



Effect of Animated Instructional Strategy on Gender and Learning Motivation in Chemistry in Ogoja Education Zone, Nigeria

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Abstract

This study examined the impact of animated video-based instructional strategies on students' motivation and gender differences in learning chemistry in Ogoja Local Government Area, Cross River State, Nigeria. Using a quasi-experimental pre-test, post-test design, 200 SSII students were selected from a population of 2,700. The instruments used included the Chemistry Achievement Test (CAT), with a reliability coefficient of 0.85 (KR-20), and a Student Learning Motivation Questionnaire, with a Cronbach alpha of 0.82. Data were analyzed using descriptive statistics and ANCOVA. The findings revealed a statistically significant improvement in students' motivation towards chemistry for those taught using animated instructional strategies, with $F(1, 179) = 6.27, p < 0.001$. The mean gain score for the animated group was 20.07, indicating a substantial performance improvement. Furthermore, the effect size, represented by a partial eta squared value of 0.736, suggests a strong practical significance, with the animated strategy accounting for approximately 73.6% of the variance in motivation outcomes. However, the interaction effect between gender and instructional strategy was not statistically significant, with the effect size, represented by a partial eta squared value of .004, suggesting a low practical significance, accounting for approximately 4% of the variance in outcomes, indicating that gender did not influence the effectiveness of the animated method. These results suggest that animation enhances motivation and achievement in chemistry learning regardless of gender. Therefore, it is recommended that chemistry and science educators adopt animated instructional strategies in classroom instruction to improve student engagement and academic performance. Incorporating animation can serve as an effective pedagogical tool to foster deeper understanding and sustained interest in science subjects.

Keywords: Animated Video-Based, Conventional Strategy, Gender, Student Interest, Motivation

Introduction

One of the primary challenges educators face in the classroom is maintaining student engagement and motivation, particularly in subjects perceived as abstract or difficult. The subject often demands that learners grasp complex, theoretical concepts, which can hinder understanding and reduce interest if not taught with relatable and practical approaches. As Hofstein and Mamlok-Naaman (2021) observed, students' interest in science increases significantly when interactive, student-centered strategies are employed that contextualize learning and connect it to real-life experiences. In contrast, traditional teaching methods, dominated by lecture and rote memorization, often lead to disengagement, especially among students who struggle to perceive the relevance of science concepts to their everyday lives. To address these pedagogical challenges, animated video-based instructional strategies have gained attention as effective tools for enhancing students' conceptual understanding and cognitive engagement. According to Nsofor et al., (2023), animated instructional strategies involve the use of purposefully designed animations to visually represent abstract ideas and support comprehension. The evolution of computer graphics technology has made the creation of such animations more accessible and cost-effective, enabling educators to move beyond static images and employ dynamic, engaging instructional materials. These often include animated texts, graphics, and cartoon-like visuals that can hold students' attention and clarify complex scientific content. Mayer et al., (2023) elaborate that animated teaching may take various forms, including instructional media such as Video Compact Discs (VCD), Digital Video Discs (DVD), PowerPoint presentations, or educational films. These media integrate still images, moving graphics, background audio, and narrations,

thereby fostering multisensory learning and deeper cognitive processing. Obeka (2020) emphasizes the necessity of aligning animated content with instructional objectives; when improperly contextualized, animations may distract learners and undermine the intended learning outcomes.

