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# Production and evaluation of audiovisual material to support the teaching of mathematics in eighth-grade learners

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## Abstract

Audiovisual materials have been widely investigated in mathematics education for their capacity to improve learning outcomes and mitigate student disengagement. Therefore, this study aims to evaluate the acceptance of audiovisual materials as instructional aids among eighth-grade students. Adopting a mixed-method approach, the research first involved semi-structured interviews with mathematics teachers to identify key teaching and learning challenges. Based on the insights gained, educational videos were developed, adhering to motivational and didactic criteria. In the final phase, 78 students from a public high school in Ibarra, Ecuador, participated in a Likert-scale survey, guided by the Technology Acceptance Model (TAM), to assess their reception of the videos. The findings revealed that teachers highlighted fear of mathematics, insufficient prior knowledge, and the abstract nature of the content as major obstacles to be addressed. Most students responded positively, considering the videos effective for enhancing their understanding of mathematical concepts and boosting their motivation to learn. This study underscores the potential of audiovisual materials as effective tools to address educational challenges and foster student engagement in mathematics.

**Keywords**: Audiovisual Material, Didactic Tools, Eight-Grade Students, Mathematics Education

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The quest to enhance mathematics education for eighth-grade students presents a critical challenge, particularly in addressing the persistent difficulties that many learners encounter with complex mathematical concepts. These challenges often lead to significant gaps in understanding, which can, in turn, adversely affect academic performance. Traditional teaching methods, which may fail to engage all students or meet diverse learning needs, often exacerbate these issues, further hindering students' mathematical development.

This study seeks to address these educational challenges by first identifying the specific learning difficulties perceived by mathematics teachers. Subsequently, it aims to develop targeted audiovisual materials designed to mitigate these difficulties and evaluate the acceptability and effectiveness of these resources among eighth-grade students. The study is guided by the following research questions:

1. What are the primary learning difficulties in mathematics as perceived by eighth-grade teachers?
2. How can audiovisual materials be effectively designed to address these identified learning difficulties?
3. What is the acceptability and perceived effectiveness of these educational videos among eighth-

grade students?

To achieve these objectives, this research adopts a mixed-method approach comprising three key phases. Initially, a diagnostic assessment was conducted with mathematics teachers to pinpoint the specific challenges encountered in the teaching-learning process. Following this, audiovisual materials, formatted akin to TV broadcasts, were developed with the goal of engaging students more effectively. Finally, the acceptability of these materials was assessed through surveys based on the Technology Acceptance Model (TAM), offering insights into their potential impact on student learning.

The subsequent sections of this paper will delve into critical areas pertinent to the study's objectives. First, it will examine the main difficulties encountered in teaching and learning mathematics, identifying common challenges faced by both educators and students. Next, it will discuss the role of multimedia materials in simplifying abstract mathematical concepts, emphasizing how these tools can enhance comprehension. Finally, the specific application of videos and multimedia materials in mathematics instruction will be analyzed, with a focus on their effectiveness in promoting student engagement and understanding.

## Learning Difficulties in the Teaching and Learning of Mathematics

The academic performance in mathematics among students in Ecuador reveals a concerning trend. A substantial majority, approximately 70%, fail to meet the minimum standards, demonstrating only very low proficiency in solving basic mathematical tasks. Although the remaining 30% have reached level 2, this level is deemed the minimum standard of mathematical performance globally, according to the PISA Assessment Framework (Ineval, 2018).

One of the critical challenges students face in mathematics is mathematization—the process of transforming real-world problems into mathematical terms and organizing them within a mathematical framework. This challenge is particularly evident when students attempt to formulate mathematical models, leading to frequent errors across various topics such as functions, fractions, equation creation, and schematic or diagrammatic representations (Jupri & Drijvers, 2016; Lima et al., 2019). The disconnect between real-life applications and mathematical knowledge not only diminishes students' interest in mathematics but also deprives them of opportunities to interact with peers and engage in the social aspects of learning (Wilkie et al., 2023). This, in turn, contributes to demotivation and a general lack of interest in the subject.

Anxiety is another significant factor affecting academic performance in mathematics. As students' progress in their studies, they encounter increasingly complex mathematical tasks, leading to lower grades (Namkung et al., 2019) and persistent low performance at higher levels (Lima et al., 2019; Nelson & Powell, 2018). The demands of understanding abstract concepts increase as students advance, resulting in elevated stress levels and a negative attitude towards mathematics, which is reflected in their poor achievement.

