Journal of Tertiary Education and Learning (JTEL)

ISSN: 2994-4015 (ONLINE)

VOLUME 3 ISSUE 1 (2025)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Journal of Tertiary Education and Learning (JTEL)
Previous Title: Journal of Student and Education (JSE)

Volume 3 Issue 1, Year 2025
ISSN: 2994-4015 (Online)
DOI: https://doi.org/10.54536/jtel.v3i1.3276
https://journals.e-palli.com/home/index.php/jtel

Analyzing Learning Experience and Retention: The Role of Multimedia Resources in Physical Science Education

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Article Information

Received: June 07, 2024

Accepted: July 01, 2024

Published: February 18, 2025

Keywords

Retention, Multimedia, Learning Experience, Science Education, Motivation

ABSTRACT

This study aimed to analyze the learning experience and retention of physical science students with multimedia resources. This quantitative research utilized a descriptive-correlation design to assess the data collected from 133 senior high school students of Valencia City, Bukidnon, Philippines. The study's findings revealed that engagement and motivation, learning styles and preferences, and technical aspects of the learning experiences have an overall score of 4.06, which signifies that the students have a great learning experience with multimedia integration in physical science class. It also revealed that the students' retention improved with the help of multimedia resources. Additionally, it also revealed that there is a significant relationship between learning experience and retention in physical science classes aided with multimedia. Multimedia plays a significant role in enhancing the learning experience and retention of physical science concepts for students. This leads to a deeper understanding of complex physical science concepts and improved knowledge retention compared to text-based methods. As research continues to explore the optimal design and implementation of multimedia in physical science education, it holds great promise for fostering a more engaging and effective learning environment for students.

INTRODUCTION

With the rise of technology, educational tools that combine different media have become widespread. These multimedia tools improve both the quality of education and student achievement. As younger generations are already comfortable with technology, schools should leverage this by incorporating multimedia tools into classrooms to maximize their educational potential (Alzubi, 2023). By incorporating videos, animations, interactive simulations, and even virtual reality, educators can use a variety of informative formats to capture students' attention and cater to different learning styles (Kilag *et al.*, 2023).

Multimedia technologies facilitate the tailoring of learning materials to diverse learning objectives. This adaptability aligns with pedagogical principles of personalization, allowing educators to cater to students with varied learning styles and needs. Studies have shown that personalization enhances student motivation and engagement, promoting more effective learning (Gañán *et al.*, 2014).

Understanding the universe around us lies at the heart of physical science education. Traditionally, this field has relied on textbooks and lectures to impart knowledge. However, recent advancements in multimedia technologies offer a dynamic and multifaceted approach to learning. This research investigates how learning experiences with multimedia resources influence students' physical science retention.

Theoretical Framework

Constructivism explains how multimedia resources can enhance knowledge acquisition and learning experiences in physical science education. Central to constructivism is the idea that learners actively construct their knowledge by associating new information with existing cognitive structures (Driver, Russ, & Billingham, 1994). Multimedia resources can play a vital role in this process by offering learners multiple modalities for engaging with scientific concepts.

Visualizations, simulations, and animations can all serve as concrete representations of abstract physical science phenomena. This can aid learners in assimilating new information by providing connections to their prior knowledge and experiences. Furthermore, interactive multimedia resources can promote accommodation by allowing learners to manipulate variables, explore cause-and-effect relationships, and test hypotheses within a simulated environment. Through this active exploration, learners can refine their understanding of physical science concepts and build more robust mental models (Mayer, 2005). Using multimedia resources in constructivist learning environments can foster deeper understanding, critical thinking skills, and a more meaningful learning experience for students in physical science education.

Conceptual Framework

This framework examines the influence of learning experiences with multimedia resources on retention in physical science education. It proposes a reciprocal relationship between these factors. Multimedia resources (videos, animations, simulations, VR) act as multifaceted learning tools, delivering information through various modalities (visual, auditory, and kinesthetic). This engagement with multimedia can enhance students'

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motivation and cognitive processes, leading to deeper knowledge acquisition in physical science concepts. Conversely, a strong foundation in physical science principles can influence how students perceive and interact with multimedia resources, maximizing their learning potential.