In a similar vein, video-based instructional strategies have also proven effective in science education. Haruna and Lawan (2025) define video-based instruction as the use of motion-based media to electronically capture, process, and present content. Videos offer learners a rich, immersive experience by engaging both visual and auditory senses, and allow for flexible instructional design through features such as pausing, replay, and close-up demonstrations. These affordances enable students to engage with content at their own pace, thus enhancing personalized learning. Adedeji et al., (2022) reinforce this perspective, arguing that video-based instruction, through its visual and aural appeal, increases student attention, facilitates content retention, and supports long-term learning. Numerous empirical studies have reported positive outcomes associated with the use of animated video-based instructional strategies in science education. For instance, research conducted by Ahmad et al. (2021), Nsabayezu et al., (2023), Cevahiret et al., (2022), and Gambari et al., (2021) demonstrated that students taught with these strategies exhibited significantly higher levels of learning motivation and academic achievement compared to those taught through conventional methods. Interactive simulations, animations, and virtual labs allow students to manipulate variables and observe outcomes, enhancing conceptual clarity (Obi et al., 2025). Cooper et al. (2021) define motivation as the internal or external drive that influences engagement in a particular behavior, an essential component of academic success. While intrinsic motivation is widely regarded as a crucial factor for sustained academic interest, extrinsic motivators can also play an important role, particularly in structured learning environments (Ryan & Deci, 2017). By creating **visual, interactive, and manipulable representations**, digital tools can bridge the gap between abstract concepts and students' existing knowledge structures, fostering **deep understanding** rather than rote memorization (Anari et al., 2025).

Gender, as a social construct, encompasses the culturally and socially defined roles, behaviors, and attributes that a given society considers appropriate for individuals identified as male or female. Unlike biological sex, which is determined by physiological characteristics, gender roles are shaped through socialization and reinforced by cultural norms. Okeke (2017) notes that societies typically associate qualities such as assertiveness, aggressiveness, logical reasoning, intelligence, tactfulness, and self-confidence with males, while females are more often characterized by traits such as submissiveness, fearfulness, emotionality, and talkativeness. These socially constructed attributes have significant implications for students' educational experiences, particularly with respect to **learning motivation** and **academic achievement**.

In science education, and Chemistry in particular, the extent to which gender influences academic performance remains a contested issue. While some researchers argue that male students tend to outperform their female counterparts in science-related subjects, emerging evidence suggests that gender-based differences in achievement may not be as clear-cut. For example, studies conducted by Alemneh et al., (2024), Anari et al., (2023), Egolom et al., (2021), Gambari et al., (2021), and Gongden et al., (2020) report no statistically significant differences in academic achievement between male and female students, indicating that when equal learning opportunities are provided, both genders demonstrate comparable levels of performance.

Conversely, other studies present conflicting findings, suggesting that gender-based disparities in academic achievement are neither uniform nor universally applicable. For instance, Gongden et al. (2020) and Ikwuka et al. (2017) reported significantly higher achievement levels among male students in science subjects, reinforcing traditional assumptions about male dominance in STEM fields. These findings imply that certain educational environments may continue to reinforce gendered expectations and opportunities, thereby affecting student outcomes. In contrast, Yanarates (2022) found that female students outperformed their male counterparts in specific Chemistry concepts, challenging longstanding narratives of male superiority in science and pointing to potential shifts in classroom dynamics, instructional quality, or learner engagement.

Gender differences in academic achievement are influenced by contextual factors such as instructional methods, socio-cultural norms, and learner self-perception. Rather than being a fixed determinant, gender interacts with pedagogical practices and learning environments. This study, therefore, examines how animated video-based instructional strategies affect students' motivation and achievement in Chemistry, with a focus on how gender may moderate these effects. By treating gender as an interactive variable, the study aims to offer insights into promoting equity through innovative teaching methods.

Research Questions

1. Is there any significant difference in the mean motivation scores of students taught chemistry using an animated video-based instructional strategy and those taught using a conventional strategy?
2. Is there any interaction effect of gender, instructional strategies, and academic achievement in chemistry?

Hypotheses

1. There is no significant difference in the mean motivation scores of students taught chemistry using an animated video-based instructional strategy and those taught using a conventional strategy.
2. There is no significant interaction effect of gender, instructional strategies, and academic achievement in chemistry.

