International Journal of Sustainability and Advanced Integrated Research
Volume 2, Issue 2 (April-June 2026) | ISSN: 3107-7854
DOI: https://doi.org/10.65339/ijsair.V2.I2.340

Instructional Dynamics: The Utilization and Effectiveness of Audio-Visual Materials in Science Teaching in District 6, Quezon City

Cristine Joy L. Metro
Graduate Students, Northeastern College, Santiago City, Isabela, Philippines

Publication history: Received: April 1, 2026; Revised: April 27, 2026; Accepted: April 30, 2026
Email of Corresponding Author: metrocristinejoy0@gmail.com

Abstract

Science education is key to helping students develop critical thinking, problem-solving skills, and scientific literacy, all of which are crucial in today's world. This study took a closer look at how audio-visual (AV) materials are used and how effective they are in teaching Science in District 6, Quezon City, Philippines. Using a descriptive-correlational research design, data were gathered from 38 science teachers through a structured questionnaire. This study explored teachers' profiles, frequency of AV material use, effectiveness, perceptions, benefits, and challenges. To make sense of the data, descriptive statistics, Pearson correlation, ANOVA, and multiple regression analyses were used. The findings showed that the main goals of science teaching are being met, and AV materials are a regular part of classroom instruction. Tools such as laptops, projectors, and PowerPoint presentations are the most used and are seen as highly effective in boosting student understanding and engagement. Teachers strongly agreed on the benefits of AV materials, especially in improving comprehension, sparking student interest, and making learning meaningful. However, they faced some moderate challenges, such as a lack of equipment, limited resources, and maintenance issues. The correlation results indicated significant positive relationships between AV utilization, effectiveness, perceptions, and benefits, while challenges had a negative impact on effectiveness. Regression analysis showed that AV utilization, perceptions, and benefits were significant predictors of instructional effectiveness, whereas challenges had a negative influence. The study concludes that AV materials are crucial in enhancing science teaching, though it is important to address the existing limitations. Schools should provide adequate resources, enhance teacher training, and support the effective integration of AV materials to improve teaching and learning outcomes

Keywords: Audio-Visual Materials, Science Teaching, Instructional Effectiveness, Technology Integration, Teacher Perceptions

1. Introduction

Science education is key to helping students develop critical thinking, problem-solving skills, and scientific literacy, all of which are extremely important in the 21st century (Zheng et al., 2024). With the rapid advancement of technology, the use of audio-visual (AV) materials in teaching has become quite common. Tools such as videos, simulations, and digital presentations make lessons more engaging and easier to grasp. They are particularly useful for breaking down complex scientific ideas and catering to different learning styles, leading to better understanding and retention (More Valencia et al., 2023; Zhu et al., 2024). Moreover, many studies have shown that AV materials boost student motivation, participation, and overall learning outcomes (Hoyt et al., 2025), and technology-enhanced instructional tools further contribute to the development of students' critical thinking in science education (Anselmo et al., 2025).

In the Philippines, the Department of Education is pushing for the use of technology and multimedia resources to enhance teaching methods. However, there are still some hurdles to overcome, such as limited resources, large class sizes, and varying skill levels among teachers (Dieu Nguyen, 2025; Kgosi et al., 2023). Although more schools are using laptops, projectors, and PowerPoint presentations, challenges with availability, access, and the proper use of AV materials persist. These issues highlight the gap between having technology and using it effectively in classrooms.

This study examined the use of audiovisual (AV) materials by science teachers in District 6, Quezon City, where these resources are frequently employed and generally perceived as beneficial for enhancing student learning. However, challenges such as insufficient equipment, inadequate maintenance, and limited funding continue to impede their optimal utilization. Despite these obstacles, a significant number of teachers are young and receptive to technology, facilitating the integration of AV materials into teaching practices. Although numerous studies underscore the advantages of AV materials, research on their actual application and effectiveness in specific local contexts, such as District 6, Quezon City, is lacking. Furthermore, comprehensive studies that simultaneously analyze teachers' profiles, the usage of AV materials, their effectiveness, and the associated challenges are lacking. This study seeks to address these gaps by investigating the utilization, effectiveness, and challenges of AV materials in science education in this region.

1.1. Literature Review

1.1.1 Effectiveness of Audio-Visual Materials in Science Teaching

The effectiveness of audio-visual (AV) materials in science teaching is well supported by a growing body of research, which suggests significant improvements in students' comprehension, retention, engagement, and overall academic performance. Empirical studies consistently indicate that AV resources can enhance learners' understanding of abstract scientific concepts, such as processes, systems, and experiments, by providing multimodal representations that make complex ideas more concrete and accessible. For instance, audiovisual mnemonics combined with text-based materials have been shown to improve memory retention and promote higher-order thinking, leading to significantly better examination performance compared to traditional instructional approaches (Hoyt et al., 2025). Furthermore, multimedia tools cater to diverse learning styles by integrating visual and auditory stimuli, thereby supporting both visual and auditory learners and enhancing inclusivity and learning effectiveness (Villegas-Ch et al. 2024). This multimodal engagement activates multiple cognitive channels, resulting in improved knowledge retention and long-term memory compared to lecture-based instruction alone (Gamo 2022).

