Online ISSN: 3107 - 7676
IJMR 2026; 2(1): 01-07
2026 January - February
www.allmultiresearchjournal.com

Received: 02-10-2025
Accepted: 03-11-2025
Published: 01-01-2026
DOI: **https://doi.org/10.54660/IJMR.2026.2.1.1-7**

Evaluating the Impact of Video-Assisted Instruction and Traditional Teaching Methods on Student Learning Outcomes in Grade 9 Integrated Science at a Secondary School in Guyana: A Comparative Study

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Abstract
This study investigated the impact of video-assisted instruction on student learning outcomes in Integrated Science among Grade 9 students at a secondary school in Guyana. Motivated by observations of low engagement and frequent distractions during traditional "chalk and talk" lessons, a quasi-experimental design was implemented with two Grade 9 classes (n = 40). Class A received traditional text-based instruction, while Class B was taught using video-based instructional materials. Both groups were taught by the same teacher over a two-week period to control for instructional bias. A researcher-developed Integrated Science achievement test, aligned with Bloom's Taxonomy and validated by subject matter experts, was administered as both pre-test and post-test to measure learning gains. Quantitative data were analyzed using paired-sample t-tests and ANOVA, and qualitative insights were derived from semi-structured student interviews. Results indicated statistically significant improvements in post-test scores for both groups ($p < 0.001$), with Class B (video instruction) showing a higher mean gain ($\Delta = 15.35$) compared to Class A ($\Delta = 9.45$). Thematic analysis revealed that students exposed to video instruction reported greater engagement, clearer visualization of abstract concepts, and enhanced motivation to learn. These findings suggest that integrating video-based instruction into science classrooms may substantially improve conceptual understanding and academic performance. The study concludes that video instruction potentially can serve as an effective pedagogical tool for enhancing student engagement and learning outcomes in Integrated Science, with implications for curriculum development and teacher training in the Guyanese secondary education system.

Keyword: Integrated Science, Video Instruction, Student Achievement, Educational Technology, Teaching Methods

1. Introduction

Integrated Science offers a unique opportunity to engage students through dynamic and interactive classroom activities. However, in many classrooms, lessons often rely heavily on traditional "chalk and talk" methods, which can result in monotonous teaching and lead to student disengagement. When students lose focus, they frequently engage in disruptive behaviors such as talking, playing, or sleeping, which interrupt the learning process and reduce valuable instructional time [7].

This presents a significant challenge for teachers striving to maintain order while ensuring effective learning.

To address these issues, educators have explored various strategies to make lessons more engaging while maintaining student engagement and interest. One such approach is the integration of video instruction, delivered via smartboards, laptops, or projectors, which offers a fresh and interactive classroom experience [15]. Videos have been shown to capture students' attention, reduce disruptive behavior, and improve classroom discipline [25]. The interactive nature of educational videos demands sustained attention, thereby fostering a more focused and orderly learning environment [9].

Beyond discipline, video instruction has been linked to significant improvements in student achievement. Multimedia learning theories, such as Mayer and Moreno's dual-channel assumption, suggest that combining auditory and visual inputs enhances cognitive processing and memory retention [16]. Students exposed to video-based instruction can pause and review content at their own pace, which is particularly beneficial for understanding complex scientific concepts and problem-solving [17]. This approach not only promotes deeper conceptual understanding but also encourages active participation, as evidenced by increased note-taking, group collaboration, and attentive behavior in classrooms utilizing video materials [16, 17].

The growing accessibility of digital resources has accelerated the adoption of video instruction, a trend highlighted during the COVID-19 pandemic when remote learning became necessary [15]. Studies have demonstrated that video learning enhances cognitive engagement [3], improves retention by allowing learners to control their learning pace [27], and supports innovative pedagogical models like the flipped classroom, which emphasizes active learning during class time [25].

