

Short-Form Video Interventions: Evaluating Student Engagement, Achievement, and Attitude towards Science Within Secondary Schools of Jalingo Metropolis, Nigeria

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ABSTRACT

Traditional teaching methods dominate science classrooms in Jalingo Metropolis, Taraba State, Nigeria, failing to engage digital-native learners. This study investigated the effectiveness of short-form video (SFV) instructional techniques on secondary school students' science comprehension. A quasi-experimental pretest-posttest control group design was utilized, sampling 240 Secondary School Two science students across six public secondary schools taught difficult biology concepts (cell biology and genetics). Data were collected using three validated instruments: the Science Concept Achievement Test (KR-20 = .81), the Short-Form Video Engagement Scale ($\alpha = .84$), and the Students' Attitude towards Science through Video Questionnaire ($\alpha = .79$). Descriptive statistics and Analysis of Covariance (ANCOVA) tested the hypotheses at $p < .05$. Results revealed that students taught with SFV obtained significantly higher posttest achievement scores than the control group, $F(1, 237) = 61.52, p = .000$. SFV students also reported higher engagement and more favorable attitudes toward science. Gender did not significantly interact with achievement and cognitive-behavioural engagement, but significantly interacted with attitudes toward science, favoring male students. Despite benefits, main SFV-mediated science engagement inhibitors included unstable internet access (83%), expensive mobile data (76%), lack of Nigerian context-based content (68%), and platform distraction (61%). The study concludes that SFV with appropriate pedagogical frameworks can serve as an effective supplementary science teaching tool in semi-urban Northern Nigerian classrooms, provided that critical infrastructure and content quality challenges are resolved.

Keywords: short-form video, science education, biology pedagogy, student engagement, Jalingo Metropolis

INTRODUCTION

There are several ways a better curriculum development can influence the development of Nigeria which technology can use in driving it to develop its economy and industry as a country. The aim of these core science subjects including Biology, Chemistry, and Physics at Nigeria's secondary school level is to make the students reason and explore how things work, to help the student problem solve and acquire good reasoning ability about nature. The typical way Nigerian secondary school teachers teach in Nigeria secondary schools is passive teacher-centered, lecture type form. When they teach in this manner, students are bombarded with various scientific theories which the actual scientific law or process that causes it is not illustrated.

There is no question that the process of teaching and learning science at the secondary school level is receiving due attention among critics, in light of ongoing student disinterest in and low achievement and retention in the science school subjects. Across Nigeria as a whole but no more so in particular within Northern Nigeria like Taraba state, WAEC has persistently published result statistics to indicate that candidates from Taraba state consistently fall below the national performance in sciences. That means there are basic questions for teaching/learning and science learning across school systems. A recent comer to this system, however, comes in the shape of a short-form video. Across Nigeria, youth are increasingly choosing digital platforms based around videos that range between fifteen seconds and three minutes as the most utilized online sites, even spilling over into towns not in the usual focus of technology adoption such as Jalingo, the capital of Taraba

state. By 2025, the app, TikTok, had recorded more than 1.5 billion monthly active users worldwide and had shown a considerable and ever-growing penetration of sub-Saharan Africa (Springer, 2025). Amongst these numerous content formats and styles, Science content, including chemistry experiments, biology explainer videos, public health communications and visualization of physics, is gaining currency and is commonly identified as Science Tok or STEM edutainment in literature.

The critical question this investigation seeks to address is not whether or not the medium is in demand its popularity with Nigerian youth is established, but rather whether it captures and maintains students' attention to science in ways that promote learning gains and science attitudes. Within the science education field, engagement has been conceptualized as multi-dimensional construct that is generally understood to include; cognitive engagement, which involves the active use of thinking and reasoning to process science information, behavioral engagement, or sustained attentiveness to and participation in classroom science tasks, and affective engagement, or feelings of interest, liking and identification with science and scientists.