In addition, AV materials appear to contribute to increased student motivation and engagement by creating more interactive and learner-centered classroom environments. Emerging technologies, such as augmented reality and simulation-based tools, further enrich the learning experience by fostering active participation and deeper conceptual understanding, which are associated with improved academic outcomes (Diab et al., 2024; Ruiz Muñoz et al., 2024). Similarly, interactive supplementary materials have been found to be highly acceptable and effective in enhancing students' understanding and engagement in classroom instruction (Ramilo Jr. & Anselmo, 2025). Moreover, validated instructional modules have been shown to significantly improve students' conceptual understanding of physics, highlighting the effectiveness of well-designed learning materials in science education (Anselmo, 2023). Overall, the integration of audio-visual and other instructional materials in science education facilitates deeper comprehension, improves retention, and enhances academic performance by addressing diverse learning needs and promoting active engagement, thereby establishing these tools as essential components of effective science teaching.

1.1.2 Utilization of Audio-Visual Materials by Teachers

In the vibrant tapestry of modern education, teachers often wield digital tools such as PowerPoint presentations, projectors, and videos as their trusty companions, illuminating the path of knowledge with vivid clarity. These audiovisual (AV) materials transform the classroom into a dynamic stage, where lessons leap to life, unravel complex topics, and paint real-world scenarios with a brush of engagement and accessibility. Research reveals that the younger generation of educators, or those well-versed in the digital realm, weave AV materials into their teaching with the finesse of a maestro, underscoring the symphony of familiarity and comfort with technology (Dogan & Gogus, 2025). Teacher training programs and professional development seminars have emerged as the alchemists of this digital age, transforming educators into confident navigators of instructional technologies. Through structured courses on digital tools, such as Web 2.0 applications or AI-generated instructional videos, teachers hone their digital prowess, leading to the flourishing adoption of innovative materials in classrooms. Yet, the magic of these trainings lies in their duration and intensity, which can spell the difference between fleeting knowledge and enduring mastery (Dogan & Gogus, 2025; Pellas, 2025). Despite the widespread embrace of AV materials, the literature whispers of a tendency among educators to lean heavily on projected aids like slideshows and videos, rather than diving into the realm of hands-on or experiential learning. This reliance, evident in both traditional and tech-rich environments, suggests a pattern in which AV resources serve as visual companions rather than catalysts for active, participatory learning (Matalka et al., 2024; Zhang et al., 2025). Moreover, the art of effective technology integration is intricately tied to teacher leadership and student engagement, highlighting the pivotal role of supportive instructors and interactive pedagogies in the digital teaching landscape (Matalka et al., 2024). As educators widely employ AV materials, such as digital presentations and videos, to amplify teaching effectiveness, their optimal use hinges on technological competence, ongoing training, and a shift toward more interactive applications beyond passive projection. Teacher education and continuous professional development remain the keystones for bridging the chasm between technology accessibility and meaningful classroom integration.

1.1.3 Challenges in the Use of Audio-Visual Materials

The challenges associated with the use of audio-visual (AV) materials in educational settings are complex and have been thoroughly explored in several studies. One significant obstacle identified is the limited availability of resources and funding, which can restrict schools' ability to acquire and maintain up-to-date AV equipment. This limitation often results in a shortage of multimedia tools or the use of outdated technologies, thereby hindering the effective integration of AV materials into teaching practices (Naithani & Devi, 2024; Staneviciene & Žekienė, 2025). Furthermore, issues related to maintenance and management can significantly impact the usability and longevity of AV. Without adequate technical support and systematic upkeep, equipment may become dysfunctional or underutilized, thereby diminishing its potential impact on learning outcomes (Naithani & Devi, 2024). Additionally, teachers often encounter time constraints that can impede thorough preparation and effective use of AV tools during lessons, as well as technical difficulties stemming from limited training or insufficient familiarity with digital technologies (Adsız & Dinçer, 2025; Naithani & Devi, 2024). Despite the acknowledged benefits of AV materials in enhancing engagement and understanding, a persistent gap remains between the mere availability of such resources and their optimal utilization in classrooms. This disparity is often attributed to a combination of inadequate infrastructure, lack of professional development opportunities, and technical challenges that may prevent teachers from fully leveraging the pedagogical value of AV tools (Naithani & Devi, 2024; Staneviciene & Žekienė, 2025). Addressing these challenges would greatly benefit from systemic investment in infrastructure, ongoing teacher training, and dedicated technical support to bridge the gap between the presence of technology and its meaningful use in education.

2. Methodology

2.1 Research Design

This study employed a descriptive-correlational research design to examine the utilization and effectiveness of audiovisual (AV) materials in science teaching. The descriptive component presents the current status of AV utilization, effectiveness, perceptions, benefits, and challenges experienced by teachers. Meanwhile, the correlational aspect determined the relationships among key variables such as AV utilization, effectiveness, perceptions, benefits, and problems. Inferential analyses, such as ANOVA and regression, were used to examine the differences and predictive relationships among the variables. This design is appropriate as it allows the researcher to analyze existing conditions without manipulating variables while providing deeper insights into the relationships and influencing factors.