In Integrated Science education, where hands-on and conceptual learning are essential, video instruction offers a promising avenue to bridge gaps in understanding concepts while catering to diverse learning styles [9]. It aligns with modern educational strategies that combine multiple learning modalities, visual, auditory, and kinesthetic, to foster a richer learning experience [17].

Given these benefits, this study aims to explore the effectiveness of video instruction compared to traditional teaching methods in improving student engagement, discipline, and academic achievement in Integrated Science classrooms.

This study seeks to contribute valuable insights into the effectiveness of video instruction in Integrated Science education. By exploring its impact on student participation and academic performance, the findings could inform teaching practices and curriculum design, potentially encouraging wider adoption of video-based learning to enhance student engagement and achievement.

2. Methodology

2.1 Sample Selection and Research Design

Participants in this study were drawn from Grade 9 students at a Secondary School A in the county of Berbice in Guyana. Two classes were purposively sampled, with each class comprising 20 students. The participants ranged in age from 13 to 15 years and came from diverse socio-economic backgrounds, reflecting the demographic composition of the school population. This research utilized a quasi-experimental design.

2.2 Instrumentation

The primary instrument used in this study was a researcher-developed Integrated Science achievement test designed to evaluate students' conceptual understanding of elements and the periodic table. The test comprised 20 items, divided into three sections: 10 multiple-choice questions, 5 true/false items, and 5 short-answer (essay-type) questions, totaling 40 marks. The test was structured according to a table of specification, ensuring a balanced representation of cognitive levels, knowledge (37.5%), comprehension (35%), and application (27.5%), as guided by Bloom's Taxonomy.

Separate pre-tests were administered to both Class A and Class B, followed by post-tests after the instructional intervention. The same test was used for both pre- and post-assessments to evaluate learning gains within each group. The instrument was reviewed by subject matter experts to ensure content validity and curriculum alignment.

In addition to the achievement test, semi-structured interviews were conducted to gain qualitative insights into students' learning experiences. Students were encouraged to reflect on and describe their understanding of the content and their perceptions of the instructional methods used.

2.3 Materials

Standardized video materials were developed to cover the same core concepts as those taught through traditional instruction. These videos were aligned with the national Integrated Science curriculum and included animations, narrated explanations, and embedded questions to enhance engagement. Additionally, text-based materials were prepared to match the content delivered in the videos to ensure content equivalency between instructional methods.

2.4 Procedure and Implementation

The intervention was carried out over a two-week period. During this time, Class A received instruction using traditional face-to-face methods, such as lectures and textbook-based learning. Class B, on the other hand, received instruction using video-based materials integrated into their science lessons. Both groups were taught by the same teacher to control for instructional bias. The pre-test was administered at the beginning of the study period and the post-test was administered at the conclusion of the intervention.

2.5 Data Collection

Quantitative data were collected through the administration of pre-tests and post-tests to both classes. The tests measured students' achievement in topics related to elements and their properties. Additionally, qualitative data were collected through interviews, providing richer insights into students' perceptions of the learning methods.

2.6 Data Analysis

Quantitative data were analyzed using SPSS statistical software. Descriptive statistics were computed, followed by inferential statistical tests, including paired sample t-tests and ANOVA, to compare the pre- and post-test scores within and between groups. The qualitative data from interviews were coded thematically to identify trends in student feedback related to their learning experiences.

3. Results and Discussion

3.1 Effectiveness of Traditional Text-Based Instruction on Learning Outcomes in Integrated Science

To assess the effectiveness of traditional text-based instruction on students' learning outcomes in Integrated

Science, a pre-test and post-test were administered to students in Class A (n = 20). Table 1 presents the summary statistics for both assessments. The mean score increased from 13.00 (SD = 2.80) in the pre-test to 23.00 (SD = 4.30) in the post-test, indicating a substantial gain in student understanding following traditional instruction. The increase in standard deviation suggests a broader distribution of post-test scores, implying that while most students improved, the degree of improvement varied.