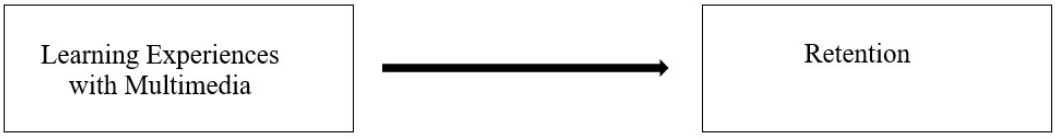

Figure 1: Relationship between learning experience and retention

Hypothesis of the Study

H_0: There is no significant relationship between the student's learning experience with multimedia resources and retention in physical science.

Objectives of the Study

This study aimed to analyze the learning experience and retention of the students in physical science. Specifically, it aimed to:

1. Assess the learning experience of the students in physical science with the aid of multimedia resources in terms of:
   a. Engagement and Motivation;
   b. Learning Style and Preference and;
   c. Technical Aspect and Usability.
2. Analyze how multimedia resources help the students' retention in physical science
3. Identify the relationship between learning experience and retention

LITERATURE REVIEW

The rise of multimedia technology is fundamentally reshaping education. This has led to a new era of learning, marked by innovative content development, diverse communication methods, and a growing emphasis on the learner's experience. While future research should ensure widespread accessibility of multimedia tools, it is crucial to utilize them strategically, capitalizing on their pedagogical strengths. Recognizing the value of diverse perspectives and methodologies, the multimedia community presents a perfect platform for educators and researchers from various backgrounds to collaborate and advance multimedia-based education, ultimately improving teaching and learning for all (Almara'beh, Amer. & Sulieman, 2015).

When coupled with effective teaching methods, multimedia technologies can be a powerful tool for attracting and motivating future educators. This translates to a higher quality of education as these future teachers will be equipped to create personalized learning environments that cater to each student's individual needs and growth. This focus on personalization, facilitated by multimedia tools, is key to a successful educational system (Tayirova, 2023). The study by Bulut (2019) revealed that while traditional teaching has its merits, multimedia-based learning appears to hold significant advantages. Studies suggest it can significantly boost academic achievement compared to traditional methods. By presenting information in engaging and interactive formats, multimedia tools can make complex topics more comprehensible and transform the learning environment into a stimulating and enjoyable space for students.

Using multimedia in education helps students improve their critical thinking skills (Saputra et.al., 2023). Multimedia resources act as a catalyst for students' critical thinking. They engage multiple learning styles and spark curiosity by delivering information through diverse channels like videos, animations, and simulations. This active engagement fosters deeper analysis and encourages students to evaluate information from various perspectives. Studies have shown that multimedia resources can improve critical thinking skills by promoting a more investigative learning approach, where students are not just passive receivers of information but active participants who question, analyze, and form their conclusions.

Multimedia technologies are a powerful force for positive change in education. By ensuring accessibility, utilizing them strategically, and fostering collaboration within the multimedia community, educators and researchers can continue to develop and refine multimedia-based learning, ultimately improving teaching and learning for all.

METHODOLOGY

This quantitative study analyzes the learning experience and retention of physical science students using multimedia resources. The study is conducted in Valencia City, Bukidnon. The data was collected from 133 senior high school students who were enrolled in Physical Science subject was collected from 133 senior high school students who were enrolled in Physical Science subjects enrolled in Physical Science. The main instruments of the study are the researcher's self-made questionnaires entitled, Learning Experience Assessment Questionnaire and Retention Assessment Questionnaire. These two instruments underwent pilot testing, which revealed their Cronbach alpha values of 0.87 and 0.85, respectively. Before the study was conducted, the researcher secured all the necessary documents and approvals. Descriptive statistics and Pearson correlation test were used as statistical method and it is done using SPSS.

Table 1: Scaling Matrix of the Research Instruments

Scale	Interval	Descriptive Rating
5	4.21 – 5.00	Strongly Agree
4	3.41 – 4.20	Agree
3	2.61 – 3.40	Not Sure
2	1.81 - 2.60	Disagree
1	1.00 – 1.80	Strongly Disagree

RESULTS AND DISCUSSION

Analysis of the Learning Experience with Multimedia Resources of the Students in Physical Science

Engagement and Motivation

Table 2 shows the result of the learning experience assessment in terms of engagement and motivation assessment. It reveals the overall mean score of 4.17 (Agree) among the following ten indicators: "Multimedia presentations in physical science make the subject more interesting to learn" (4.33); "I find myself paying closer attention during lessons that incorporate multimedia." (4.31); "Multimedia elements (videos, simulations) create a more engaging learning environment." (4.28); "Using multimedia resources motivates me to learn more about physical science concepts." (4.28); "I look forward to using multimedia tools in physical science class." (4.17); "Multimedia helps me stay focused during physical science lessons." (4.16); "I feel more motivated to participate in class discussions when multimedia is used." (4.10); "Multimedia presentations spark my curiosity about physical science topics." (4.07); "Learning physical science with multimedia feels less like a chore." (4.03); and "Overall, multimedia makes learning physical science more enjoyable." (4.00). The result implies that when using multimedia resources in physical science class, the students are engaged and motivated to learn and willing to participate. The resources themselves may be stimulating and interactive, keeping students' attention.