Furthermore, the difficulties in learning mathematics are compounded by several factors, including ineffective teaching methods, inadequate school facilities, unsupportive family environments, and misaligned curricula (Guner, 2020; Haddar & Novianti, 2019; Mazana et al., 2019). Students often perceive that they are not receiving appropriate instructional methods and that their schools lack the necessary resources and teacher training. To address these complex challenges, it is recommended that educators adopt teaching methods grounded in mathematical learning theories, complemented by

learning aids designed to enhance student motivation and cultivate positive attitudes towards mathematics (Hussein et al., 2021).

## The Role of Multimedia Tools in Helping Comprehension

The use of multimedia learning approaches in education and their impact on both learners and teachers has garnered significant attention in recent years. This growing interest stems from the integration of various visual aids—such as pictures, static and dynamic graphics, maps, figures, and animations—into text-based materials to enhance and promote learning outcomes (Mayer, 2002). Such materials serve as a learning adjunct by combining verbal and pictorial information into a cohesive element, enabling students to select and organize relevant information in a manner that supports their metacognitive processes. Research has shown that multimedia technology enhances students' ability to recall information and comprehend new knowledge by fostering the formation of mental models that connect text and images (Mayer, 2002).

Effectively incorporating multimedia technology into teaching practices requires a thorough understanding of how these tools can accurately represent the concepts and ideas to be conveyed (Abdulrahaman et al., 2020). Thus, the combination of multimedia components—including text, video, audio, images, and animations—must align directly with the target audience and the specific learning objectives. When this technology is paired with generative strategies, such as summarizing or answering questions, students are encouraged to engage more deeply with the material presented (Kuhlmann et al., 2023).

The benefits of using multimedia materials are particularly evident in the early stages of education. For instance, visual and audio enhancements in storybooks have been shown to improve children's comprehension and learning of new vocabulary (Li & Bus, 2023). Moreover, when appropriately applied, multimedia resources can effectively complement and support the teaching of various subjects at any educational level. However, it is important to recognize that the mere use of multimedia materials alone does not guarantee that learners will effectively integrate and engage with new information as part of the learning process (Zourmpakis et al., 2022). It is crucial to activate previously processed knowledge through multimedia resources to ensure that new information is coherently and consistently internalized (Frick & Schüler, 2023).

In the context of mathematics education, concepts, tasks, definitions, and instructions—especially those involving complex abstractions—become more accessible through audiovisual mediums. This approach allows students to take a more autonomous role in their learning, using images, audio, and animations to develop a deeper understanding of mathematical topics with minimal guidance. Compared to traditional teaching methods that lack audiovisual resources, multimedia materials transform the learning process into a more engaging and purposeful activity, ultimately fostering student autonomy and reshaping their perspective on learning mathematics (Russo et al., 2021).

## Using Audiovisual Resources for the Teaching of Mathematics

One significant reason for integrating audiovisual materials in teaching is the challenge students face in perceiving abstract concepts, particularly in mathematics (Žakelj & Klancar, 2022). Beyond creating an engaging learning environment, audiovisual aids such as still and moving images play a crucial role in bridging the gap between abstract concepts and their real-world applications (Abdulrahaman et al., 2020; Pierce et al., 2005). Animation, a common format within multimedia tools, enhances learning by stimulating student interest and altering perceptions about the learning process. This can lead to

improved academic performance, especially in STEM fields (Mou, 2023). Compared to traditional teaching methods that lack audiovisual aids, the incorporation of videos and multimedia materials into mathematics instruction has been shown to enhance students' understanding and make the subject matter more engaging (Ahmad et al., 2010).

In the context of early childhood education, educational technologies are transforming mathematics instruction. For instance, applications designed for preschool and pre-primary students are increasingly recognized for their potential to bolster computational thinking and coding skills, which are essential for 21st-century competencies (Papadakis, 2020). Digital technologies also play a transformative role in mathematics education, prompting ongoing research into their educational impacts (Molina-Toro et al., 2019). Virtual Mathematics Kits (VMK) have proven effective in improving students' mathematical proficiency, particularly when used alongside traditional teaching methods. These kits make abstract concepts tangible and manipulable, addressing a critical need in educational settings (Pradana et al., 2020).