Materials and methods

This study employed a **quasi-experimental design**, appropriate for educational contexts where random assignment is not feasible. The design allowed for meaningful comparisons between treatment and control groups using intact classroom settings, thereby preserving ecological validity. A total of **200 Senior Secondary School II (SSII) students** (75 males and 125 females) were selected from a population of 2,700 through **multistage sampling**, ensuring representativeness and logistical feasibility. SSII students were chosen due to their curriculum exposure and academic maturity, making them suitable for both the **Chemistry Achievement Test (CAT)** and the **Learning Motivation Questionnaire**. The CAT comprised **25 multiple-choice items** drawn from standardized national examination bodies (NECO and JAMB), covering key Chemistry topics such as stoichiometry, mole concept, and thermochemical equations. The test was administered as both a pre-test and a post-test, with question order rearranged. A **10-item, 4-point Likert scale questionnaire** assessed students' motivation toward Chemistry learning. Instrument validity was established through expert review, and reliability was confirmed using **Kuder-Richardson R-20 (0.85)** for the CAT and **Cronbach's Alpha (0.82)** for the motivation scale. Instruction was delivered over **four weeks** during regular class periods using both animated video-based and conventional strategies. Data analysis involved **mean, standard deviation, and ANCOVA**, with a significance level of 0.05. All ethical protocols were strictly observed. **Informed consent** was obtained from school authorities and participants, who were made aware of the study's purpose, procedures, and their right to withdraw at any point without penalty. Participants were assured of **confidentiality**, and data were anonymized to protect identities. The study upheld the principles of **voluntary participation, non-maleficence, and academic integrity** throughout its execution.

Results

Research Question 1:

Table 1: Mean (M) and standard deviation of students' pre-motivation and post-motivation scores classified by treatment groups

Treatment Groups	N	Pre-motivation		Post-motivation		Mean Gain Score
		M	SD	M	SD	
Conventional strategy	100	13.71	1.40	25.98	1.89	12.27
Animated video-based strategy	100	14.75	1.48	34.82	2.98	20.07

Source: Author's Field Data, 2025

Table 1 shows the pre- and post-motivation mean scores and standard deviation of scores of students taught using animated video-based and conventional strategies. The pre- and post-motivation scores of students in the conventional group were 13.71 and 25.98, with a mean gain of 12.27, while the pre- and post-motivation scores of students in the animated video-based group were 14.75 and 34.82, with a mean gain of 20.07. This suggests that after the treatment, the experimental group ended with a higher mean score and subsequently a higher mean gain when compared to the conventional group. Expectedly, the two groups had post-motivation mean scores that

were higher than their pre-motivation mean scores. Whether the observed difference in the mean scores of the two groups was statistically significant was determined by the results of hypothesis testing 1, displayed in Table 2.

Hypothesis one:

Table 2: Summary of Analysis of Covariance (ANCOVA) of the students' post-motivation scores classified by treatment groups with pre-motivation scores as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3907.289 ^a	2	1953.644	311.203	.000	.760
Intercept	1859.277	1	1859.277	296.171	.000	.601
TREATMENT	3451.436	1	3451.436	549.791	.000	.736
PREMOTIVATION	.009	1	.009	.001	.970	.000
Error	1236.711	197	6.278			
Total	189976.000	200				
Corrected Total	5144.000	199				

a. R Squared = .760 (Adjusted R Squared = .757)

b. Computed using alpha = .05

In Table .2, the calculated F-ratio for the effect of instructional strategies at (df 1, 197) is 549.791, while its corresponding calculated level of significance is .000 alpha. This level of significance is lower than .05, at which the decision is based, indicating that there was a significant difference in the motivation scores of students in the concepts taught using an animated video-based and a Conventional strategy. The effect size, represented by a partial eta squared value of 0.736, suggests a strong practical significance, with the animated strategy accounting for approximately 73.6% of the variance in motivation outcomes. With this observation, null hypothesis 1 was rejected.

Question two

Table 3: Mean and standard deviation of students' pre-test and post-test scores classified by treatment groups and gender

Treatment Groups	Gender	N	Pre-test		Post-test		Mean Gain Score
			M	SD	M	SD	
Animated video strategy	Male	46	10.08	1.87	66.34	7.42	56.26
	Female	54	10.44	1.70	64.51	8.33	54.07
conventional strategy	Male	45	5.15	1.53	43.06	4.01	37.91
	Female	55	4.54	1.60	42.74	4.87	38.20

Table 3 shows the pre-test and post-test mean scores and standard deviation of scores of the male and female students taught using Animated video-based and conventional strategies. The post-test-pre-test mean gain scores of male and female students in the Animated video-based group are 56.26 and 54.07, respectively, while those of male and female students in the conventional group are 37.91 and 38.20, respectively. These observations show that both the male and female students taught using the Animated video-based strategy benefited more from the instructions given. Whether the differences between the mean scores of the male and female students in the two groups were statistically significant is assessed by the results in Table 4. used in the testing hypothesis two.

