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Research Article

MATHematikula: The Use of Cinematic Mathematics Videos to Enhance Students' Numeracy Skills in the Least-Learned Competencies in Statistics and Probability

Jovito B. Crodua Jr.[1]*, Estela C. Itaas[2]

[1]Senior High School Department, Tibanban National High School, DepEd – Davao Oriental, 8210, Philippines
[2]College of Education Graduate Studies, Bukidnon State University, 8700, Philippines

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**Corresponding author:*
E-mail:
jovito.crodua@deped.gov.ph

ABSTRACT

This study investigated the effectiveness of MATHematikula, a cinematic mathematics video, in enhancing numeracy skills among senior high school students, particularly in the least-learned competency of Statistics and Probability. Utilizing an explanatory sequential mixed-method design, 50 participants were randomly assigned to either an experimental group, which received instruction supplemented with the cinematic video, or a control group taught using the traditional approach. A paired samples t-test revealed significant posttest score improvements in both groups, while analysis of covariance (ANCOVA) confirmed that the experimental group outperformed the control group, demonstrating the intervention's effectiveness. Qualitative findings from interviews with 10 participants further highlighted their experiences with MATHematikula, including its ability to simplify learning, make lessons more engaging, and the technical challenges encountered. To cope with these challenges, students employed peer collaboration, resourcefulness, and self-motivation. Additionally, insights revealed that students actively engaged with the platform's interactive features, utilized it as a learning tool, and expressed enthusiasm for promoting it to their peers. These findings reveal the potential of cinematic mathematics videos as an innovative pedagogical tool for improving student learning outcomes in mathematics.

Keywords: *MATHematikula, Cinematic Mathematics Video, Numeracy Skills, Statistics and Probability*

Background

Mathematics education faces a persistent challenge, as many students struggle to develop fundamental numeracy skills. This issue is particularly evident in senior high school core subjects such as Statistics and Probability, where

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abstract concepts and a lack of engaging instructional methods often hinder student understanding. These difficulties not only impact academic achievement but also limit students' ability to apply mathematical reasoning in real-life scenarios, contributing to broader educational and societal gaps.

Globally, mathematics education continues to face significant challenges in ensuring that students develop essential numeracy skills. Numeracy, defined as the ability to understand and work with numbers, plays a critical role in problem-solving, decision-making, and functioning in society. According to the Organization for Economic Cooperation and Development (OECD, 2022), a substantial proportion of students worldwide struggle to attain proficiency in mathematics, with areas such as Statistics and Probability often identified as the least mastered domains. These challenges are amplified in developing countries, where resources and innovative teaching strategies are often limited.

Additionally, the Philippines has persistently underperformed in international assessments of mathematics achievement, such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA). For instance, the 2018 PISA results revealed that Filipino students ranked last among 79 participating countries in mathematics (Department of Education, 2019). The findings underscore the need for targeted interventions to address least-learned competencies, particularly in Statistics and Probability, which are foundational for developing data literacy and critical thinking skills in a data-driven world.

In the context of Region XI, the struggle to enhance numeracy skills is evident in the low mastery levels observed in assessments of senior high school students. Factors contributing to this issue include limited instructional resources, traditional teaching methods, and a lack of engaging and contextualized learning materials that cater to diverse learning needs.

To address these gaps, innovative pedagogical approaches are necessary. One promising avenue is the integration of cinematic mathematics videos, referred to in this study as "MATHematikula." These videos combine visual storytelling, real-world scenarios, and engaging problem-solving activities to develop a deeper understanding of mathematical concepts. Research suggests that multimedia tools can significantly enhance student engagement and comprehension by catering to different learning styles (Mayer, 2021). Furthermore, cinematic videos have the potential to contextualize abstract concepts, making them more relatable and easier to grasp for students.

The primary purpose of this research is to enhance students' numeracy skills in the least-learned competencies in Statistics and Probability. Specifically, this action research aimed to answer the following questions:

1. How does the use of cinematic mathematics video enhance students' numeracy skills, specifically in the least learned competencies in Statistics and Probability?
2. Is there a significant difference in the students' numeracy skills, specifically in the least learned competencies when the cinematic mathematics video is utilized?
3. What are the students' experiences in using cinematic mathematics video?
4. What are the students' coping mechanisms with the challenges in using cinematic mathematics video?
5. What are the insights of the students in using the cinematic mathematics video?

Methods

Research Design

The researcher utilized an explanatory sequential mixed-method design to provide a comprehensive understanding of the research problem. This approach, as outlined by Creswell and Creswell (2017), involves two sequential phases. Initially, quantitative data was collected and analyzed to identify measurable trends and patterns in students' numeracy skills. This phase involved administering pre-tests and post-tests to determine the impact of cinematic mathematics videos on students' mastery of the least-learned competencies in Statistics and Probability.