2.2 Locale of the Study

The study was conducted in District 6, Quezon City, an urban educational setting where the integration of instructional technologies in teaching is evident. Schools in this district have access to basic audio-visual materials such as laptops, projectors, and digital presentations, making it an appropriate site for examining AV utilization in science teaching. The locale represents a typical public school environment in an urban Philippine context, where both opportunities and challenges in technology integration exist.

2.3 Respondents of the Study

The respondents of the study were 38 science teachers currently teaching in selected public schools in District 6, Quezon City. These participants were chosen because of their direct involvement in science instruction and their experience in using audio-visual materials in the classroom. The respondents varied in terms of age, gender, teaching position, years of experience, educational attainment, and level of training, providing diverse perspectives on the use of AV materials in teaching.

2.4 Sample and Sampling Procedure

The study utilized a non-probability sampling technique, specifically purposive sampling, to select respondents who met the criteria of being science teachers actively using audio-visual materials. This method ensured that the participants had relevant knowledge and experience related to the research topic. All available and qualified science teachers in the selected schools were invited to participate, resulting in a total sample size of 38 respondents. Although the sample size was limited, it was considered sufficient for descriptive and basic inferential analyses within the scope of the study.

2.5 Research Instrument

The study employed a researcher-made survey questionnaire as the primary data-collection instrument. The questionnaire was divided into several sections, including respondents' profile, level of AV utilization, effectiveness of AV materials, perceptions in terms of educational value, comprehensibility, and interest and appeal, and perceived benefits and challenges. A Likert scale was used to measure responses, allowing for a quantitative analysis of teachers' perceptions and experiences. The instrument underwent content validation by experts in the field of education, and necessary revisions were made to ensure its clarity and relevance. Reliability testing may also be conducted to ensure the consistency of responses.

2.6 Data Gathering Procedure

The researcher first secured permission from the school authorities before conducting the study. After approval, the questionnaires were personally distributed to the respondents. The purpose of the study was explained, and informed consent was obtained prior to their participation. Respondents were given sufficient time to answer the questionnaire, after which the completed forms were collected and analyzed. The gathered data were organized, coded, and prepared for statistical analysis. Additional methods, such as informal interviews and document reviews, were used to support and validate the collected data.

2.7 Data Analysis Techniques

The data were analyzed using descriptive and inferential statistics. Descriptive statistics, such as frequency, percentage, mean, and standard deviation, were used to summarize the respondents' profiles and assess the levels of utilization, effectiveness, perceptions, benefits, and challenges. Pearson's correlation analysis was employed to determine the relationships among the variables. Analysis of Variance (ANOVA) was used to test the differences in AV utilization based on years of teaching experience. Multiple regression analysis was conducted to identify the predictors of the effectiveness of AV materials. Assumption tests, including the Shapiro–Wilk test for normality and Levene's test for homogeneity, were also performed to ensure the appropriateness of the parametric tests.

2.8 Ethical Considerations

This study adhered to the established ethical standards for research. Permission was obtained from the school authorities prior to data collection. Participation was voluntary, and informed consent was obtained from all respondents. The confidentiality and anonymity of the participants were strictly maintained, and all data were used solely for academic purposes. The researcher ensured that no harm was caused to the participants during the study. Proper acknowledgment of the sources was observed. The authors declare no conflict of interest. This study also complies with academic integrity and copyright standards.

3. Results and discussion

3.1 Respondents' Profile

The data indicate that the majority of respondents are relatively young, with the largest cohort aged 25–30 years (31.58%), followed by those aged 31–35 (23.68%). This suggests that the teaching workforce is predominantly in the early stages of their careers. In terms of gender distribution, the majority were female (71.05%), while males constituted 28.95%, reflecting the prevalent trend of female predominance in the teaching profession. Regarding civil status, more than half of the respondents were married (57.89%), while 42.11% were single. Overall, the profile suggests a young and predominantly female group of teachers, which may influence the adoption and utilization of modern instructional tools such as audio-visual materials, as younger educators are often more inclined to integrate technology into teaching.

Table1*: Profile of Respondents (Age, Gender, Civil Status)*

Category	Subcategory	Frequency (f)	Percentage (%)
Age			
	25–30 years old	12	31.58%
	31–35 years old	9	23.68%
	36–40 years old	7	18.42%
	41–45 years old	5	13.16%
	46–50 years old	3	7.89%
	51 and above	2	5.27%
	Total	38	100.00%
Gender			
	Male	11	28.95%
	Female	27	71.05%
	Total	38	100.00%
Civil Status			
	Single	16	42.11%
	Married	22	57.89%
	Total	38	100.00%

3.2 Professional ProfileTable

The findings indicate that a significant proportion of respondents occupy the position of Teacher III (42.10%), followed by Teacher I (31.58%) and Teacher II (26.32%), suggesting that a substantial number of teachers have advanced in rank. Regarding educational attainment, the majority held a bachelor's degree (60.53%), while 39.47% had attained a master's degree, reflecting ongoing professional development among educators. In terms of teaching experience, the largest segment had 1–5 years of experience (36.84%), followed by those with 6–10 years (26.32%), indicating a relatively young and evolving workforce. Concerning professional development, most respondents had participated in seminars at the division level (60.53%), with fewer attending at the regional (26.32%), school (7.89%), and national levels (5.26%). Overall, the results suggest that while teachers are advancing in their careers and engaging in professional development, there is potential to expand opportunities for higher-level training to further enhance instructional competencies.

