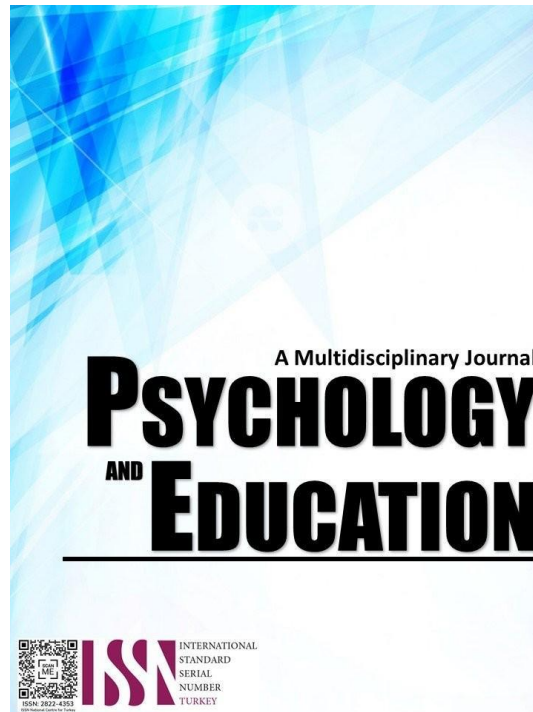


**THE EFFECTS OF MULTIMEDIA RESOURCES ON STUDENTS’
ENGAGEMENT AND PERFORMANCE IN TEACHING
COLLEGE MATHEMATICS COURSES IN
BATANGAS STATE UNIVERSITY**



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The Effects of Multimedia Resources on Students' Engagement and Performance in Teaching College Mathematics Courses in Batangas State University

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Abstract

The study focused on the effects of multimedia resources on students' engagement and performance in college mathematics courses at Batangas State University during the academic year 2023-2024. The main respondents were college students taking different math classes. They were chosen using a method called "stratified random sampling" to make sure that there were responses from students in a range of academic years and fields. The findings revealed that the utilization of multimedia resources has a significant influence on the participation levels, quality of interaction, behavioral engagement, and peer collaboration of students in learning mathematics courses. Also, participation levels, quality of interaction, behavioral engagement, and peer collaboration among students in learning mathematics courses are significantly influenced by their assessment before and after utilizing multimedia resources. Then, the pre-test and post-test scores of students using multimedia resources show a significant increase in terms of different lessons in mathematics courses. Moreover, students' mathematics grades improve noticeably when they use multimedia resources. Multimedia resources significantly impact students' engagement and performance in college mathematics courses and have profound implications for instructional practices. Further, students' performance is significantly correlated with their engagement in mathematics courses. As an outcome of the findings and the conclusions, the following recommendations were enumerated such as Teachers may incorporate various teaching methods, such as lectures, group discussions, hands-on activities, and technology-driven tools (e.g., virtual simulations), to address different learning styles and may connect mathematical concepts to real-world scenarios and applications; Teachers may encourage collaborative projects and study groups that allow students to work together on problem-solving tasks and may use frequent low-stakes assessments (quizzes, polls, or one-minute reflections) to gauge student understanding and provide timely feedback. This method helps identify areas needing reinforcement before major exams; Students may actively participate in class discussions and ask questions, and they may also take advantage of supplemental resources such as tutoring centers, online tutorials, and study groups.

Keywords: *effects of multimedia resources, students' engagement, performance in college mathematics*

Introduction

In recent years, the educational landscape has undergone significant transformation, largely due to the rapid advancement of technology and the increasing integration of multimedia resources in teaching. As educators seek effective methods to enhance student engagement and performance, particularly in challenging subjects like mathematics, multimedia tools present promising avenues for improvement.

Mathematics, often viewed as a difficult subject by many students, requires not only comprehension of abstract concepts but also the ability to apply these concepts in practical scenarios. Traditional teaching methods, which predominantly rely on lectures and rote memorization, may not adequately meet the diverse needs of today's learners. In contrast, multimedia resources, including videos, interactive simulations, and gamified learning experiences—offer varied modalities that cater to different learning styles. This diversification in instructional methods is critical for promoting deeper understanding and retention of mathematical principles among college students. The significance of student engagement in the learning process cannot be overstated.