Table 1: Pre-Test and Post-Test Results for Class A (Traditional Instruction)

Metric	Pre-Test	Post-Test
Number of Students	20	20
Mean Score	13.00	23.00
Standard Deviation	2.80	4.30
Maximum Score	18	29
Minimum Score	9	15

These findings support the effectiveness of traditional text-based teaching methods in enhancing students' comprehension of Integrated Science concepts. The strong statistical significance and meaningful gain in mean scores affirm that traditional approaches can lead to substantial academic progress in secondary-level science education.

A paired samples t-test was conducted to evaluate the difference in students' performance before and after the instructional intervention. Results revealed a statistically significant improvement in post-test scores compared to pre-test scores, with a t-statistic of -8.25 and a p-value of 1.06×10^{-7}, which is well below the conventional significance threshold of 0.05. These results confirm that the observed improvement is unlikely due to chance (Table 2).

Table 2: Paired Samples Test for Class A (Traditional Instruction)

Statistic	Value
Mean Difference (Pre - Post)	-9.450
Standard Deviation	5.125
Standard Error of the Mean	1.146
95% Confidence Interval (Lower)	-11.848
95% Confidence Interval (Upper)	-7.052
t-value	-8.247
Degrees of Freedom (df)	19
Significance (2-tailed)	0.000

Soyibo (2000) [22] analyzed Jamaican high-school students' performance on five Integrated Science process skills and reported measurable differences in achievement linked to school type, socio-economic background and prior preparation. The author concluded that well-structured, teacher-led instruction paired with targeted support for lower-performing students can improve process-skill mastery and recommended differentiated teacher interventions.

Soyibo & Hudson (2000) [24] investigated the effects of computer-assisted instruction (CAI) on 11th-grade biology students in Jamaica and found that CAI boosted students' attitudes and some topic-specific understanding. However, the authors noted that carefully planned traditional lessons (lectures and teacher demonstrations) continued to produce significant achievement gains and recommended combining CAI with strong teacher guidance.

Soyibo (2005) [23] examined Jamaican Grade-11 students' achievement on science and reported that performance was substantially influenced by learner variables (prior ability, socio-economic status); the study concluded that traditional teacher-centered strategies remain effective for concept delivery but must be adapted to students' backgrounds and supplemented with formative assessment to close achievement gaps.

Maharaj-Sharma (2014) [12] conducted a classroom study in Trinidad and Tobago using interactive worksheets for lower-secondary Integrated Science and found increased student participation and clearer concept acquisition when teacher-structured activities supported the worksheets; the recommendation stressed that teacher-guided (traditional) structuring of activities improves engagement and learning when integrated with interactive materials.

Similarly, a Trinidad study on using creative drama in science teaching (Maharaj-Sharma, 2017) [13] showed that drama increased student motivation and some conceptual gains, but the authors emphasized that conventional teacher demonstrations and structured explanations still delivered consistent improvements in core concept mastery; they recommended blended approaches that keep teacher modelling central.

A quasi-experimental report by Bhagarathi *et al.* (2025a) [1] compared differentiated and conventional (traditional) instruction in Integrated Science found that both methods produced statistically significant pre-post gains, and that conventional instruction delivered meaningful improvements in student scores at that site; the authors recommended teacher professional development to optimize whichever approach is used. Similarly, Bhagarathi *et al.* (2025b) [2] conducted another study found that both demonstration and differentiated instructional methods improved Grade 7 students' learning outcomes in Integrated Science; however, differentiated instruction resulted in significantly greater gains. Students taught using differentiated strategies achieved higher post-test scores than those taught through demonstration methods, indicating that instruction tailored to learners' abilities, interests, and learning styles was more effective. Statistical analysis confirmed a significant difference between the two approaches, favoring differentiated instruction. The study concluded that student-centered, differentiated teaching enhances science learning more effectively than traditional demonstration methods and should be encouraged in secondary school classrooms in Guyana.

Another 2025 Guyana study on time-management and Grade-9 Integrated Science (Indardat *et al*., 2025) [8] reported that classroom organization and teacher-directed pacing, features commonly present in traditional instruction, were associated with better on-task behaviour and higher post-test scores, prompting recommendations that teachers explicitly teach time-management and maintain structured lessons to support learning.

