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Research Article

Watch and Learn: Enhancing the Performance in Mathematics of Grade 3 Pupils through the use of Video-Based Instructional Material

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ABSTRACT

Mathematics is a foundational subject, yet many elementary pupils struggle with abstract concepts such as multiplication and division. In the Philippines, gaps in mathematical proficiency remain evident in national and international assessments, further aggravated by limited instructional support and inadequate learning resources. Video-based instructional materials offer a promising approach by integrating visual, auditory, and contextual elements to make mathematics more interactive and accessible. This study employed a one-group pretest–posttest design with 38 Grade 3 pupils from Tinigaw Elementary School during S.Y. 2023–2024. A validated researcher-made test (KR-20 = 0.822) identified least mastered competencies and measured learning gains, while semi-structured interviews explored pupils' challenges. Experts evaluated the acceptability of the developed materials using the DepEd LRMDS tool. Pretest results showed low mastery in the properties of multiplication (42%) and multi-digit division problems (62%). Qualitative findings revealed that pupils struggled with weak foundational knowledge, limited guidance, and poor-quality modules. Difficulties in multiplication and division, especially in problem-solving, and mismatched examples contributed to frustration and incomplete activities. After 12 weeks of video-based lessons, pupils' mean performance improved significantly from 5.16 (SD = 2.03) to 8.61 (SD = 1.17), with a paired-sample t-test confirming statistical significance ($t = -10.795$, $p < .05$). Expert evaluation rated the materials "Acceptable" (M = 1.99). These results suggest that video-based instructional materials effectively enhance mathematical performance, increase engagement, and address learning gaps, supporting their integration in basic education to improve achievement in Mathematics.

Keywords: *Video-based Instruction, Least Learned Competencies, Mathematics Performance*

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Background

Mathematics is a discipline that relies heavily on conceptual understanding, visualization, and problem-solving—skills that many young learners struggle to develop, especially when abstract concepts are not supported by appropriate learning tools. Instructional video lessons have emerged as a promising supplementary resource that can address these challenges by providing multimodal representations of mathematical ideas and supporting learners in remote, blended, and face-to-face environments.

Prior research has highlighted the cognitive and affective benefits of using videos in instruction. Studies show that video-based materials promote deeper understanding (Mitra et al., 2010), foster positive attitudes toward learning (Shyu, 2000; Kinnari-Korpela, 2015), and stimulate students' interest, creativity, and engagement (Lonergan, 1984; Kearney & Schuck, 2005; Berk, 2009; Nordstrom & Korpelainen, 2011). They can also enhance collaborative learning and strengthen peer interaction (McCombs & Liu, 2007; Tarantino et al., 2013). From the teacher's perspective, videos reduce the time required for lengthy concept explanations and allow more opportunities for higher-order activities and formative assessment (Cruse, 2006; Felton et al., 2001). As shown in studies by Choi and Johnson (2005) and Pan et al. (2012), well-designed video lessons can capture learners' attention, motivate independent study, and improve content retention.

While these studies demonstrate the potential of video-based instruction, the literature reveals two key gaps. First, most prior research focuses on general benefits of video use, with limited exploration of how theoretically grounded video design—particularly those based on principles of multimedia learning—affects young learners' mathematics performance. Second, there is a scarcity of studies contextualized within Philippine public schools, where resource limitations, learning gaps, and pandemic-related disruptions have heightened the need for effective instructional interventions.

To address this gap, the present study draws on Mayer's Cognitive Theory of Multimedia Learning (CTML), which posits that learners understand concepts more effectively when information is presented through coordinated verbal and visual channels (Mayer, 2001, 2005). CTML emphasizes that meaningful learning occurs when learners engage in selecting, organizing, and integrating information from both auditory and visual input (Mayer, 2009). According to this theory, instructional videos become more effective when they follow principles such as coherence (removing extraneous information), signaling (highlighting key points), segmenting (breaking content into manageable chunks), modality (using spoken words rather than on-screen text), and redundancy (avoiding simultaneous text and narration) (Mayer, 2014; Mayer & Moreno, 2003). Integrating these principles helps reduce cognitive load and enhances mental representation of mathematical concepts, making them especially beneficial for young learners who often struggle with abstract ideas.

