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What Young Learners Want in Mathematics Videos: A Preference Study Informed by the Cognitive Theory of Multimedia Learning in Philippine Early Primary Education

Sybel Joy Farillon-Labis* **and Jonathan Celiz-Glorial**
College of Education, West Visayas State University
Iloilo City, Philippines

Abstract. While Mayer's Cognitive Theory of Multimedia Learning (CTML) has been extensively validated with adult and higher education populations, its applicability to early primary learners in multilingual contexts remains underexplored. This study examined the mathematics instructional video preferences of 120 Grade 1 to Grade 3 learners in a Philippine integrated laboratory school using a descriptive survey design. A researcher-developed preference checklist, validated through the Content Validity Index (CVI) procedure (scale-level CVI = 0.94), was administered via a facilitated video-viewing protocol, allowing learners to view representative video examples before indicating their preferences. Results showed a strong preference for microvideos and animated formats, with 96.7% of learners selecting videos under two minutes. Subtitles were preferred by 67.5% of participants, although this preference declined slightly from Grade 1 to Grade 3. Teacher narration was the most consistently preferred audio feature, whereas preference for peer narration declined with increasing grade level. These findings are discussed in relation to the CTML principles of segmenting, modality, signaling, and redundancy and are presented as context-sensitive indications rather than confirmatory evidence. Alternative interpretations, including cultural familiarity, media exposure, and Philippine classroom dynamics, are also acknowledged. This study establishes the first systematic preference-based empirical dataset for this population, generating design-oriented hypotheses for future research on the effectiveness of CTML-aligned video features in supporting mathematics learning among early primary students in multilingual educational settings.

Keywords: microvideos; primary mathematics videos; subtitles; learner preference; teacher narration

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*Corresponding author: Sybel Joy Farillon-Labis; *sj_labis@wvsu.edu.ph*

1. Introduction

Mathematics education in the early elementary grades forms the bedrock of foundational numeracy skills, which are robust predictors of long-term academic achievement. The United Nations Sustainable Development Goal (SDG) 4 emphasizes the urgency of delivering inclusive, equitable, and high-quality primary education, targeting universal numeracy by 2030 (United Nations, 2015). This imperative is particularly pronounced in the Philippines, where recent international assessments have highlighted critical learning gaps. For example, Filipino Grade 4 students ranked last among 58 countries in TIMSS 2019, with an average mathematics score of 297 (Mullis et al., 2020).

Similarly, only 16% of Filipino students achieved baseline mathematical proficiency in PISA 2022, compared to the OECD average of 69% (OECD, 2023). National findings further underscore these challenges: the Second Congressional Commission on Education reported that only one in four Grade 3 students could perform division, with mathematical proficiency declining sharply from 30.52% in Grade 3 to 0.47% in Grade 12. Given that early academic skills and mathematics performance are closely linked to long-term educational success (Allen et al., 2024), these foundational deficits may have profound and long-lasting consequences.

Addressing these persistent gaps requires not only curricular reform but also the development and integration of effective instructional resources. Instructional videos have emerged as valuable digital tools in early mathematics teaching, offering dynamic combinations of visual and auditory information that make abstract mathematical concepts accessible to diverse learners (Asnaini, 2025; Evangelou, 2023). In order to optimize the design of these resources, researchers and practitioners frequently rely on Mayer's Cognitive Theory of Multimedia Learning (CTML) as a theoretical framework for instructional video design (Brame, 2016; Fyfield et al., 2022; Mayer, 2021a). In the present study, CTML serves as an interpretive lens for understanding learner preferences rather than as a framework being experimentally tested or confirmed.

Despite extensive validation of CTML, a consistent demographic gap remains in the educational video research literature, with early primary learners remaining significantly underrepresented (Walsh & Henderson, 2022). Young children's developing cognitive and working memory capacities mean that video design guidelines derived from adult populations cannot be assumed to apply directly to early primary classrooms without empirical verification involving younger learners.

This gap is further compounded in the Philippine multilingual context, where Grade 1 to Grade 3 learners receive instruction across multiple languages under the Mother Tongue-Based Multilingual Education policy (Aperocho, 2023), introducing linguistic factors that standard CTML models do not explicitly address. Understanding of how these learners perceive and prefer specific video design features remains limited, and establishing a preference baseline is a

necessary precursor to experimental studies evaluating CTML-aligned video features in this context.

This study aims to address these gaps by systematically documenting the mathematics instructional video preferences of Grade 1 to Grade 3 learners in a Philippine integrated laboratory school, using CTML as an interpretive reference. Specifically, the study investigates:

1. What types of mathematics instructional videos do Grade 1 to Grade 3 learners prefer?
2. Which video lengths are most engaging for these learners?
3. To what extent are subtitles preferred in mathematics instructional videos?
4. Which audio features are favored in mathematics video content?

By providing the first empirical dataset on instructional video preferences among Grade 1 to Grade 3 learners in a Philippine multilingual laboratory school setting, this research provides a locally grounded foundation for evidence-based mathematics video design. While this study does not establish causal links between video features and learning outcomes, it generates design-oriented hypotheses for future experimental work, advancing the understanding of effective early primary mathematics video design in multilingual educational environments and contributing to the ongoing response to the Philippine numeracy crisis in line with SDG 4.

2. Literature Review

This literature review synthesizes the theoretical and empirical foundations across four interconnected areas: the evidence base for video-based mathematics instruction in primary grades; the theoretical underpinnings and cognitive implications of Mayer's Cognitive Theory of Multimedia Learning (CTML) for young learners; the core video design features relevant to this study; and the specific gaps in current knowledge that this research seeks to address.

2.1 Video-Based Mathematics Instruction: Evidence and Emerging Research

The integration of digital technologies has fundamentally transformed educational practices, especially following the accelerated adoption of online tools during the COVID-19 pandemic (Cevikbas & Kaiser, 2023; Polat et al., 2025). In mathematics education, instructional videos now serve as essential multimodal resources for making abstract concepts accessible. Research demonstrates that combining dynamic visuals with auditory narration supports procedural understanding (Tani et al., 2022; Mayer, 2021a), while interactive video formats enhance engagement in elementary mathematics settings (Wibowo et al., 2024). Meta-analytic evidence further links active video designs with increased motivation, engagement, and retention (Zhang et al., 2025), positioning instructional videos as central tools for primary mathematics learning.

However, this evidence is not evenly distributed across learner populations. Walsh and Henderson (2022) found that primary-grade mathematics video instruction is relatively underexplored compared with secondary and tertiary contexts. The limited existing research involving young learners reports

inconsistent findings regarding effective video features, formats, and durations (Beege et al., 2023; Beege et al., 2025; Fyfield et al., 2022), indicating that design recommendations developed for older students may not apply to early primary classrooms. This inconsistency underscores the need for systematic, primary-grade-specific preference studies before experimental research can be meaningfully designed and conducted; this gap is addressed in detail in Section 2.4.

