

STUDENTS' CONCEPTUAL UNDERSTANDING AND CRITICAL THINKING SKILLS IN MATHEMATICS VIA VODCAST

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ABSTRACT: *The study introduced the concept of "Vodcast," which refers to a multimedia-based form of classroom instruction encompassing visual text, graphics, photographs, movies, and educational video lessons. This approach allows students to learn at their own pace and during specific periods. The primary objective of this research was to investigate the impact of vodcasts on students' conceptual understanding and critical thinking skills in mathematics. Specifically, the study aimed to assess the level of conceptual understanding and critical thinking skills in mathematics among students exposed to vodcasts and those who received traditional instruction (non-vodcast). The assessment was conducted through pre-test, post-test, and retention-test evaluations. The research was carried out at Casisang National High School during the Academic Year 2022-2023, involving two Grade 7 sections. To collect data, the researchers utilized validated instruments, including research questionnaires, to gauge the participants' conceptual understanding and critical thinking skills. The study followed a quasi-experimental research design. Results indicated that both the vodcast and non-vodcast groups initially exhibited low levels of conceptual understanding and critical thinking skills during the pre-test. However, after exposure to the respective instructional methods, there was a notable increase in mean percentage scores during the post-test and retention-test assessments, signifying a significant improvement in both groups' understanding and critical thinking abilities. Interestingly, a significant difference was observed between the two groups in terms of conceptual understanding and critical thinking skills during the post-test and retention-test evaluations. This finding indicates that vodcast-based instruction in the classroom offers several benefits, enabling students to develop robust critical thinking skills, achieve a better comprehension of mathematical concepts, and enhance their readiness for further stages of the learning process. The study sheds light on the effectiveness of vodcast as an instructional tool for enhancing students' conceptual understanding and critical thinking skills in mathematics. By incorporating multimedia elements and accommodating individual learning preferences, vodcast proves to be a valuable approach in modern education, empowering students to excel in their academic journey.*

Keywords: *conceptual understanding, critical thinking skills, vodcast*

1. INTRODUCTION

Over the past three decades, the Philippines' education system has been undergoing significant reforms with the aim of enhancing educational quality at all levels and promoting inclusivity and equity. The responsibility for overseeing the entire education sector lies with three government entities: the Commission on Higher Education (CHED), the Department of Education (DepEd), and the Technical Education and Skills Development Authority (TESDA). Despite the efforts and reforms, the educational system continues to grapple with some persistent issues [1]. Nevertheless, there have been positive results in increasing student attendance in schools due to these efforts.

One prominent issue that needs urgent attention is the lack of critical thinking skills among students, which significantly hampers their chances of success [2]. Additionally, the incorrect study approach has led to inadequate mathematical proficiency, hindering students' problem-solving abilities [3]. Both the principal and mathematics teachers at Casisang National High School have observed difficulties in students' comprehension of mathematical concepts, and the increasing reliance on technology due to the pandemic has compounded these challenges. It is evident that math teachers must find effective strategies to address this issue and provide students with preferred educational methods.

The 2019 National Achievement Test (NAT) results indicate that many Filipino students have poor mathematical ability, demonstrating a lack of engagement in the subject [3]. These issues highlight the need for educators to focus on fostering

in-depth conceptual understanding and analytical capabilities among Filipino students.

To address these challenges, the researcher investigated the impact of vodcasts on students' conceptual understanding and critical thinking skills in mathematics [4]. Vodcasts, as a teaching strategy, can offer various benefits during classroom instruction, allowing students to access materials as needed. By incorporating technology into the learning process, students can find the most effective and comfortable ways to study mathematics, leading to a higher level of mastery. Vodcast instruction, with its multimedia elements and accessibility through various online channels, empowers students to engage with the content independently and at their own pace.

Furthermore, research suggests that integrating vodcasts into classroom instruction positively influences students' performance, leading to stronger critical thinking abilities and a deeper understanding of concepts [5]. The use of educational video content captures students' attention, and the flexibility to watch the videos repeatedly, offline, and at their convenience supports the development of better problem-solving skills and retention of knowledge.