In the second phase, qualitative data was collected to gain deeper insights into the quantitative findings. Semi-structured interviews were conducted with students to explore their

experiences using cinematic mathematics videos. This phase aimed to uncover the factors influencing their learning, the challenges they faced, and their strategies for addressing these challenges.

By integrating these phases, the explanatory sequential mixed-method design ensured that the qualitative findings provided context and depth to the quantitative results. This methodological approach is particularly suited for studies examining both the measurable impact of an intervention and the underlying experiences of participants, as it allows for a holistic understanding of the research problem (Plano Clark & Ivankova, 2016).

Participants and/or Sources of Data

This study was conducted at Tibanban National High School during the second semester of the 2022–2023 academic year. Participants were drawn from two Grade 11 sections, HUMSS (A) and HUMSS (B), which were randomly assigned as the control and experimental groups, respectively. Each group comprised 25 students, resulting in a total of 50 participants. To ensure equivalence between groups and minimize potential biases, a stratified randomization approach was employed. Initially, students' academic performance in mathematics was assessed based on their previous grading period scores. Participants were then categorized into performance strata (e.g., high, average, and low achievers), and random assignment to either the control or experimental group was conducted within each stratum. This process ensured that both groups had comparable distributions in terms of prior mathematical achievement, reducing confounding variables and strengthening the internal validity of the study (Bland & Altman, 1999).

In addition to the quantitative data collection, qualitative insights were obtained through in-depth interviews with a subset of participants. Ten students from the experimental group were selected using purposive sampling, focusing on those who actively engaged with the cinematic mathematics videos. This approach allowed for a more comprehensive exploration of student experiences, challenges encountered, and coping mechanisms. Informed consent was obtained from all participants before their involvement in the study, ensuring ethical compliance with research guidelines on autonomy and participant protection. Participation was entirely voluntary, with no penalties imposed on those who opted out.

Data Gathering Procedure

The researcher employed both qualitative and quantitative methods to address the research questions. For the quantitative aspect, data were collected through pre-test and post-test assessments. The teacher-made test instrument used in the study underwent a validity check to ensure its appropriateness for measuring the targeted competencies. In addition to the quantitative data, qualitative data were gathered through recorded interviews. An in-depth interview process was conducted to capture rich, meaningful responses from the participants.

The data collection process followed a systematic series of steps. First, the researcher sought permission both from Schools Division Superintendent of the Division of Davao Oriental and from the principal of Tibanban National High School to conduct the study with the selected participants. After obtaining approval, the researcher proceeded with designing and developing the intervention material. A cinematic mathematics video, titled MATHematikula, was created and produced in three stages: pre-production, production, and post-production. The video content was specifically focused on addressing the least-learned competency in Statistics and Probability.

To ensure the quality and relevance of the intervention material and the teacher-made test, both were validated by content and language experts, along with the School Learning Resources Management and Development System (SLRMDS) coordinator. This validation process aimed to confirm the appropriateness and accuracy of the materials for the study.

Since the participants were minors, the researcher sought informed assent from the students and obtained parental consent for participation in the study. Once the necessary permissions were secured, the researcher administered the pre-test. Students individually

completed the teacher-made instrument, which assessed their ability to compute probabilities corresponding to a random variable.

Following the pre-test, the intervention, MATHematikula, was administered to the participants. After the intervention, the same test instrument used in the pre-test was re-administered as a post-test to evaluate the impact of the intervention on student performance.

Finally, the researcher conducted an in-depth interview with a randomly selected group of 10 participants. The interviews were transcribed, translated, and encoded for analysis. The qualitative data were then analyzed to gain insights into the participants' experiences and perceptions of the intervention.

Data Analysis

The pre-test and post-test results were collected, recorded, and analyzed using appropriate statistical methods. A paired T-test was employed to examine the enhancement of students' numeracy skills, specifically in the least-learned competency in Statistics and Probability. Table 1 displays the mean range of test scores, along with the corresponding proficiency levels and their interpretations.

Table 1. Test Scores Mean Range, Proficiency Level, and Interpretation

Mean Range	Proficiency Level	Interpretation
18-20	Advanced	The student exceeds the core requirements in terms of knowledge, skills, and understanding.
15-17	Proficient	The student developed the fundamental knowledge, skills, and core understanding and can transfer them independently through authentic tasks.
10-14	Approaching Proficiency	The student developed fundamental knowledge, skills, and core understanding.
5-9	Developing	The student possesses the minimum knowledge, skills, and core understanding.
0-4	Beginning	The student struggles with his/her understanding.

To assess the significance of any differences in students' numeracy skills, particularly regarding the least-learned competencies, Analysis of Covariance (ANCOVA) was applied. An alpha level of 0.05 was used for all statistical analyses. Additionally, an interview was conducted to gather insights into the experiences, coping mechanisms and insights of students using the mathematics cinematic video. The interview data were analyzed using thematic analysis. Significant responses were coded, and these codes were then grouped to identify recurring themes.