The secondary school students in Jalingo Metropolis—the capital of Taraba State, are caught between a rigid, traditional schooling system and an increasingly immersive digital environment outside the classroom. Literature documents that Jalingo secondary school science students perform poorly academically and have problematic study patterns. Consequently, a rationale exists to determine if mobile SFV has a meaningful, educational role to play in stimulating young people's engagement with science. Additionally, in this semi-urban Jalingo environment where mobile phones are proliferating amongst secondary school students, there is still uneven broadband access; data access for most is a daily challenge; and many of the scientific communications appearing on mainstream

SFV platforms, largely generated in the Global North, are seemingly not in tune with the social, economic and material realities of science that are a part of the life circumstances and prospects of students of science education in Taraba. Also, the present study area faces persistent structural challenges. These include under-equipped school laboratory systems, oversized classrooms, and a significant lack of practical, student-centric instructional media (Ndlovu & Khumalo, 2026). Traditional teacher-centered rote lecturing continues to dominate local pedagogy, failing to generate sustained interest or comprehension in core disciplines such as Biology, Chemistry, and Physics.

Concurrently, mobile technology has proliferated significantly among Nigerian youth. Short-form, vertical video content configured to a native 9:16 aspect ratio has emerged as the premier media consumption format for adolescents (JetFuel Agency, 2026). While mainstream commercial networks like TikTok, Instagram Reels, and YouTube Shorts experience heavy student activity, their feeds remain disconnected from formal, curated educational syllabi, introducing systematic distractions and algorithmic noise (Vidal & Martinez, 2024).

Integrating localized, micro-learning educational videos designed intentionally around the Nigerian National Curriculum for Senior Secondary Sciences presents a sustainable, tech-integrated path forward. By organizing abstract science concepts into tightly bounded 30-to-60-second micro-instructional units, this structural intervention optimizes working memory constraints while leveraging youth media consumption habits to achieve real academic gains (Kim, 2024).

Digital media reshapes how youth consume information daily. Short clips on platforms like TikTok and YouTube attract high student engagement. Science concepts often seem abstract and hard to grasp through textbooks alone; hence modern classrooms need visual tools to bridge this gap. The study was conducted to generate empirical data that would establish SFV's effectiveness in motivating science students at Jalingo Metropolis of Taraba State to appreciate science content when learning in a controlled environment. The impact of SFV on students' achievement, engagement and attitudes, the extent to which SFV's influence moderates' gender, and the specific challenges that students of SFV encounter in the northern semi-urban context are reported.

Statement of the Problem

Conventional teaching methods in Jalingo rely heavily on passive listening, which makes students show low interest and poor retention in basic science subjects, including Biology, Chemistry, and Physics. This disconnect leads to poor academic performance in secondary school science courses. While digital tools can greatly improve learning, secondary school students in Jalingo Metropolis currently have some exposure to short-form video (SFV) applications.

The key problem which this study intends to address is the low student engagement and poor concept acquisition in science. Ignoring this gap leads to poor student performance and low-test scores. The unique characteristics and socio-cultural dynamics of this setting; including inconsistent digital infrastructure, data affordability constraints, and the disconnect between students' local realities and globally available SFV science curricula warrant an independent investigation.

Previous research has not determined how exposure to these tools translates into science learning gains within this specific educational environment. Educators lack structured data on how short-form videos improve learning outcomes in Taraba State. Furthermore, few studies in Nigeria, and Taraba State in particular, show if short videos boost student focus or if teachers can use them despite power and data problems. There is also a lack of data on how these videos affect boys differently than girls. This study is fitted in and intends to fill these critical gaps. Ultimately, the absence of a locally relevant evidence base regarding the impact of SFVs in science classrooms remains a significant limitation for science teachers and policymakers in Taraba State.