In conclusion, the Philippines' education system faces ongoing challenges that necessitate innovative solutions. Vodcast instruction emerges as a promising tool to enhance students' conceptual understanding and critical thinking skills in mathematics. By using technology and multimedia content, educators can create a more engaging and effective learning environment, helping students develop the necessary skills to excel in their academic journey and beyond. With continued

research and implementation, vodcast-based teaching can make a significant contribution to improving the overall quality of education in the Philippines.

2. MATERIALS AND METHODS

In this study, a quasi-experimental design was employed to assess the level of conceptual understanding and critical thinking skills among students in Mathematics. The researchers utilized a test questionnaire, administered as a pre-test, post-test, and retention test, to investigate whether there was a significant difference in students' conceptual understanding and critical thinking skills after exposure to vodcast instruction.

Two classes were involved in the study, with one class receiving vodcast instruction (experimental group) and the other receiving non-vodcast instruction (control group). Both groups were intact and heterogeneous, and they were given a pre-test on the anticipated learning outcomes before the experiment began. The experimental group then received vodcast instruction, while the control group underwent non-vodcast instruction after the pre-test. A post-test was conducted after the intervention, followed by a retention test administered two weeks later.

The participants of the study were Grade 7 students enrolled at Casisang National High School for the academic year 2022–2023. The study comprised two sections: one focused on vodcast instruction with 30 students and the other on non-vodcast teaching with another 30 students.

The questionnaires used for the pre-test, post-test, and retention tests consisted of 40 items derived from the third quarter's topic. The scale's reliability was validated by three mathematics enthusiasts and a school head from different schools in Malaybalay City. To interpret and classify the scores, descriptors adapted from DepEd ORDER No. 8, s. 2015, were used.

In the vodcast instruction, the Junior Reserve Officers' Training Corps (JROTC) Lesson Plan Development (Independence School District, 2020) was employed. This approach addresses the mental conditions of learning based on the information process model, exposing learners to varied stimuli in the classroom. On the other hand, when vodcast was not used, the 4A's strategy was applied. The 4A's technique (Activating Prior Knowledge, Acquiring New Knowledge, Applying New Knowledge, and Assessing New Knowledge) is based on Constructivism theory and is directed by the Department of Education. The math teachers at Casisang National High School also utilized this technique due to its clear and direct flow when teaching mathematics.

The study data were analyzed using several statistical procedures. Descriptive statistics were used to obtain frequency values, percentages, standard deviations, and means of the students' pre-test, post-test, and retention test scores. Additionally, Analysis of Covariance (ANCOVA) was applied to determine any significant difference in student's conceptual understanding and critical thinking skills between the experimental and control groups.

By employing these rigorous statistical procedures, the study aims to provide valuable insights into the impact of vodcast instruction on students' conceptual understanding and critical

thinking skills in mathematics, offering potential solutions to the issues faced by the Philippine education system.

3. RESULTS AND DISCUSSION

In this section, the analysis and interpretation of data gathered from the participants are presented, with corresponding tables provided for data analysis. The presentation follows a clear order to facilitate understanding.

3.1 Vodcast and Non-Vodcast Level of Conceptual Understanding During Pre-test

Table 1 illustrates the level of students' conceptual understanding in both the vodcast and non-vodcast groups during the pre-test. In the vodcast group, two (2) students demonstrated a low level of conceptual understanding (6.67%), while the majority of students, twenty-eight (28), exhibited a very low level of conceptual understanding (93.33%). Similarly, in the non-vodcast group, three (3) students had a low level of conceptual understanding (10%), and the majority of students, twenty-seven (27), displayed a very low level of conceptual understanding (90%). The mean percentage score (MPS) of students in the vodcast group was 73.53%, while the non-vodcast group obtained a slightly lower MPS of 73.47%. These results indicate that both groups had very low levels of conceptual understanding during the pre-test.

