ETCOR Educational Research Center Inc.
SEC Reg. No. 2024020137294-00
Sta. Ana, Pampanga, Philippines
INTERNATIONAL MULTIDISCIPLINARY RESEARCH CONFERENCE
Website: https://etcor.org
iJOINED ETCOR
P - ISSN 2984-7567
E - ISSN 2945-3577
The Exigency
P - ISSN 2984-7842
E - ISSN 1908-3181

Integrating Technology in Teaching Science: A Quasi-Experimental Study

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Received: 13 July 2025 **Revised**: 15 August 2025 **Accepted**: 17 August 2025

Available Online: 18 August 2025

Volume IV (2025), Issue 3, P-ISSN – 2984-7567; E-ISSN - 2945-3577

https://doi.org/10.63498/etcor436

Abstract
Aim: This study aimed to investigate the impact of integrating educational videos into science instruction on students' academic performance. Specifically, it evaluated the effectiveness of technology-enhanced teaching compared to traditional instruction through a quasi-experimental design.
Methodology: A quantitative one-group pretest-posttest quasi-experimental design was employed. A lesson plan incorporating educational videos was implemented, and students' knowledge, comprehension, and application skills were assessed using a validated multiple-choice test administered before and after the intervention. Data were analyzed using mean scores and paired sample t-tests.
Results: Findings revealed that students had low to moderate pretest scores, indicating limited understanding and misconceptions in science concepts. After exposure to technology-integrated instruction, students demonstrated notable improvement in academic performance. Statistical analysis confirmed a significant difference between pretest and posttest scores, indicating that educational videos effectively enhanced learning outcomes.
Conclusion: The integration of educational videos in teaching science significantly improved students' academic performance. The findings suggest that technology-based teaching strategies are effective in promoting comprehension and engagement in science instruction.
Keywords: *technology integration, educational videos, science instruction, academic performance, quasi-experimental design*

INTRODUCTION

Teaching science is a fundamental subject that equips learners with the knowledge and skills needed to understand the world around them. However, teaching science effectively at the elementary level poses challenges due to its abstract concepts and the limited availability of engaging instructional resources. There has been a growing interest in the integration of educational technology into science classrooms. Research suggests that digital learning tools can improve motivation, deepen conceptual understanding, and support differentiated instruction (Kirkwood & Price, 2013; Carvajal et al., 2025).

Globally, science education has been recognized as a key driver of economic growth, technological innovation, and sustainable development. International education systems have increasingly emphasized the need for inquiry-based, student-centered approaches to science teaching. However, despite reforms, many countries still face challenges in making science education accessible, engaging, and relevant to students' lives (OECD, 2019). Global studies show that student performance in science is heavily influenced by teaching strategies, availability of learning resources, and the integration of technology. According to the Programme for International Student Assessment (PISA), students from systems that employ more hands-on, interactive, and technology-supported methods in science instruction tend to outperform those from systems relying solely on memorization or textbook-based teaching (OECD, 2019; Pangilinan, 2025).

Similarly, Bybee (2013) emphasized that 21st-century science teaching should include digital literacy, inquiry-based learning, and collaboration, aligning closely with the use of platforms like Khan Academy, Kahoot, and educational videos in classrooms around the world. Countries such as Singapore, Finland, and South Korea have invested in professional development for teachers and have adopted national strategies for integrating ICT in science

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education. These efforts have been associated with higher student achievement and motivation in science (UNESCO, 2021; Carvajal et al., 2024). Such global examples provide a model and rationale for localized studies, like this one, which seek to understand how technology integration can improve science instruction in specific contexts such as Grade 5 classrooms in the Philippines.

In Monkayo, Davao de Oro, the effectiveness of technology integration in basic education classrooms continues to face significant challenges despite advancements in access and resources. At Monkayo Central Elementary School, the common problems faced by Grade 5 students include difficulties in technology use, such as trouble navigating learning platforms or using tools like educational apps. Another issue is distractions while using technology, especially when students access non-educational content. Additionally, inconsistent access to devices or the internet at home creates equity issues that hinder the effective use of digital tools for learning (Amihan & Sanchez, 2023).

Despite the growing availability of digital tools and technological resources in education, the effective integration of technology into science instruction at the elementary school level remains inconsistent and underutilized. As a result, there is a need to examine whether and how integrating technology into science instruction can significantly impact students' academic performance and engagement in elementary science education. This study seeks to address this gap through a quasi-experimental design, evaluating the effectiveness of technology-enhanced instruction compared to traditional teaching methods.

Objectives

This research project investigated technology integration in grade 5 classrooms at Monkayo Central Elementary School to understand and assess its effectiveness.

The following questions guided the investigation:

1. What is the students' academic performance level based on pretest results?
2. What is the students' academic performance level based on posttest scores?
3. Is there a significant difference between the pretest and posttest scores?

Hypothesis

In order to treat the problems extensively and accurately, the following hypothesis is formulated at 0.05 level of significance:

H_0: There is no significant difference between the students' academic performance in the pretest and posttest results.

METHODS

Research Design

This study employed a quantitative one-group quasi-experimental approach to collect data. A pre-test and post-test design was utilized to assess the effectiveness of integrating technology into science instruction. The design focused on measuring the academic performance of one group of students before and after their exposure to technology-based teaching strategies. Such a design is often used to determine changes in learning outcomes as a result of instructional interventions (Pangilinan, 2025).