2.2 Theoretical Underpinnings: CTML and the Cognitive Vulnerabilities of Early Learners

CTML posits that humans process information through dual, limited-capacity visual and auditory channels, and effective video design must minimize extraneous cognitive load, manage essential processing, and foster generative learning (Mayer, 2021a; Mayer, 2021b). While extensively validated in adult populations, its direct applicability to early primary learners remains uncertain due to two main factors.

First, the transient information effect demonstrates that young learners are especially vulnerable to the rapid disappearance of on-screen information, a challenge distinct from the more stable working memory limitations experienced by adults (Leahy & Sweller, 2011; Beege et al., 2025). Recent studies confirm that this vulnerability interacts with cognitive offloading demands, increasing the risk of overload for learners whose metacognitive skills are still developing (Chen et al., 2026; Armitage & Gilbert, 2025). Consequently, cognitive load thresholds established for adults cannot be presumed to apply to primary students.

Second, unresolved tensions within CTML—such as the redundancy principle and instructor presence—are particularly consequential for young learners. The redundancy principle cautions against simultaneous on-screen text and narration, yet emerging evidence suggests that subtitles may serve as compensatory scaffolds for early readers, especially in multilingual contexts (Black, 2021; Li, 2025). The question of whether subtitles support or hinder Grade 1 to Grade 3 learners under the Philippine Mother Tongue-Based Multilingual Education (MTB-MLE) policy remains open. Similarly, while visible instructor presence can split attention and increase cognitive load (Colliot & Jamet, 2018; Fiorella & Mayer, 2018), meta-analytic findings suggest that it can also enhance motivation and social presence, particularly for younger students (Alemdag, 2022; Beege et al., 2023). Thus, age-specific preference data are essential to clarify these effects.

2.3 Key Design Features Influencing Learner Engagement

To optimize video-based instruction for young learners, it is necessary to critically examine the specific design features that influence cognitive processing and engagement.

2.3.1 Video typology, format, and instructor presence

Chorianopoulos (2018) presents a detailed taxonomy of asynchronous video modalities, including teacher-led tutorials, explainer videos and demonstrations, as well as various animation-based and presentation-based styles. Within mathematics education, animated videos have demonstrated particular

effectiveness in illustrating abstract and dynamic processes, as originally identified by Thompson and Riding (1990) and more recently confirmed by Nasvi et al. (2025) in elementary fraction instruction. Microvideos, which are short videos typically under two minutes in length, have received empirical support for facilitating germane cognitive processing. Systematic reviews by Monib et al. (2025) indicate that these short formats help reduce extraneous cognitive load and segment content into manageable units, which is especially beneficial for young learners. Hybrid formats such as lightboard videos combine the benefits of social presence with clear visual representation. However, their instructional value is highly dependent on both production quality and the instructor's delivery style, as noted by Gedik et al. (2023).

The question of instructor presence continues to generate debate and appears to be highly context-dependent. The interference hypothesis, rooted in cognitive load theory, argues that a visible instructor can act as a seductive detail, diverting attention and increasing extraneous cognitive load (Colliot & Jamet, 2018; Fiorella & Mayer, 2018). In contrast, Social Agency Theory suggests that instructor visibility and familiar voices foster parasocial interaction, which can stimulate generative processing and increase learner motivation (Atkinson et al., 2005; Mayer et al., 2003). A meta-analysis by Beege et al. (2023) showed that while instructor presence consistently enhances motivation, its cognitive effects are variable and often moderated by learner age. This underscores the need for age- and context-specific empirical studies.

2.3.2 Video duration and pacing

The optimal length for instructional videos remains a contested topic in educational research. Guo et al. (2014) analyzed millions of video sessions and found that viewer engagement declines rapidly for videos longer than six minutes. This observation has contributed to the widely cited 'six-minute rule' in digital content design. However, this rule does not always apply, particularly in mathematics education, where the complexity of concepts and multi-step reasoning often require longer, scaffolded instructional sequences (Demir & Birgili, 2024).

Research by Konukoğlu and Özmantar (2025) highlights that engagement is influenced more by content focus, instructional intent, and the developmental appropriateness of pacing than by duration alone. Seidel (2024) further demonstrates that segmented video structures, in which content is divided into discrete and logically ordered units, better support sustained engagement and cognitive processing than overall video length. For early primary learners, who are still developing metacognitive self-regulation, the appropriateness of pacing and segment length is particularly important. Empirical data on learner preferences are therefore vital to inform decisions about video duration and structure in mathematics instruction.

2.3.3 Subtitles and the redundancy principle

The use of subtitles in instructional videos, particularly in relation to the redundancy principle, remains a topic of active scholarly discussion. Kalyuga and Sweller (2014) argue that presenting identical information as both on-screen text

and narration imposes unnecessary cognitive demands, a conclusion strongly supported by studies involving adult learners. However, recent research suggests that this principle may not hold for early primary and multilingual learning environments. Black (2021) reviewed evidence showing that carefully formatted subtitles can serve as effective scaffolds for young readers, supporting both linguistic decoding and comprehension. Meta-analyses by Reynolds et al. (2022) further indicate that captioned and subtitled videos enhance vocabulary acquisition and comprehension, especially for emergent readers and language learners.

Li (2025) demonstrated that the benefits of subtitles are most pronounced for learners with lower proficiency levels, making subtitle support particularly relevant for linguistically diverse classrooms such as those in Grades 1 to 3 in the Philippines. The relationship between the redundancy principle and the scaffolding function of subtitles remains unresolved for early primary mathematics learners in multilingual contexts, highlighting the need for rigorous, context-specific empirical research on this issue.

2.4 Critical Gaps in the Knowledge Base

A review of the literature reveals a pronounced demographic gap at three levels. Globally, studies of educational video design overwhelmingly target older students, with early primary learners representing a negligible proportion of published research (Polat et al., 2025). Regionally, Southeast Asian research has mostly focused on secondary and tertiary learners, with minimal work on early primary video design preferences (Nabayra, 2023; Sagge & Segura, 2023). Most specifically, no studies have systematically documented the video format, subtitle, and audio preferences of Grade 1 to Grade 3 learners navigating multilingual instruction in the Philippines (Aperocho, 2023).

This study directly addresses these gaps by providing the first systematic, preference-based empirical dataset on mathematics instructional video design features among Grade 1 to Grade 3 learners at a Philippine integrated laboratory school. The findings establish a locally grounded preference baseline upon which future experimental studies can build to examine whether CTML-aligned video design features predict actual mathematics learning gains in this underrepresented and theoretically underexplored population.