In the Philippine context, the Department of Education (DepEd) emphasizes early development of mathematical skills, as reflected in the K to 12 Mathematics Curriculum Guide. Grade 3 learners are expected to demonstrate understanding of key concepts and apply them in reasoning, communication, representation, and problem-solving using appropriate technologies. However, despite these curricular goals, mathematical difficulties persist among Filipino learners. Local reports indicate issues such as weak mental representations and limited problem-solving ability (Gatchalian, 2021). At Tinigaw Elementary School, for example, Grade 3 Mathematics averages declined from 86 (S.Y. 2021–2022) to 81 (S.Y. 2022–2023), partly due to the absence of direct teacher guidance during remote learning. Teachers also observed that many pupils relied on memorization rather than conceptual understanding and often described mathematics as boring—unless supported by educational videos that made lessons more interactive and engaging.

These local challenges mirror national and international assessments. Results from the 2019 Trends in International Mathematics and Science Study (TIMSS) and the Southeast Asia Primary Learning Metrics (SEA-PLM) showed that the Philippines ranked lowest among 58 participating countries in mathematics, with

only 19% of learners achieving even the low benchmark (Magsambol, 2020). Such findings underscore the urgent need for interventions that strengthen conceptual understanding and improve mathematics performance at the foundational level.

Given this situation, integrating theoretically informed video-based instructional materials becomes a promising strategy to enhance mathematics learning. By applying Mayer's multimedia principles, video lessons can support cognitive processing, help learners form accurate mental models, and enhance understanding of mathematical procedures and concepts (Mayer, 2017).

Therefore, this study proposes the development and implementation of a video-based instructional intervention grounded in multimedia learning theory to improve the Mathematics performance of Grade 3 pupils at Tinigaw Elementary School for S.Y. 2023–2024. Anchored on the belief that well-designed remedial instruction is crucial in addressing learning gaps, this research contributes to the growing work on multimedia-based mathematics instruction, particularly within low-resource Philippine public school contexts.

Methods

This study employed a one-group pretest–posttest design to determine the effect of the video-based instructional intervention on the mathematical performance of Grade 3 pupils (Allen, 2017). Learners completed a pretest aligned with key Grade 3 competencies, received a 12-week video-based instructional intervention focusing on the least mastered skills identified in the pretest, and subsequently took a posttest to measure improvement. The researcher acknowledges that this design is vulnerable to threats to internal validity such as history, maturation, testing effects, and instrumentation because there was no comparison or control group. However, alternative designs were not feasible due to the school's context because only one intact Grade 3 class was available, making random assignment impossible, and ethical considerations prevented withholding the intervention from any group of learners. Despite these limitations, the design was appropriate for evaluating changes in learners' performance within the constraints of the school setting.

Research Instruments

Three research instruments were used for data collection:

1. **Researcher-Made Pretest–Posttest**
   The test consisted of two parts: (a) the demographic profile of pupils and (b) 85 multiple-choice questions, with five items per competency based on the second quarter Most Essential Learning Competencies (MELCs) in Mathematics 3. The instrument was validated by experts with a mean score of 5 (excellent). Reliability was established through a pilot test on 30 Grade 3 pupils from Kalibo Elementary School, yielding a KR-20 coefficient of 0.822, which indicates high reliability (>0.70).
2. **Interview Protocol**
   A semi-structured interview was conducted to determine the pupils' psychographic profile, challenges in learning Mathematics, and the topics they found most difficult. Responses informed the development of the video-based instructional material. The protocol was validated by three experts.
3. **Validation Tool**
   The developed video-based instructional materials were assessed using a modified version of the Learning Materials Validation Tool provided by the Learning Resource Management and Development System (LRMDS) of DepEd. Three experts (content, language, and technical) validated the materials to ensure quality before classroom use.

Participants

The participants were all 38 Grade 3 pupils enrolled at Tinigaw Elementary School during S.Y. 2023–2024 (24 males and 14 females), selected through purposive sampling with total population coverage, as all learners in the grade level were included. Based on the Modified Learner Enrolment and Survey Form (MLESF), all participants had access to gadgets and stable internet connectivity, which enabled the use of video-based instructional materials.