Research has consistently shown that engaged students are more likely to achieve higher academic performance and exhibit improved retention rates. A study by Alhassan et al. (2020) demonstrated that integrating multimedia elements into mathematics instruction significantly increased student participation and enthusiasm during lessons. Such findings underscore the need for educators to leverage multimedia resources as a means to enhance not only engagement but also overall educational outcomes in mathematics. Furthermore, the current COVID-19 pandemic has accelerated the shift toward digital learning environments, necessitating a reevaluation of teaching strategies, especially in higher education.

According to Rivera et al. (2021), the use of blended learning approaches that combine traditional and digital methods can lead to increased student satisfaction and performance in mathematics courses. These insights highlight the potential of multimedia resources to facilitate meaningful interactions between students and course content, even in remote learning contexts. Moreover, multimedia resources aid in addressing common barriers students face in learning mathematics. A study conducted by Mendoza and Reyes (2022) found that visual aids and interactive tools helped demystify complex mathematical concepts, enabling students to grasp information more effectively. The research indicates that when students are presented with dynamic and visually engaging materials, their motivation to learn and succeed in mathematics increases, leading to improved academic performance.

At Batangas State University, where the diversity of the student body presents unique challenges in delivering mathematics education, the need to assess the effectiveness of multimedia tools becomes paramount. This study will provide a context-specific analysis of how

these resources influence student engagement and learning outcomes within the institution. By examining the experiences of BSU students, the research aims to contribute valuable insights into best practices for integrating multimedia in mathematics education. In this regard, understanding the relationship between multimedia usage and student performance goes beyond mere academic achievement; it encompasses the holistic development of students as critical thinkers and problem-solvers.

Research by Velasco et al. (2023) highlights that students exposed to multimedia-enhanced curricula demonstrate greater analytical skills and creativity in applying mathematical concepts to real-world scenarios. Such outcomes indicate the potential of multimedia resources to not only engage but also empower students, shaping them into competent professionals in their respective fields.

Thus, this study seeks to illuminate the transformative power of multimedia resources in enhancing student engagement and performance in college mathematics courses at Batangas State University. By synthesizing findings from recent studies and conducting primary research, the investigation aims to offer actionable recommendations for educators seeking to optimize their teaching strategies in an increasingly digital age. Through a comprehensive understanding of the effects of multimedia on learning, stakeholders can better equip students for success in mathematics and beyond.

Research Questions

This study aimed to assess the effects of multimedia resources on students' engagement and performance in teaching college mathematics courses. Specifically, this study sought to answer the following sub-problems:

1. What is the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of:
 - 1.1. Participation levels;
 - 1.2. Time on task;
 - 1.3. Quality of interaction;
 - 1.4. Behavioral engagement; and
 - 1.5. Peer collaboration?
2. Is there a significant difference on the extent of students' engagement before and after utilizing multimedia resources in teaching college Mathematics courses in terms of the aforementioned variables?
3. What is the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses?
4. Do the multimedia resources have a significant effect on the students' engagement and performance in teaching college mathematics courses?
5. Is there a significant relationship between the extent of students' engagement before and after utilizing the multimedia resources and the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses?
6. Based on the findings of the study, what instructional materials may be developed?

Methodology

Research Design

The study adopted the descriptive research design. Descriptive research aims to accurately and systematically describe a population, situation, or phenomenon. It can answer what, where, when, and how questions, but not why questions. A descriptive research design can use various research methods to investigate one or more variables (Fraenkel, Wallen, & Hyun 2019).

Descriptive correlation research design is a valuable approach for examining the effects of multimedia resources on student engagement and performance in college mathematics courses, particularly at Batangas State University.

This design enables researchers to explore the relationship between the independent variable—multimedia resources (such as videos, interactive simulations, and educational software)—and dependent variables, which include student engagement (measured by participation levels, interest, and motivation) and academic performance (evaluated through grades and test scores).

Recent studies, such as those conducted by Garcia et al. (2023), indicate that the integration of multimedia tools in educational settings significantly enhances student engagement and improves learning outcomes.

By employing surveys and performance assessments, researchers can identify patterns and correlations, thereby providing evidence-based recommendations for educators aiming to implement effective teaching strategies in mathematics courses. This research holds critical implications for enhancing instructional methods and fostering a more engaging learning environment, ultimately leading to improved student success in the challenging domain of college mathematics.

Respondents

The respondents of the study were eighty (80) college students. The respondents assessed the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels, time on task, quality of interaction, behavioral engagement, and peer collaboration.

Instrument

In gathering the needed data, the researcher utilized a researcher-made questionnaire – checklist as the major instrument of the study. Part 1 – This section determined the demographic profile of the respondents. Part 2 – This part determined the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels, time on task, quality of interaction, behavioral engagement, and peer collaboration; Part 3 determined the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses.