3. Methodology

This section outlines the methodological framework employed to document the mathematics instructional video preferences of Grade 1 to Grade 3 learners. It details the research design, participant selection, instrumentation, data collection procedures, and data analysis strategies. Each component was carefully selected to ensure methodological rigor and the validity of the results for the intended population.

3.1 Research Design

This study employed a descriptive survey design to systematically document the mathematics instructional video preferences of primary-grade learners.

Descriptive survey designs enable researchers to obtain a representative picture of a target population by collecting quantifiable data that reflect prevailing attitudes and tendencies (Creswell & Creswell, 2018). This design was particularly appropriate because the study sought to document learners' choices regarding video features such as type, length, subtitle use, and audio narration without manipulating variables or introducing experimental conditions.

3.2 Participants

A total of 130 primary learners were invited to participate, of whom 120 volunteered, representing a 92.31% response rate. The 10 non-participating learners were excluded solely because their parents or guardians did not return signed consent forms within the designated collection period, and teacher adviser reports indicated no observable differences between participants and non-participants in terms of grade-level distribution or classroom characteristics.

Participants were enrolled during the 2023-2024 academic year at an integrated laboratory school affiliated with a state university in Iloilo City, Region VI, Philippines. This school was selected purposively because its structured pedagogical environment facilitated standardized data collection across grade levels, its university affiliation provided the institutional access and ethical oversight appropriate for research involving young children, and its MTB-MLE multilingual instructional context made it a theoretically relevant site for this study. It is acknowledged that laboratory schools typically serve learners from relatively stable socioeconomic backgrounds under closer pedagogical supervision than public elementary schools, meaning that the findings represent a context-specific preference baseline rather than a generalizable characterization of Philippine Grade 1 to Grade 3 learners more generally.

The sample comprised 40 Grade 1 learners (33.33%), 41 Grade 2 learners (34.17%), and 39 Grade 3 learners (32.50%), representing a reasonably balanced grade-level distribution. In terms of sex assigned at birth, 46 learners identified as male (38.33%) and 74 as female (61.67%), resulting in a female-skewed composition reflecting voluntary participation rather than deliberate sex-balanced sampling. Table 1 presents the demographic composition of the sample.

Table 1: Learners' demographics

Categories	N	%
Entire Group	120	100.0
Grade Level		
Grade 1	40	33.3
Grade 2	41	34.2
Grade 3	39	32.5
Sex assigned at birth		
Male	46	38.3
Female	74	61.7

3.3 Instruments

A researcher-developed survey checklist was used to collect data on learners' preferences for mathematics instructional video characteristics. The checklist included demographic items and asked learners to indicate their preferences regarding video format, video length, subtitle use, and audio features. Learners selected from ten video format categories, seven duration options, and five audio features, and were also asked to indicate whether they preferred subtitles. Table 2 presents the Table of Specifications, showing the alignment between the study's research variables, corresponding research questions, instrument items, response formats, and theoretical basis.

Table 2: Table of specifications for the mathematics instructional video preference checklist

Research Variable	Research Question	Instrument Item	Response Format	Theoretical Basis
Video type preference	RQ1: What types of mathematics instructional videos do Grade 1 to Grade 3 learners prefer?	Item B1: Select your preferred video format from ten categories.	Single selection from ten options: microvideos, tutorials, instructional videos, explainer videos, animated learning videos, presentation videos, training videos, drawing-based videos, lightboard videos, and demonstration videos.	CTML segmenting principle; microlearning theory (Monib et al., 2025); video taxonomy (Chorianopoulos, 2018)
Video length preference	RQ2: Which video lengths are most engaging for these learners?	Item B2: Indicate your preferred video length.	Single selection from seven duration options ranging from less than 60 seconds to more than 1200 seconds.	CTML segmenting principle; transient information effect (Leahy & Sweller, 2011)
Subtitle preference	RQ3: To what extent are subtitles preferred in mathematics instructional videos?	Item B4: Would you like to have subtitles in the video?	Three-option selection: Yes, Maybe, No.	CTML redundancy principle (Kalyuga & Sweller, 2014); subtitle scaffolding hypothesis (Black, 2021)
Audio feature preference	RQ4: Which audio features are favored in mathematics video content?	Item B3: What type of audio material would you pick?	Multiple selections from five options: teacher narration, background music, sound effects, peer narration, and interactive audio prompts.	CTML modality and signaling principles (Mayer, 2021a); Social Agency Theory (Beege et al., 2023)

Note. RQ = Research Question. CTML = Cognitive Theory of Multimedia Learning

To ensure the instrument was age-appropriate, each category included operational definitions in child-friendly language. Learners were shown brief representative video examples before completing the checklist, ensuring that responses reflected genuine format recognition rather than participants'

interpretation of abstract labels. Teacher advisers read all definitions and instructions aloud to ensure consistency across classrooms.

Content validity was assessed using the Content Validity Index procedure (Lynn, 1986; Polit & Beck, 2006). Three expert reviewers representing information and communication technology and mathematics education independently rated each item on a four-point relevance scale. The majority of the items achieved item-level CVI scores of 1.00. The video type item initially yielded a lower score and was revised based on expert feedback before final administration. The average scale-level CVI was 0.94, exceeding the recommended threshold of 0.90 and indicating strong content validity. Face validity was additionally supported by the expert panel's confirmation of developmental appropriateness for Grade 1 to Grade 3 learners and by a pilot test conducted with a small group of primary learners not included in the main study, which confirmed item clarity and ease of administration.

Because the checklist measured independent preferences across heterogeneous categories rather than a unidimensional latent construct, internal consistency was not assessed (Streiner, 2003). Procedural reliability was maintained through standardized administration protocols and structured teacher adviser briefings conducted before each data collection session, consistent with best practices in survey research involving young learners (Arthur et al., 2017; Colorado Legacy Foundation, 2014).

3.4 Data Collection Procedure

This study followed a structured sequence of ethical and methodological procedures. Formal institutional permission was obtained from the laboratory school director, after which parental consent forms were distributed to the parents or guardians of all invited participants. Only those learners whose parents provided written authorization were included, resulting in the exclusion of 10 learners whose consent forms were not returned within the designated collection period, consistent with established ethical guidelines for research involving children (Robinson, 2025).

Grade 1, 2, and 3 teacher advisers were recruited to facilitate data collection, due to the developmental age of the participants, consistent with best practices in classroom-based research with young children (Kirby, 2020; Montreuil et al., 2021). Recognizing that teacher facilitation carries an inherent risk of social desirability bias, several procedural safeguards were implemented. Prior to each session, advisers attended standardized briefings in which they were instructed to read all definitions and instructions exactly as written, without elaborating or expressing personal preferences regarding any response option. At the start of each session, learners were reminded that there were no correct answers and that the study required only their honest personal preferences. Individual response forms were completed independently to prevent peer influence and minimize response bias.