Result and Discussion

Students' Numeracy Skills in the Least-Learned Competencies of the Control and Experimental Group

Numeracy skills in statistics and probability refer to the ability to use and understand numerical data, statistical concepts, and probability theories. In the context of this study, it is measured using a 20-item researcher-made test on a least-learned competency of the subject. Provided in Table 2 are descriptive statistics on the pretest and posttest of both the control and experimental group.

Table 2. Descriptive Statistics on the Pretest and Posttest Scores of the Control and Experimental Group

Group		Mean	N	Standard Deviation	Interpretation
Control	Pretest	4.72	25	1.838	Developing
	Posttest	11.08	25	1.913	Approaching Proficiency
Experimental	Pretest	4.92	25	2.448	Developing
	Posttest	16.64	25	2.644	Proficient

It can be noted from Table 2 that there is an increase in the score of the control group from 4.72 in the pretest which is interpreted as developing to 11.08 in the posttest which corresponds to an approaching proficiency level. This means that from possessing the minimum knowledge, skills, and core understanding, students developed fundamental knowledge, skills, and core understanding after being taught using the traditional approach.

Additionally, there was also an increase in the pretest score of the experimental group from 4.92 which can be interpreted as developing to 16.64 which corresponds to a proficient descriptive equivalent. This implies that after being supplemented with cinematic mathematics video, students developed the fundamental knowledge, skills, and core understanding and can transfer them independently through authentic tasks. Also, results revealed that there is an increase in the scores of both the control and experimental group from the pretest to the posttest.

To determine the statistical difference between the pretest and posttest scores of the control and experimental group, a paired samples t-test was conducted on a sample of 25 students as shown in Table 3.

Table 3. Significant Difference in the Pre-test and Post-test of the Control and Experimental Group

		Control Group		Experimental Group	
		Pretest	Posttest	Pretest	Posttest
Mean		4.72	11.08	4.92	16.64
N		25	25	25	25
Standard Deviation		1.838	1.913	2.448	2.644
Standard Error Mean		0.368	0.383	0.490	0.529
Paired Differences	Mean	-6.360		-11.720	
	Standard Deviation	2.660		2.246	
	Standard Error Mean	0.532		0.449	
T		-11.957		-26.094	
Df		24		24	
Sig (2-tailed)		.000		.000	

These findings are supported by the study of Mercado (2022) which also revealed that the performance in mathematics of the pupils improved after exposure to the video clip presentation and those who are taught using traditional methods. However, those pupils exposed to the video clip presentation performed better than those pupils exposed to the traditional method of teaching.

Difference in the Students' Numeracy Skills in the Least-Learned Competencies between the Control and Experimental Group

In order to determine if there is a significant difference between the control and experimental group in the posttest, a one-way analysis of variance was conducted with the pretest scores as the covariate. The test for normality and homogeneity were completed, and the assumptions are met. Table 4 and 5 shows the results of the analysis of covariance (ANCOVA).

Table 4. ANCOVA Results for the Posttest Scores with Pretest Scores as Covariate

Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Pretest	39.997	1	39.997	8.719	.005	.156
Groups	373.953	1	373.953	81.519	.000	.634
Errors	215.603	47	4.587			
Total	10247.000	50				

Table 4 indicates that there is a significant difference for both the experimental group (with a mean of 16.958 and a standard error of 0.429) and control group (with a mean of 11.122 and standard error of 0.429) adjusted posttest scores while controlling for the pretest scores, $F(1,47)=81.519$ with $p<0.05$. It revealed that the performance level of the experimental and control group after the intervention were not similar.

Consequently, the partial eta squared provides the measure of effect size to quantify the proportion of variance in the students' numeracy skills that is attributable to the intervention used. With a partial eta squared value of 0.634, it points that a large effect size, as it suggests that approximately 63.4% of the variance in the students' numeracy skills can be attributed to the use of cinematic mathematics video. This implies that the intervention used has a strong and significant influence on the students' numeracy skills, and the effect size is large enough to be considered practically significant. This finding is validated by the study of Gratela and Janer (2022) which states that video lessons have a large effect on the numeracy level of students and must be used as supplemental learning material. Additionally, Borko et al. (2007) revealed that video is gaining popularity as a tool for teacher professional development due to its distinctive ability to preserve the depth and complexity of classroom interactions for future analysis.

In addition, table 5 shows the Bonferroni pairwise comparison for the adjusted marginal posttest mean which will provide the result on which group had significantly improved their performance level after the conduct of the intervention.