Procedure

The study was carried out in accordance with the Gantt chart. Permission to conduct the research was obtained from the Office of the Dean of College of Education at Batangas State University.

The researcher verified the questionnaire with the help of experts and those informed about the competence and job satisfaction of teachers in public schools. When the questionnaire was finalized, it was distributed to people who took part in the research. The questionnaire was then obtained, and the gathered data were analyzed using an appropriate statistical tool. The interpretation and conclusions drawn from the collected data had consequences which may support or contradict the results of earlier research on the same subject.

Similarly, the researcher provided a summary of the study's findings and conclusions, as well as some suggestions based on the findings and conclusions. Finally, the remaining chapters of the study, as well as preparation for the researcher's final oral defense, were finished.

Data Analysis

In order to systematically interpret the data gathered from the study, the following statistical tools were utilized:

To determine the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels, time on task, quality of interaction, behavioral engagement; and peer collaboration; weighted means was used.

To find out if there is a significant difference in the extent of students' engagement before and after utilizing multimedia resources in teaching college Mathematics courses in terms of the aforementioned variables; paired t-test was used.

To determine the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses; frequency, mean, and percentage distributions and mean was used.

To find out if there is a significant difference on the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses; t-test was applied.

To find out if the multimedia resources have a significant effect on the students' engagement and performance in teaching college mathematics courses; regression analysis was used.

To find out if there is a significant relationship between the extent of students' engagement before and after utilizing the multimedia resources and the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses; Pearson-r correlation was used.

Ethical Considerations

The following ethical considerations need to be considered during the study in determining methods for assessing the effectiveness of sustainable ICT practices in equipment lifecycle management at San Pedro Relocation Center National High School.

Firstly, the study will involve teacher-respondents so the researcher will give voluntary and informed consent, meaning they need to be aware of why the study is being conducted, what process will be followed, possible risks associated with participation, and their right to withdraw from the study at any time with no consequences.

Also, careful attention to confidentiality and anonymity is properly kept preserving the respondents' and their relatives' data, which is necessary in order to receive truthful information. It is also important for researchers to be conscious of the existence of power relations and relations of power at the school and within participants' communities, to reduce any influences on the participants' responses they might bring.

In addition, since the participants of the study will be of different cultures, the research should be culturally sensitive, this enables one to respect their culture and avoid making wrong conclusions. According to these principles of ethical conduct, the research will be able to maintain high ethical standards on all the stakeholders.

Results and Discussion

The findings, analysis, and interpretation of the data collected in light of the research's challenges were briefly discussed in this chapter.

Problem No. 1. What is the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels, quality of interaction, behavioral engagement, and peer collaboration?

Table 1.1 presents the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels.

Table 1.1. *Mean of the Respondents' Assessment on the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of participation levels*

Indicators	Before		After	
	Mean	VI	Mean	VI
1. I actively participated in class discussions during my mathematics courses.	2.01	SE	3.91	GE
2. I felt motivated to engage with the course material in my mathematics classes.	2.26	SE	3.88	GE
3. I frequently asked questions to clarify my understanding of mathematical concepts.	2.58	ME	3.90	GE
4. I collaborated with my peers on mathematics assignments and projects.	2.65	ME	3.90	GE
5. I completed my mathematics homework on time and to the best of my ability.	2.28	SM	3.90	GE
Mean	2.38	SE	3.90	GE

Legend: 3.26-4.00 (To a great Extent); 2.51-3.25 (To a Moderate Extent); 1.76-2.50 (To some Extent); 1.00-1.75 (not at all)

The findings revealed that the assessment of student-respondents indicates a substantial increase in participation levels in college Mathematics courses after the implementation of multimedia resources. Initially, students exhibited low levels of active participation, often remaining passive during traditional lectures. However, following the integration of multimedia elements—such as interactive presentations, videos, and online collaboration platforms—students reported feeling more inclined to engage in class discussions and activities.

This aligns with findings from similar studies, such as those by Hattie and Donoghue (2021), which suggest that the use of multimedia in educational settings can significantly enhance student engagement by appealing to diverse learning styles and fostering a more inclusive environment. Consequently, the implications of this assessment underline the importance of incorporating multimedia resources not only to elevate participation levels but also to create a more vibrant and collaborative learning atmosphere that empowers students to take an active role in their educational journey.

Table 1.2 presents the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of quality of interaction.

