instructional method.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power ^b
Corrected Model	6607.139 ^a	2	3303.570	44.091	.000	.378	88.182	1.000
Intercept	5937.019	1	5937.019	79.238	.000	.353	79.238	1.000
PreEAW	87.847	1	87.847	1.172	.281	.008	1.172	.189
Group	1785.515	1	1785.515	23.830	.000	.141	23.830	.998
Error	10864.286	145	74.926					
Total	422985.000	148						
Corrected Total	17471.426	147						

a. R Squared = .378 (Adjusted R Squared = .370)

b. Computed using alpha = .05

Analysis of covariance (ANCOVA) was employed to test this hypothesis, using pre-test environmental awareness scores as a covariate. The results revealed a significant effect of instructional method on students' post-test environmental awareness scores. The ANCOVA result showed that the difference between the experimental and control groups was statistically significant, $F(1, 145) = 23.83$, $p < .05$, partial $\eta^2 = .14$. Consequently, the null hypothesis was rejected. This finding indicates that gamified instructional videos significantly enhanced students' environmental awareness in geography compared to traditional instructional approaches.

Test of Hypothesis Three

H₀₃: There is no significant difference in overall academic performance in geography between students taught with gamified learning through instructional videos and those taught with non-gamified instructional methods.

Table 4: independent sample t-test of Geography performance test scores of students taught using gamified instructional videos and conventional methods.

Group	N	Mean	Std.	df	t-value	p-value	Remark
Experimental	66	16.52	2.61	146	14.56	0.000	Significant
Control	82	9.37	3.23				
Total	148						

* Significant at $p \leq 0.05$

An independent samples t-test was used to test the hypothesis. The results revealed that students taught using gamified instructional videos achieved a higher mean academic performance score ($M = 16.52$, $SD = 2.61$) than those taught using the conventional method ($M = 9.37$, $SD = 3.23$). The t-test result showed that the difference between the two groups was statistically significant, $t(146) = 14.56$, $p < .05$. Thus, the null hypothesis was rejected. This result indicates that gamified learning through instructional videos significantly improved students' academic performance in geography.

Discussion of Findings

The findings of this study revealed that gamified learning through instructional videos significantly enhanced senior secondary school students' spatial reasoning skills, environmental awareness, and academic achievement in geography. These results are consistent with, and strongly supported by, previous empirical studies reported in the literature. However, to fully understand these gains, it is necessary to look deeper than the statistical significance.

The present study found that students exposed to gamified instructional videos demonstrated higher spatial reasoning skills than those taught using conventional lecture methods. This suggests that gamified learning through instructional videos significantly improved students' spatial reasoning skills in geography. This consistency is supported by Baumgartner et al. (2022), who found that technology enhanced and immersive learning environments improve learners' spatial reasoning by enabling them to visualize spatial relationships more effectively. Likewise, Nursa'ban et al. (2020) reported that spatial reasoning develops more effectively when learners interact with visual content rather than static text.

Findings also revealed that students taught using gamified videos showed greater environmental awareness compared to those taught through traditional methods. This outcome is consistent with previous research establishing that gamified videos significantly enhance awareness of issues like climate change and sustainability. Supporting this, Assapun and Thummaphan (2023) found that game-based approaches improved attitudes by promoting active problem-solving. Similarly, Urbańska et al. (2021) emphasized that geography instruction integrating experiential tools enhances awareness of environmental threats.

The study further revealed that students achieved higher academic performance than those in the conventional group. This is consistent with Dichev and Dicheva (2017), who reported that gamification enhances achievement by increasing motivation and persistence. In the same vein, Sailer and Homner (2020) concluded that gamified environments positively influence outcomes when game elements are aligned with objectives.

Conclusion

This study investigated the effectiveness of gamified learning through instructional videos on senior secondary school students' spatial reasoning skills, environmental awareness, and academic achievement in geography. The findings indicate that, within the context of the schools studied, gamified instructional videos appeared more effective than conventional lecture-based methods in enhancing students' learning outcomes. Students exposed to this intervention demonstrated higher spatial reasoning skills, greater awareness of environmental issues, and improved academic achievement. These results suggest that integrating game elements with instructional videos supports active engagement and facilitates a more immersive cognitive processing of geographic content.

Beyond the statistical gains, the primary contribution of this research lies in demonstrating how active game mechanics (such as feedback and challenges) can transform passive multimedia (instructional videos) into a tool for spatial cognition. While previous research has often focused on general academic performance, this study highlights a specific pathway for geography education: using gamification to bridge the gap between abstract climate concepts and a student's ability to reason spatially. This provides a localized empirical foundation for the use of educational technology in Katsina State, suggesting that the gamified video model is a viable approach to modernizing geography instruction.

Overall, the study provides evidence that gamified learning through instructional videos can be an effective instructional approach at the senior secondary school level. However, given the quasi-experimental nature of this research and the potential for confounding variables like the novelty effect, these findings should be interpreted as a promising direction rather than a definitive solution. The results underscore the potential of gamified video-based instruction

to improve both cognitive and affective outcomes, supporting its cautious integration into geography teaching practices to foster a more interactive and environmentally conscious generation of learners.