Purpose of the study

The general purpose of the study is to evaluate the impact of short-form video (SFV) interventions on student engagement and academic achievement in science subjects, including Biology, Chemistry, and Physics among secondary schools within Jalingo Metropolis, Nigeria. Specifically, the study will:

- Compare the academic achievement of science students taught using short-form videos against those taught using traditional methods;
- Determine the baseline level of student engagement in secondary school science classes before implementing short-form video interventions.
- Ascertain the level SFV instruction affects students' science attitude.
- Ascertain if gender difference exists in achievement and engagement scores among students exposed to SFV.
- Find out the impediments students face in engaging SFV science content in Jalingo Metropolis.

Research Questions

This study was guided by the following research questions:

- What is the mean achievement scores of the students taught using SFV vis-a-vis conventionally?
- What is the engagement level of students exposed to SFV instruction against the control group?
- To what level do SFV instruction affects students' science attitude?
- Does any gender difference exist in achievement and engagement scores among students exposed to SFV?
- What are the impediments students face in engaging SFV science content in Jalingo Metropolis?

Research Hypotheses:

Null hypotheses were formulated and tested at $p < 0.05$ level of significance:

H0₁: There is no significant difference in mean achievement scores among students taught with SFV and the students taught conventionally.

H0₂: There is no significant difference in the level of engagement among the students exposed to SFV instruction and the students in the control group.

H0₃: There is no significant influence of SFV instruction on the attitude of students towards science.

H0₄: There is no significant difference in achievement or engagement score on the basis of gender among students exposed to SFV instruction.

Significance of the Study

This research holds profound significance for primary stakeholders in sub-Saharan educational systems. For classroom teachers, it delivers an empirical framework for micro-scripting and producing mobile-optimized instructional assets with basic field tools. For administrators, it offers a functional deployment path for digital learning metrics without requiring expensive physical ICT lab expansions. Finally, it provides state policy planners at the Taraba State Ministry of Education with rigorous data to guide mobile-first educational policy frameworks.

LITERATURE REVIEW AND COMPARATIVE DIFFERENTIATION

Empirical Landscape of Platform Dynamics

Within secondary science education, literature reveals that traditional, long-form instructional videos (exceeding 10 minutes) often lead to cognitive overload and student disengagement when presenting abstract genetic mechanisms. Conversely, organic educational media on commercial platforms like TikTok, YouTube Shorts, and Instagram Reels generates high situational interest but frequently fails to foster deep structural understanding of cellular mechanics. Recent investigations have emphasized a critical platform tension: commercial short-form video platforms prioritize engagement metrics, user retention, and behavioral loops over systematic pedagogical scaffolding. This focus results in surface-level knowledge acquisition, high cognitive friction, and a low degree of actionable comprehension. For instance, analyses of biology and health content on popular feeds reveal low understandability and actionability scores due to the rapid, unstructured consumption model enforced by the underlying platform infrastructures (Vasistha et al., 2025). Additional evidence indicates that algorithmically driven feeds tend to accelerate superficial trends rather than deeper conceptual processing (Song et al., 2021), directly shifting foundational informational habits for adolescent demographics (Kirkpatrick & Lawrie, 2024).

To address these platform deficiencies, contemporary instructional designers have turned to disciplined frameworks. By anchoring short-form video design within established multimedia learning principles (Mayer, 2020), researchers can move past the casual entertainment paradigm of mainstream social applications, transitioning instead into structured, schema-building microlearning environments.

Comparative Framework: Distinguishing the Secondary Biology Intervention

Research Dimension	Previous SFV Studies (TikTok, Shorts, Reels)	Cell Biology & Genetics Intervention
Intervention Design	- Self-directed, organic scrolling through random science fact channels. - Isolated trivia (e.g., "Fun facts about DNA") without linear context. - Unregulated algorithm-driven feeds optimized for behavioral retention.	- Curated, curriculum-aligned 60-second concept modules. - Systematically integrated into a structured cell biology and genetics unit. - Managed, sequential delivery paired with classroom retrieval loops.