Data collection was conducted over approximately three weeks, with Grade 1 scheduled during the first week, Grade 2 during the second, and Grade 3 during the third. During each session, learners were first shown standardized video examples representing all ten format categories before completing the survey checklist. All examples were sourced from publicly available TikTok and YouTube content and covered fractions as a common Grade 1 to Grade 3 mathematics topic across all format categories, minimizing content difficulty as a confounding variable.

The presentation order was randomized across sessions to control for primacy and recency effects. It is acknowledged that platform-sourced videos inevitably vary in production quality across format categories, and this variability cannot be entirely ruled out as having partially influenced the observed preferences. After viewing the examples, learners completed the checklist independently, with adviser support limited to reading items aloud and re-reading definitions as needed.

3.5 Data Analysis

The study employed descriptive statistical techniques—specifically frequency counts, percentage distributions, and ranking—to analyze the survey data. These measures are widely recognized as appropriate for descriptive survey designs, as they provide a clear summary of categorical responses and allow researchers to identify patterns and trends within a population (Creswell & Creswell, 2018). Frequency analysis was used to determine the number of learners selecting each option across video type, length, subtitle preference, and audio features, while percentages were calculated to express these results relative to the total number of participants. Ranking was used to identify the most preferred video features among participants. This approach ensured that the findings accurately reflected the prevailing preference patterns among the target learners, consistent with the purpose of descriptive research in educational contexts.

4. Results and Findings

This section presents the findings of the study across four preference dimensions: video type, video length, subtitle use, and audio features. Each subsection reports aggregate frequency and percentage distributions, followed by grade-level disaggregated analyses to examine developmental patterns across Grade 1, Grade 2, and Grade 3 subgroups.

4.1 Learners' Preferences for Types of Mathematics Instructional Videos

As shown in Table 3, microvideos were the most preferred video type, selected by 62 learners (51.7%). This preference was consistent across grade levels, with Grade 2 showing the strongest concentration at 61.0% and Grade 1 at 55.0%. Animated learning videos ranked second (n = 27, 22.5%), followed by tutorials (n = 11, 9.2%), instructional videos (n = 9, 7.5%), and demonstration videos (n = 7, 5.8%). Lightboard and explainer videos received minimal selection, with two learners each (1.7%). Presentation videos, training videos, and drawing-based videos were not selected by any participant, indicating a clear preference against these approaches among young learners. Notably, Grade 3 showed a comparatively

more distributed preference pattern than the lower grades, with tutorials (n = 7, 17.9%) and instructional videos (n = 5, 12.8%) receiving proportionally higher selections, suggesting a modest developmental shift toward more structured instructional formats among older primary learners.

Table 3: Learners' preferred video types

Video type	Grade 1	Grade 2	Grade 3	Total	%	Rank
Microvideos/TikTok type	22	25	15	62	51.7	1
Animated Learning Videos	13	8	6	27	22.5	2
Tutorials	1	2	8	11	9.2	3
Instructional Videos	1	3	5	9	7.5	4
Demonstration Videos	1	2	4	7	5.8	5
Lightboard Videos	1	1	0	2	1.7	6.5
Explainer Videos	1	0	1	2	1.7	6.5
Presentation Videos	0	0	0	0	0.0	--
Training Videos	0	0	0	0	0.0	--
Drawing-Based Videos	0	0	0	0	0.0	--
Total	40	41	39	120	100.0	

Note. Percentages rounded to 1 decimal place

4.2 Learners' Preferences for Video Length for Mathematics Instruction

As shown in Table 4, learners across all three grade levels strongly preferred short-form mathematics videos. A total of 57 participants (47.5%) favored videos shorter than 60 seconds, while 54 learners (45.0%) preferred videos ranging from 60 to 120 seconds. Together, these two categories accounted for 92.5% of all responses, indicating a consistent inclination toward brief instructional formats. A small proportion selected longer durations, with five participants (4.2%) preferring videos between 121 and 300 seconds and four learners (3.3%) choosing videos between 301 and 600 seconds. No respondents preferred videos exceeding 600 seconds.

Grade-level disaggregation reveals nuanced differences within this overall pattern. Grade 1 learners showed a near-equal split between the two shortest categories, with 50.0% preferring videos under 60 seconds and 45.0% preferring those lasting 60 to 120 seconds. Grade 2 learners showed the strongest preference for videos lasting 60 to 120 seconds (63.4%), while Grade 3 learners showed the highest proportion selecting videos under 60 seconds (59.0%). Notably, Grade 3 was the only grade level to select videos in the 301-to-600 second range, with four learners (10.3%) choosing this option, suggesting a slightly greater tolerance for longer formats among older primary learners.

Table 4: Learners' preferred video length by grade

Video length (in seconds)	Grade 1 (n=40)	%	Grade 2 (n=41)	%	Grade 3 (n=39)	%	Total	%
< 60	20	50.0	14	34.1	23	59.0	57	47.5
60 – 120	18	45.0	26	63.4	10	25.6	54	45.0
121 – 300	2	5.0	1	2.4	2	5.1	5	4.2
301 – 600	0	0.0	0	0.0	4	10.3	4	3.3
601 – 900	0	0.0	0	0.0	0	0.0	0	0.0
901 – 1200	0	0.0	0	0.0	0	0.0	0	0.0
>1200	0	0.0	0	0.0	0	0.0	0	0.0
Total	40	100.0	41	100.0	39	100.0	120	100.0

Note. Percentages rounded to 1 decimal place

4.3 Learners' Preference for Subtitles in Mathematics Instructional Video

As shown in Table 5, a substantial majority of learners (n = 81, 67.5%) expressed a preference for subtitles in mathematics instructional videos. Among the remaining participants, 27 learners (22.5%) indicated no preference for subtitles and 12 learners (10.0%) were uncertain.

Grade-level disaggregation reveals a consistent but gradually declining preference for subtitles from Grade 1 to Grade 3. Grade 1 learners showed the highest proportion of Yes responses (n = 29, 72.5%), followed by Grade 2 (n = 28, 68.3%) and Grade 3 (n = 24, 61.5%). The proportion of Maybe responses increased modestly from Grade 1 (7.5%) and Grade 2 (7.3%) to Grade 3 (15.4%), suggesting that older primary learners expressed slightly more uncertainty about their subtitle preferences than younger learners. Despite this gradual decline, majorities across all three grade levels preferred subtitles, indicating a broadly consistent preference for on-screen text support among early primary mathematics learners in this context.