Table 2: Results of the Engagement and Motivation Assessment

Indicators	Mean	Descriptive Rating
Multimedia presentations in physical science make the subject more interesting to learn.	4.33	Strongly Agree
I find myself paying closer attention during lessons that incorporate multimedia.	4.31	Strongly Agree
Multimedia elements (videos, simulations) create a more engaging learning environment.	4.28	Strongly Agree
Using multimedia resources motivates me to learn more about physical science concepts.	4.28	Strongly Agree
I look forward to using multimedia tools in physical science class.	4.17	Agree
Multimedia helps me stay focused during physical science lessons.	4.16	Agree
I feel more motivated to participate in class discussions when multimedia is used.	4.10	Agree
Multimedia presentations spark my curiosity about physical science topics.	4.07	Agree
Learning physical science with multimedia feels less like a chore.	4.03	Agree
Multimedia makes learning physical science more enjoyable.	4.00	Agree
Overall Mean	**4.17**	**Agree**

The study by Yueh *et al.* (2012) revealed that students who actively engaged with multimedia resources, like reviewing videos after class, found them more helpful for learning. This aligns with existing research suggesting that a student's level of engagement directly influences their perception of how effective educational technology is. In a similar study by Brande and Arslan (2013), using multimedia with appropriate pedagogy may enhance the learning experience, especially classroom engagement and learning.

Learning Style and Preference

The table below shows the result of the learning experience assessment in terms of learning style and preference. It reveals the overall mean score of 3.95 (Agree) from the following indicators: "Multimedia caters to my preferred way of learning physical science." (4.22); "I learn best through a combination of visual and auditory information offered by multimedia." (4.16); "Multimedia resources allow me to learn at my own pace." (4.09); "The interactive nature of some multimedia tools allows me to actively participate in the learning process." (4.02); "Multimedia helps me learn independently by providing access to additional learning resources." (3.98); "I feel more comfortable asking questions about physical science after using multimedia." (3.96); "Multimedia resources cater to different learning styles (visual, auditory, kinesthetic)." (3.90); "The use of multimedia allows me to explore physical science concepts in greater depth." (3.87); "I feel more confident in my ability to

learn physical science with the help of multimedia." (3.65); and "Multimedia helps me learn physical science in a way that suits my learning style and preferences." (3.63). This implies that the students' learning styles and preferences are being catered to when using multimedia resources in physical science. Incorporating multimedia resources in physical science classrooms indicates a move towards catering to diverse student learning styles and preferences. This variety ensures something for everyone, potentially making physical science more accessible and engaging for a wider range of learners.

Table 3: Results of the Learning Style and Preference Assessment

Indicators	Mean	Descriptive Rating
Multimedia caters to my preferred way of learning physical science.	4.22	Strongly Agree
I learn best through a combination of visual and auditory information offered by multimedia.	4.16	Agree
Multimedia resources allow me to learn at my own pace.	4.09	Agree
The interactive nature of some multimedia tools allows me to actively participate in the learning process.	4.02	Agree
Multimedia helps me learn independently by providing access to additional learning resources.	3.98	Agree
I feel more comfortable asking questions about physical science after using multimedia.	3.96	Agree
Multimedia resources cater to different learning styles (visual, auditory, kinesthetic).	3.90	Agree
The use of multimedia allows me to explore physical science concepts in greater depth.	3.87	Agree
I feel more confident in my ability to learn physical science with the help of multimedia.	3.65	Agree
Multimedia helps me learn physical science in a way that suits my learning style and preferences.	3.63	Agree
Overall Mean	**3.95**	**Agree**

Differentiated instruction is crucial because it acknowledges that students learn in different ways and at varying paces. It offers a personalized approach to teaching, catering to individual needs and learning styles. The study of Alarcon, Dumagan, Lumakang, and Nuezca (2022) revealed that using online platforms to teach science improves students' attitudes toward learning. However, they also revealed that implementing differentiated instruction is very challenging, especially when hindered by the scarcity of resources.