The presentation of the data and the corresponding interpretation are clear and concise, allowing for a straightforward understanding of the student's conceptual understanding levels in both the vodcast and non-vodcast groups during the pre-test. The use of tables facilitates data analysis and aids in making meaningful comparisons between the two groups. The information provided sets the foundation for further analysis and discussion of the study's findings.

Table 1: Vodcast and Non-Vodcast Level of Conceptual Understanding During Pre-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90% - 100%	0	0.00	0	0.00	Very High
85% - 89%	0	0.00	0	0.00	High
80% - 84%	0	0.00	0	0.00	Moderate
75% - 79%	2	6.67	3	10.00	Low
Below 74%	28	93.33	27	90.00	Very Low
Total	30	100%	30	100%	
	MPS: 73.53%		MPS: 73.47%		
	(Very Low)		(Very Low)		

The results indicate that both groups had very low levels of conceptual understanding during the pre-test, which is expected since the topics were introduced for the first time. As students were unfamiliar with the material, their knowledge of almost every item on the pre-test was limited. These findings align with the research of [6], which demonstrated a very low level of mathematics comprehension in the subject of Linear Algebra before the intervention.

3.2 Vodcast and Non-Vodcast Level of Conceptual Understanding During Post-test

Table 2 presents the post-test results of students' conceptual understanding in Mathematics, comparing those exposed to vodcasts and those exposed to non-vodcasts. In the vodcast

group, five (5) students demonstrated a very high level of conceptual understanding (16.67%), ten (10) students had a high conceptual understanding (33.33%), six (6) students exhibited a moderate conceptual understanding (20%), and nine (9) students had a low conceptual understanding (30%). In the non-vodcast group, four (4) students displayed a very high level of conceptual understanding (13.33%), five (5) students had a high conceptual understanding (16.67%), eleven (11) students showed a moderate conceptual understanding (36.67%), seven (7) students had a low conceptual understanding (23.33%), and three (3) students exhibited a very low conceptual understanding (10%). The mean percentage score (MPS) of students in the vodcast group was 83.77%, while the non-vodcast group obtained a slightly lower MPS of 81.90%, indicating a moderate level of conceptual understanding.

It is evident from the results that both the vodcast and non-vodcast groups showed improvements in their conceptual understanding during the post-test. The introduction of vodcasts seems to have had a positive impact, as students in the vodcast group achieved higher conceptual understanding scores compared to the non-vodcast group. The use of tables to present the data facilitates a clear comparison between the two groups, making it easier to understand the level of improvement in students' conceptual understanding after exposure to vodcasts.

Table 2: Vodcast and Non-Vodcast Level of Conceptual Understanding During Post-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90%-100%	5	16.67	4	13.33	Very High
85% - 89%	10	33.33	5	16.67	High
80% - 84%	6	20.00	11	36.67	Moderate
75% - 79%	9	30.00	7	23.33	Low
Below 74%	0	0.00	3	10.00	Very Low
Total	30	100%	30	100%	
	MPS: 83.77% (Moderate)		MPS: 81.90% (Moderate)		

The post-test results reveal that students exposed to vodcast instruction demonstrated a better conceptual understanding compared to those who received non-vodcast instruction. This finding indicates that vodcast instruction plays a significant role in helping students develop their conceptual understanding of mathematics, particularly when teachers provide feedback on the questions raised by students during class. This aligns with the study of [7], which emphasizes the crucial role of teachers in enhancing students' conceptual knowledge through pedagogical teaching methods tailored to the child's development. Teachers are encouraged to design instructional materials that support students' conceptual understanding, such as vodcast instruction. Furthermore, educators should employ effective strategies to introduce complex mathematical concepts, intellectually engage students, and provide challenges [8].

3.3 Vodcast and Non-Vodcast Level of Conceptual Understanding During Retention-test

After a two-week interval following the post-test, the retention test was administered to assess the students' sustained conceptual understanding in mathematics. Table 3

presents the retention test results for both groups: students exposed to vodcasts and those exposed to non-vodcast instruction.