Moreover, Computer-Based Instruction has shown significant benefits for children with mathematical learning difficulties, enhancing their mathematical skills and facilitating the acquisition of additional competencies (Küçükalkan et al., 2019). The integration of digital technologies in early education includes mathematical activities such as Numbers and Operations, Geometry, and Measurement, reflecting a proactive approach to distance learning (Lavidas et al., 2022). This shift is supported by the involvement of parents and digital learning communities, which are crucial for guiding and innovating educational practices. However, despite the availability of various evaluation tools, many are insufficient for aiding teachers and parents in effectively assessing the educational benefits of apps. There is a pressing need for more effective digital learning and evaluation tools to support educators and parents (Papadakis, 2021).

Instructional videos have also emerged as powerful tools for enhancing students' mathematical competence. Applications such as Camtasia have been particularly effective in improving comprehension among students struggling with mathematics (Albert et al., 2021). Additionally, video micro-classes have been recognized for their efficiency in helping students with learning difficulties grasp mathematical concepts through brief, focused sessions (Tan et al., 2021). Innovative approaches, such as interest-driven video creation activities, have been shown to enhance mathematics achievement and foster positive attitudes towards learning among both high- and low-achieving students. These activities also improve communication skills, teamwork, and video production proficiency, highlighting their extensive educational benefits (Huang et al., 2020).

Overall, audiovisual materials are an effective means of presenting real-life situations in mathematics classes and contextualizing topics through dynamic resources (Pierce et al., 2005). The use of moving images and digital animations, compared to static text or images, provides a superior method for visualizing abstract mathematical content (Russo et al., 2021). Consequently, these materials are likely to motivate students and improve academic performance.

## METHODS

### Research Design

The research employs a mixed-methods approach to systematically address the research questions. The study is conducted in three distinct phases:

1. Qualitative Data Collection
   In the initial phase, qualitative data were gathered through semi-structured interviews with eighth-grade mathematics teachers. The primary objective was to identify and understand the key learning difficulties perceived by these educators.
2. Development of Educational Materials
   The insights obtained from the interviews informed the development of educational videos aimed at addressing the specific teaching and learning challenges identified in the first phase. These videos were designed to provide targeted support for the issues highlighted by the educators.
3. Evaluation of Materials
   In the final phase, the acceptance of the educational videos among students was assessed using a Likert scale questionnaire, based on the Technology Acceptance Model (TAM) (Davis, 1989). This phase evaluated the students' perceptions of the videos' effectiveness and acceptability.

This methodological framework ensures that each phase of the research is directly aligned with the main research questions: identifying key learning difficulties, designing targeted audiovisual materials, and evaluating the acceptability and perceived effectiveness of these educational tools among eighth-grade students.

## Participants Involved

This research received approval from the Faculty of Postgraduate Studies at Universidad Técnica del Norte (N° UTN-POSGRADO-2022-361) and was conducted in accordance with the university's ethical code (UTN, 2012). The study involved mathematics teachers and eighth-grade students from Ibarra, Ecuador. Initially, a semi-structured interview was conducted with 11 mathematics teachers from seven educational institutions to gather qualitative insights. These interviews were recorded and conducted online to facilitate participation. In the subsequent phase, a Likert scale questionnaire was administered to eighth-grade students at UTN University High School in the Province of Imbabura, Ibarra canton. The necessary permissions were obtained from the high school principal, and participants received a detailed written explanation of the research objectives. A total of 78 eighth-grade students, aged 12 to 13, participated in the survey. To ensure a comprehensive data set, the students were divided into two parallel groups of 39 students each.

## Instruments

### *Semi-Structured Interview*

The interview was divided into two main sections. The first set of questions focused on identifying problems or challenges:

Q1 : In general terms, what are the main difficulties you identified in mathematics teaching?
Q2 : In your experience, are certain topics more difficult to teach? Why?
Q3 : There is a great lack of interest in mathematics and low performance in most high school students. In your experience as a teacher, what do you believe is causing this phenomenon?
Q4 : Do you believe audiovisual material (videos) related to teaching mathematics could help solve some of your identified problems? Why?

The second section sought suggestions to address these problems, which included the following questions:

Q4 : Do you believe audiovisual material (videos) related to teaching mathematics could help solve some of your identified problems? Why?
Q5 : What strategies would you recommend for improving mathematics teaching and motivating students?