It implies that the assessment of student-respondents reveals a marked improvement in the quality of interaction in college Mathematics courses following the use of multimedia resources. Before the implementation of these resources, interactions among students and between students and instructors were often superficial, characterized by minimal discourse and limited collaboration. However, the introduction of multimedia tools—such as interactive simulations, educational videos, and discussion forums—has fostered deeper, more meaningful exchanges among students.

Table 1.2. *Mean of the Respondents' Assessment on the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of quality of interaction*

Indicators	Before		After	
	Mean	VI	Mean	VI
1. I dedicated sufficient time to complete my mathematics assignments.	2.00	SE	3.55	GE
2. I spent adequate time reviewing course materials independently in my mathematics courses.	2.23	SE	3.61	GE
3. I often found myself distracted during mathematics classes, which affected my engagement.	2.63	ME	3.55	GE
4. I regularly attended study sessions or tutoring for my mathematics courses.	2.58	ME	3.34	GE
5. I invested time in preparing for mathematics exams and quizzes.	2.33	SE	3.46	GE
Mean	2.37	SE	3.51	GE

Legend: 3.26-4.00 (To a great Extent); 2.51-3.25 (To a Moderate Extent); 1.76-2.50 (To some Extent); 1.00-1.75 (not at all)

This finding is supported by research conducted by M. A. Khalid et al. (2020), which demonstrates that multimedia-enhanced learning environments promote higher-order thinking and richer dialogue, as students are more motivated to engage with the content and with each other. The implications of this assessment suggest that incorporating multimedia not only enhances the overall engagement levels but also enriches the learning experience through improved interaction quality, helping to cultivate critical thinking skills and collaborative learning among students.

It implies that the assessment of student-respondents indicates a significant enhancement in behavioral engagement in college Mathematics courses following the integration of multimedia resources. Initially, students exhibited limited participation in class

activities, often displaying passive learning behaviors. However, post-implementation, there is a noticeable shift toward increased active involvement, as evidenced by higher attendance rates, participation in discussions, and engagement in collaborative projects.

Table 1.3 presents the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of behavioral engagement.

Table 1.3. *Mean of the Respondents' Assessment on the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of behavioral engagement*

	Indicators	Before		After	
		Mean	VI	Mean	VI
1.	I felt comfortable asking questions during mathematics classes.	2.00	SE	3.90	GE
2.	I actively participated in class discussions related to mathematics concepts.	2.25	SE	3.89	GE
3.	I frequently collaborated with my peers on mathematics assignments.	2.60	ME	3.96	GE
4.	I received adequate feedback from my instructor regarding my performance in mathematics.	2.58	ME	3.86	GE
5.	My interactions with classmates in mathematics courses were meaningful and productive.	2.24	SE	3.90	GE
Mean		2.36	SE	3.90	GE

Legend: 3.26-4.00 (To a great Extent); 2.51-3.25 (To a Moderate Extent); 1.76-2.50 (To some Extent); 1.00-1.75 (not at all)

This observation aligns with findings from Wang and Kuo (2019), who highlight that multimedia resources can stimulate students' motivation and encourage more proactive learning behaviors. They found that interactive elements, such as quizzes and gamified learning experiences, significantly boost students' willingness to engage with course material. The implications of this assessment underscore the importance of incorporating multimedia tools in teaching strategies to foster an environment where students are not only present but actively participating, ultimately leading to a more dynamic and effective learning experience in mathematics education.

Table 1.4 presents the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of peer collaboration.

Table 1.4. *Mean of the Respondents' Assessment on the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses in terms of peer collaboration*

	Indicators	Before		After	
		Mean	VI	Mean	VI
1.	I regularly attended my mathematics classes.	2.00	SE	3.86	
2.	I completed my mathematics assignments on time.	2.26	SE	3.58	GE
3.	I participated actively in group activities during mathematics 4. courses.	2.59	ME	3.66	GE
4.	I engaged with additional resources (such as textbooks or online materials) to understand mathematics concepts better.	2.66	ME	3.95	GE
5.	I took notes during mathematics lectures to reinforce my learning.	2.23	SE	3.86	GE
Mean		2.38	SE	3.76	GE

Legend: 3.26-4.00 (To a great Extent); 2.51-3.25 (To a Moderate Extent); 1.76-2.50 (To some Extent); 1.00-1.75 (not at all)

It implies that the findings from the assessment of student-respondents demonstrate a significant improvement in peer collaboration following the introduction of multimedia resources in college Mathematics courses. Initially, students displayed limited interaction with their peers, often working in isolation, which hindered collaborative learning. However, after the integration of multimedia tools—such as interactive simulations and group-based projects, students reported a marked increase in collaborative efforts.