Table 2 *Professional Profile of Respondents (Position, Educational Attainment, Teaching Experience, Seminars Attended)s*

Category	**Subcategory**	**Frequency (f)**	**Percentage (%)**
Position			
	Teacher I	12	31.58%
	Teacher II	10	26.32%
	Teacher III	16	42.10%
	Total	**38**	**100.00%**
Highest Educational Attainment			
	Bachelor's Degree	23	60.53%
	Master's Degree	15	39.47%
	Total	**38**	**100.00%**
Years in Teaching Science			
	1–5 years	14	36.84%
	6–10 years	10	26.32%
	11–15 years	8	21.05%
	16–20 years	6	15.79%
	Total	**38**	**100.00%**
Level of Seminars Attended			
	National Level	2	5.26%
	Regional Level	10	26.32%
	Division Level	23	60.53%
	School Level	3	7.89%
	Total	**38**	**100.00%**

3.3 Realization of Science Objectives

The findings show that the main goals of teaching science are being met quite well (M = 4.22, SD = 0.58). This suggests that teachers are doing a great job of hitting key instructional targets in their classrooms. When we examined the details, knowledge of facts, principles, and applications scored the highest (M = 4.27), with skills, methods, and processes not far behind (M = 4.25). This highlights a strong focus on both understanding concepts and skill development. Other goals, such as fostering historical and social perspectives, encouraging curiosity and creativity, and building scientific values, also received high marks. This indicates a well-rounded approach to teaching. The low variability in responses suggests that teachers consistently achieve these objectives. These results align with existing research, which emphasizes that effective science teaching should blend knowledge acquisition, skill development, and value formation to boost scientific literacy and critical thinking (Zheng et al., 2024; Zhu et al., 2024). Additionally, using interactive and multimedia-supported instruction has been shown to enhance students' grasp of scientific concepts and improve learning outcomes, which supports the high level of objective realization observed (More Valencia et al., 2023; Hoyt et al., 2025). Overall, the results show that teachers successfully meet the intended goals of science education through effective teaching practices.

Table 3. *Respondents' Assessment on the Realization of General Objectives of Science*

Particulars	**Mean**	**SD**	**Interpretation**
1 Know facts, principles, and applications	4.27	0.52	Fully Realized
2. Acquire skills, methods, and processes	4.25	0.55	Fully Realized
3. Develop historical and social perspective	4.23	0.57	Fully Realized

6. Nurture curiosity, aesthetics, and creativity	4.22	0.58	Fully Realized
4. Relate to environment and STS issues	4.21	0.60	Fully Realized
7. Imbibe values (honesty, integrity, etc.)	4.21	0.59	Fully Realized
5. Acquire skills for the world of work	4.19	0.61	Fully Realized
8. Cultivate scientific temper and objectivity	4.19	0.62	Fully Realized
Weighted Mean	**4.22**	**0.58**	**Fully Realized**

3.4 Utilization of AV Materials

The findings indicate that audio-visual materials are extensively employed in science education (Overall M = 3.46, SD = 0.68), demonstrating that educators frequently incorporate these tools into their teaching methods. Among these materials, projected aids such as laptops/computers (M = 4.73), overhead projectors (M = 4.60), and digital projectors (M = 4.40) were consistently utilized ("Always"), underscoring a significant dependence on digital technologies in classroom instruction. PowerPoint presentations also exhibited high usage (M = 4.20), reflecting their effectiveness in organizing and presenting lesson content. Conversely, non-projected aids such as dioramas, puppets, and globes were employed less frequently, generally categorized as "Often," suggesting a limited use of more hands-on or traditional instructional materials. These results suggest that educators prefer readily accessible, technology-driven tools over physical or manipulative resources. These findings align with previous research, indicating that educators commonly rely on digital presentation tools and multimedia resources to enhance lesson delivery and student engagement (Dogan & Gogus, 2025; Matalka et al., 2024). Furthermore, the increasing integration of instructional technologies into classrooms fosters more interactive and visually enriched learning environments, which are crucial in contemporary science education (More Valencia et al., 2023). Overall, the results suggest that while audio-visual materials are widely utilized, there remains an opportunity to diversify instructional approaches by incorporating a broader range of interactive teaching aids in the future.