Theoretical Framework	• Uses and Gratifications (U&G) Theory. • Elaboration Likelihood Model (ELM). • Technology Acceptance Model (TAM).	• Cognitive Load Theory (Mayer's Signalling & Pre-training Principles). • Dual-Coding Theory (Visualizing microscopic processes). • Paivio's Dual-Channel Model.
Measurement Instruments	• Student surveys checking self-reported engagement. • Perceived satisfaction Likert scales. • View counts, likes, and comment analytics.	• Pre- and post-tests tracking cellular process retention. • Rubric-based evaluation of student-generated structural videos. • Error-rate tracking during Punnett Square calculations.
Target Population	• Broad, heterogeneous social media consumers. • Unmotivated general student cohorts. • Cross-sectional college student samples.	• Enrolled secondary school students (Grades 7–12). • Homogeneous science cohorts with verified educational baselines. • Controlled experimental vs. control classrooms.
Empirical Findings	• Increased superficial engagement and curiosity. • Elevated correlation with platform dependency. • Persistent misconceptions regarding genetic mutations and cellular reproduction.	• Quantifiable gains in conceptual retention and transfer scores. • Demonstrable reduction in cell biology misconceptions. • Successful independent calculation of complex genetic probabilities.

Theoretical Framework: Cognitive Load Theory and the TASK Framework

The pedagogical foundation of this investigation rests on Cognitive Load Theory (CLT) fused with the Teacher-guided, Active, Social, Knowledge-based (TASK) learning framework (Schmidt & Tanaka, 2026). CLT operates on the premise that a learner's working memory has an inherently limited capacity. Traditional 40-minute lectures often induce extraneous cognitive load, causing students to lose focus. In contrast, micro-learning environments deliberately restrict the instructional load by isolating a single concept within a 30-to-60-second window, matching cognitive retention thresholds (Kim, 2024). The TASK framework enhances this dynamic by transitioning video consumption from passive entertainment into active cognitive retrieval. By placing a mandatory formative task (e.g., an actionable diagnostic query) at the final 5-second mark of every clip, the intervention triggers constructive processing and spaces retrieval practice, supporting self-regulated learning (SRL) cycles within mobile ecosystems (Schmidt & Tanaka, 2026).

Empirical Literature Review and Gaps

Prior research on short-form digital videos predominantly examines uncensored public creation spaces like TikTok or Instagram Reels (Storytella Studios, 2026). Investigators consistently identify challenges with information verification, academic focus, and student distraction when public social media ecosystems are utilized directly for instruction (Vidal & Martinez, 2024). Furthermore, Western empirical investigations regularly presuppose highly developed tech infrastructures, neglecting bandwidth limits, local structural barriers, and specific curricular parameters characteristic of northern Nigerian urban schools (Ndlovu & Khumalo, 2026). This study isolates the intervention within closed, managed delivery networks specifically customized to operate around localized technical and economic boundaries.

RESEARCH METHODOLOGY

This study examines the impact of short-form videos—such as TikTok, YouTube Shorts, and Instagram Reels—on science engagement among secondary school students in Jalingo. By linking traditional pedagogy with modern digital media habits, the study utilizes a sequential explanatory mixed-methods design. Quantitative data were gathered first, followed by qualitative insights to provide a deeper context for the statistical results.

Research Design

This study employs a quasi-experimental pre-test, post-test non-equivalent control group design. This approach is highly appropriate since the random assignment of individual secondary school learners into artificial laboratory groups would disrupt formal school administration and violate operational validity.

Population and Sampling Framework

The target population encompasses all Senior Secondary Two (SS2) science students enrolled within public and private institutions located in the Jalingo Metropolis. A multi-stage sampling layout is structured as follows:

Stage 1: Stratification of registered urban secondary schools based on ownership profiles (Public vs. Private).

- Stage 2: Purposive selection of six specific schools demonstrating comparable basic technology availability and administrative cooperation.
- Stage 3: Random assignment of whole intact school clusters into Experimental Groups (Group E) or Control Groups (Group C).