Table 5. Bonferroni Pairwise Comparison for the Adjusted Marginal Posttest Mean

Source	N	Mean	Std. Error	Mean Difference (I-J)	Std. Error	Sig.[b]
Experimental (I)	25	16.598[a]	.429	5.476	.606	.000
Control (J)	25	11.122[a]	.429			

It was revealed that the experimental group obtained a greater increase in performance level compared to the control group with a mean difference of 5.476, a standard error of 0.606, and $p<0.05$. This suggests that the intervention implemented in the experimental group was effective in improving students' numeracy skills and could be considered for wider implementation or further research. It is supported by a study which found that a multimedia intervention that included videos, simulations, and interactive activities improved students' understanding of statistical concepts (Muniz et al., 2018). In addition, Helem et al. (2002) highlighted that digital technologies serve as a powerful tool for enhancing education by simplifying the creation of instructional materials for educators and introducing innovative ways for learners to engage and collaborate. The researchers found that the intervention was particularly effective for students who had low prior knowledge of statistics.

Students' Experiences in using Cinematic Mathematics Videos

Using the data collected among the participants on the experiences in using cinematic mathematics video, three main themes emerged which are the following as shown in figure 1.

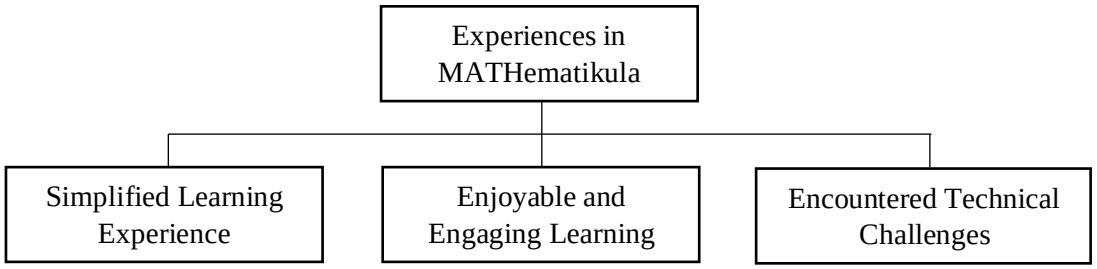

Figure 1. Themes on students' experiences in Cinematic Mathematics Video

Simplified Learning Experience

The utilization of cinematic mathematics videos has demonstrated a substantial impact on simplifying the learning process for students, as reflected in their interview responses. These videos provide a structured and accessible approach to understanding mathematical concepts, particularly in solving word problems and identifying appropriate mathematical symbols.

One participant highlighted the effectiveness of the videos in addressing problem-solving challenges, stating, "*Students will learn how to solve word problems in a simpler way*" (S1). This observation underscores the clarity with which the videos present complex problems, enabling students to deconstruct and solve them more efficiently. Another student emphasized the ease of symbol identification, noting, "*It is easy, sir. You will learn how to determine what symbols to use faster*" (S3). This suggests that the videos facilitate quicker comprehension of mathematical operations by visually representing abstract ideas.

The ability to revisit content as needed was also frequently mentioned by students. For instance, one participant remarked, "*It is nicer to use because you can rewatch the video whenever you forget something*" (S2). This feature ensures that students can review challenging concepts at their own pace, reducing anxiety leading to a more personalized learning experience.

Several responses further affirmed the overall ease brought about by the video format. Statements such as, "*It is easier to interpret now that there is that mathematics video*" (S4), and "*It makes you learn the lesson easily*" (S9) reflect the accessibility and user-friendly design of the resource. These insights indicate that the integration of audiovisual elements significantly enhances comprehension and retention of mathematical concepts.

Additionally, some students reported a faster learning process because of using the videos. For example, one participant stated, "*You will learn faster*" (S10), pointing to the potential of these videos to streamline the acquisition of knowledge through concise and engaging content delivery.

Cinematic mathematics videos enhance students' learning by providing structured, visually engaging, and accessible ways to understand mathematical concepts. The use of videos for solving word problems and identifying mathematical symbols is consistent with the findings of Fiorella and Mayer (2015), who argue that instructional videos promote active learning by visually demonstrating problem-solving processes and guiding students through step-by-step procedures. This aligns with student feedback highlighting the clarity and efficiency these videos provide in breaking down complex mathematical problems and enabling quicker comprehension of abstract concepts. It is also supported by Phuong et al. (2022) stating that the incorporation of ICT into mathematics education stems from its capability to enhance students' learning and performance in mathematics.

The ability to review video content also offers significant benefits for personalized learning. According to Guo et al. (2014), video-based instruction supports diverse learning needs by allowing students to revisit content at their own pace, improving retention and reducing cognitive overload. This flexibility ensures that learners can revisit challenging topics, enhancing their overall confidence and understanding of mathematical principles.

Enjoyable and Engaging Learning

The use of cinematic mathematics videos has not only simplified the learning process but has also created an enjoyable and engaging environment for students, as reflected in their interview responses. The integration of multimedia elements, including video effects and audio clips, has significantly enhanced their overall learning experience.

One student explicitly stated, "*I am happy learning with the mathematics video. The video effects are nice*" (S1), highlighting the role of visual enhancements in making the learning process more appealing. This sentiment indicates that the creative use of multimedia in the videos captures students' attention and fosters a positive emotional connection to the content.