Technical Aspect and Usability

Table 4 revealed the result of the learning experience assessment in terms of technical aspects and usability of the multimedia resources used in physical science class. The table also revealed its overall mean score of 4.05 (Agree) in the following indicators: "The multimedia resources used in class are easy to understand and navigate." (4.34); "The multimedia resources are relevant to the physical science topics being taught." (4.23); "The technical quality (sound, video) of the multimedia resources is good." (4.12); "I am able to access and use the multimedia resources without difficulty." (3.87); and "The teacher provides clear instructions on how to use the multimedia resources effectively." (3.67). The study's findings suggest that physical science teachers will likely use user-friendly multimedia resources for students. User-friendly multimedia would not be smooth and clear, and students would likely find it easy to navigate and understand the content it presents. This ease of use could contribute to the positive impact on student engagement and motivation found in the research

Table 4: Results of the Technical Aspect and Usability Assessment

Indicators	Mean	Descriptive Rating
The multimedia resources used in class are easy to understand and navigate.	4.34	Strongly Agree
The multimedia resources are relevant to the physical science topics being taught.	4.23	Strongly Agree
The technical quality (sound, video) of the multimedia resources is good.	4.12	Agree
I am able to access and use the multimedia resources without difficulty.	3.87	Agree
The teacher provides clear instructions on how to use the multimedia resources effectively.	3.67	Agree
Overall Mean	**4.05**	**Agree**

User-friendly multimedia is crucial for student success in physical science. If resources are complex or confusing to navigate, they can hinder learning instead of promoting it. Clear interfaces, intuitive controls, and explanations tailored to the appropriate age group contribute to user-friendly multimedia. These features allow students to focus on the presented scientific concepts rather than struggle with the technology. Ultimately, user-friendly multimedia empowers students to engage actively with the material, fostering a deeper understanding and a more positive learning experience in physical science. This implication is supported by the study of Alarcon *et al.* (2023). Integrating technological tools in learning must be simple and easy to understand to increase engagement and establish a connection between the student and the materials.

Summary of the Results in Learning Experience

Table 5 shows the overall results of the different dimensions of the learning experience with multimedia resources in physical science. The overall mean for the learning experience is 4.06, which means "agreeing" on engagement and motivation, learning style and preference, technical aspects, and usability. This implies that the students have a great learning experience with multimedia integration in physical science classes.

Table 5: Summary of the Results in Learning Experience

Indicators	Mean	Descriptive Rating
Engagement and Motivation	4.17	Agree
Learning Style and Preference	3.95	Agree
Technical Aspect and Usability	4.05	Agree
Overall Mean	**4.06**	**Agree**

The study of Alarcon *et al.* (2024) emphasized the importance of maintaining a high-quality learning experience. High-quality multimedia learning experiences are essential for maximizing physical science student engagement and knowledge acquisition. These resources go beyond simply presenting information; they utilize animations, simulations, and interactive features to make complex concepts visually appealing and readily understandable. This engaging format fosters a positive learning environment where students are actively involved, motivated to explore further, and better retain the information.

Analysis of the Retention of the Students in Physical Science with Multimedia Resources

Table 6 shows the understanding and knowledge retention of the students in physical science while using multimedia resources. It revealed an overall score of 4.18 (Agree) from the following indicators: "Multimedia resources (animations, simulations) help me visualize complex physical science concepts." (4.54); "I find it easier to understand physical science concepts presented with multimedia." (4.30); "Multimedia helps me connect physical science concepts to real-world applications." (4.23); "I feel more confident in my understanding of physical science topics after using multimedia resources." (4.21); "Multimedia helps me retain information from physical science lessons for a longer period." (4.16); "I am better able to explain physical science concepts to others after using multimedia." (4.12); "Multimedia resources (videos, simulations) clarify challenging physical science concepts" (4.05); "Using multimedia helps me identify important details and facts in physical science lessons." (4.01); and "I am able to apply the knowledge gained from multimedia resources to solve problems" (3.97).

The study's findings on multimedia resources suggest a positive impact on student knowledge retention in physical science. This can be attributed to several factors. Multimedia presents information in multiple formats, like visuals, narration, and interactive elements. This caters to different learning styles and reinforces understanding through various pathways. Additionally, the engaging nature of multimedia can keep students focused and interested, leading to deeper processing of the material. Furthermore, simulations and animations can visualize abstract concepts, making them more memorable and easier to recall later. Combining these elements, multimedia resources create a more effective learning environment that fosters long-term retention of complex physical science concepts.