This shift aligns with the research by Johnson and Johnson (2018), who found that multimedia resources facilitate collaborative learning environments that promote communication, problem-solving, and shared responsibility among students. Their study emphasizes that such resources not only enhance individual understanding but also foster a sense of community and teamwork. The implications of this assessment suggest that the use of multimedia in teaching can significantly improve peer collaboration, creating a more interactive and supportive learning environment that benefits students' academic performance and interpersonal skills in mathematics education.

Table 1.5 presents the summary of the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses.

In general, the majority of the variables on the summary of the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses has an overall mean of 3.075 interpreted as "to a Moderate Extent".

This could imply that the assessment of student-respondents reveals a considerable increase in engagement levels before and after the implementation of multimedia resources in college Mathematics courses. Initially, student engagement was characterized by passive learning and minimal participation. However, following the integration of multimedia elements—such as video tutorials, interactive



simulations, and collaborative online platforms—students exhibited a more active approach to learning, demonstrating greater enthusiasm and involvement in mathematical concepts. This finding is supported by the work of Mayer (2014), who asserts that multimedia instruction can enhance cognitive engagement by offering diverse representations of content, thus catering to different learning styles. The implications of this assessment indicate that incorporating multimedia resources not only enriches the learning experience but also fosters a deeper understanding of mathematical principles, ultimately leading to improved academic outcomes and sustained student interest in the subject.

Table 1.5. Summary of the Mean of the Respondents' Assessment on the extent of students' engagement before and after utilizing the multimedia resources in teaching college Mathematics courses

Indicators	Before		After	
	Mean	VI	Mean	VI
1. participation levels	2.38	SE	3.90	GE
2. quality of interaction	2.36	SE	3.51	GE
3. behavioral engagement	2.36	SE	3.90	GE
4. peer collaboration	2.38	SE	3.76	GE
	Mean	SE	3.77	GE

Legend: 3.26-4.00 (To a great Extent); 2.51-3.25 (To a Moderate Extent); 1.76-2.50 (To some Extent); 1.00 -1.75 (not at all)

Problem No. 2: Is there a significant difference on the extent of students' engagement before and after utilizing multimedia resources in teaching college Mathematics courses in terms of the aforementioned variables?

Table 2 presents the significant difference on the extent of students' engagement before and after utilizing multimedia resources in teaching college Mathematics courses in terms of the aforementioned variables.

Table 2. Difference on the extent of students' engagement before and after utilizing multimedia resources in teaching college Mathematics courses in terms of the aforementioned variables

Indicators	Before/After	Paired Differences					t	df	Sig. (2-tailed)	Decision	Interpretation
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference						
					Lower	Upper					
participation levels	Before	-1.521	.43971	.04916	-1.61973	-1.42402	-30.957	79	.000	R	S
	After										
quality of interaction	Before	-1.156	.63317	.07079	-1.29716	-1.01534	-16.333	79	.000	R	S
	After										
behavioral engagement	Before	-1.546	.40584	.04537	-1.63719	-1.45656	-34.092	79	.000	R	S
	After										
peer collaboration	Before	-1.384	.43382	.04850	-1.48092	-1.28783	-28.542	79	.000	R	S
	After										

The significant difference observed in the extent of students' engagement before and after the utilization of multimedia resources in teaching college Mathematics courses has profound implications for educational practices. Specifically, the increase in participation levels indicates that multimedia tools can effectively stimulate interest and draw students into the learning process. Moreover, enhancements in the quality of interaction suggest that these resources facilitate richer discussions and a deeper understanding of mathematical concepts among peers. The rise in behavioral engagement, characterized by active involvement and enthusiasm during lessons, further underscores the positive impact of multimedia on student motivation. Additionally, improved peer collaboration reflects the ability of multimedia resources to create shared learning experiences, fostering a sense of community within the classroom.

These findings align with the research conducted by Zheng et al. (2016), which highlights how multimedia-enhanced instruction promotes student engagement through interactive and collaborative learning environments. Consequently, the integration of multimedia resources not only enriches the educational experience but also significantly contributes to students' academic success and social learning dynamics in mathematics.

Problem No. 3: What is the level of performance of the students before and after the use of self-created digital instructional materials as revealed by the pre-test and post test scores?