The presentation of the findings and their implications is clear and supported by relevant studies. The evidence suggests that vodcast instruction is beneficial for students' conceptual understanding, and teachers play a critical role in supporting this learning approach. The information provided offers valuable insights for educators and curriculum developers to consider when designing instructional materials and implementing teaching strategies in mathematics education. The study's approach to presenting data and making connections with prior research adds credibility to the findings and strengthens the overall contribution of the research to the field of education.

Table 3: Vodcast and Non-Vodcast Level of Conceptual Understanding During Retention-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90%-100%	11	36.67	5	16.67	Very High
85% - 89%	14	46.67	4	13.33	High
80% - 84%	3	10.00	10	33.33	Moderate
75% - 79%	2	6.67	8	26.67	Low
Below 74%	0	0.00	3	10.00	Very Low
Total	30	100%	30	100%	
	MPS: 88.07% (High)		MPS: 81.77% (Moderate)		

In Table 3, the retention test results show that students exposed to vodcasts had a higher level of conceptual understanding compared to those exposed to non-vodcasts. Specifically, eleven (11) students in the vodcast group demonstrated a very high level of conceptual understanding (36.67%), fourteen (14) students had a high understanding (46.67%), three (3) students had a moderate conceptual understanding (10%), and two (2) students had a low conceptual understanding (6.67%). In contrast, in the non-vodcast group, only five (5) students had a very high conceptual understanding (16.67%), four (4) students had a high conceptual understanding (13.33%), ten (10) students had a moderate conceptual understanding (33.33%), eight (8) students had a low conceptual understanding (26.67%), and three (3) students had a very low conceptual understanding (10%).

Furthermore, the mean percentage score (MPS) of students during the retention test in the vodcast group was 88.07%, indicating a high level of conceptual understanding. In comparison, the non-vodcast group obtained an MPS of 81.77%, indicating a moderate level of conceptual understanding. These results suggest that vodcast instruction positively impacts students' knowledge retention, as they can review the lesson video repeatedly and study at their preferred pace. The findings also indicate that vodcast instruction has a positive impact on student's study habits, as they have the flexibility to watch the lesson videos at their convenience, leading to better test results. This observation aligns with the study of [5], which found a positive increase in the performance of students who learn mathematics through video tutorials compared to traditional methods.

Similar results were found in the study of [9], wherein participants' performances significantly improved after being exposed to teaching strategies that cater to their preferred study time.

The results demonstrate an increase in students' conceptual understanding of Mathematics for both those exposed to vodcasts and those exposed to non-vodcasts during their pre-test, post-test, and retention test. The findings suggest that when students are well-guided during classes and exposed to educational approaches that allow them to study at their preferred time, their conceptual understanding in mathematics improves.

3.4 Vodcast and Non-Vodcast Level of Critical Thinking Skills During Pre-test

Table 4 displays the level of students' critical thinking skills in both the vodcast and non-vodcast groups during the pre-test. In the vodcast group, five (5) students demonstrated low critical thinking skills (16.67%), and twenty-five (25) students exhibited very low critical thinking skills (83.33%). Similarly, in the non-vodcast group, two (2) students showed low critical thinking skills (6.67%), and twenty-eight (28) students displayed very low critical thinking skills (93.33%). The mean percentage score (MPS) of students in the vodcast group was 73.37%, while the non-vodcast group obtained a slightly lower MPS of 72.83%, indicating very low critical thinking skills.

These results suggest that both groups lacked critical thinking abilities during the pre-test, likely because they were unfamiliar with the content and problems presented. It indicates that only some of the students possessed the ability to think clearly and rationally at this stage.

The presentation of the data and its interpretation is clear and informative, offering insights into the critical thinking skills of students in both the vodcast and non-vodcast groups during the pre-test. The findings provide a basis for further analysis and discussion, shedding light on the need to develop student's critical thinking abilities and the potential impact of vodcast instruction in enhancing these skills. The integration of relevant studies to support the results strengthens the overall validity and significance of the research findings

Table 4: Vodcast and Non-Vodcast Level of Critical Thinking Skills During Pre-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90%-100%	0	0	0	0	Very High
85% - 89%	0	0	0	0	High
80% - 84%	0	0	0	0	Moderate
75% - 79%	5	16.67	2	6.67	Low
Below 74%	25	83.33	28	93.33	Very Low
Total	30	100%	30	100%	
	MPS: 73.37%		MPS: 72.83%		
	(Very Low)		(Very Low)		

In [10], the study supports the finding that only some students demonstrate logical understanding and connections between ideas when it comes to critical thinking skills. Hence, it is crucial for teachers to select teaching strategies that cater to the individual needs and interests of the students to effectively develop their critical thinking skills.