Table 6: Result of the Retention Assessment

Indicators	Mean	Descriptive Rating
Multimedia resources (animations, simulations) help me visualize complex physical science concepts.	4.54	Strongly Agree
I find it easier to understand physical science concepts presented with multimedia.	4.30	Strongly Agree
Multimedia helps me connect physical science concepts to real-world applications.	4.23	Strongly Agree
I feel more confident in my understanding of physical science topics after using multimedia resources.	4.21	Strongly Agree

Multimedia helps me retain information from physical science lessons for a longer period.	4.16	Agree
I am better able to explain physical science concepts to others after using multimedia.	4.12	Agree
Multimedia resources (videos, simulations) clarify challenging physical science concepts	4.05	Agree
Using multimedia helps me identify important details and facts in physical science lessons.	4.01	Agree
I am able to apply the knowledge gained from multimedia resources to solve problems	3.97	Agree
Overall Mean	**4. 18**	**Agree**

The positive impact of multimedia resources on student comprehension in your study aligns with the concept of the multimedia learning theory (Moreno & Mayer, 2019). This theory suggests that presenting information through multiple channels (visual, auditory, and textual) enhances knowledge retention compared to relying solely on text. The brain can process information more efficiently when presented in a way that simultaneously activates different learning pathways (Mayer, 2014). Studies by Betts and Bachman (2018) further support this notion, demonstrating that students using multimedia resources exhibited better recall of information compared to those relying solely on traditional textbooks.

Correlation between Learning Experience and Retention

The table below shows the correlation between learning experience and retention. The correlation test revealed a significant relationship between learning experience and retention. Thus, it rejected the study's null hypothesis, which showed no significant relationship between the two variables. This implies that incorporating elements like images, videos, and interactive components into lessons can improve learners' memory and understanding of the material. Multimedia can engage multiple senses, cater to different learning styles, and create a more immersive learning environment, contributing to stronger memory encoding and easier retrieval of information later on.

Table 7: Correlation between the two variables

	p-value (p <0.05)	**Statistical Significance**	**Decision**
Learning Experience	**Retention**		
Engagement and Motivation	0.000844*	Yes	Reject H^0
Learning Style and Preference	0.000737*	Yes	Reject H^0
Technical Aspect and Usability	0.006925*	Yes	Reject H^0

A growing body of research suggests a positive correlation between multimedia learning experiences and information retention. Studies have found that incorporating various media elements, such as text, images, audio, and video, can enhance engagement, improve knowledge acquisition, and promote better knowledge retention than traditional text-based learning methods (Mayer, 2014; Sanchez & Harrington, 2014). This is likely because multimedia presentations activate different learning pathways in the brain, leading to a more comprehensive understanding of the information (Chi & Bassok, 2010).

For example, Sanchez and Harrington (2014) found that students who learned about historical events through multimedia presentations that included text, images, and audio narration demonstrated better recall of factual information than those who learned from text-only materials. Similarly, Mayer (2014) conducted a study where students learned about scientific concepts through multimedia presentations incorporating animations and narration. The results showed that students in the multimedia group performed significantly better on knowledge retention tests than those who learned from text and static images alone.

These findings highlight the potential benefits of incorporating multimedia into educational materials and instructional practices. Multimedia can promote deeper understanding and improve information retention by engaging learners through multiple senses and providing a more interactive learning experience.

CONCLUSION

In conclusion, this research suggests that multimedia significantly enhances student learning experiences and information retention within physical science. Educators can incorporate various media elements to cater to diverse learning styles, improve engagement with complex scientific concepts, and promote deeper understanding and knowledge retention. The activation of multiple learning pathways in the brain through multimedia presentations is a key factor in this positive impact. Further research is necessary to explore the most effective design principles for multimedia learning experiences in physical science, but the current evidence strongly supports its continued integration into instructional practices.

Acknowledgments

I want to thank my mother and father, Charito and Julie Alarcon, for their continuous support. Special gratitude

to my friends Kenth, Gwendy, Diether, Leslie, Ramil, Lynmar, Remy, Raffy, April and Mary Rhose for their unwavering support and understanding of my activities. To Wilfredo, thank you for being there.

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