Data Gathering Procedure

Prior to data collection, the researcher sought approval from the school principal and conducted an orientation with parents to explain the study's purpose and the intervention plan. To identify learners' challenges, semi-structured interviews were carried out via phone calls to gather information on pupils' difficulties in Mathematics and modular distance learning. Permission was obtained from participants to record and transcribe the interviews for analysis. A pretest was then administered over two days, with the first eight competencies tested on the first day and the remaining competencies on the second day. The results helped determine the least mastered competencies, defined as those with a mean percentage score of 75–80% or below. Based on these findings, video-based instructional materials were developed and subsequently validated using the DepEd LRMDS Learning Materials Validation Tool to ensure quality and appropriateness. The validated instructional videos were then implemented as an intervention during the second quarter of S.Y. 2023–2024. After the intervention period, a posttest was administered with the assistance of parents and guardians to measure improvements in pupils' mathematical performance and problem-solving skills.

Ethical Considerations

Assent was obtained from pupils, and informed consent was secured from their parents. Participation was voluntary, and withdrawal was permitted at any stage without consequence. Confidentiality and privacy of data were ensured, with all information used solely for research purposes.

Data Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including frequency counts, percentages, means, and mean percentage scores, were used to interpret results. Mastery levels were categorized as follows:

Table 3. Mastery/Achievement Level

Mean Percentage Score	Description
95–100%	Mastered
88–94%	Closely Approximating Mastery
81–87%	Moving Towards Mastery
75–80%	Low Mastery
Below 74%	No Mastery

To determine the acceptability of the video-based instructional materials, mean ratings were interpreted using a modified scale from Torrefranca (2017):

Table 4. Acceptability Scale

Range	Response	Description	Interpretation
1.50–2.00	Yes	Acceptable	Excellently met standards; no revisions needed
1.00–1.49	No	Not Acceptable	Did not meet standards; revisions needed

The normality of data was assessed using the Kolmogorov–Smirnov test. To test for significant differences between pretest and posttest scores, a paired-sample *t*-test was employed.

Result and Discussion

Least Mastered Competencies of Grade 3 Pupils in Mathematics

Table 1 presents the mastery indices of the different competencies in Mathematics for the second grading period. Findings reveal that the two least mastered competencies were: (a) illustrating the properties of multiplication in relevant situations (commutative, distributive, or associative property) with only 42% correct responses, and (b) solving routine and non-routine problems involving the division of 2- to 4-digit numbers by 1- to 2-digit numbers, with or without the use of other operations of whole

numbers, including money, with only 62% correct responses.

These results indicate that the aforementioned competencies are the least learned skills among Grade 3 pupils. They subsequently served as the basis for the development of the video-based instructional materials.

Table 1. Mastery Index per Competency in Mathematics 3 (Second Grading Examination)

COMPETENCIES	Number. Of Correct Responses	Percentage of Correct Responses	Mastery Level
1. Visualizes multiplication of numbers 1 to 10 by 6,7,8 and 9.	169	89%	CAM
2. Visualizes and states basic multiplication facts for numbers up to 10.	175	92%	CAM
3. Illustrates the properties of multiplication in relevant situations (commutative property, distributive property, or associative property)	79	42%	N.M.
4. Multiplies numbers 2- to 3-digit numbers by 1-digit numbers without or with regrouping	158	83%	MTM
5. Multiplies numbers 2-digit numbers by 2-digit numbers with and without regrouping	153	81%	MTM
6. Multiplies numbers 2- to 3-digit numbers by multiples of 10 and 100	154	81%	MTM
7. Multiplies numbers 1- to 2-digit numbers by 1 000	165	87%	MTM
8. Estimates the product of 2- to 3-digit numbers and 1- to 2-digit numbers with reasonable results.	153	81%	MTM
9. Multiplies mentally 2-digit by 1-digit numbers without regrouping with products of up to 100.	170	89%	CAM
10. Solves routine and non-routine problems involving multiplication without or with addition and subtraction of whole numbers including money using appropriate problem-solving strategies and tools.	155	82%	MTM
11. Visualizes and states the multiples of 1- to 2-digit numbers.	154	81%	MTM
12. Visualizes division of numbers up to 100 by 6,7,8 and 9 (multiplication table of 6, 7, 8, and 9).	158	83%	MTM
13. Visualizes and states basic division facts of numbers up to 10.	153	81%	MTM
14. Divides numbers without or with the remainder: a. 2- to 3-digit numbers by 1- to 2- digit numbers b. 2-3 digit numbers by 10 and 100	159	84%	MTM
15. Estimates the quotient of 2- to 3- digit numbers by 1- to 2- digit numbers.	155	82%	MTM