Another participant expressed a similar sentiment, noting simply, "*I am happy with the mathematics video, sir*" (S2). While brief, this statement emphasizes the emotional satisfaction students derive from engaging with the

videos, which can contribute to increased motivation and interest in mathematics.

The combination of entertainment and education was particularly appreciated by one respondent, who shared, "*I am happy because aside from learning I also enjoy the video and audio clips used*" (S3). This response emphasizes the dual purpose of the videos, serving both as an instructional tool and a source of enjoyment. The incorporation of audio-visual elements likely aids in sustaining students' attention and enhancing their overall engagement with the material.

Furthermore, another student described the experience as "*cool and fun*" (S10), which highlights the contemporary appeal of the videos. By aligning the content delivery with students' preferences for engaging and dynamic media, the videos make the subject matter more relatable and enjoyable.

Berk (2009) emphasizes that multimedia tools capture attention and create a more appealing learning experience, aligning with students' feedback on the videos' creative and entertaining nature. Moreover, Moreno and Mayer (2007) highlight that "edutainment" not only aids comprehension but also sustains attention and promotes a positive attitude toward learning. By addressing both cognitive and emotional aspects, these videos make mathematics more relatable and enjoyable while enhancing learning outcomes.

Encountered Technical Challenges

While the use of cinematic mathematics videos has been beneficial for learning, students have reported encountering technical challenges that affect their ability to fully engage with the material. These challenges are largely related to the limitations of their personal devices.

One student shared, "*I struggled at first because I only have limited file storage. I still need to delete other files in my cellphone*" (S1), highlighting the issue of inadequate storage capacity, which necessitates additional effort to accommodate the videos. Another participant noted, "*I find difficulty playing the video because my phone has a low processor*" (S3), reflecting the impact of device performance on video playback and overall accessibility.

Issues with audio clarity were also identified as a barrier. One student explained, "*Sometimes, I cannot hear the audio clearly due to the defective speaker of my phone*" (S6), emphasizing how hardware problems can hinder comprehension. Additionally, visual accessibility was a concern for another respondent, who stated, "*It is difficult to see some part of my video since my phone screen has cracked*" (S7), demonstrating how physical damage to devices can impede learning.

These responses illustrate the various technical challenges students face, which stem from the reliance on personal devices of varying quality. Addressing these issues may require providing alternative solutions, such as optimizing videos for low-spec devices or offering support for hardware repairs, to ensure equitable access to educational materials.

The technical challenges students face when using cinematic mathematics videos highlight the disparities in access to technology, which can impede learning. Selwyn (2011) emphasizes that unequal access to devices with sufficient storage, processing power, and screen quality creates significant barriers to engaging with educational technologies. Students' struggles with limited storage and low-performance devices, as well as hardware issues like defective speakers or cracked screens, hinder their ability to effectively interact with multimedia content. Warschauer and Matuchniak (2010) note that such technological barriers can exacerbate educational inequalities, while Bebell and O'Dwyer (2010) argue that access to reliable devices is essential for successful learning experiences. Addressing these challenges requires optimizing educational resources for diverse technological environments and ensuring equitable access to functional devices.

Students' Coping Mechanisms with the Challenges in using the Cinematic Mathematics Video

Students have applied coping mechanisms as they dealt with the challenge and difficulty

encountered in using cinematic mathematics videos. There were three main themes that emerged from the data collected from the responses of the participants. These themes are depicted in figure 2.

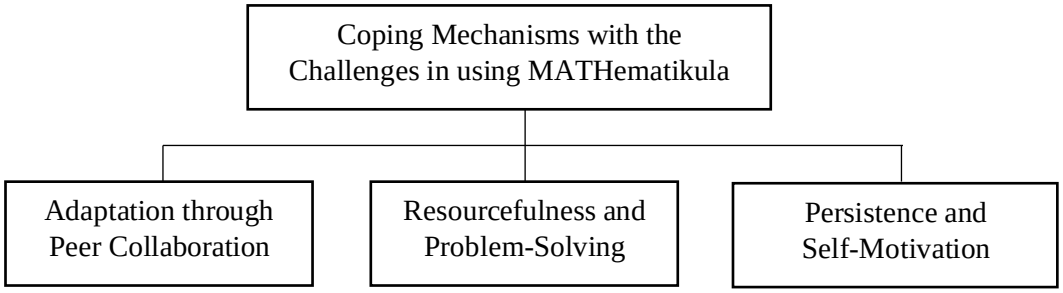

Figure 2. Themes on students' coping mechanisms in Cinematic Mathematics Video

Adaptation through Peer Collaboration

Students have demonstrated effective coping mechanisms for overcoming challenges in using Cinematic Mathematics Videos, with peer collaboration emerging as a key strategy. By working together, students are able to address various difficulties, from understanding content to managing technical limitations.