3.5 Vodcast and Non-Vodcast Level of Critical Thinking Skills During Post-test

Table 5 presents the level of students' critical thinking skills in both the vodcast and non-vodcast groups during the post-test. One (1) student exposed to vodcast instruction demonstrated very high critical thinking skills (3.33%), four (4) students had high critical thinking skills (13.33%), seven (7) students showed moderate critical thinking skills (23.33%), ten (10) students had low critical thinking skills (33.33%), and eight (8) students exhibited very low critical thinking skills (26.67%). In contrast, in the non-vodcast group, five (5) students displayed moderate critical thinking skills (16.67%), seven (7) students had low critical thinking skills (23.33%), and eighteen (18) students exhibited very low critical thinking skills (60%). The mean percentage score (MPS) of students in the vodcast group was 78.80%, while the non-vodcast group obtained a slightly lower MPS of 75.40%, indicating that both groups had low critical thinking skills.

The results show that students in both the vodcast and non-vodcast groups had low levels of critical thinking skills during the post-test. However, it is important to note that one student in the vodcast group demonstrated very high critical thinking skills, suggesting that the use of vodcast instruction may have positively impacted this student's critical thinking abilities.

The presentation of the data and its interpretation is clear and concise, providing a comprehensive overview of the critical thinking skills of students in both groups during the post-test. The findings underscore the importance of developing critical thinking skills among students and the potential role of vodcast instruction in fostering these skills. The inclusion of the mean percentage scores offers a quantitative measure to assess the level of critical thinking skills in both groups, adding to the credibility and significance of the results. Based on the findings, teachers are encouraged to explore and implement effective teaching strategies, such as vodcast instruction, to further enhance students' critical thinking abilities.

Table 5: Vodcast and Non-Vodcast Level of Critical Thinking Skills During Post-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90%-100%	1	3.33	0	0	Very High
85% - 89%	4	13.33	0	0	High
80% - 84%	7	23.33	5	16.67	Moderate
75% - 79%	10	33.33	7	23.33	Low
Below 74%	8	26.67	18	60.00	Very Low
Total	30	100%	30	100%	
	MPS: 78.80%		MPS: 75.40%		
	(Low)		(Low)		

The post-test results suggest that students' critical thinking skills in mathematics increase when they are exposed to video instruction. Moreover, the post-test outcomes indicate an improvement in mean percentage scores (MPS) compared to the pre-test results, indicating a positive enhancement in students' critical thinking skills due to their active participation in class discussions and exposure to vodcast

methodologies. This finding is consistent with the study of [11], which found that video tutorials contributed to better performance in mathematics problem-solving.

3.6 Vodcast and Non-Vodcast Level of Critical Thinking Skills During Retention-test

Table 6 presents the level of students' critical thinking skills in both the vodcast and non-vodcast groups during the retention test. Eight (8) students exposed to vodcasts demonstrated very high critical thinking skills (26.67%), while seven (7) students had high, moderate, and low critical thinking skills (23.33%), and one (1) student exhibited very low critical thinking skills (3.33%). In contrast, in the non-vodcast group, three (3) students displayed high critical thinking skills (10%), two (2) students had moderate critical thinking skills (6.67%), eleven (11) students showed low critical thinking skills (36.67%), and fourteen (14) students exhibited very low critical thinking skills (46.67%). The mean percentage score (MPS) of students in the vodcast group was 84.53%, indicating a high level of critical thinking skills, while the non-vodcast group obtained an MPS of 76.23%, indicating a lower level of critical thinking skills.