COMPETENCIES	Number. Of Correct Responses	Percentage of Correct Responses	Mastery Level
16. Divides mentally 2-digit numbers by 1-digit numbers without remainder using appropriate strategies.	160	84%	MTM
17. Solves routine and non-routine problems involving the division of 2- to 4-digit numbers by 1- to 2-digit numbers without or with any of the other operations of whole numbers, including money, using appropriate problem-solving strategies and tools.	117	62%	N.M.

Legend: M-Mastery; CAM-Closely Approximating Mastery; MTM-Moving Towards Mastery; NM-No Mastery

Problems Encountered by the Grade 3 pupils in Learning Mathematics

The findings of the study on Grade 3 pupils' problems encountered in learning Mathematics in modular distance learning yielded three (3) central themes: difficulty in understanding lessons and activities due to limited foundational knowledge and inadequate module support, absence of assistance, and poor quality module and the lack of materials to supplement the learning modules.

Difficulty in Understanding Lessons and Activities Due to Limited Foundational Knowledge and Inadequate Module Support

The majority of the pupils found the lessons difficult to understand, making it challenging for them to complete the activities in the Mathematics modules and lessons. Even before the use of the video-based instructional material, many pupils already struggled with Mathematics due to limited mastery of foundational concepts and insufficient learning support at home. Several pupils also mentioned that they encountered difficulty in solving multiplication problems.

Pupil 5 said,

> *"Indi ako kaantigo magtimes."* (I don't know how to multiply (numbers).)

While Pupil 9 similarly stated,

> *"Malisod magtimes ag divide."* (It is hard to multiply and divide (numbers).)

The challenge extended to problem-solving involving multiplication, as Pupil 6 shared,

> *"Ang nalisdan hay sa pagmultiply kung paalin e-solbar do problima."* (I find multiplication in problem-solving difficult.)

The same problem was shared by Pupil 2, who said,

> *"Ro problima ag nalisdan nakun hay ro multiplication dahil kaabo ro pamaagi."* (Multiplication is very challenging for me because there are a lot of ways to solve for its answer.)

The limited examples provided in the modules contributed to the difficult experience of the pupils in learning the lesson.

Pupil 3 mentioned,

> *"Sankiri abi do example sa module."* (There are a few examples in the module.)

Further, it was also said that though there are examples provided, they did not match with the activities to be answered, which leads to the pupils' difficulty in answering the activities in the module.

Pupil 5 said,

> *"Indi ko maintindihan do activity kasi iba man abi do example. Indi ko masundan kung paalin obrahon do activity dahil wa ako it masundan nga example."* (I cannot understand the activity because the example does not coincide to it. I cannot work on the activity correctly because there is no example which can serve as my guide.)

The examples found in the modules are the only guidance the pupils can lean on. However, the modules provided contain only a few examples in every topic and are sometimes different from the activities given in the modules. Thus, when the pupils tried to answer the activities in the module, they could not answer them as they had limited resources on how to respond to the activities. Pupils gain from modular distance learning, but it needs certain learning resources to be of high quality (Panganiban & Madrigal, 2021). The lack of information in the learning modules that were provided to the students is one of the reasons why they struggle to complete them (Panganiban & Madrigal, 2021). With these problems, some pupils tend to leave answer sheets in the modules unanswered, or worse, they tend not to submit their modules anymore. The results of this study corroborated a prior finding that most students had trouble answering the learning modules and that mathematics is the most difficult self-learning module (Pe Dangle, 2020).

Absence of Assistance

The second theme highlights the lack of help given to the pupils while learning Mathematics using the self-learning module. Many pupils had to learn independently, and they expressed their frustration about not receiving adequate assistance while working on their Mathematics lessons and activities.

According to Pupil 10,

> *"Owa abi si mama ag papa hay gatrabaho sanda."* (My mother and father are busy working.)

It is difficult to study independently without aid from others. Parents who act as para teachers at home are needed to assist pupils who are studying during modular distance learning. This corroborated with what Panganiban & Madrigal (2021) mentioned, that learners during modular distance learning are frustrated when they cannot find a competent guide to help them understand the lesson.