Table 5: Learners' preference for subtitles by grade

Subtitle Preference	Grade 1	%	Grade 2	%	Grade 3	%	Total	%
Yes	29	72.5	28	68.3	24	61.5	81	67.5
Maybe	3	7.5	3	7.3	6	15.4	12	10.0
No	8	20.0	10	24.4	9	23.1	27	22.5
Total	40	100.0	41	100.0	39	100.0	120	100.0

Note. Percentages rounded to 1 decimal place.

4.4 Learners' Preferred Audio Features in Mathematics Instructional Videos

As shown in Table 6, teacher narration was the most preferred audio feature, selected by 82 learners (68.3%). Sound effects for emphasis were favored by 76 learners (63.3%), followed by background music, preferred by 70 learners (58.3%), and interactive audio prompts, positively received by 67 learners (55.8%). In contrast, peer narration was the least preferred feature, with only 11 learners (9.2%) selecting it and 59 learners (49.2%) explicitly rejecting it.

Grade-level disaggregation reveals important developmental patterns across audio feature preferences. Teacher narration was consistently preferred across all three grade levels, with Yes responses of 70.0% in Grade 1, 65.9% in Grade 2, and

69.2% in Grade 3, indicating a robust and developmentally stable preference for teacher-led audio across early primary grades. Background music preferences were similarly consistent across grades, with Yes responses ranging from 56.1% to 60.0%. Sound effects were broadly preferred across all grades, with Yes responses ranging from 58.5% in Grade 2 to 69.2% in Grade 3. Interactive audio prompt preferences showed a slight decline from Grade 1 (60.0% Yes) and Grade 2 (61.0% Yes) to Grade 3 (46.2% Yes), with Grade 3 also recording the highest proportion of No responses at 33.3%.

The most analytically significant grade-level finding concerns peer narration rejection, which increased progressively and substantially across grades, from 32.5% in Grade 1 to 43.9% in Grade 2 and 71.8% in Grade 3. This developmental gradient suggests that older primary learners develop increasingly strong preferences against peer-led instruction in mathematics video contexts, a pattern which is consistent with growing emphasis on perceived instructional credibility and authority as learners advance through the primary grades.

Table 6: Learners' preference for audio features

Audio Feature	Response	Grade 1 (n=40)	%	Grade 2 (n=41)	%	Grade 3 (n=39)	%	Total	%
Teacher	Yes	28	70.0	27	65.9	27	69.2	82	68.3
Narration	Maybe	6	15.0	8	19.5	7	17.9	21	17.5
	No	6	15.0	6	14.6	5	12.8	17	14.2
Background	Yes	24	60.0	23	56.1	23	59.0	70	58.3
Music	Maybe	7	17.5	12	29.3	9	23.1	28	23.3
	No	9	22.5	6	14.6	7	17.9	22	18.3
Sound	Yes	25	62.5	24	58.5	27	69.2	76	63.3
Effects	Maybe	7	17.5	15	36.6	10	25.6	32	26.7
	No	8	20.0	2	4.9	2	5.1	12	10.0
Peer	Yes	5	12.5	4	9.8	2	5.1	11	9.2
Narration	Maybe	22	55.0	19	46.3	9	23.1	50	41.7
	No	13	32.5	18	43.9	28	71.8	59	49.2
Interactive	Yes	24	60.0	25	61.0	18	46.2	67	55.8
Prompts	Maybe	9	22.5	10	24.4	8	20.5	27	22.5
	No	7	17.5	6	14.6	13	33.3	26	21.7

Note. Percentages rounded to 1 decimal place

5. Discussion

This study systematically documented the mathematics instructional video preferences of Grade 1 to Grade 3 learners in a Philippine integrated laboratory school, using the Cognitive Theory of Multimedia Learning as an interpretive framework rather than as a theory being empirically tested (Mayer, 2021a; Mayer, 2021b). All interpretations presented here are preliminary and inferential, and alternative explanations rooted in cultural context, media exposure, and classroom dynamics are considered alongside CTML-based perspectives. It is important to acknowledge the theoretical boundaries of CTML for this population, as the theory was primarily developed and validated with adult learners, with the vast majority of its supporting evidence being drawn from higher education populations in controlled experimental conditions (Polat et al.,

2025; Mayer, 2021a). Its cognitive load assumptions and design recommendations may not fully reflect the developmental realities of Grade 1 to Grade 3 learners, whose working memory systems and metacognitive capacities are still developing (Leahy & Sweller, 2011; Panesi et al., 2022), nor the multilingual processing demands of Philippine MTB-MLE classrooms, where learners simultaneously navigate between their mother tongue, Filipino, and English as instructional languages (Aperocho, 2023). As such, even when preferences align with CTML principles, causal interpretations should be approached with caution.

A key finding was the strong preference for microvideos, with animated formats ranking second and Grade 3 learners showing a slight trend toward longer instructional formats. This is consistent with prior research indicating that short, focused video segments support schema construction and align with the segmenting principle of CTML (Brame, 2016; Mayer, 2021a; Seidel, 2024). However, it is equally plausible that these preferences reflect the influence of increased exposure to short-form digital content, particularly given the rise of social media and digital learning platforms in the wake of the COVID-19 pandemic (Gong & Tao, 2024; Monib et al., 2025; Polat et al., 2025; Rathnasekara et al., 2025). Experimental studies comparing learning outcomes for microvideos and longer formats, while accounting for learners' media exposure, would help clarify the basis for these preferences.

Across grade levels, learners favored videos under two minutes in length, echoing prior findings that brief videos are associated with greater engagement and cortical activation during mathematical tasks (Amalric et al., 2023; Guo et al., 2014). Older learners in Grade 3 demonstrated some tolerance for longer videos, which may reflect developmental changes in attention span. Nevertheless, factors such as attentional fatigue, cultural norms favoring short-form media, and differences between survey-based and naturalistic preferences may also contribute to these results. Future research may therefore examine both learner preferences and learning outcomes in more naturalistic viewing environments.

Subtitle preferences were consistently high across grades but showed a modest decline from Grade 1 to Grade 3, indicating that on-screen text support may be broadly valued among young learners. This finding stands in contrast to CTML's redundancy principle, which warns of increased cognitive load from simultaneous on-screen text and narration (Kalyuga & Sweller, 2014). Other research, however, suggests that subtitles can serve as linguistic scaffolds for young, multilingual readers (Black, 2021; Li, 2025), especially in contexts such as the Philippines, where multiple languages are used in instruction. Given the prevalence of captioned content in Filipino children's digital experiences (Amper, 2023; Sagge & Segura, 2023), media habituation may also play a role. The observed grade-level decline may indicate that as reading proficiency increases, the perceived need for subtitles decreases. Eye-tracking and comprehension studies could shed light on these mechanisms.