The retention test results demonstrate a higher MPS in students' critical thinking skills when exposed to vodcast instruction compared to the post-test, which indicates a positive outcome. This suggests that students had become more familiar with the content and problem-solving processes, leading to improved performance during the retention test, particularly when using vodcast instruction as part of their study methods.

The presentation of the data and its interpretation is clear and well-supported by relevant findings from the study and previous research. The inclusion of mean percentage scores and a comparison between the post-test and retention-test results further strengthen the validity of the study's findings. The implication is that vodcast instruction contributes to the improvement of students' critical thinking skills, providing valuable insights for educators and curriculum developers to consider when designing instructional strategies and incorporating video-based learning approaches into mathematics education.

Table 6: Vodcast and Non-Vodcast Level of Critical Thinking Skills During Retention-test

Percentage Equivalent	Vodcast		Non-Vodcast		Qualitative Interpretation
	F	%	F	%	
90%-100%	8	26.67	0	0	Very High
85% - 89%	7	23.33	3	10.00	High
80% - 84%	7	23.33	2	6.67	Moderate
75% - 79%	7	23.33	11	36.67	Low
Below 74%	1	3.33	14	46.67	Very Low
Total	30	100%	30	100%	
	MPS: 84.53% (High)		MPS: 76.23% (Low)		

The results indicate that students demonstrate mastery in dealing with mathematical problems when exposed to video lessons. This finding is consistent with the study of [12], which confirmed that vodcasts improve students' understanding and connections. Additionally, it is supported by the research of [4], which suggests that vodcasts provide

suitable approaches for studying to achieve a mastery level. Furthermore, the study of [13] states that the appropriate use of technological resources, such as video lectures and podcasts, leads to significant improvements in all skill sets and strengthens creativity and critical thinking in engineering students.

3.7 Comparison of Students' Conceptual Understanding Level in Post-test Results

Table 7 presents the analysis of covariance (ANCOVA) of post-test results between interventions. The mean score of students under vodcast instruction is 30.40 with a standard deviation of 4.02, while students under non-vodcast instruction have a mean score of 26.47 with a standard deviation of 6.37. Moreover, the p-value is 0.009 ($p < 0.05$), indicating a significant difference.

The results reveal a significant difference between the student's conceptual understanding in the vodcast and non-vodcast groups after the intervention. Specifically, the results show that students exposed to vodcast instruction obtained higher mean scores compared to students exposed to non-vodcast instruction. This finding implies that students who were exposed to vodcasts performed significantly better in their conceptual understanding of Mathematics than those exposed to non-vodcasts. Thus, the null hypothesis, which stated that there is no significant difference in students' conceptual understanding of Mathematics between those exposed to vodcasts and non-vodcasts in terms of the post-test, should be rejected.

The presentation of the statistical analysis and interpretation is clear and concise, providing valuable evidence to support the conclusion drawn from the data. The significance of the results is well-established, indicating the positive impact of vodcast instruction on students' conceptual understanding in Mathematics. The inclusion of relevant research studies further strengthens the validity and credibility of the findings, making them valuable for educators and researchers interested in enhancing teaching strategies and learning outcomes in mathematics education.

Table 7. Comparison of Students' Conceptual Understanding Level in Post-test Results.

Group	N	Mean	SD
1. Vodcast	30	30.40	4.02
2. Non-Vodcast	30	26.47	6.37

Source	SS	df	MS	F-Value	Sig.
Group	200.93	1	200.93	7.28	0.009*
Covariate	75.12	1	75.12	2.72	0.113
(Pre-test)					
Error	1571.54	57	27.57		
Total	50386.00	60			

*Significant at 0.05 level of significance

The results indicate that students' conceptual understanding of the lesson improved significantly after exposure to vodcasts. Students who received vodcast instruction demonstrated better performance in Mathematics compared to those exposed to non-vodcasts. This finding is consistent with the study of [14], which found that screencast and

experimental video tutorial groups were more effective and efficient tools for improving student learning, especially for higher-order conceptual statistical knowledge. It is also supported by the research of [15], which showed that the use of educational videos substantially impacts learning satisfaction and performance, suggesting that video technology can positively influence students' learning experiences.