Hypothesis two:

Table 4: Summary of Analysis of Covariance (ANCOVA) of students' post-test scores classified by treatment groups, and gender, with pre-test scores as covariate

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	25337.287 ^a	4	6334.322	151.509	.000	.757
Intercept	26337.617	1	26337.617	629.964	.000	.764
GENDER	55.799	1	55.799	1.335	.249	.007
TREATMENT	6588.575	1	6588.575	157.591	.000	.447
PRETEST	6.564	1	6.564	.157	.692	.001
GENDER * TREATMENT	31.609	1	31.609	.756	.386	.004
Error	8152.588	195	41.808			
Total	619393.000	200				
Corrected Total	33489.875	199				

a. R Squared = .757 (Adjusted R Squared = .752)

b. Computed using alpha = .05

In Table 4, the calculated F-ratio for the interaction effects of treatment and gender, at df 1, 195, is .756, while its corresponding calculated level of significance is .386. This level of significance is greater than .05, in which the decision is based indicating that there were no significant interaction effects of treatment and gender on Chemistry students' academic achievement. The effect size, represented by a partial eta squared value of .004, suggests a low practical significance, accounting for approximately 4% of the variance in outcomes. With this observation, null hypothesis 2 was upheld.

Discussion

The results of this study revealed a statistically significant difference in students' learning motivation in Chemistry between the experimental group taught using an animated video-based instructional strategy and the control group taught using a conventional strategy. The animated video group recorded a post-treatment mean score of 34.82, which is markedly higher than the 25.98 recorded by the conventional group. Additionally, the experimental group had a mean gain of 20.07, compared to 12.27 in the conventional group. The partial eta squared value of 0.736 indicates a strong effect size, suggesting that approximately 73.6% of the variance in students' motivation can be attributed to the instructional strategy employed. This significant outcome can be attributed to several pedagogical advantages inherent in animated video-based instruction. First, animated videos foster a student-centered learning environment, which shifts the role of the learner from a passive recipient of information to an active constructor of knowledge. In this mode of instruction, students engage in interactive visual and auditory learning experiences that stimulate their cognitive engagement, curiosity, and sustained interest. The dynamic and multimodal nature of animations facilitates the visualization of abstract concepts, making difficult content more accessible and meaningful, especially in concept-heavy subjects like Chemistry.

In contrast, conventional strategies, often characterized by teacher-centered delivery, verbal exposition, and rote memorization, may lack the multisensory and engaging qualities necessary to maintain student interest and motivation, especially among learners with diverse learning styles. Traditional instruction can create a cognitive load that impairs comprehension and reduces affective engagement, particularly when content is abstract or procedural. Moreover, the emotional and psychological climate created by animated instruction is often more supportive and stimulating. As noted by prior studies (Ahmad et al., 2021; Nsabayeze et al., 2022; Cevahiret et al., 2022; Gambari et al., 2021), animated content contributes to reducing learning anxiety, increasing emotional involvement, and cultivating intrinsic motivation by presenting material in a playful yet educationally meaningful context. This emotional engagement plays a crucial role in shaping students' willingness to persist with complex