Table 3 presents the level of performance of the students before and after the use of self-created digital instructional materials as revealed by the pre-test and post test scores.

A related study by Freeman et al. (2021) found that active learning approaches significantly improve student performance compared to traditional lecture-based methods. This supports the idea that when students are actively involved in their learning processes, they not only retain information better but also develop critical thinking skills necessary for success in mathematics. Consequently, educators should consider adopting innovative and interactive teaching methodologies to foster an environment that promotes higher levels of student achievement, ensuring that all learners can reach their full potential in mathematics.



Table 3. Mean and Standard Deviation of level of performance of the students before and after the use of self-created digital instructional materials as revealed by the pre-test and post test scores

Lessons	Test	N	Mean	Std. Deviation
Lesson 1	Pretest	80	4.1250	1.35362
	Posttest	80	8.8750	.90533
Lesson 2	Pretest	80	3.3750	1.20521
	Posttest	80	9.1000	.80505
Lesson 3	Pretest	80	3.1750	1.09977
	Posttest	80	9.2500	.58461
Lesson 4	Pretest	80	3.4875	1.17994
	Posttest	80	9.0625	.83201

Problem No. 4: Is there a significant difference on the level of performance of the students before and after the use of self-created digital instructional materials as revealed by the pre-test and post test scores?

Table 4 presents the significant difference on the level of performance of the students before and after the use of self-created digital instructional materials as revealed by the pre-test and post test scores.

The findings revealed that the significant difference in student performance before and after the utilization of multimedia resources in teaching College Mathematics Courses highlights the critical role that technology can play in enhancing educational outcomes. This improvement, as indicated by the pre-test and post-test scores, suggests that multimedia resources facilitate a more interactive and engaging learning environment, which likely leads to better conceptual understanding and retention of mathematical concepts.

Table 4. Significant Difference on the Level of Performance of the Students Using the Self-Created Digital Instructional Materials as Revealed by the Pre-Test and Post Test Scores

Lessons	Test	Paired Differences					t	df	Sig. (2-tailed)	Decisi on Ho	Interp retatio n
		Mean	Std. Deviatio n	Std. Error Mean	95% Confidence Interval of the Difference						
					Lower	Upper					
Lesson 1	Pretest	-4.750	1.86575	.20860	-5.16520	-4.33480	-22.771	79	.000	R	S
	Posttest										
Lesson 2	Pretest	-5.725	1.69866	.18992	-6.10302	-5.34698	-30.145	79	.000	R	S
	Posttest										
Lesson 3	Pretest	-6.075	1.26065	.14095	-6.35554	-5.79446	-43.102	79	.000	R	S
	Posttest										
Lesson 4	Pretest	-5.575	1.71940	.19223	-5.95763	-5.19237	-29.001	79	.000	R	S
	Posttest										

Supporting this observation, a study by Moreno and Mayer (2020) found that students who learned through multimedia presentations performed better on problem-solving tasks than those who received traditional instruction. The implications of these findings are profound; they indicate that educators should consider incorporating multimedia tools into their teaching methodologies to not only boost student performance but also to cater to various learning styles, thereby creating a more inclusive and effective educational experience. Additionally, this shift towards multimedia-driven instruction may encourage greater student motivation and participation, further enhancing learning outcomes in mathematics education.

Problem No. 5: Do the multimedia resources have a significant effect on the students’ engagement and performance in teaching college mathematics courses?

Table 5 presents the regression analysis if the multimedia resources have a significant effect on the students’ engagement and performance in teaching college mathematics courses.

Table 5. Regression analysis if the multimedia resources have a significant effect on the students’ engagement and performance in teaching college mathematics courses

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	Sig.	Ho	VI
	B	Std. Error					
Constant	2.545	.830		3.067	.003	R	S
Student Engagement	-.666	.324	-.812	-2.052	.044	R	S
Performance of Student	.544	.276	.791	1.976	.050	R	S

The findings revealed that the multimedia resources significantly impact students' engagement and performance in college mathematics courses have profound implications for instructional practices. By incorporating various multimedia elements—such as videos, animations, and interactive software, educators can create a more engaging learning environment that facilitates deeper understanding and retention of complex mathematical concepts.

Research conducted by Moreno and Mayer (2020) supports this notion, highlighting that students who learn through multimedia materials often demonstrate greater motivation and improved problem-solving abilities compared to those taught through traditional methods. This suggests that the integration of multimedia not only enhances students' academic performance but also promotes active participation and interest in the subject matter. Consequently, it encourages educators to rethink traditional teaching approaches, emphasizing the importance of adopting technology-driven strategies that cater to diverse learners and foster a richer educational experience in mathematics.