Teacher narration emerged as the preferred audio feature across all grades, while sound effects and background music were also popular. Interactive audio

prompts were less favored by Grade 3 learners. While these preferences align with the modality and signaling principles of CTML and Social Agency Theory, which highlights the motivational value of familiar authoritative voices (Atkinson, et al., 2005), alternative explanations may be considered. The teacher-centered culture of Philippine classrooms could shape these preferences through socialization and learned deference to teacher authority (Alemdag, 2022; Vygotsky, 1978). The survey captured what learners preferred but not why, making it difficult to distinguish whether preferences were driven by instructional value, enjoyment, or familiarity. Cross-cultural and qualitative studies would be valuable for disentangling these factors.

A notable developmental trend was the progressive rejection of peer narration from Grade 1 to Grade 3. This may reflect a growing preference for authoritative sources, as suggested by Social Agency Theory (Atkinson et al., 2005), but could also be influenced by linguistic familiarity or an increasing awareness of instructional credibility (Flavell, 1979; Mayer et al., 2003). Qualitative methods to explore learners' reasoning about their preferences would help clarify this finding.

Across all four preference dimensions, the observed patterns are consistent with the recommendations of experienced instructional designers and the principles of CTML. However, this alignment should be interpreted as suggestive rather than confirmatory, and alternative explanations rooted in cultural familiarity, media habituation, sociocultural conditioning, and motivational ambiguity remain viable throughout.

6. Conclusion

This study documented the mathematics instructional video preferences of Grade 1 to 3 learners in a Philippine integrated laboratory school, using CTML as an interpretive reference point rather than a framework being tested or confirmed. Learners consistently preferred microvideos, animated formats, short durations under two minutes, subtitles, and teacher narration supported by sound cues, while longer formats and peer narration were the least preferred. Grade-level disaggregation revealed a progressive increase in peer narration rejection from Grade 1 through Grade 3 and modest declines in subtitle preference and interactive prompt acceptance among older learners. These patterns, while not constituting causal evidence, suggest developmentally meaningful tendencies worthy of further investigation.

Interpreted through a CTML lens, the observed preferences are broadly consistent with the segmenting, modality, signaling, and redundancy principles, as well as Social Agency Theory's proposition that familiar authoritative voices may support motivational engagement. However, preference data cannot establish whether the selected features are more effective for mathematics learning than rejected ones. Equally plausible alternative explanations rooted in cultural familiarity, media habituation, and Philippine classroom dynamics remain viable, and all CTML-based interpretations are preliminary hypotheses rather than confirmed theoretical conclusions.

The contribution of this study lies in providing the first systematic, preference-based empirical dataset from Grade 1 to 3 learners in a Philippine multilingual laboratory school context. Rather than extending or validating CTML, this study uses it as a productive interpretive framework to identify where adult-derived multimedia design principles appear intuitively resonant with this underrepresented population and to highlight the boundary conditions where experimental testing is most urgently needed, specifically the applicability of the redundancy principle to multilingual early readers, the competing predictions of Social Agency Theory and sociocultural conditioning regarding teacher narration preference, and the extent to which CTML cognitive thresholds transfer to learners with still-developing working memory systems.

7. Limitations

Several limitations should be considered when interpreting the findings of this study. First, the descriptive survey design captures expressed preferences at a single point in time and cannot establish causal relationships between video design features and learning outcomes. All CTML-based interpretations are therefore inferential rather than confirmed, and the findings are best understood as a preliminary preference baseline pending experimental verification.

Second, the sample was drawn from a single integrated laboratory school in Iloilo City, which is institutionally distinctive in terms of its socioeconomic profile, pedagogical supervision, and technology access. Thus, the findings cannot be assumed to represent Philippine Grade 1 to Grade 3 learners more broadly, limiting the external validity of the conclusions.

Third, the 10 non-participating learners were excluded due to unreturned parental consent forms rather than learner-level characteristics, introducing a modest but unverifiable risk of selection bias. Future studies should address this through active consent procedures or incentive-based consent return strategies.

Fourth, despite procedural safeguards, including standardized adviser briefings, neutral facilitation protocols, individual response forms, and explicit no-correct-answer instructions, the inherent risk of social desirability bias in teacher-facilitated research with young children cannot be entirely eliminated. Future studies may consider paired comparison tasks or visual preference-sorting activities as complementary data collection approaches.

Fifth, video stimuli were sourced from publicly available TikTok and YouTube content, meaning that production quality varied across format categories in ways that could not be fully controlled. Purpose-produced stimuli of matched quality across all format categories would strengthen construct validity in future preference studies.

Sixth, the preference measurement design addressed each video design feature independently, which meant that it could not capture the combinatorial nature of actual video preferences. Therefore, the independent measurement of each feature underestimates the complexity of learners' actual video preferences.

Seventh, while grade-level disaggregated data are reported for all four preference dimensions, subgroup sizes were insufficient to support inferential statistical comparisons between grades. The grade-level patterns reported here are descriptive indications rather than statistically tested differences and should be interpreted as preliminary tendencies rather than established findings.

Eighth, the sample's female skew, at 61.67% female versus 38.33% male, and the absence of sex-disaggregated analyses limit the study's ability to detect sex-based preference differences that may exist within this age group.

Ninth, the absence of data on learners' prior media exposure, home language, reading proficiency, and device access limits the study's ability to explain preference variation or identify moderating learner characteristics.

Addressing these limitations in future research will substantially strengthen the evidence base for CTML-informed video design in early primary mathematics education across multilingual Southeast Asian contexts.

8. Recommendations

Based on the preference-based findings of this study, the following recommendations are offered for practitioners, policymakers, and future researchers. Because the study documents what learners preferred rather than what produces measurable learning gains, each recommendation is offered as a tentative, evidence-informed starting point rather than a prescriptive design standard.

For instructional designers and mathematics teachers, mathematics instructional videos for Grade 1 to Grade 3 learners may be tentatively designed as microvideos not exceeding two minutes, prioritizing animated formats with teacher narration, subtitle support, and strategic audio cues. Due to its consistent rejection across grade levels, peer narration may be used sparingly or avoided, pending experimental verification with specific learner populations.

For curriculum developers and educational policymakers, the preliminary nature of this evidence base warrants caution against immediate policy prescription. Given the severity of the Philippine mathematics learning crisis, as reflected in TIMSS 2019, PISA 2022, and EDCOM 2, policymakers may consider supporting multi-site replication studies and experimental studies of learning outcomes before embedding specific design standards in frameworks such as the DepEd MATATAG curriculum.

For future researchers, experimental studies may be designed to examine whether preferred video features predict actual mathematics learning gains across diverse Philippine school contexts. Multi-site studies may replicate this preference mapping across public, rural, and linguistically diverse settings. Grade-level and sex-based analyses may explore whether preferences differ across subgroups. Furthermore, future studies may investigate how learners' mother tongue and reading proficiency mediate subtitle preferences and may employ conjoint

analysis to capture the combinatorial nature of video preferences that the current design could not address.