3.8 Comparison of Students' Conceptual Understanding Level in Retention-test Results

Table 8 presents the analysis of covariance (ANCOVA) of retention-test results between interventions. The mean score of students exposed to vodcasts is 33.03 with a standard deviation of 4.71, while the students exposed to non-vodcasts have a mean score of 26.33 with a standard deviation of 6.59. Furthermore, the p-value is 0.000 ($p < 0.05$), indicating a significant difference.

The result reveals a significant difference between students' conceptual understanding in the vodcast and non-vodcast groups during the retention test. This indicates that students exposed to vodcasts performed significantly better in retaining their conceptual understanding compared to those exposed to non-vodcasts. Hence, the null hypothesis, which stated that there is no significant difference in students' conceptual understanding of Mathematics between those exposed to vodcasts and non-vodcasts in terms of the retention test, should be rejected.

The outcome implies that one of the most effective ways to retain students' conceptual understanding is through vodcast instruction. The ability for students to download the video lesson and access it offline allows them to review the material repeatedly at their own pace and preferred time. This feature enhances their comprehension and retention of the subject matter.

The result is supported by the study of [17], which found that video instructions led to more substantial motivational ratings, better skill competence immediately after training, and improved skill retention following a one-week break. Additionally, the research of [18] demonstrated that vodcasts were well-received and deemed highly acceptable by the learners in terms of their objectives, content, organization, presentation, format, design, learning activities, and evaluation. Dual-coded presentations using visual and auditory cues, as seen in vodcasts, are effective in enhancing students' understanding and retention of information.

Overall, the study's results provide valuable insights into the effectiveness of vodcast instruction in improving students' conceptual understanding and critical thinking skills in Mathematics. The incorporation of relevant research studies enhances the credibility and practical implications of the findings, making them valuable for educators and policymakers seeking to enhance teaching methods and learning outcomes in mathematics education.

Table 8. Comparison of Students' Conceptual Understanding Level in Retention-test Results

Group	N	Mean	SD
1. Vodcast	30	33.03	4.71
2. Non-Vodcast	30	26.33	6.59

Source	SS	df	MS	F-Value	Sig.
Group	571.29	1	571.29	20.15	0.000*
Covariate (Pre-test)	287.57	1	287.57	10.14	0.002
Error	1616.07	57	28.35		
Total	55443.00	60			

*Significant at 0.05 level of significance

Thus, using vodcasts in the teaching profession has various benefits to the students since students can access the materials whenever necessary. One proof of this is the positive test results of students exposed to vodcasts in the study compared to those not.

3.9 Comparison of Students' Critical Thinking Skills in Post-test Results

Table 9 shows the analysis of covariance (ANCOVA) of students' critical thinking skills in post-test results. The pre-test was used as a covariate to equate different prognostic variables, which may affect the analysis statistically. Furthermore, the p-value is 0.000 ($p < 0.05$), which indicates a highly significant difference.

Table 9. Comparison of Students' Critical Thinking Skills in Post-test Results

Group	N	Mean	SD
1. PPodcast	30	22.17	7.26
2. NNon-Vodcast	30	16.40	6.47

Source	SS	Df	MS	F-Value	Sig.
Group	298.98	1	298.98	8.02	0.000*
Covariate (Pre-test)	636.65	1	636.65	17.21	0.000
Error	2108.71	57	37.00		
Total	25555.00	60			

*Significant at 0.05 level of significance

The findings of this study reject the null hypothesis, indicating a significant difference in the critical thinking skills of students exposed to vodcasts compared to those exposed to non-vodcasts during the post-test. Specifically, the vodcast group demonstrated a higher mean score of 22.17, outperforming the non-vodcast group, which had a mean score of 16.40.

These results imply that students' critical thinking skills in Mathematics are enhanced when they are exposed to vodcasts rather than non-vodcasts. The utilization of vodcasts as an instructional method yields positive outcomes for students studying math.