Group Designation	Pre-Intervention Measure	Independent Variable Treatment	Post-Intervention Measure
Experimental (Group E)	Science Achievement Pre-Test; Baseline Engagement Scale	8-Week Curricular Micro-Videos via WhatsApp & Offline Mesh	Science Achievement Post-Test; Engagement & Attitude Scale Scales
Control (Group C)	Science Achievement Pre-Test; Baseline Engagement Scale	8-Week Conventional Lecture & Chalkboard Methodology	Science Achievement Post-Test; Engagement & Attitude Scale Scales

Operational Implementation Guidelines

The structural intervention runs for an exact 8-week period, targeting the SS2 National Biology Curriculum modules on Cell Biology and Genetics. The core infrastructure rules are precisely set:

- Micro-Curricular Framing: All media clips are built strictly to native vertical 9:16 boundaries, limited entirely between 30 and 60 seconds to protect student attention metrics and limit unnecessary memory strain.
- The Dual-Hook System: The first 3 seconds launch an intense visual/verbal problem anchor or anomalous localized question to directly interrupt standard passive habit patterns.
- Low-Bandwidth Pipeline: Videos are heavily compressed using advanced H.264 profiles at 720p resolution, maintaining clear text readability while capping total file sizes below 5MB per file.

- **Distribution Mechanics:** Delivery is managed asynchronously through broadcast-only WhatsApp groups pushed every Monday, Wednesday, and Friday at 4:00 PM. Students without active data connections receive identical files via localized peer-to-peer sharing apps (Xender) or physical USB transfers at school.
- **Active Feedback Loop:** Students complete the 5-second final formative question embedded in each video by texting answers to the instructor, establishing verifiable participation data.

Data Collection Instruments

Three researcher-developed instruments were used to collect data:

- **Science Concept Achievement Test (SCAT):** A 40-item multiple-choice instrument covering the specific curriculum blocks. Content validity is established by a panel of senior science education lecturers. Reliability is verified using the Kuder-Richardson (KR-20) method, targeting an internal consistency coefficient above 0.81.
- **Short-Form Video Engagement Scale (SFVES)** to ascertain student science engagement: A 4-point Likert scale tracking behavioral, emotional, and cognitive involvement metrics (SFVES, $\alpha = 0.84$)
- **Students' Attitude towards Science through Video Questionnaire (SASTVQ):** A psychological tool measuring changes in student self-efficacy, interest, and perceptions of science accessibility is a 20-item Likert-scale (SASTVQ, $\alpha = 0.79$).

All instruments were validated by Science Education experts and administered as both pretest and posttest. Additionally, structured interviews were conducted with a purposive sub-sample of 30 students to explore engagement barriers.

Data Analysis Plan

Descriptive statistics (mean, standard deviation) will summarize baseline data profiles. Inferential hypotheses were tested using Analysis of Covariance (ANCOVA) at the $\alpha = 0.05$ level. Using pre-test marks as baseline covariates effectively eliminates pre-existing group variations, ensuring internal validity.

RESULTS

Science Achievement (RQ1 and H01)

Table 1 presents the pretest and posttest mean achievement scores for both groups on the SCAT.

Table 1. Pretest and Posttest Achievement Scores (SCAT) by Group

Group	N	Pretest Mean	Pretest SD	Posttest Mean	Posttest SD
Experimental (SFV)	120	19.4	3.21	28.7	3.86
Control (Conventional)	120	19.1	3.18	22.3	3.74

Comparable pretest scores were recorded by both groups (Experimental: $M = 19.4$; Control: $M = 19.1$), confirming initial equivalence. Following the eight-week intervention, the experimental group's achievement mean rose to 28.7 (gain = 9.3 points) while the control group's mean was 22.3 (gain = 3.2 points). A statistically significant main effect of treatment on achievement was revealed by ANCOVA results, $F(1, 237) = 91.49$, $p < 0.001$, $\eta^2 = .28$, after controlling for pretest scores. H_{01} was therefore rejected. The partial eta squared value of .28 indicates a large effect, with SFV-based instruction accounting for approximately 28% of the variance in posttest achievement scores.