One student shared, *"We formed a group chat where we discuss the parts of the video we didn't understand"* (S1). This response highlights the use of digital communication platforms as a collaborative tool to clarify concepts and share insights. Another participant added, *"I ask my classmates for help when I don't know how to solve a problem shown in the video"* (S7), emphasizing the value of peer support in addressing academic challenges.

Technical difficulties were also resolved through peer collaboration. One student noted, *"One of my friends is good with technology, so they help me when I encounter issues with playing the video"* (S6), illustrating how students leverage each other's strengths to overcome barriers. Additionally, resource-sharing was evident in one response: *"We take turns using a classmate's tablet since I don't have my own device at home"* (S4). This highlights the cooperative spirit among students, ensuring access to learning materials despite resource limitations.

Peer collaboration has proven to be an effective coping mechanism for students facing challenges in using MATHematikula, facilitating both academic support and technical problem-solving. According to Vygotsky's (1978) social constructivist theory, learning is enhanced through interaction with peers, as seen in students forming group chats to clarify concepts and seek assistance with problem-solving. Digital communication platforms play a crucial role in fostering collaborative learning (Hrastinski, 2008), enabling students to discuss unclear content and exchange insights.

This is also supported by Mercier and Higgins (2012) which emphasized the importance of incorporating collaborative and whole class learning activities that foster adaptive expertise, creating opportunities for students to develop both innovation and efficiency. Additionally, peer support extends to overcoming technical difficulties, as students rely on technologically skilled classmates for assistance (Voogt et al., 2011). Resource-sharing, such as taking turns using a peer's device, further highlight the importance of collaboration in ensuring equitable access to learning materials.

Resourcefulness and Problem-Solving

Students have displayed resourcefulness and problem-solving skills to cope with the challenges of using MATHematikula. These strategies highlight their ability to take initiative and adapt to limitations, ensuring they effectively engage with the material.

One student shared, "*I rewatched the difficult parts of the video multiple times until I understood it*" (S2), emphasizing persistence and the use of repetition to master challenging concepts. This approach reflects the students' ability to maximize the flexibility of video-based learning by controlling the pace of their study.

Another participant noted, "*Whenever I don't understand a concept in the video, I search for tutorials on YouTube to learn more*" (S8), showcasing their proactive use of external resources to supplement their learning. This demonstrates how students utilize readily available online tools to address gaps in understanding and enhance their comprehension.

Some students employed traditional study techniques to reinforce learning, as evidenced by the response, "*I write down key points from the video in my notebook to help me review later*" (S3). This practice not only aids retention but also provides a tangible resource for revision and future reference.

Additionally, resourcefulness in overcoming technical limitations was evident in the statement, "*When I couldn't watch the video at home, I borrowed a device from my cousin*" (S4). This response illustrates how students navigate hardware constraints by seeking alternative means to access the videos, ensuring continuity in their learning.

Students' resourcefulness and problem-solving skills in overcoming challenges with MATHematikula highlight the importance of self-regulated learning (SRL) strategies in digital education. According to Zimmerman (2002), self-regulated learners take initiative in their learning process by monitoring their comprehension and adjusting their strategies accordingly. The act of rewatching difficult video segments exemplifies metacognitive regulation, allowing students to refine their understanding (Panadero, 2017).

Additionally, seeking supplementary materials on platforms like YouTube demonstrates proactive resource management, which is crucial for independent learning (Broadbent & Poon, 2015). Furthermore, borrowing devices to overcome technical limitations showcases adaptability and perseverance, traits essential for academic resilience in digital learning environments (Cleary & Zimmerman, 2004). Collectively, these strategies reflect the critical role of self-regulation and resourcefulness in facilitating effective mathematics learning through digital tools.

Persistence and Self-Motivation

Students have demonstrated persistence and self-motivation as key coping mechanisms for overcoming challenges in using Cinematic Mathematics Videos. These strategies reflect their resilience to achieving their academic goals despite the difficulties encountered.

One student remarked, "*Even when I feel frustrated, I remind myself that I need to learn this for my future*" (S9), highlighting the role of long-term aspirations in sustaining their motivation. By focusing on the broader purpose of their studies, students can push through moments of frustration and remain engaged.

Another participant shared, "*I make sure to focus on the video and avoid distractions, even when it's difficult to concentrate*" (S5). This indicates a deliberate effort to maintain attention and prioritize learning, despite potential external or internal challenges. Such focus illustrates their determination to make the most of the resources available to them.

Students also adopt strategic approaches to manage their workload effectively. One response, "*I set a goal to finish one video at a time, so I don't get overwhelmed*" (S3), illustrates the use of goal-setting as a means of maintaining progress while reducing stress. This method allows students to break down their tasks into manageable steps, developing a sense of accomplishment and control.

Additionally, another student explained, "*When I get tired, I take a short break and come back to the video feeling more focused*" (S7). This response highlights the importance of self-regulation, with students recognizing the need to balance effort and rest to sustain productivity and concentration.