Conflict of Interest
The authors declare no conflicts of interest.

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10. References

Alemdag, E. (2022). Effects of instructor-present videos on learning, cognitive load, motivation, and social presence: A meta-analysis. *Education and Information Technologies*, *27*(9), 12713–12742. https://doi.org/10.1007/s10639-022-11154-w

Amalric, M., Roveyaz, P., & Dehaene, S. (2023). Evaluating the impact of short educational videos on the cortical networks for mathematics. *Proceedings of the National Academy of Sciences*, *120*(6), Article e2213430120. https://doi.org/10.1073/pnas.2213430120

Amper, E. P. (2023). Development and validation of contextualized video lessons in mathematics for Grade 7 learners. *International Journal of Research in Innovation and Sustainability, 1*(1), 5–12. https://journal.ijris.com/index.php/ijris/article/view/2

Aperocho, M. D. B. (2023). A policy reform framework for mother tongue-based multilingual education in the Philippines. *International Journal of Multidisciplinary: Applied Business and Education Research*, *4*(3), 692–700. https://doi.org/10.11594/ijmaber.04.03.02

Armitage, K. L., & Gilbert, S. J. (2025). The nature and development of cognitive offloading in children. *Child Development Perspectives*, *19*(2), 108–115. https://doi.org/10.1111/cdep.12532

Arthur, A. M., Smith, M. H., White, A. S., Hawley, L., & Koziol, N. A. (2017). *Age-sensitive instrument design for youth: A developmental approach* (Technical Report). Nebraska Center for Research on Children, Youth, Families & Schools, University of Nebraska–Lincoln. ERIC. https://files.eric.ed.gov/fulltext/ED590480.pdf

Asnaini, A. (2025). Perceptions of students on differentiated learning of video content. *PPSDP International Journal of Education (PIJED)*, *4*(1), Article 407. https://doi.org/10.59175/pijed.v4i1.407

Atkinson, R. K., Mayer, R. E., & Merrill, M. M. (2005). Fostering social agency in multimedia learning: Examining the impact of an animated agent's voice. *Contemporary Educational Psychology*, *30*(1), 117–139. https://doi.org/10.1016/j.cedpsych.2004.07.001

Beege, M., Scheller, N., & Rey, G. D. (2025). Improving learning from instructional videos in primary education: The use of a mindfulness meditation. *Current Psychology*, *44*(13), 11649–11661. https://doi.org/10.1007/s12144-025-07940-7

Beege, M., Schroeder, N. L., Heidig, S., Rey, G. D., & Schneider, S. (2023). The instructor presence effect and its moderators in instructional video: A series of meta-analyses. *Educational Research Review*, *41*, Article 100564. https://doi.org/10.1016/j.edurev.2023.100564

Black, S. (2021). The potential benefits of subtitles for enhancing language acquisition and literacy in children: An integrative review of experimental research. *Translation, Cognition & Behavior*, *4*(1), 116–143. https://doi.org/10.1075/tcb.00051.bla

Brame, C. J. (2016). Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education*, *15*(4), Article es6. https://doi.org/10.1187/cbe.16-03-0125

Cevikbas, M., & Kaiser, G. (2023). Can flipped classroom pedagogy offer promising perspectives for mathematics education on pandemic-related issues? A systematic literature review. *ZDM – Mathematics Education*, *55*(1), 177–191. https://doi.org/10.1007/s11858-022-01388-w

Chen, O., Allen, R., Waterman, A., & Retalis, S. (2026). The relationship between cognitive offloading and the transient information effect. *Educational Psychology Review*, *38*, Article 35. https://doi.org/10.1007/s10648-026-10132-9

Chorianopoulos, K. (2018). A taxonomy of asynchronous instructional video styles. *International Review of Research in Open and Distributed Learning, 19*(1), 295–311. https://doi.org/10.19173/irrodl.v19i1.2920

Colliot, T., & Jamet, É. (2018). Understanding the effects of a teacher video on learning from a multimedia document: An eye-tracking study. *Educational Technology Research and Development*, *66*(6), 1415–1433. https://doi.org/10.1007/s11423-018-9594-x

Colorado Legacy Foundation. (2014). *Guidelines and best practices for surveying young learners*. Colorado Education Initiative. https://www.coloradoedinitiative.org/wp-content/uploads/2014/07/K2GuidancedocFINAL.pdf

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approach (5th ed.)*. SAGE Publications.

Demir, Ö., & Birgili, B. (2024). The mediating role of instructional design and video length between grade level and pupil-content interaction in instructional mathematics videos on YouTube. *Education and Information Technologies, 29*(5), 5599–5629. https://doi.org/10.1007/s10639-023-12004-z

EDCOM 2. (2025). *Fixing the foundations: EDCOM Year Two Report*. Second Congressional Commission on Education. https://edcom2.gov.ph

Evangelou, F. (2023). Video as an educational tool for teaching and learning for primary school students: A research approach by Greek teachers. *European Journal of Education and Pedagogy*, *4*(1), 104–111. https://doi.org/10.24018/ejedu.2023.4.1.575

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, *34*(10), 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Fiorella, L., & Mayer, R. E. (2018). What works and doesn't work with instructional video. *Computers in Human Behavior*, *89*, 465–470. https://doi.org/10.1016/j.chb.2018.07.015

Fyfield, M., Henderson, M., & Phillips, M. (2022). Improving instructional video design: A systematic review. *Australasian Journal of Educational Technology*, *38*(4), 1–29. https://doi.org/10.14742/ajet.7296

Gedik, N., Uça Güneş, E. P., Beylik, A., Çabuk, A., & Tıraş, E. (2023). Portable lightboard use in online higher education. *Open Praxis*, *15*(2), 162–174. https://doi.org/10.55982/openpraxis.15.2.548

Gong, Q., & Tao, T. (2024). The relationship between short video usage and academic achievement among elementary school students: The mediating effect of attention and the moderating effect of parental short video usage. *PLoS ONE*, *19*(11), Article e0309899. https://doi.org/10.1371/journal.pone.0309899

Guo, P. J., Kim, J., & Rubin, R. (2014). How video production affects student engagement: An empirical study of MOOC videos. In *Proceedings of the first ACM conference on Learning @ scale conference* (pp. 41–50). Association for Computing Machinery. https://doi.org/10.1145/2556325.2566239

Kalyuga, S., & Sweller, J. (2014). The redundancy principle in multimedia learning. In R. E. Mayer (Ed.), *The Cambridge handbook of multimedia learning* (2nd ed., pp. 247–262). Cambridge University Press. https://doi.org/10.1017/CBO9781139547369.013