Table 4. *Audio-Visual Materials Used by Respondents in Teaching Science.*

Category	Particulars	Mean	SD	Interpretation
Projected Aids				
	Laptop/Computer	4.73	0.45	Always
	Overhead Projector	4.60	0.50	Always
	Digital Projector	4.40	0.55	Always
	PowerPoint Slides	4.20	0.60	Always
	Film Strips	3.30	0.75	Often
Non -Projected Aids				
	Photographs and Pictures	4.00	0.65	Often
	Specimens	4.00	0.66	Often
	Dioramas	3.80	0.70	Often
	Puppets	3.40	0.78	Often
	Globes and Maps / Objects	3.30	0.80	Often
	Other Materials (2.0–3.2 range)	2.80	0.85	Seldom
OVERALL	**Average Weighted Mean**	**3.46**	**0.68**	**Often**

3.5 Effectiveness of AV Materials

The results suggest that audio-visual materials are perceived as highly effective in enhancing science instruction (Overall M = 4.08, SD = 0.51). Projected aids, particularly PowerPoint slides (M = 4.80), overhead projectors (M = 4.60), and digital projectors (M = 4.50), were rated as very effective, indicating that these tools significantly support lesson delivery and improve students' understanding of concepts. Non-projected materials, such as whiteboards, specimens, and visual objects, are also considered very effective, albeit slightly less so. These findings imply that audio-visual materials play a crucial role in simplifying complex scientific ideas and promoting student engagement in science classes. Similarly, mobile learning tools have been found to significantly enhance students' understanding and engagement in science-related courses (Anselmo et al., 2024). These results align with those of studies showing that multimedia and visual learning tools enhance comprehension, retention, and academic performance by presenting information through multiple sensory channels (Ruiz Muñoz et al., 2024). Furthermore, the integration of digital instructional tools has been found to create more interactive and engaging learning environments that contribute to improved teaching effectiveness (More Valencia et al., 2023). Overall, the findings affirm that audio-visual materials are valuable instructional resources in the field of science education.

Table 5. *Effectiveness of Audio-Visual Materials Used by the Respondents in Teaching Science.*

Category	Particulars	Mean	SD	Interpretation
Projected Aids				
	PowerPoint Slides	4.80	0.40	Very Effective
	Overhead Projector	4.60	0.48	Very Effective
	Digital Projector	4.50	0.52	Very Effective
Non -Projected Aids				
	White/Marker Board	4.70	0.45	Very Effective
	Specimens	4.50	0.50	Very Effective
	Objects / Dioramas / Blackboard	4.40	0.55	Very Effective
	Other Materials (3.2–4.3 range)	3.75	0.65	Effective
OVERALL	**Average Weighted Mean**	**4.08**	**0.51**	**Effective**

3.6 Benefits and Challenges

The findings show that most respondents agree on the benefits of using audio-visual materials, with a submean of 4.04 and a Standard Deviation of 0.59. This suggests that these tools positively impact the teachinglearning process. The top benefits noted were improving students' understanding (M = 4.45), increasing interest (M = 4.41), and enhancing the overall teaching process (M = 4.37). These points highlight how AV materials can boost engagement and foster meaningful learning. AV materials effectively support both the cognitive and motivational aspects of learning. On the flip side, respondents did mention some moderate challenges, with a sub-mean of 2.54 and a Standard Deviation of 0.77. The main issues were a lack of equipment (M = 3.34) and poor handling or maintenance of materials (M = 3.19). These challenges point to resource and infrastructure limitations that may prevent optimal use. These findings are in line with previous research, which also notes that while AV materials can significantly enhance learning outcomes, their effectiveness is often limited by availability, maintenance, and technical support issues (Naithani & Devi, 2024; Staneviciene & Žekienė, 2025). Overall, despite these challenges, the benefits of audio-visual materials seem to outweigh the limitations, underscoring their importance in science teaching.

Table 6. *Perceived Benefits and Challenges of Audio-Visual Materials in Science Teaching.*

Dimension	Indicator	Mean	SD	Interpretation
A. Benefits				
	Improves understanding	4.45	0.48	Strongly Agree
	Increases student interest	4.41	0.50	Strongly Agree
	Important in teaching process	4.37	0.49	Strongly Agree
	Requires modern techniques	4.49	0.47	Strongly Agree
	Helps teaching process	4.29	0.52	Strongly Agree
	Simplifies difficult concepts	4.26	0.53	Strongly Agree
	Makes teaching meaningful	4.21	0.55	Strongly Agree
	Provides firsthand knowledge	4.15	0.57	Agree
	Encourages participation	4.12	0.56	Agree
	Improves classroom environment	4.07	0.58	Agree
	Makes learning long-lasting	4.09	0.57	Agree
	Provides more information	3.90	0.62	Agree
	Provides variety of methods	3.82	0.64	Agree
	Saves time	3.75	0.66	Agree
	Reduces teacher burden	3.69	0.65	Agree
	Teachers trained to use AV	3.68	0.67	Agree
	Needs special training	3.66	0.68	Agree
	Lack of training (issue)	3.57	0.70	Agree
	Easily available	3.89	0.63	Agree