Persistence and self-motivation are essential for student success in digital learning environments, particularly when faced with academic challenges. According to Zimmerman and Schunk (2011), self-motivated learners set personal goals and develop strategies to sustain their engagement, as seen in students' efforts to focus on videos and minimize distractions. The use of goal-setting, such as breaking tasks into smaller steps, aligns with Locke and Latham's (2002) goal-setting theory, which

emphasizes that specific and attainable goals enhance persistence and performance. Furthermore, self-regulation strategies, including taking strategic breaks to maintain concentration, reflect findings by Pintrich (2004), who highlighted that students who actively manage their learning process are more likely to maintain motivation and achieve academic success. These findings emphasize the significance of self-discipline and resilience in maximizing the benefits of MATHematikula for learning.

Students' Insights in using the Cinematic Mathematics Video

Figure 3 presents the three overarching themes derived from students' insights into their experiences with the MATHematikula. These themes provide a deeper understanding of how students interact with and perceive the cinematic mathematics video.

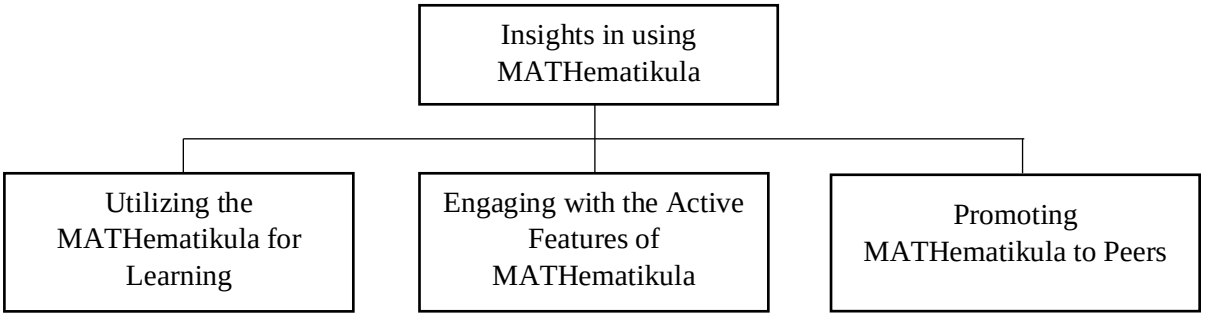

Figure 3. Themes on students' coping mechanisms in Cinematic Mathematics Video

Utilizing the MATHematikula for Learning

Students recognize the significant value of the MATHematikula resource as an effective tool for enhancing their learning experience. Their insights reflect an appreciation for its ability to simplify complex concepts and support their academic growth.

One student expressed, "*Students shall use MATHematikula because it is easier to understand the concepts now. Others may forget the discussion made by teachers*" (S2). This highlights the resource's advantage in reinforcing lessons, providing students with a means to revisit and internalize content that may have been forgotten or unclear during classroom instruction.

Another participant stated, "*We shall use this one because you will understand more than the lesson*" (S3). This response emphasizes how MATHematikula goes beyond traditional instruction, promoting deeper comprehension of mathematical concepts and offering supplementary explanations that enhance learning outcomes.

The effectiveness of MATHematikula was further emphasized by a student who remarked, "*This must be used because it is very effective*" (S5). This succinct yet compelling statement underscores the students' recognition of the resource as a practical and impactful educational tool.

Hattie and Donoghue (2021) highlight that multimedia-based educational materials improve comprehension by simplifying complex concepts and facilitating deeper understanding. Similarly, Rosenshine (2012) underscores the importance of reinforcement and repetition, noting that frequent review strengthens retention and supports students who may need to revisit content after classroom instruction. These findings align with students' feedback on MATHematikula's ability to simplify concepts and provide opportunities for review.

The integration of innovative tools, such as MATHematikula, into mathematics education enhances learning outcomes and supports deeper comprehension. This is further supported by Vygotsky's (1978) scaffolding theory, which emphasizes the role of tools in helping students learn within their zone of proximal development. The use of MATHematikula promotes a student-centered approach that

promotes academic growth and supports long-term learning outcomes.

Engaging with the Active Features of MATHematikula

Students have expressed positive insights regarding the active features of MATHematikula, highlighting its engaging and accessible elements that enhance their learning experience. The combination of interactive components, contextual relevance, and convenience has contributed to their increased interest in mathematics.

One student remarked, "*It is fun to watch the video because aside from the discussion there are also clips and audio that are fun to watch*" (S3), emphasizing the engaging multimedia elements incorporated into the videos. This demonstrates how integrating visual and auditory components makes the learning process more enjoyable and immersive.