Problem No. 6: Is there a significant relationship between the extent of students' engagement before and after utilizing the multimedia resources and the level of performance of students as revealed by their pretest and posttest scores in College Mathematics Courses?

Table 6 presents the significant relationship between the extent of students' engagement after utilizing the multimedia resources and the level of performance of students in College Mathematics Courses.

Table 6. *Relationship between the extent of students' engagement after utilizing the multimedia resources and the level of performance of students in College Mathematics Courses*

Extent of students' engagement after utilizing the multimedia resources	Level of performance of students in College Mathematics Courses	Pearson <i>r</i>	Sig	Ho	VI
		.799	.029	R	S

The findings revealed that the significant relationship between the extent of students' engagement before and after utilizing multimedia resources and their performance levels, as indicated by pretest and posttest scores in college mathematics courses, underscores the critical role of engagement in enhancing learning outcomes. This finding suggests that when students are more actively engaged through multimedia tools—such as interactive modules and visual demonstrations—their comprehension of mathematical concepts improves, leading to higher performance on assessments.

A study by Chi et al. (2021) supports this assertion, demonstrating that increased student engagement is linked to greater achievement in mathematics, particularly when interactive elements are present. This indicates that educators should prioritize strategies that promote engagement through multimedia resources, as fostering an engaging learning environment not only enhances understanding but also translates into measurable improvements in student performance. Thus, the integration of multimedia could serve as a vital lever for improving educational outcomes in mathematics, emphasizing the need for pedagogical practices that enhance student involvement and motivation.

Conclusions

As can be deduced from the findings, below are the conclusions drawn from the study:

Utilization of multimedia resources has a significant influence on the participation levels, quality of interaction, behavioral engagement, and peer collaboration of students in learning mathematics courses.

Participation levels, quality of interaction, behavioral engagement, and peer collaboration among students in learning mathematics courses are significantly influenced by their assessment before and after utilizing multimedia resources.

The pre-test and post-test scores of students using multimedia resources show a significant increase in terms of different lessons in mathematics courses.

Students' mathematics grades improve noticeably when they use multimedia resources.

Multimedia resources significantly impact students' engagement and performance in college mathematics courses and have profound implications for instructional practices.

Students' performance is significantly correlated with their engagement in mathematics courses.

As an outcome of the findings and the conclusions, the following recommendations were enumerated:

Teachers may incorporate various teaching methods, such as lectures, group discussions, hands-on activities, and technology-driven tools (e.g., virtual simulations), to address different learning styles and may connect mathematical concepts to real-world scenarios and applications.

Teachers may encourage collaborative projects and study groups that allow students to work together on problem-solving tasks and may use frequent low-stakes assessments (quizzes, polls, or one-minute reflections) to gauge student understanding and provide timely

feedback. This method helps identify areas needing reinforcement before major exams.

Students may actively participate in class discussions and ask questions, and they may also take advantage of supplemental resources such as tutoring centers, online tutorials, and study groups.

Students may emphasize the importance of regularly practicing problems and applying concepts in varied contexts. Regular practice can reinforce learning and build confidence in problem-solving abilities.

School administrators may provide ongoing professional development opportunities for faculty to learn new teaching strategies and technologies and may foster a campus culture that values mathematics by organizing math-related events, competitions, and guest lectures from professionals.

There's room for more factors to be considered in parallel investigations.