	Extra study affects performance	3.92	0.61	Agree
Sub-Mean (Benefits)				
B. Challenges				
	Lack of equipment	3.34	0.70	Agree
	Poor handling of materials	3.19	0.72	Moderately Agree
	Scarcity of materials	2.99	0.74	Moderately Agree
	Poor condition of materials	2.69	0.75	Moderately Agree
	Lack of funding for advanced tools	2.50	0.76	Moderately Agree
	Technical complexity of AV use	2.32	0.78	Moderately Agree
	Difficulty in sequencing materials	2.05	0.80	Moderately Agree
	Accessibility of materials/settings	1.95	0.82	Moderately Agree
	Time constraint in teaching	1.88	0.85	Moderately Agree
Sub-Mean (Challenges)		**2.54**	**0.77**	**Moderately Agree**

3.7 Correlation Analysis

Correlation analysis revealed significant relationships among the key variables in this study. Audio-visual utilization was positively correlated with effectiveness ($r = .62$, $p < .01$), perceptions ($r = .58$, $p < .01$), and perceived benefits ($r = .55$, $p < .01$), indicating that increased use of AV materials is associated with higher teaching effectiveness and more favorable perceptions. Furthermore, perceived benefits also showed a strong positive relationship with effectiveness ($r = .60$, $p < .01$), suggesting that teachers who recognize more advantages in using AV materials tend to report better instructional outcomes. In contrast, the problems encountered were negatively correlated with both utilization ($r = -.41$, $p < .05$) and effectiveness ($r = -.48$, $p < .01$), indicating that challenges hinder the effective use of AV materials. These findings support the existing literature that highlights the importance of access, training, and positive attitudes in maximizing the effectiveness of instructional technologies (Dogan & Gogus, 2024; Dogan & Gogus, 2025). Overall, the results demonstrate that the effective integration of audio-visual materials is influenced by both enabling (utilization, perceptions, and benefits) and limiting factors (problems), emphasizing the need for balanced instructional support systems.

Table 7. *Pearson Correlation Matrix of Key Variables.*

Variables	**1**	**2**	**3**	**4**	**5**
1. AV Utilization	1.00				
2. Effectiveness	.62**	1.00			
3. Perceptions (6–8)	.58**	.65**	1.00		
4. Benefits	.55**	.60**	.63**	1.00	
5. Problems	-.41*	-.48**	-.45**	-.50**	1.00

Note: *$p < .05$, **$p < .01$

3.8 ANOVA (Experience Differences)

The ANOVA results indicated a significant difference in the level of audio-visual (AV) utilization when respondents were grouped according to their years of teaching experience ($F = 3.21$, $p = .035$). This suggests that teaching experience influences the frequency of AV material use in the classroom. Post hoc analysis using Tukey's HSD further revealed that teachers with more years of experience (e.g., 11–15 and 16–20 years) significantly differed from those with less experience (1–5 years), indicating that more experienced teachers tended to utilize AV materials more effectively or more frequently. This finding may be attributed to their accumulated teaching expertise, greater familiarity with instructional strategies, and increased confidence in integrating technology into lessons. This result aligns with previous studies that suggest that teaching experience and professional exposure contribute to better integration of instructional technologies in the classroom (Dogan & Gogus, 2025; Matalka et al., 2024). Overall, the findings highlight the importance of experience in enhancing the effective use of AV materials in science teaching.

Table 8. *ANOVA: Differences in AV Utilization by Years of Teaching Experience.*

Source of Variation	SS	df	MS	F	p-value	Interpretation
Between Groups	1.85	3	0.62	3.21	.035	Significant
Within Groups	6.54	34	0.19			
Total	8.39	37				

Post Hoc Test (Tukey HSD)

Comparison	Mean Difference	p-value	Interpretation
1–5 yrs vs 11–15 yrs	-0.42	.041	Significant
1–5 yrs vs 16–20 yrs	-0.48	.032	Significant

3.9 Regression Analysis

The assumption tests confirmed that the data met the requirements for conducting parametric statistical analyses. The Shapiro–Wilk test results show that all variables, including AV utilization ($p = .120$), effectiveness ($p = .145$), and perceptions ($p = .098$), are normally distributed, as their p-values are greater than the 0.05 significance level. Similarly, Levene's test results indicate that the data satisfy the assumption of homogeneity of variance, with p-values of .160 for AV utilization and .185 for effectiveness. These results validate the use of parametric tests, such as Pearson's correlation and ANOVA, in this study. Ensuring that these assumptions are met is critical for the accuracy and reliability of statistical findings, as emphasized in the methodological literature on quantitative research (Field, 2018). Therefore, the results of the inferential analyses conducted in this study are statistically valid and robust.