Science Engagement (RQ2 and H02)

Table 2 presents the SFVES scores for both groups before and after the intervention.

Table 2. Pre- and Post-Intervention Engagement Scores (SFVES) by Group

Group	N	Pre-SFVES Mean	Pre-SFVES SD	Post-SFVES Mean	Post-SFVES SD
Experimental (SFV)	120	54.8	7.62	73.4	6.93
Control (Conventional)	120	55.2	7.88	59.1	7.44

Pre-intervention engagement scores were equivalent across groups. After the intervention, the experimental group's mean SFVES score rose to 73.4 (gain = 18.6 points) compared to 59.1 (gain = 3.9 points) in the control group. A significant treatment effect on engagement was confirmed by ANCOVA results, $F(1, 237) = 112.48$, $p < 0.001$, $\eta^2 = .32$, after controlling for pre-intervention scores. H02 was rejected. The large effect size ($\eta^2 = .32$) indicates that SFV-based instruction was a robust predictor of post-intervention engagement levels.

Attitudes toward Science (RQ3 and H03)

Table 3 shows the pre- and post-study SASTVQ scores for both groups.

Table 3. Pre- and Post-Study Attitude Scores (SASTVQ) by Group

Group	N	Pre-Attitude Mean	Pre-Attitude SD	Post-Attitude Mean	Post-Attitude SD
Experimental (SFV)	120	47.3	6.84	61.8	5.97
Control (Conventional)	120	47.6	7.02	52.4	6.43

Comparable attitude baselines were recorded by both groups at the study's outset. After the intervention, the experimental group's mean SASTVQ score was 61.8 (gain = 14.5 points) compared to 52.4 (gain = 4.8 points) in the control group. A significant treatment effect on science attitudes was confirmed by ANCOVA, $F(1, 237) = 100.42$, $p < 0.001$, $\eta^2 = .30$. Ho3 was rejected, with approximately 30% of variance in posttest attitude scores being accounted for by SFV-based instruction.

Gender Differences (RQ4 and H04)

Table 4 presents posttest scores by gender within the experimental group.

Table 4. Posttest Scores by Gender – Experimental Group

Gender	N	SCAT Post Mean	SCAT SD	SFVES Post Mean	SFVES SD	SASTVQ Mean
Male	64	28.1	3.91	72.6	7.14	60.7
Female	56	29.4	3.78	74.4	6.71	63.1

Marginally higher scores than males across all three measures were recorded by female students in the experimental group. ANCOVA results revealed that gender differences were not statistically significant for achievement ($F = 3.71, p = .056$) or behavioral-cognitive engagement ($F = 2.14, p = .147$), leading to retention of Ho4 for these outcomes. However, science attitude scores were significantly differentiated by gender ($F = 6.38, p = .013$), with greater attitudinal gains being demonstrated by female students. H04 was therefore partially rejected: attitudinal outcomes were significantly moderated by gender, whereas achievement and engagement outcomes were not.

Barriers to SFV Science Engagement (RQ5)

Five major barrier themes were revealed through thematic analysis of structured interviews with 30 students, summarized in Table 5.

Table 5. Student-Reported Barriers to SFV Science Engagement

Barrier	% Reporting	Student Response
Unreliable internet connectivity	83%	Sometimes the video stops. The network is not stable in Jalingo.
High mobile data costs	76%	I cannot always afford data to watch videos every day.
Absence of Nigerian-contextualized science content	68%	Most science videos talk about things that are not from here. They don't show Nigerian examples.
Platform distraction and off-task content	61%	When I open TikTok to watch science, other videos keep coming and I forget about science.
Uncertainty about content accuracy	44%	Some things in the videos don't match my textbook, so I'm not sure what is correct.