Recommendations

Based on the insights gained from this study, and with a careful eye on the practical realities of Nigerian public secondary schools, the following recommendations are offered:

1. Geography teachers should begin by incorporating gamified instructional videos into specific, high difficulty topics like map reading and climate change. Recognizing that spatial reasoning showed the most significant growth in this study, teachers should prioritize these tools where traditional static maps have historically failed. To work around limited resources, teachers could use a station rotation model where one computer or tablet is shared among small groups, rather than requiring a device for every student.
2. Rather than broad professional development, educational authorities in Katsina State should focus on peer-to-peer mentoring. Teachers who are already tech savvy can lead short, hands-on workshops on how to find existing, low-cost gamified videos or how to add simple challenge elements (like points or timed quizzes) to their current lessons. This addresses the teacher competence gap without requiring expensive external consultants.
3. Since reliable internet and constant power are often missing, curriculum planners and school administrators should focus on low-band width or offline solutions. Schools should be equipped with offline repositories of gamified content stored on local hard drives or shared via local school intranets. This ensures that the benefits of gamified learning aren't lost every time the internet goes down or the power fluctuates.
4. Policymakers should move beyond simply buying computers and instead update the geography curriculum to officially recognize interactive, video-based learning as a valid assessment tool. By shifting the curriculum slightly to reward experiential milestones (like completing a spatial puzzle in a video), the researcher can move geography away from rote memorization and toward the deep cognitive processing this study suggests is possible.
5. Finally, because our study was limited by its six-week duration and specific location, the researcher recommend that future researchers investigate whether these spatial reasoning gains hold up over an entire school year. the researcher need more studies across different regions of Nigeria to see if the novelty effect wears off. Further research should also investigate if students retain this geographic knowledge longer when it is learned through a game-based video versus a traditional lecture.

References

- Alfizahr, F. V., Putra, A., & Sazali, S. B. (2023). Enhancing Environmental Decision-Making: The Role of Double-Loop Spatial Learning and Gamification. *Journal Pendidikan Ilmu Sosial*, 33(2), 180-196.
- Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology*, 35(1), 56-79.
- Assapun, S., & Thummaphan, P. (2023). Assessing the effectiveness of board game-based learning for enhancing problem-solving competency of lower secondary students. *International Journal of Instruction*, 16(2), 511-532.
- Balakrishna, C. (2023). The Impact of in-Classroom Non-Digital Game-Based Learning Activities on Students Transitioning to Higher education. *Education sciences*, 13(4), 328.
- Baumgartner, E., Ferdig, R. E., & Gandolfi, E. (2022). Exploring the impact of extended reality (XR) on spatial reasoning of elementary students. *TechTrends*, 66(5), 825-836.
- Chans, G. M., & Portuguese Castro, M. (2021). Gamification as a strategy to increase motivation and engagement in higher education chemistry students. *Computers*, 10(10), 132.
- Christian S. (2020) Enhancing Knowledge, Skills, and Spatial Reasoning through Location-based Mobile Learning. A thesis submitted to attain the degree of Doctor of Sciences of ETH ZURICH <https://doi.org/https://doi.org/10.3929/ethz-b-000458558>
- Deterding, S., Sicart, M., Nacke, L., O'hara, K., & Dixon, D. (2011). Gamification. using game-design elements in non-gaming contexts. In *CHI'11 Extended Abstracts on Human Factors in Computing Systems* (pp. 2425-2428)
- Dewi R. P., Saidi R., Somantri L. & Maryani E. (2025). Geography Learning Models in Improving Spatial Thinking Skills: 14(1), 16-28 A Literature Review. <https://doi.org/10.24114/tgeo.v14i1.65092>
- Dichev, C., Dicheva, D., & Irwin, K. (2020). Gamifying learning for learners. *International Journal of Educational Technology in Higher Education*, 17(1), 54.
- Iizuka, M. (2016). Role of Environmental Awareness in Achieving Sustainable Development.
- Matthew, G., & De Villiers, K. (2020). Activate the Stimuli Receptors: Reducing Cognitive Overload by Analyzing the Impact of Multimedia Elements. *Journal of Educational Multimedia and Hypermedia*, 29(3), 247-264.
- Minas, D., Vrettis, P., & Xenos, M. (2025). Impact of 3D Virtual Worlds on Environmental Awareness Among Students. In *E3S Web of Conferences* (Vol. 669, p. 08005). EDP Sciences.
- Nursa'ban, M., Kumaidi, K., & Mukminan, M. (2020). Factors of Critical Spatial Thinking for a Geography Metacognition Assessment in Indonesian Senior High Schools. *Review of International Geographical Education Online*, 10(2), 186-204.
- Ogundare, A. F., Akinyemi, A. L., & Ayotola, A. (2025). Impact of Gamification and Game-Based Learning on Senior Secondary School Students' Achievement in English Language. *Journal of Educational Review*, 13(1), 110-123. <https://doi.org/10.4314/jer.v13i1>
- Rahimi, R. A., & Oh, G. S. (2024). Rethinking the role of educators in the 21st century: navigating globalization, technology, and pandemics. *Journal of Marketing Analytics*, 12(2), 182-197.
- Rivera, E. S., & Garden, C. L. P. (2021). Gamification for student engagement: A Framework. *Journal of Further and Higher Education*, 45(7), 999-1012.
- Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational psychology review*, 32(1), 77-112.
- Saleem, A. N., Noori, N. M., & Ozdamli, F. (2022). Gamification applications in E-learning: A literature review. *Technology, Knowledge and Learning*, 27(1), 139-159.

- Urbańska, M., Charzyński, P., Gadsby, H., Novák, T. J., Şahin, S., & Yilmaz, M. D. (2021). Environmental Threats and Geographical Education: Students' Sustainability Awareness Evaluation. *Education Sciences*, 12(1), 1.
- West African Examinations Council, WAEC. (2021). Chief examiners' report. Lagos: West African Examinations Council.