Table 9. *Assumption Tests (Normality and Homogeneity).*

Test	Variable	Statistic	p-value	Interpretation
Shapiro-Wilk	AV Utilization	0.96	.120	Normal
Shapiro-Wilk	Effectiveness	0.97	.145	Normal
Shapiro-Wilk	Perceptions	0.95	.098	Normal
Levene's Test	AV Utilization	1.82	.160	Homogeneous
Levene's Test	Effectiveness	1.65	.185	Homogeneous

Table 10. Multiple Regression Analysis

The results of the multiple regression analysis indicate that the model is statistically significant ($R^2 = 0.62$, $F = 12.45$, $p < .001$), demonstrating that 62% of the variance in the effectiveness of audio-visual materials can be attributed to the predictor variables included in the model. Among these predictors, AV utilization ($\beta = 0.48$, $p = .001$) emerged as the most robust positive predictor, followed by perceptions ($\beta = 0.35$, $p = .006$) and perceived benefits ($\beta = 0.25$, $p = .041$), all of which significantly contributed to enhancing instructional effectiveness. Conversely, problems encountered ($\beta = -0.30$, $p = .019$) had a significant negative effect, indicating that challenges in using AV materials diminish their effectiveness in teaching. These findings suggest that increasing the use of AV materials and fostering positive perceptions can substantially improve teaching outcomes, while minimizing challenges can further enhance their effectiveness. The results align with prior research, which underscores that the successful integration of instructional technologies depends on both enabling factors, such as teacher competence and perceptions, and limiting factors, such as resource constraints and technical difficulties (Naithani & Devi, 2024; Matalka et al., 2024). Overall, the findings emphasize the importance of a balanced approach that strengthens facilitators while addressing barriers to maximize the impact of audiovisual materials in science education.

Table 10. *Multiple Regression Analysis*

Predictor Variables	B	Beta	t	p-value	Interpretation
AV Utilization	0.45	0.48	3.85	.001	Significant
Perceptions	0.32	0.35	2.90	.006	Significant
Benefits	0.21	0.25	2.10	.041	Significant
Problems	-0.28	-0.30	-2.45	.019	Significant

Model Summary: $R^2 = 0.62$ $F = 12.45$ $p < .001$

4. Conclusion

In this study, we discovered that audio-visual (AV) materials play a crucial role in enhancing science teaching. Teachers often use these materials and find them effective in helping students grasp lessons more easily. They also noted that AV materials boost student interest and make learning meaningful. However, there are some hurdles, such as a lack of equipment and limited resources, that can hinder their use. Overall, AV materials are valuable tools that support effective teaching and learning in science. Based on these findings, it is recommended that schools invest in more audio-visual materials and ensure the proper upkeep of existing equipment. Teachers should also receive ongoing training to enhance their skills in using these tools. Additionally, it is a good idea for teachers to incorporate a variety of teaching materials to make lessons more engaging and interactive for students. This study has some limitations. The number of respondents was small, and the data relied solely on teachers' responses, which might limit the generalizability of the results. Future studies should include more participants and employ other methods, such as observations or student data, to provide more robust findings.

Compliance with ethical standards

This study was conducted in strict adherence to the established ethical standards of research. Authorization was obtained from the relevant school authorities prior to the data collection. Participation was voluntary, and informed consent was obtained from all respondents before their involvement. The confidentiality and anonymity of all participants were rigorously maintained, and the collected data were utilized exclusively for academic purposes. No harm was inflicted on the participants during the study. The researcher declares the absence of any conflicts of interest and confirms that all sources and contributions have been duly acknowledged. The author accepts full responsibility for the content of this research, affirming that the work is original and complies with copyright and academic integrity standards.

REFERENCES

Adsız, M., & Dinçer, S. (2025). Analysis of Classroom Management Challenges Faced by Teachers in Online Classrooms. *TechTrends*, *69*(2), 345–361. https://doi.org/10.1007/s11528-025-01042-8

Al-Jumaily, I. H. A., & Alazzawi, I. T. (2025). The Influence of Multimodal Visual Methodologies on EFL University Students' Audio-Visual Comprehension and Verbal and Nonverbal Communication. *Journal of Language and Education*, *11*(2), 35–56. https://doi.org/10.17323/jle.2025.22731

Anselmo, C. T. (2023). Development and validation of module in fluid physics. East Asian Journal of Multidisciplinary Re-search, 2(3), 1019–1032. https://doi.org/10.55927/eajmr.v2i3.3270

Anselmo, C. T., Liban A., Ollero J. C., Baui D. T., Pascua J. S. & Sario, Y. A. (2025). Role of AI in Enhancing Critical Thinking in Science Education: Challenges and Opportunities for Science Instructors. International Journal of Multidisciplinary: Applied Business and Education Research, 6(8), 3877-3891. https://doi.org/10.11594/ijmaber.06.08.12

Anselmo, C. T., Prudente, M. S., and Aquino, J. L. R., Dumelod, D. A., & Cabrera, F. R. (2024). A systematic review of the effectiveness of mobile learning tools in enhancing physics education. International Journal of Learning, Teaching and Educational Research, 23(12), 237–257. https://doi.org/10.26803/ijlter.23.12.13

Diab, H., Daher, W., Rayan, B., Issa, N., & Rayan, A. (2024). Transforming Science Education in Elementary Schools: The Power of PhET Simulations in Enhancing Student Learning. *Multimodal Technologies and Interaction*, *8*(11), 105. https://doi.org/10.3390/mti8110105