tasks and actively participate in the learning process. Furthermore, the novelty and interactivity of animated instructional materials capture students' attention more effectively than static or text-based materials. By offering concrete representations of scientific processes that unfold over time, animations reduce the cognitive barrier posed by abstract Chemistry concepts. This temporal-spatial representation of change and motion aligns with cognitive theories of multimedia learning (Mayer, 2009), which suggest that integrating visual and auditory information enhances memory retention and understanding. In essence, the superior performance of the animated video group in motivation scores underscores the pedagogical value of technology-enhanced, visually engaging instruction. The study supports the notion that motivation is not only influenced by content, but by how the content is delivered, especially when the method actively engages learners in a personally meaningful and cognitively stimulating way. The findings of this study revealed that gender did not have a statistically significant effect on students' academic achievement in Chemistry, regardless of whether they were taught using an animated video-based instructional strategy or a conventional strategy. The analysis showed a p-value of 0.386, well above the accepted threshold for statistical significance ($p < 0.05$), and a partial eta squared value of 0.004, indicating a very small effect size. This suggests that gender accounted for only 0.4% of the variance in achievement outcomes, a practically negligible effect. This outcome implies that both male and female students demonstrated comparable levels of achievement, indicating that gender is not a significant predictor of academic success in Chemistry within the context of this study. While mean differences in post-test scores were observed between males and females in the experimental and control groups, these differences were not statistically significant, reinforcing the conclusion that the instructional method had a more meaningful impact on performance than gender. These results are theoretically supported by the Gender Similarities Hypothesis, proposed by Hyde (2005), which asserts that males and females are more alike than different in most cognitive and educational outcomes, including academic achievement. This perspective challenges long-standing gender stereotypes that ascribe greater logical reasoning and science aptitude to males, and instead emphasizes the role of contextual and instructional variables in shaping performance. The findings of the current study align with this framework, demonstrating that when students, regardless of gender, are exposed to effective and engaging instructional strategies such as animated video-based instruction, they are equally capable of achieving high academic outcomes. Moreover, from a constructivist learning perspective, particularly the Cognitive Theory of Multimedia Learning by Mayer (2009), learning is optimized when instruction activates multiple sensory channels and supports meaningful knowledge construction. These processes are not inherently gender-specific. Both male and female students are likely to benefit equally from multimedia learning environments that provide clarity, reduce cognitive load, and promote conceptual understanding through dual coding (visual and verbal input). This theoretical foundation supports the empirical finding that instructional design, rather than student gender, is the primary factor influencing learning gains in this study. The present findings are also in agreement with empirical evidence from Anari et al., (2023), Egolom et al., (2021), and Gambari et al., (2021), who similarly found no significant gender difference in science achievement when students were exposed to innovative instructional strategies. However, the results contrast with those of Ikwuka et al. (2017), who reported male students outperforming females, and Yanarates (2022), who found the reverse. These conflicting findings in the literature further emphasize the importance of instructional quality and learning context over gender-based generalizations. Ultimately, the findings of this study reinforce the conclusion that animated video-based instructional strategies are equitable, providing effective learning opportunities for all students, regardless of gender. This has significant implications for educational practice, suggesting that curriculum designers and teachers should focus on inclusive, learner-centered pedagogies that transcend traditional gender assumptions and instead prioritize active engagement, accessibility, and conceptual clarity for all learners.

Conclusion

This study concludes that animated video-based instructional strategies significantly enhance students' academic achievement and learning motivation in Chemistry, particularly by improving comprehension of abstract concepts and fostering active engagement. The absence of a significant gender interaction effect further indicates that the strategy is equally effective for both male and female students, affirming its gender-neutral impact on learning. These findings are especially relevant to the Nigerian educational context, where addressing gender disparities and improving science performance remain key priorities. By providing empirical support for student-centered, technology-enhanced instructional approaches, this study contributes meaningfully to the discourse on innovative science pedagogy in Nigeria. It highlights the potential of animated instruction to improve conceptual understanding, stimulate interest in science, and promote equity in STEM education. The findings underscore the need for curriculum integration, policy support, and teacher training initiatives to embed animated video-based strategies into mainstream Chemistry instruction. Such efforts could play a transformative role in enhancing science education outcomes and closing persistent engagement and achievement gaps in Nigerian secondary schools.

Recommendations

1. Chemistry teachers should integrate animated video-based strategies into classroom instruction to enhance conceptual understanding, stimulate interest, and support student engagement with abstract scientific concepts.
2. Education authorities and curriculum developers (e.g., NERDC) should incorporate animated video content into the national Chemistry curriculum and develop standardized, syllabus-aligned instructional materials to support effective implementation.

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