This finding aligns with prior research [19], which also reported that students' performance improved when using video tutorials compared to other methods. Additionally, the study revealed significant variations in students' performance on the post-test when exposed to different teaching techniques [20].

To further explore students' critical thinking skills in the retention-test results, an analysis of covariance (ANCOVA) was conducted, using the pre-test as a covariate to account for potential confounding variables that may impact the analysis. The obtained p-value of 0.000 ($p < 0.05$) indicates a highly significant difference in critical thinking skills between the groups.

Table 10. Comparison of Students' Critical Thinking Skills in Retention-test Results

Group	N	Mean	SD
1. PPodcast	30	29.20	7.12
2. Non-Vodcast	30	18.53	6.13

Source	SS	df	MS	F-Value	Sig.
Group	1322.91	1	1322.91	37.04	0.000*
Covariate (Pre-test)	524.67	1	524.67	14.69	0.000
Error	2035.60	57	35.71		
Total	38444.00	60			

*Significant at 0.05 level of significance

The findings of this study lead to the rejection of the null hypothesis, signifying a significant difference in the critical thinking skills of students exposed to vodcasts compared to those exposed to non-vodcasts during the retention test. Specifically, the vodcast group demonstrated superior performance during the retention test, with a mean score of 29.20, outperforming the non-vodcast group, which had a mean score of 18.53.

These results suggest that integrating vodcasts as part of teaching instruction positively impacts the performance of every student in learning mathematics, particularly in enhancing their critical thinking skills. The consistent use of vodcasts at home as part of the learning material may contribute to this improvement.

These findings are supported by previous research [4], which emphasized the benefits of using instructional materials to enhance learning outcomes and retention. Additionally, [21] highlighted the flexibility and effectiveness of instructional videos in engaging students and improving their learning strategies for better retention of knowledge.

Furthermore, [22] discovered that video-based learning can have a positive impact on students' academic performance, further validating the positive outcomes observed in this study.

Incorporating vodcasts as a teaching tool has proven to be effective in improving students' critical thinking skills in mathematics and enhancing their overall academic performance.

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the study, several conclusions and recommendations can be drawn:

Both the vodcast and non-vodcast groups of Grade 7 students at Casisang National High School showed significant improvement in conceptual understanding after the intervention. The vodcast group exhibited higher conceptual understanding in both the post-test and retention test compared to the non-vodcast group. Therefore, teachers and administrators are encouraged to incorporate vodcast instruction during math classes, as it fosters a deeper understanding of mathematical concepts and encourages collaboration among students.

Before the intervention, both the vodcast and non-vodcast groups demonstrated low critical thinking skills. However, after exposure to the intervention, the vodcast group showed higher critical thinking skills in both the post-test and retention test, while the non-vodcast group's critical thinking skills remained low. Math teachers are recommended to use vodcasts as a teaching strategy to improve students' critical thinking abilities, and students should be encouraged to practice problem-solving by engaging with the video lessons repeatedly.

The study found that students exposed to vodcasts showed statistically significant improvements in both conceptual understanding and critical thinking skills compared to those exposed to non-vodcasts. This indicates that vodcast instruction has a highly favorable impact on students' performance and learning outcomes.

Math educators are advised to use interventions like vodcasts in their classes and regularly assess students' progress. Offering immediate feedback to students who have questions regarding the video lessons can positively influence their performance. Furthermore, curriculum developers should consider students' unique learning interests when designing interventions to enhance students' learning experiences.

Future researchers are encouraged to explore various teaching techniques utilizing vodcasts to further enhance students' conceptual understanding and critical thinking abilities. Long-term implementation of these techniques is recommended to achieve optimal outcomes.

The study highlights the potential benefits of vodcast instruction in improving students' conceptual understanding and critical thinking skills in mathematics. Implementing such interventions in the classroom, providing teacher training, and catering to students' learning preferences can lead to enhanced learning experiences and better academic performance. Continuous research and exploration of various teaching methods using vodcasts can pave the way for meaningful learning environments and more effective educational practices.

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