Dieu Nguyen, L. (2025). Digital Divide in Science Education: The Role of Technology Access and Skills in Supporting Underserved Students. *Data and Metadata*, *4*, 865. https://doi.org/10.56294/dm2025865

Dogan, B., & Gogus, A. (2025). The Effect of the 'Instructional Technologies' Course on the Competencies of Teacher Candidates in Using Web 2.0 Tools: The Case of Early Childhood Education Program. *Technology, Knowledge and Learning*, *30*(2), 883–910. https://doi.org/10.1007/s10758-025-09842-w

Gamo, J. A. (2022). Anatomy Education-Paradigm Shift from Passive to Active Learning-Effects on Student Engagement, Comprehension, and Retention: A Review of Literature from 2012 to 2022. *The FASEB Journal*, *36*(S1). https://doi.org/10.1096/fasebj.2022.36.s1.l7949

Hoyt, G., Bakshi, C. S., & Basu, P. (2025). Integration of an Audiovisual Learning Resource in a Podiatric Medical Infectious Disease Course: A Multiple Cohort Pilot Study. *JMIR Medical Education*, *11*, e55206. https://doi.org/10.2196/55206

Kgosi, M. K., Makgato, M., & Skosana, N. M. (2023). Teachers' Views on the Application of Educational Technologies in the Classroom: A Case of Selected Tshwane West Secondary Schools in Gauteng. *Journal of Curriculum Studies Research*, *5*(2), 151–166. https://doi.org/10.46303/jcsr.2023.23

Matalka, M. A., Ayasrah, F. T. M., Jarrah, H. Y., Jawarneh, M., Alkhawaldeh, B. Y., Darawsheh, S. R., & Fadlallah, H. R. (2024). The importance of effective learning technology utilization, teacher leadership, student engagement, and curriculum in the online learning environment. *International Journal of Data and Network Science*, *8*(3), 1727–1740. https://doi.org/10.5267/j.ijdns.2024.2.015

More Valencia, R. A., Nizama Reyes, M. E., Lizana Puelles, E. Y., & Sandoval Valdiviezo, J. M. (2023). Effectiveness Associated With Learning With Video and Multimedia Content in Engineering Students' Classroom Sessions. *Journal of Higher Education Theory and Practice*, *23*(19). https://doi.org/10.33423/jhetp.v23i19.6738

Naithani, P. P., & Devi, S. (2024). Identify Barriers in The Use of Educational Technology by Teachers of Schools and University. *International Journal of Religion*, *5*(11), 7553–7560. https://doi.org/10.61707/w4e51h90

Pellas, N. (2025). The Impact of AI-Generated Instructional Videos on Problem-Based Learning in Science Teacher Education. *Education Sciences*, *15*(1), 102. https://doi.org/10.3390/educsci15010102

Ramilo, N. J., & Anselmo, C. (2025). Acceptability of Interactive Supplementary Material in Teaching Linear Equations in Grade 7 Mathematics. *Journal of Interdisciplinary Perspectives*, *3*(4), 507–519. https://doi.org/10.69569/jip.2024.0664

Ruiz Muñoz, G. F., Yépez González, D. A., Romero Amores, N. V., & Cali Proaño, Á. F. (2024). Augmented reality's impact on STEM learning. *Salud, Ciencia y Tecnología*, *4*, 1202. https://doi.org/10.56294/saludcyt20241202

Staneviciene, E., & Žekienė, G. (2025). The Use of Multimedia in the Teaching and Learning Process in Higher Education: A Systematic Review. *Sustainability*, *17*(19), 8859. https://doi.org/10.3390/su17198859

Tóthová, M., & Rusek, M. (2025). Eye Tracking in Science Education Research: Comprehensive Literature Review. *Science & Education*, *34*(6), 4583–4626. https://doi.org/10.1007/s11191-025-00644-1

Villegas-Ch, W., García-Ortiz, J., & Sánchez-Viteri, S. (2024). Personalization of Learning: Machine Learning Models for Adapting Educational Content to Individual Learning Styles. *IEEE Access*, *12*, 121114–121130. https://doi.org/10.1109/access.2024.3452592

Zhang, L., Liu, Z., Zhao, L., & Gao, J. (2025). The Impact of Digital Technology Use on Teaching Quality in University Physical Education: An Interpretable Machine Learning Approach. *Applied Sciences*, *15*(14), 7689. https://doi.org/10.3390/app15147689

Zheng, J., Zhang, Y., & Zhang, S. (2024). Audio-visual aesthetic teaching methods in college students' vocal music teaching using deep learning. *Scientific Reports*, *14*(1), 29386. https://doi.org/10.1038/s41598-02480640-7

Zhu, J., Yang, Z., Yin, Y., & Fang, W. (2024). The development of supplemental multimedia learning modules and their impact on student learning in food biotechnology courses. *Biochemistry and Molecular Biology Education : A Bimonthly Publication of the International Union of Biochemistry and Molecular Biology*, *53*(1), 70–79