Kirby, P. (2020). 'It's never okay to say no to teachers': Children's research consent and dissent in conforming schools' contexts. *British Educational Research Journal*, *46*(4), 811–828. https://doi.org/10.1002/berj.3638

Konukoğlu, L., & Özmantar, M. F. (2025). Video duration and engagement in mathematics instruction on YouTube: An analysis of content-level moderators. *International Journal of Curriculum and Instruction*, *17*(3), 689–711. https://ijci.net/index.php/IJCI/article/view/1633

Leahy, W., & Sweller, J. (2011). Cognitive load theory, modality of presentation and the transient information effect. *Applied Cognitive Psychology*, *25*(6), 943–951. https://doi.org/10.1002/acp.1787

Li, Y. (2025). Listen or read? The impact of proficiency and visual complexity on learners' reliance on captions. *Behavioral Sciences*, *15*(4), Article 542. https://doi.org/10.3390/bs15040542

Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research, 35*(6), 382–386. https://doi.org/10.1097/00006199-198611000-00017

OECD. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Mayer, R. E. (2021a). Evidence-based principles for how to design effective instructional videos. *Journal of Applied Research in Memory and Cognition, 10*(2), 229–240. https://doi.org/10.1016/j.jarmac.2021.03.007

Mayer, R. E. (2021b). *Multimedia learning* (3rd ed.). Cambridge University Press. https://doi.org/10.1017/9781316941355

Mayer, R. E., Fiorella, L., & Stull, A. (2020). Five ways to increase the effectiveness of instructional video. *Educational Technology Research and Development, 68*(3), 837–852. https://doi.org/10.1007/s11423-020-09749-6

Mayer, R. E., Sobko, K., & Mautone, P. D. (2003). Social cues in multimedia learning: Role of speaker's voice. *Journal of Educational Psychology, 95*(2), 419–425. https://doi.org/10.1037/0022-0663.95.2.419

Monib, W. K., Qazi, A., & Apong, R. A. (2025). Microlearning beyond boundaries: A systematic review and a novel framework for improving learning outcomes. *Heliyon*, *11*(2), Article e41413. https://doi.org/10.1016/j.heliyon.2024.e41413

Montreuil, M., Bogossian, A., Laberge-Perrault, E., & Racine, E. (2021). A review of approaches, strategies and ethical considerations in participatory research with

children. *International Journal of Qualitative Methods*, *20*, Article 1609406920987962. https://doi.org/10.1177/1609406920987962

Mullis, I. V. S., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2020). *TIMSS 2019 international results in mathematics and science*. TIMSS & PIRLS International Study Center, Boston College. https://timssandpirls.bc.edu/timss2019/international-results

Nabayra, J. N. (2023). Teacher-made videos as learning tool in elementary statistics during the pandemic: Developmental research. *International Journal of Information and Education Technology*, *13*(1), 10–18. https://doi.org/10.18178/ijiet.2023.13.1.1774

Nasvi, H., Maritasari, D. B., & Yazid, M. (2025). Pengembangan video animasi dengan materi pecahan kelas IV sekolah dasar [Development of animated videos with fraction material for grade IV elementary school]. *HISTOGRAM: Jurnal Pendidikan Matematika, 9*(2), 68–80. https://doi.org/10.31100/histogram.v9i2.3924

Panesi, S., Bandettini, A., Traverso, L., & Morra, S. (2022). On the relation between the development of working memory updating and working memory capacity in preschoolers. *Journal of Intelligence, 10*(1), Article 5. https://doi.org/10.3390/jintelligence10010005

Polat, H., Kayaduman, H., & Battal, A. (2025). Trend and issues in educational video research: A bibliometric mapping analysis. *Open Praxis, 17*(1), 145–165. https://doi.org/10.55982/openpraxis.17.1.721

Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what's being reported? Critique and recommendations. Research in Nursing and Health, 29(5), 489–497. https://doi.org/10.1002/nur.20147

Rathnasekara, K., Yatigammana, K., & Suraweera, N. (2025). Innovative pedagogical framework in K12 education: Enhancing productivity and engagement of digital natives within resource-constrained environments. *Quality Education for All*, *2*(1), 415–440. https://doi.org/10.1108/QEA-11-2024-0129

Reynolds, B. L., Cui, Y., Kao, C.-W., & Thomas, N. (2022). Vocabulary acquisition through viewing captioned and subtitled video: A scoping review and meta-analysis. *Systems*, *10*(5), Article 133. https://doi.org/10.3390/systems10050133

Robinson, C. (2025). Ethical considerations of children's involvement in school-based research: Balancing children's provision, protection, and participation rights. *Research Ethics*, *21*(3), 480–502. https://doi.org/10.1177/17470161241285642

Sagge, R. G., Jr., & Segura, R. T., Jr. (2023). Designing and developing video lessons in mathematics using code-switching: Design-based research. *International Journal of Information and Education Technology*, *13*(9), 1391–1398. https://doi.org/10.18178/ijiet.2023.13.9.1942

Seidel, N. (2024). Short, long, and segmented learning videos: From YouTube practice to enhanced video players. Technology, Knowledge and Learning, 29, 1965–1991. https://doi.org/10.1007/s10758-024-09745-2

Streiner, D. L. (2003). Starting at the beginning: An introduction to coefficient alpha and internal consistency. *Journal of Personality Assessment*, *80*(1), 99–103. https://doi.org/10.1207/S15327752JPA8001_18

Tani, M., Manuguerra, M., & Khan, S. (2022). Can videos affect learning outcomes? Evidence from an actual learning environment. *Educational Technology Research and Development*, *70*(5), 1675–1693. https://doi.org/10.1007/s11423-022-10147-3

Thompson, S. V., & Riding, R. J. (1990). The effect of animated diagrams on the understanding of a mathematical demonstration in 11- to 14-year-old pupils. *British Journal of Educational Psychology, 60*(1), 93–98. https://doi.org/10.1111/j.2044-8279.1990.tb00925.x

United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations. https://sdgs.un.org/2030agenda

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Walsh, T., & Henderson, M. (2022). *The impact of video in the K-12 classroom: A scoping study of instructional video research* (Version 1). Monash University. https://doi.org/10.26180/19614093.v1

Wibowo, S. A., Degeng, M. D. K., & Praherdhiono, H. (2024). Interactive video for learning mathematics element of measurement in elementary school. *Inovasi Kurikulum, 21*(2), 723–736. https://doi.org/10.17509/jik.v21i2.67125

Zhang, Y., Lawson, A. P., & Mayer, R. E. (2025). Active learning strategies in video learning: A meta-analysis. *Educational Research Review*, *48*, Article 100708. https://doi.org/10.1016/j.edurev.2025.100708