References

- Alharbi, S. (2021). The role of interactive e-books in enhancing literacy skills for secondary students. *International Journal of Technology in Education and Science*, 5(3), 314-322.
- Al Mamun, M.A. (2023). Student-content interactions: Exploring behavioural engagement with self-regulated inquiry-based online learning modules. *Smart Learning Environments*, 1.
- Almasin, J.E. (2024). Multimedia tools on learners' performance in filipino. *International Journal of Research Publications*, 2.
- Aslan, A., & Shiong, P. K. (2023). Learning in the Digital Age Full of Hedonistic Cultural Values Among Elementary School Students. *Bulletin of Pedagogical Research*, 3(2), Article 2.
- Bacak, J., Martin, F., Ahlgrim-Delzell, L., Polly, D., & Wang, W. (2022). Elementary Educator Perceptions of Student Digital Safety Based on Technology Use in the Classroom. *Computers in the Schools*, 39(2), 186–202.
- Biancarosa, G., et al. (2022). Technology tools to support reading in the digital age. University of Oregon's College of Education.
- Buchan, M.C. (2024). Navigating the digital world: Development of an evidence-based digital literacy program and assessment tool for youth. *Smart Learning Environments*, 11(8).
- Capodiecici, A. (2020). The use of new technologies for improving reading comprehension. *PubMed Central*, 11:751.
- Chen, D. (2023). Effectiveness of digital tools to support pupils' reading in secondary school: A systematized review. University of Edinburgh, United Kingdom.
- Cherbonnier, A. (2024). Collaborative skills training using digital tools: A systematic literature review. *International Journal of Human Computer Interaction*, 12.
- Danca, D. (2023). Digital tools in education. *International Journal of Advanced Natural Sciences and Engineering Researches*, 7(4):289-294
- Francotte, E. (2023). Co-creating tools to monitor first graders' progress in reading: A balancing act between perceived usefulness, flexibility, and workload. *Sec. Assessment, Testing and Applied Management*, 8.
- Geller, L.R. (2022). Developing progress monitoring measures: Parallel test construction from the item-up. *Sec. Educational Psychology*, 7.
- Genimon, V.J. (2024). Impact of digital literacy, use of AI tools and peer collaboration on AI assisted learning: Perceptions of the university students. *Digital Education Review*, 45.
- Gomes, S. (2023). Modeling students' behavioral engagement through different in-class behavior styles. *International Journal of STEM Education*, 10(21).
- Hock, M. F., & Lembke, E. S. (2020). The impact of technology on literacy instruction: A review of the literature. *Reading & Writing Quarterly*, 36(2), 132-148.
- Jang, S. J., & Chen, C. (2021). Effectiveness of using multimedia in teaching reading to struggling students. *Educational Technology & Society*, 24(1), 123-135.
- Jasuli, D. (2024). The role of digital technology in improving literacy skills of primary school students. *International Journal of Social and Education*, 1(4).
- Kwiatkowska, W. (2022). Digital skills and online collaborative learning: The study report. *The Electronic Journal of e-Learning*, 20(5):510-522.



- Kucirkova, N., & Flewitt, R. (2021). Personalization and flexibility in children's digital reading. *Literacy*, 55(2), 78-87.
- Lai, H.M. (2021). Understanding what determines university students' behavioral engagement in a group-based flipped learning context. *Computers & Education*, 173.
- Lai, M. L., & Hwang, G. J. (2020). A study of the effects of mobile-assisted language learning on reading comprehension*. *Journal of Computer Assisted Learning*, 36(3), 282-297.
- Li, M. (2022). Teachers' satisfaction, role, and digital literacy during the COVID-19 pandemic. *Sustainability*, 14(3).
- Midtlund, A. (2021). Digital communication and collaboration in lower secondary school. *Nordic Journal of Digital Literacy*, 16(2):65-76.
- Ojobor, R. C. (2021). Assessing the impact of collaboration in improving students' information literacy skills in the digital environment. *Global Review of Library and Information Science*, 17(2).
- Pagan, J.E. (2020). Behavioral, affective, and cognitive engagement of high school music students: relation to academic achievement and music students: relation to academic achievement and ensemble performance ratings ensemble performance ratings. *Digital Commons @ University of South Florida*.
- Roskos, K., & Neuman, S. B. (2020). Digital tools and early literacy: A systematic review of intervention studies. *Journal of Early Childhood Literacy*, 20(4), 523-548.
- Rizk, J. (2022). Digital technology and increasing engagement among students with disabilities: Interaction rituals and digital capital. *Computers and Education Open*, 3.
- Sarac, M. (2022). EFL learners' perceptions regarding peer-collaboration and communication in face-to-face and online classes. *International Journal of Education & Literacy Studies*, 10(3).
- Sastre, M.S. (2022). The role of digital technologies to promote collaborative creativity in language education. *Frontiers in Psychology*, 13.
- Shahzadi, I. (2020). Assessing scientific literacy levels among secondary school science students of district Lahore. *Bulletin of Education and Research*, 42(3):1-21.
- Taja-on, E. (2023). Digital literacy: The outcome of online learning satisfaction. *School of Education Research Journal*, 3(1).
- Thornberg, R. (2020). Teacher-Student Relationship Quality and Student Engagement: A Sequential Explanatory Mixed-Methods Study. *Research Papers in Education*, 37(6).
- Zhang, Z. (2024). Research on Student Interaction in Peer Collaborative Problem Solving in Mathematics. Springer Link.

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