The pupils also expressed their challenges in learning Mathematics and answering activities in the modules because the teacher was not present to explain the topic further.

As Pupil 1 said:

> *"Malisod ro Math kung owa it gaturo. Nalisuran ako magsabat kung owa ako kaintindi it akon natun-an."* (Math is hard to understand when no one is teaching (me). I find it hard to answer the activities if I don't understand the topic.)

Pupil 2 shared,

> *"Indi ako kaintindi it leksyon kung owa it gaturo kakun."* (I cannot understand the lesson if no one is teaching me.)

The same line of thought was noted by Pupil 3,

> *"Malisod magintindi kung bukon it teacher ro gaturo."* (It is hard to understand (the lesson) if there is no teacher teaching.)

The same result was found in the study of Pe Dangle (2020), which stated that pupils felt dissatisfied with modular distance learning because of the difficulty in communicating with their teachers.

Pupils are encouraged to learn independently as the new norm for education emerges. However, it was difficult for them to develop it. Thus, they sought help from their community, particularly parents and teachers, in learning mathematics using modules. However, not all pupils' sentiments were addressed by the stakeholders. The same finding was presented in the study conducted by Salammudin (2021), which stated that most learners do not

like the modular distance learning approach because they feel abandoned.

Poor Quality Module and the Lack of Materials to Supplement the Learning Module

The third theme described how pupils perceive the quality of provided printed Mathematic modules from the Department of Education (DepEd). Learning tools are a crucial component of education since they help pupils navigate, especially when a teacher is unavailable, or a crisis occurs. However, the pupils had a problem with the caliber of the self-learning materials made available to them.

Pupil 8 shared,

> *"May mga words ag picture nga indi maklaro."* (Some words and pictures were not clear.)

The majority of pupils relied on the provided examples from the self-learning modules. However, given the limited learning resources available as a guide, it was not enough for the participants to properly understand the topic.

As stated by Pupil 5,

> *"Sankiri abi do example sa module ag manami do may mga picture ag do mga video napatan-aw ni mam kamon."* (There are a few examples in the module, and I like it when there are pictures and videos that our teacher usually shows us before.)

Pupil 10 agreed with Pupil 5 and said,

> *"Sa module eang abi kami gatuon, wa eon kami it iba nga maboe-an it ideya parte sa lesson. Iba ta dati nga una si mam gaturo ag may amon nabasa pa gid ag ginatan-aw sa blackboard ag sa TV."* (I only study through the modules and don't have other resources to understand the lesson better. Unlike before, when my teacher is present and was teaching us and giving us more ideas through reading materials and other instructional materials posted on the blackboard and shown on T.V.)

In distant education, learning resources are important, especially if students have no alternative learning resources. However, this component of modular distance learning had not been met.

The findings of this study agree with what Panganiban & Madrigal (2021) mentioned, that the lack of supplemental materials is identified as one of the factors that contribute to the pupils' difficulty in answering their modules. This implies that there is a need to develop supplementary material that will aid pupil engagement and enable them to easily, effectively, and efficiently absorb the lesson.

Performance of Grade 3 Pupils Before and After the Intervention

Table 2 shows that the performance of Grade 3 pupils in Mathematics improved considerably after the use of instructional videos ($M = 8.61$, $SD = 1.17$) compared to their performance before implementation ($M = 5.16$, $SD = 2.03$). The smaller standard deviation after the intervention suggests that the pupils' performance was more homogeneous and closer to the mean.

This demonstrates that pupils performed better after the introduction of video-based instructional materials, supporting their effectiveness as supplementary resources in Mathematics.

Table 2. Performance of Grade 3 Pupils in Mathematics Before and After the Use of Video-Based Instructional Material

	N	Mean	SD
Before the Use of Video-Based Instructional Material (Pretest)	38	5.16	2.03
After the Use of Video-Based Instructional Material (Posttest)	38	8.61	1.17

Difference in Performance Before and After the Intervention

The paired-sample t-test (Table 3) revealed a statistically significant improvement in the mathematics performance of Grade 3 pupils after the intervention (pretest: M = 5.16, posttest: M = 8.61), $t(37) = -10.795$, $p < .001$. Prior to conducting the t-test, the normality of the pretest and posttest scores was assessed using the **Shapiro–Wilk test**, which indicated that both distributions did not significantly deviate from normality (pretest: $W = 0.964$, $p = 0.220$; posttest: $W = 0.978$, $p = 0.569$), justifying the use of a parametric test. The effect size calculated using Cohen's d was 2.08, indicating an extremely large practical significance and suggesting that the intervention had a very substantial impact on learners' performance.