An exploratory study of Grade-10 students' perceptions of the Integrated Science School-Based Assessment (SBA) in Region 6, Guyana (De France *et al*., 2025) [4] found that students viewed teacher-led instruction and school-based practical as central to their SBA preparedness; the authors concluded that maintaining high-quality teacher instruction and clearer SBA guidance would likely improve student outcomes.

3.2 Effectiveness of Video Instruction on Learning Outcomes in Integrated Science

To evaluate the impact of video instruction on students' academic performance in Integrated Science, pre-test and post-test assessments were administered to Class B (n = 20). The descriptive statistics for both assessments are presented in Table 3. The mean score increased from 13.70 (SD = 3.42) on the pre-test to 29.05 (SD = 5.69) on the post-test, marking a substantial improvement in student performance. The expanded standard deviation in the post-test indicates a wider range of performance, suggesting that while the method was broadly effective, individual students may have benefited to different extents. The higher post-test maximum (38) may also be indicative of the fact that some students achieved notably higher levels of understanding than were seen in the traditional instruction group.

Table 3: Pre-Test and Post-Test Results for Class B (Video Instruction)

Metric	Pre-Test	Post-Test
# of students	20	20
Mean score	13	29
Standard Deviation	3.4	5.7
Maximum Score	19	38
Minimum Score	9	22

Statistical analysis using a paired samples t-test revealed a significant improvement in scores following the video instruction. The t-statistic was -9.11, with a p-value of 2.31×10^{-8}, well below the significance threshold of 0.05. These results confirm that the gains observed are not due to random variation but are strongly associated with the instructional method employed (Table 4).

Table 4: Paired Samples Test for Class B (Video Instruction)

Statistic	Value
Mean Difference (Pre - Post)	-15.350
Standard Deviation	7.492
Standard Error of the Mean	1.675
95% Confidence Interval (Lower)	-18.856
95% Confidence Interval (Upper)	-11.844
t-value	-9.162
Degrees of Freedom (df)	19
Significance (2-tailed)	.000

Liburd & Jen (2021) [11] conducted a quasi-experimental study in a high school in St. Kitts and Nevis, that compared traditional instruction with a technological approach (GeoGebra plus downloaded video presentations) for coordinate geometry. The experimental group showed statistically significant gains in achievement and more positive attitudes toward learning with technology. In this study, the authors recommended scaling technology-enhanced pedagogy, teacher training, and wider use of free visualization tools to support abstract concepts.

Sharif & Khan (2023) [21] surveyed Grade-10 Integrated Science teachers across East Berbice-Corentyne, Guyana, about ICT integration. Teachers reported that ICT (including video and multimedia) was perceived as an effective classroom intervention; younger teachers were more willing to integrate ICT but faced infrastructure and training barriers. The authors recommended investment in teacher training, infrastructure, and supportive policy to improve ICT uptake in Guyanese science classrooms.

Lewis (2025) [10] examined technology integration across Guyanese classrooms and reported that digital resources (videos, smartboard content) improved student engagement and knowledge retention where infrastructure and teacher competence existed. The study concluded that thoughtful integration of video and other education technology improves classroom engagement, and recommended capacity building for teachers, as well as targeted investment in hardware and connectivity in Guyana.

Pitter (2023) [20] evaluated Jamaica's E-Learning High School pilot (e-LHSPP) and related e-Learning initiatives. The thesis reported mixed but promising effects on student attainment where schools implemented digital resources and teacher training; shortcomings were attributed to uneven rollout, lack of robust evaluation early on, and variable teacher readiness. Recommendations included rigorous evaluations, sustained teacher professional development, and ensuring equitable access to devices and connectivity.