The flexibility of MATHematikula was praised by students, as reflected in the statement, "*I like the discussion part because I can rewatch it anytime*" (S4). This feature allows learners to revisit content as needed, ensuring mastery of mathematical concepts at their own pace. Another student shared, "*Even if the teacher is not around and I forgot the lesson when I'm home, I am not scared anymore because the video alone is understandable*" (S7). This highlights the resource's capacity to provide independent learning opportunities and alleviate anxiety when traditional classroom support is unavailable.

The use of local context within the videos was another notable feature appreciated by students. One participant stated, "*I am happy because I got to appreciate the mathematical concept more since it used the context here in our locality*" (S6), indicating that the contextualized content made the lessons more relatable and meaningful.

The concise nature of the videos was also highlighted as a factor that sustains engagement. As one student explained, "*If watched properly, you will learn a lot. You will not be bored because it is just a short video*" (S9), underscoring the importance of brevity in maintaining interest and focus. Additionally, the convenience of accessing the videos beyond the classroom was expressed by another participant, who noted, "*I like it because even if I'm no longer at school, I can still rewatch the lesson through the video*" (S10).

The interactive and multimedia features of MATHematikula have significantly contributed to student engagement and learning accessibility. According to Mayer (2021), incorporating visual and auditory elements in educational videos enhances comprehension and retention by catering to multiple learning modalities. The ability to rewatch content at one's own pace aligns with self-regulated learning principles, which Zimmerman (2002) emphasizes as essential for mastery and independent learning. Furthermore, contextualized learning materials that incorporate local relevance make concepts more meaningful and relatable, supporting the findings of Averill et al. (2015), who argue that culturally responsive pedagogy fosters deeper student engagement and understanding. These features collectively enhance students' motivation and ability to grasp mathematical concepts effectively.

Promoting MATHematikula to Peers

Students expressed strong enthusiasm for sharing the MATHematikula resource with their peers, recognizing its value as an effective and engaging tool for learning mathematics. Their insights highlight the collaborative nature of their learning community and their desire to extend the benefits of this resource to others.

One student emphasized the personal impact of MATHematikula, stating, "*I will share the video to others because it helped me a lot*" (S1). This response shows students' acknowledgment of the resource's effectiveness in enhancing their understanding of mathematical concepts, motivating them to recommend it to their peers.

Another participant shared, "*I find the material very effective which is why I will also let others watch the video*" (S2). This highlights how the perceived effectiveness of MATHematikula encourages students to advocate for its use, reflecting their confidence in the resource's ability to support academic success.

The engaging and enjoyable nature of the video was also noted as a key reason for

sharing it. One student remarked, "*The video is fun and useful which is why it must be shared with others*" (S9), suggesting that the combination of entertainment and educational value makes the resource appealing and worth recommending.

Additionally, a student expressed their intent to promote MATHematikula to support others' learning, stating, "*I will tell others about this material so that they will also learn*" (S10). This response reflects a sense of responsibility and willingness to contribute to the academic progress of their peers.

Students' enthusiasm for promoting MATHematikula to their peers illustrates the role of collaborative learning in enhancing mathematical understanding. According to Vygotsky's (1978) social constructivist theory, peer interactions facilitate deeper learning by allowing students to share knowledge and support one another. The willingness to recommend MATHematikula is also aligned with the concept of reciprocal teaching, where students take an active role in disseminating effective learning strategies (Palincsar & Brown, 1984). These findings suggest that students' promotion of MATHematikula is driven by both its pedagogical effectiveness and its engaging nature, reinforcing its value as a learning tool.

Conclusion

This study showed that using cinematic mathematics videos had a significant positive effect on students' numeracy skills, especially in their least-learned competencies. The descriptive data indicated that both the control and experimental groups improved their scores from pretest to posttest. However, the experimental group, which used cinematic mathematics videos, performed better overall. This suggests that creative teaching methods like MATHematikula can help students better understand difficult mathematical concepts.

A paired samples t-test showed a significant difference between the pretest and posttest scores for both groups, with the experimental group showing a greater improvement. The analysis of covariance (ANCOVA) also confirmed the effectiveness of the intervention. The adjusted posttest scores revealed a significant difference between the groups. This highlights the strong influence of the intervention on learning outcomes.

Qualitative findings also provided insights into how students experienced the cinematic mathematics videos. Three main themes emerged: simplified learning, enjoyable engagement, and technical challenges. Many students found that the videos made mathematical concepts easier to understand, as they could replay the lessons at their own pace. The videos also made learning more interesting and motivating. However, some students faced technical problems, such as a lack of devices or difficulty accessing the videos.

To deal with these challenges, students used strategies like working with peers, finding alternative resources, and staying motivated. Peer collaboration, looking for additional learning materials, and setting personal goals helped them overcome difficulties. These actions show the importance of encouraging teamwork and resourcefulness in students.

In conclusion, this study confirmed that cinematic mathematics videos are an effective tool for improving numeracy skills. Integrating such videos into teaching practices can help students, especially in topics they find challenging. However, it is important to address technical issues and ensure all students have access to the necessary resources to fully benefit from this method.

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