These quantitative results are complemented by qualitative observations from the learners. Pupils reported that video lessons made complex concepts such as multiplication and division easier to understand, increased their engagement, and encouraged them to attempt problem-solving independently. Many learners noted that the combination of visual demonstrations and verbal explanations in the videos helped them retain information and complete their modules more confidently. These findings align with Fajaryati et al. (2017), who emphasized that video lessons facilitate efficient and effective acquisition of information, and Day (2008), who highlighted that classroom videos reduce the time spent on information transfer while increasing opportunities for meaningful learning activities that promote active knowledge construction.

Table 3. Difference in the Performance of Grade 3 Pupils in Mathematics Before and After the Use of Video-Based Instructional Material

	N	Mean	t	Sig.	95% Confidence Interval of the Difference	
Before	38	5.16	-10.795	.000*	-4.094	-2.800
After	38	8.61				

* *means significant at 0.05 level of significance*

Acceptability of the Developed Video-Based Instructional Materials

As shown in Table 4, the developed instructional videos were rated "Acceptable"

(M = 1.99) across all evaluation criteria using the DepEd LRMDS tool. This means the materials met the required standards and were deemed suitable for classroom use without revisions.

The results suggest that the video-based instructional materials are worthy of implementation and serve as an effective supplementary tool for addressing pupils' difficulties in Mathematics.

Table 4. Acceptability Level of Developed Video-Based Instructional Material

	Criterion Items	Mean	Description
1.	Is the language used in the L.R. easily understood by the target user?	2	Acceptable
2.	Are the instructions easily understood by the target user?	2	Acceptable
3.	Can the target user accomplish the activities?	2	Acceptable
4.	Can the target user perform the activities on a required period of time?	2	Acceptable
5.	Are the illustrations/pictures interesting?	2	Acceptable

	Criterion Items	Mean	Description
6.	Are the illustrations/pictures helpful to the target user in understanding the lessons and activities?	2	Acceptable
7.	Are the illustrations/pictures clear?	2	Acceptable
8.	Is the layout of the L.R. attractive, orderly, and consistent?	2	Acceptable
9.	Is the L.R. free from offensive content on gender, cultural and race?	1.93	Acceptable
10.	Are there errors found in the L.R.s? (please specify)	2	Acceptable
	Rating	1.99	**Acceptable**

Conclusion

The findings of this study indicate that video-based instructional materials have the potential to improve the mathematical performance of Grade 3 pupils by providing clearer explanations, visual representations, and flexible learning support. The positive gains observed from pretest to posttest suggest that well-designed multimedia resources can address learning gaps in key competencies such as multiplication and division, which many pupils previously struggled to master. These improvements highlight the role of technology-enhanced lessons in helping young learners construct meaning, sustain engagement, and overcome difficulties associated with abstract mathematical concepts.

However, these results should be interpreted in light of the study's methodological limitations. The use of a one-group pretest–posttest design does not allow strong causal claims because external factors such as maturation, prior exposure to content, and testing effects may have influenced the outcomes. The study was also limited to a single school with a small sample, which restricts the generalizability of the findings.

Despite these constraints, the study offers meaningful implications for practice and policy. Schools may consider integrating video-based instructional materials into regular mathematics instruction to supplement modules and address persistent misconceptions. Teachers may also be supported through training on multimedia lesson design grounded in established principles such as Mayer's Cognitive Theory of Multimedia Learning. For policymakers, the results underscore the need to invest in accessible digital resources that can enhance foundational numeracy skills, especially in contexts where learners have limited access to teacher-guided instruction.

Future research may employ more rigorous designs, such as quasi-experimental or randomized controlled studies, to validate the effectiveness of video-based interventions across diverse school settings. Studies exploring long-term learning retention, learner engagement, and integration with other teaching strategies would further strengthen evidence on the role of multimedia in elementary mathematics education.

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