The e-Learning Jamaica situational and evaluation reports (2015-2016) documented the national rollout of ICT in Jamaican schools (including video lessons and teacher training). Findings showed that structured video content and ICT resources had the potential to raise engagement and complement classroom teaching, but the program's impact depended heavily on implementation quality, monitoring, and support for teachers. Recommendations urged systematic evaluation and capacity building.

Maharaj-Sharma & Sharma (2017) [14] studied Caribbean (Trinidad & Tobago) science teachers' use of ICT-based instructional technologies. They found that teachers who used multimedia and videos tended to report enhanced student engagement and conceptual understanding, but also highlighted barriers such as limited in-class time, equipment availability, and need for pedagogical training. The study recommended targeted professional development and better resource allocation.

Nazir (2021) [18] reviewed science education in Trinidad & Tobago during COVID-19 and observed that video and remote learning initiatives exposed both opportunities (wider reach, recorded lessons, multimedia resources) and systemic challenges (connectivity, pedagogical preparedness). The author recommended strengthening remote pedagogies, investing in teacher training for video-based lessons, and building resilient remote/ blended learning infrastructures.

An older Jamaica-based study by William (2004) [26] explored multimedia, case-based learning environments for pre-service science teachers and found that multimedia (including video cases) improved pedagogical content knowledge and preparedness to use video-assisted methods in classrooms. The author concluded that video-based case materials can strengthen teachers' classroom practice if embedded in teacher education programs.

NIHERST's "Teach ME" initiative (Trinidad & Tobago) and related program materials describe competitions and practitioner development producing short curriculum-aligned video lessons for primary or secondary science. Program reports and outreach indicate teachers and students value video lessons for clarity and engagement; recommendations emphasize using the videos as complements to active in-class learning and expanding teacher support for producing effective instructional videos.

Regional syntheses and meta-analytic work (while not all Caribbean-only) show consistent positive effects of video-based instruction in science and mathematics across diverse contexts. A recent meta-analysis covering multiple studies (2019-2023) found a sizable overall effect of video-based instruction on student performance and suggested that well-designed videos (aligned to pedagogy, with opportunities for active learning) significantly boost outcomes, supporting Caribbean program findings that videos help conceptualization when implemented with teacher support. The reviewed authors recommended attention to instructional design, interactivity (embedded questions), and teacher facilitation when using videos (Dipon *et al.*, 2024) [5].

3.3 Comparative Analysis: Traditional vs. Video Instruction

When comparing the outcomes of Class A (traditional text-based instruction) and Class B (video instruction), both groups showed statistically significant gains in learning. However, the magnitude of improvement was more pronounced in Class B, the group that received video instruction. Class A improved from a mean of 13.00 to 23.00 (Δ = 10.00). Class B improved from 13.70 to 29.05 (Δ = 15.35). Further, Class B not only achieved a higher post-test mean but also exhibited a greater maximum score (38 vs. 29) and wider score range, suggesting that video instruction may better support differentiated learning and engagement.

Both instructional methods led to statistically significant improvements in student performance ($p < .001$). Class B (Video Instruction) showed a larger mean gain in scores (-15.35) compared to Class A (-9.45). The wider confidence interval and greater standard deviation in Class B suggest more variation, potentially indicating stronger outcomes for some students under video-based learning. The t-values for both groups are large in magnitude, confirming that the changes in scores were highly significant, with video instruction producing a slightly stronger effect.

3. Conclusion

The findings of this study clearly demonstrate that video-assisted instruction significantly enhanced student learning outcomes in Integrated Science at the secondary level school in Guyana that was studied. Both traditional text-based and video-based methods led to measurable gains in academic achievement; however, students exposed to video instruction achieved higher mean post-test scores and exhibited greater conceptual understanding of scientific content. The improvement observed in the video-instruction group suggests that multimedia-based teaching facilitates deeper cognitive processing by integrating visual and auditory stimuli, consistent with Mayer's cognitive theory of multimedia learning. Furthermore, qualitative feedback from students revealed increased engagement, better comprehension of abstract scientific concepts, and heightened motivation during lessons incorporating videos. These outcomes confirm that video-assisted instruction may be an effective pedagogical tool for fostering meaningful learning and improving academic performance in Integrated Science.