Population and Sampling

The respondents of this study were the Grade 5 students in Section Luna from Monkayo Central Elementary School, located in Monkayo, Davao de Oro. The selection of this grade level was based on the curriculum requirements that introduce more complex science concepts, which are ideal for assessing the impact of technology integration in teaching. The subject was chosen through universal sampling, considering the availability of students, their exposure to similar academic content, and the school's support for the research initiative. As emphasized by Amihan et al. (2023), aligning research participants with curriculum standards and institutional support strengthens the validity and applicability of educational research.

Instrument

The researchers prepared a lesson plan designed to effectively assess how technology integration impacts student learning outcomes by gauging knowledge and skill levels before and after the intervention. The Grade 5

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students served as the recipients of the treatment. The test included multiple-choice questions that measured knowledge, comprehension, and application skills. The test was divided into a pre-test to measure baseline knowledge before the intervention and a post-test to measure learning outcomes after the intervention. A Table of Specifications (TOS) was also developed to ensure that the test items were aligned with various comprehension skills. The questionnaire consisted of 20 multiple-choice items, each with four options. This systematic alignment of test instruments with intended learning outcomes mirrors best practices in curriculum and assessment design (Carvajal et al., 2025).

Data Collection

For data collection, the researchers first secured an endorsement letter from the Dean of the Graduate School at Assumption Academy of Nabunturan and a request letter to the Office of the Schools Division Superintendent of Davao de Oro for approval to conduct the study. After approval, the researchers submitted the permission letters to the school principal. The research participants were then informed of their involvement in the quasi-experimental study. A pre-test was administered to the respondents, followed by a post-test after the intervention to measure learning outcomes. This systematic process of securing institutional approval and obtaining participant cooperation reflects ethical and professional research standards (Carvajal & Sanchez, 2023).

Treatment of Data

In the current study, appropriate statistical tools were applied to analyze the data. Based on the study's objectives, the mean and paired t-test were used. The mean provided a concise numerical value that represented the average performance of the respondents in both tests. Meanwhile, the paired t-test was used to calculate the t-value by comparing the mean difference between the pre- and post-intervention scores with the variability or standard error of the differences.

Ethical Considerations

The researchers ensured that all ethical guidelines were followed, including obtaining informed consent from participants and ensuring the confidentiality and privacy of their responses throughout the study. Upholding ethical research practices is vital for maintaining integrity and credibility in educational research (Sanchez, 2025).

RESULTS and DISCUSSION

This chapter presents the results obtained from the collected data and the descriptive analyses and interpretation based on the problems presented.

Students' academic performance level based on pretest results

This section presents the result of the first statement of the problem that examines the academic performance level of the students' pretest scores during the conduct of science lesson without the integration of technology.

Table 1

Pre-test Performance of the Grade 5 Students			
	No. of Students	Mean	Std. Deviation
Pretest	51	11.6863	3.12083

Table 1 basically shows the academic performance level of students taking science lessons without integration of technology use. Students performed at a low level suggested that the students had limited knowledge or understanding of the science concept covered in the study. The standard deviation indicates some variation in students' performance but overall, most scores clustered around the mean.

Students' academic performance level based on posttest scores

This section presents the result to the second statement of the problem that examines the academic performance level of the students' posttest scores during the conduct of science lesson with the integration of technology.

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Table 2
Posttest Performance of Grade 5 Students

	No. of Students	Mean	Std. Deviation
Post Test	51	14.2549	2.79172

The table indicates that on average, students scored relatively well after the integration of educational videos in science instruction. The standard deviation reflects a moderate variability in student scores, suggesting that while most students performed above the passing level, there were some differences in the levels of achievement.

Significant Differences between the Pretest and posttest

Table 3 presents the test difference of means in pre-test and post-test performances of the Grade 5 students taking science lesson with and without the integration of technology.

Table 3
Paired Samples Test

	Paired Differences					t-value	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Conficence Interval of the Difference				
				Lower	Higher			
Pair 1 Pretest-Post test	-256863	1.76924	.24774	-3.06623	-2.07102	-10.368	50	.000

The results show a mean difference between the pretest and posttest scores, indicating an increase in student performance after the intervention. This means that the difference between pre-test and post-test scores is statistically significant. Therefore, we reject the null hypothesis and conclude that integrating technology in teaching science had a significant positive effect on the students' academic performance. This was supported by Kirkwood and Price (2024) which believed that digital learning tools can improve motivation, deepen conceptual understanding, and support differentiated instruction.

Conclusions

The view of foregoing findings, the researchers concluded that students achieved a higher level of academic performance in science following the integration of technology such video, Kahoot and Khan Academy. There is a significant difference in pre- test and post- test scores which means, the students have improved their academic performance during the integration of technology. The average score increase indicates that technology-based teaching strategies were effective in enhancing comprehension and engagement. These findings support existing literature advocating for the use of educational technology to improve learning outcomes and underscore its relevance in modern science education.

Overall, students' scores during the intervention of technology in science lessons positively increased. The data suggests that the intervention had a positive impact on the performance of the students in learning science subject.

Recommendations

Given the significant improvement in students' academic performance, school should promote the consistent integration of educational technologies such as simulation, digital quizzes and science applications into daily teaching practices. Also, regular training and professional development workshops should be conducted for science teachers to effectively use technology tools in instruction. Teachers' competence in using digital tools is crucial to maximizing student engagement and learning outcomes. Hence, DepEd should allocate resources to provide reliable internet access, updated devices and appropriate software for classroom use. Ensuring access for all students is the key to equitable learning opportunities. Moreover, further studies should be conducted across different grade levels and

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subject areas to explore the broader effectiveness of enhanced technology learning, including long term impact on student achievement and motivation.

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