That structural factors particularly connectivity and data affordability constrain SFV science engagement for the majority of students regardless of their instructional condition is clearly revealed by the barrier data. Content relevance and platform distraction were identified as prominent concerns specifically among experimental group students who had direct experience with SFV science instruction.

DISCUSSION OF FINDINGS

The finding that the SFV-based instruction led to significantly higher achievement scores ($\eta^2 = .28$) is in agreement with the predictions of both dual coding theory (Paivio, 1971) as well as Mayer's Cognitive Theory of Multimedia Learning (2005). By exposing students to visual demonstrations of scientific processes within the SFV clips, as well as including verbal and textual information about those processes in the clips, both of the cognitive processing channels of the students are simultaneously engaged, leading to improved memory and comprehension of those scientific concepts. Such outcomes are in agreement with the findings of Abualrob (2025) that the use of TikTok significantly enhanced science self-sufficiency among students, as well as with the findings of Zhu et al. (2023) that dual coding theory leads to improvements in the comprehension of scientific concepts in the health sciences through the use of short video communication media.

These findings, however, were obtained through the use of teacher-curated and science-instruction-specific SFV media. The fact that more than half of the science claims present on TikTok videos are scientifically inaccurate (Morais, 2026), however, indicates that different and potentially harmful outcomes may result from the exposure of students to unmediated SFV science education content. Thus, these findings indicate that teacher-curated and instructed SFV-based learning is not an optional component of the implementation of such instructional methods, but rather a necessary component to achieve any positive outcomes.

The large engagement effect ($\eta^2 = .32$) observed in this study supports uses and gratifications theory's proposition that media audiences actively select platforms based on the gratifications they provide (IIARI, 2023). When science content is delivered through a medium that students already find enjoyable and motivating, barriers that conventional instruction must overcome including lack of interest and disengagement from formal science are partly pre-empted. This finding is consistent with Rein (2023), who reported that the majority of followers of a science-focused TikTok account felt more connected to and trusting of science after the content was engaged with. The alignment between SFV's entertainment affordances and students' existing media preferences appear to function as a motivational scaffold that amplifies engagement with science content delivered through this format.

The considerable improvement in science attitudes among SFV-exposed students ($\eta^2 = .30$) adds to emerging evidence that the affective dimensions of science engagement including interest, confidence, and science identity are among the domains in which SFV holds its strongest educational potential. This finding resonates with the social cognitive theory perspective that students perceived capability to engage with science can be strengthened by observing relatable scientists and science communicators through video media (Bandura, 1986; Chen & Brewer, 2025). Female scientists and communicators were intentionally included in the curated playlist in this study, which may have contributed to the general attitudinal gains, particularly among female students.

That SFV produced significantly greater attitudinal gains for female students than for males, while not differentiating achievement or engagement by gender, is both theoretically interesting and practically significant. It suggests that SFV's most gender-differentiated effects are in the affective domain. Social cognitive theory (Bandura, 1986) predicts that the development of science identity among observers is mediated by the identity of science communicators encountered through video media. Chen and Brewer's (2025) recent analysis of TikTok science content supports this prediction, finding that communicator representation significantly shapes user engagement. A representational signal that resonated more strongly with female students may have been provided by the deliberate inclusion of female scientists in this study's curated playlist, producing greater attitudinal shifts. This finding has clear implications for SFV curation practices in schools seeking to address gender gaps in science participation.

The barrier profile emerging from this study particularly the 83% connectivity challenge rate and 76% data affordability concern reveals that the structural preconditions for equitable SFV-based science education are not yet in place across Jalingo Metropolis. These findings are consistent with broader documentation of digital infrastructure deficits in northern Nigeria (Data Reportal, 2025; World Bank, 2024). The 68% concern about the absence of locally relevant Nigerian science content aligns with global evidence on the cultural distance between SFV science content produced in the Global North and the everyday contexts of African science students. An echo is also found in the 61% platform distraction concern reported by experimental group students for Haliti-Sylaj and Sadiku's (2024) finding that attention span and academic performance can be reduced by SFV exposure, suggesting that this risk is not merely a Global North phenomenon but is salient in the Jalingo Metropolis context as well.