4. Limitations

While this study provides valuable insights into the impact of video instruction on student learning in Integrated Science, several limitations should be acknowledged. The study involved only 40 students from a single secondary school, limiting the generalizability of the findings to other schools or educational contexts in Guyana. The two-week instructional period may not have been sufficient to fully capture long-term knowledge retention, behavioral changes associated with video-based learning and the sustainability of learning gains.

Further, the study focused on a single topic within Integrated Science, which may not reflect the effectiveness of video instruction across other scientific themes. In addition, the positive response to video instruction may partially reflect students' excitement with the novelty of technology rather than a consistent instructional advantage. Also, both classes were taught by the same teacher, which helped reduce instructional bias but may not reflect typical classroom diversity in teaching styles.

Additionally, the study did not account for individual learning preferences, which can significantly influence how students engage with and benefit from different instructional methods. The exclusive use of test scores as a measure of academic achievement also presents a limitation, as it overlooks other important educational outcomes such as critical thinking, motivation, creativity, and collaborative skills. Future research in this area should consider longer-term studies with larger, more diverse samples and include a broader range of assessment tools to provide a more holistic evaluation of instructional effectiveness.

5. Recommendations

Educational policymakers and curriculum developers in Guyana should consider including-embedding video-assisted instructional methods into the Integrated Science curriculum to complement traditional teaching approaches and promote interactive learning. Consequently, teachers should receive training on designing and implementing effective video-based lessons to maximize student engagement and conceptual understanding. This includes developing skills in selecting, curating, and integrating multimedia resources aligned with specific learning outcomes.

Further, schools should invest in the necessary technological infrastructure, such as, projectors, smartboards, and reliable internet access, to support the use of educational videos across classrooms. Additionally, combining video instruction with hands-on experiments, discussions, and collaborative activities can create a more holistic and balanced learning environment that caters to diverse learning styles. Further, future studies should expand on this research by including larger sample sizes, diverse geographical areas, and longer intervention periods to determine the sustained impact of video-based learning on academic performance and critical thinking skills.

6. Compliance with Ethical Standards

1. Acknowledgment

The authors would like to express their sincere gratitude to the University of Guyana for providing this valuable opportunity and for supporting the successful completion of this research. A heartfelt thank you is extended to the anonymous participants; whose valuable contributions were instrumental in completing this study. Additionally, the authors wish to acknowledge the Ministry of Education for its generous support, consideration, and assistance in facilitating this research at the secondary level.

2. Statement of Ethical Approval

Permission to conduct the study was formally obtained by the researcher from the Head Teacher of the participating Secondary School A. The study was designed to adhere strictly to its stated research questions, with no element of deception involved. Ethical principles of voluntary participation, confidentiality, and academic integrity were maintained throughout the research process.

3. Confidentiality of Participants

Student participants were not required to provide any identifying information, such as their names, signatures, contact numbers, or any details that could trace back to them. The school involved in this research was not identified but is referred to as "Secondary School A" throughout the study to ensure anonymity and confidentiality.

4. Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

5. Disclosure of conflict of interest

The authors certify that this submission is original work and is not under review at any other publication. The authors hereby declare that this manuscript does not have any conflict of interest.

6. Statement of informed consent

The authors declare that informed consent was obtained from all individual participants included in the study. All work utilized in this study was fully cited and referenced so authors of prior researches are given their due credentials for their work.

7. Data Availability

Data will be made available on request.

8. Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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How to Cite This Article
De France N, Bhagarathi LK, Indardat A, Da Silva PNB, Balkarran R, Dasratt R, *et al*. Evaluating the Impact of Video-Assisted Instruction and Traditional Teaching Methods on Student Learning Outcomes in Grade 9 Integrated Science at a Secondary School in Guyana: A Comparative Study. International Journal of Multi Research. 2026; 1(1): 01-07.