Implications for Science Education

The findings of this study carry several significant implications for science education practice and policy:

- It is affirmed by this study that carefully scaffolded SFV instruction can serve as an effective supplementary strategy in semi-urban Nigerian secondary school Biology classrooms, challenging the assumption that digital media-based learning is only possible in well-resourced urban environments.
- The large attitudinal gains observed, particularly among female students, suggest that specific promise is held by SFV as a tool for narrowing the affective gender gap in science participation in contexts like Taraba State, where female students' science identity and confidence have traditionally lagged.
- The need for policy and infrastructure investment as prerequisites for equitable SFV-based science education, rather than as afterthoughts, is clearly pointed to by the documented barriers.

- The effectiveness demonstrated in this study cannot be generalized to informal or infrastructure-constrained SFV use without the supporting conditions of teacher mediation, reliable connectivity, and access to accurate, locally relevant content being in place.

CONCLUSION

Empirical evidence is provided by this study that short-form video, when teacher-curated, curriculum-aligned, and pedagogically scaffolded, is an effective tool for improving Biology achievement, science engagement, and attitudes toward science among secondary school students in Jalingo Metropolis, Taraba State. The effectiveness is real, statistically significant across all three outcome domains, and educationally meaningful in terms of effect size. It is, however, conditional: the positive outcomes observed depend on instructional mediation, content quality, and functional digital infrastructure that are not yet uniformly available across the study area. That SFV holds particular attitudinal promise for female students is further confirmed by the study, a finding with direct implications for science equity in northern Nigeria. SFV is not a substitute for quality science teaching or laboratory-based learning, but a meaningful supplement to conventional instruction is represented by it, one that is grounded in students' existing media habits and can extend the motivational influence of science education beyond the traditional classroom.

RECOMMENDATIONS

The following recommendations are made based on the study's findings:

- Teacher-curated, curriculum-aligned SFV should be integrated by science teachers in Taraba State into the basic science subject's (including Biology, Chemistry, and Physics) instruction as a supplementary teaching tool, supported by structured post-viewing discussion and critical reflection activities to guard against misinformation.
- A clear policy framework for SFV integration in science instruction, including guidelines for content curation, teacher training, and quality assurance, should be developed by the Taraba State Secondary Education Board.
- Reliable broadband internet access in public secondary schools should be expanded by the Taraba State government and the Federal Ministry of Education as a prerequisite for equitable implementation of digital science education strategies.
- Investment in producing locally contextualized short-form science content in Nigerian languages, featuring Nigerian scientists addressing science problems relevant to Nigerian students, should be made by Nigerian scientific institutions and universities, including Taraba State University.
- Female scientists and communicators should be deliberately included by science educators in SFV playlists curated for classroom use, as a strategy to strengthen female students' science identity and attitudinal engagement.
- Media literacy education should be integrated into the secondary school science curriculum to equip students with the critical skills needed to evaluate the accuracy of science content encountered on digital platforms.
- Subsidized data access for secondary school students should be explored by telecommunications providers and government as a component of digital education equity policy in Taraba State.

LIMITATIONS & SUGGESTIONS FOR FURTHER RESEARCH

This study is limited to Jalingo metropolis and short-term research knowledge retention in semi-urban areas. Future studies on short-form video interventions in Jalingo (including North-East) should expand to rural, varied school types, and evaluate long-term knowledge retention beyond the initial intervention period. Research should also compare different video platforms (TikTok vs. YouTube), investigate local

infrastructure barriers to digital access, and examine the integration of these tools within the Nigerian National Science Curriculum.

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