### *Production of Audiovisual Material*

The production of the educational videos took into account several critical aspects, including the relevance of curricular content, technical considerations related to animation and editing, the aesthetic use of images and colors, the development of engaging narratives, pedagogical recommendations, and clarity in instructional elements (Moreno et al., 2020). The creation and implementation of audiovisual materials in education are typically approached from two perspectives: transmission principles (techniques for conveying information from the source to the viewer) and transformational principles (pedagogical aspects embedded in the video) (Schulz & Iskru, 2021). The production aimed to achieve a balance between these two principles.

The design and planning of the audiovisual product encompassed several key elements: topic selection, learning objectives, content development, implementation strategies, revision processes, and evaluation criteria (Cook, 2022; Imania et al., 2021; Lesmes et al., 2022). These elements were organized into a logical sequence divided into three distinct stages: preproduction, production, and postproduction, as illustrated in Figure 1.

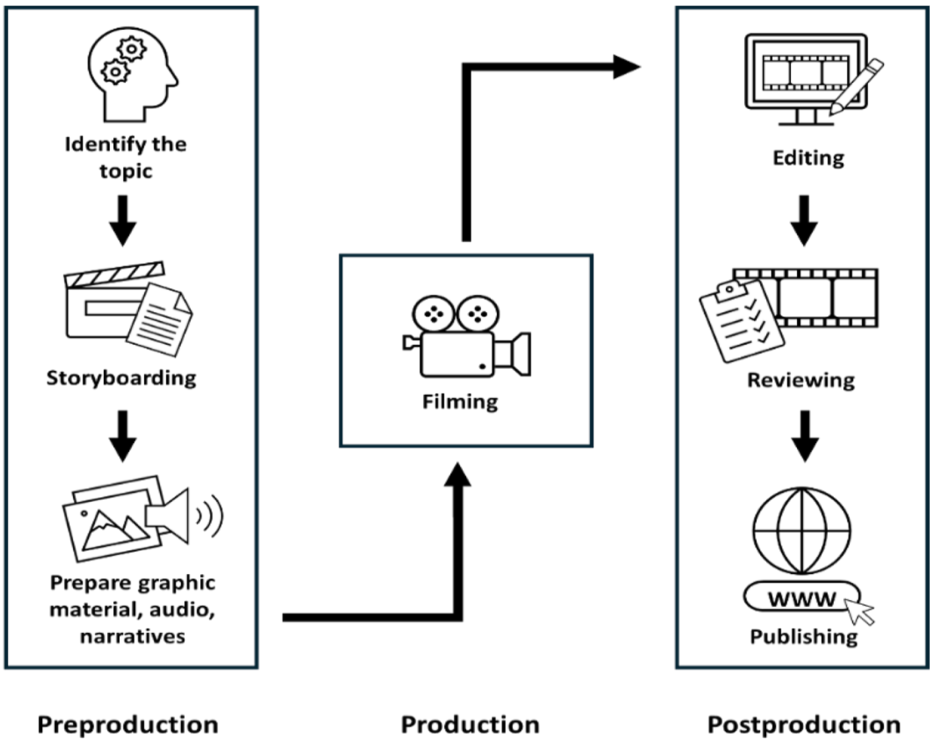


**Figure 1**. Stages to produce the audiovisual material

### *Likert Scale Questionnaire*

The questionnaire was developed based on the Technology Acceptance Model (TAM) proposed by Davis (1989), which has been utilized in various studies to evaluate the acceptability of information technologies within educational settings (Abuhassna et al., 2023; Al-Emran et al., 2018; Al-Rahmi et al., 2019; Granić & Marangunic, 2019; Rosli et al., 2022; Salloum et al., 2019). The acceptance scale was classified into three categories: adoption, neutrality, and non-adoption.

Prior to administration, the questionnaire was reviewed by experts in the field, and its reliability was confirmed with a Cronbach's alpha of 0.87, indicating strong internal consistency. The instrument assessed students' perceptions of the audiovisual material across four variables: perceived usefulness, perceived ease of use, attitude toward use, and intention to use. These variables were intended to measure the extent to which students believed the videos would enhance their academic performance, facilitate interaction with the content, influence their overall attitude towards using the videos for learning mathematics, and impact their likelihood of continued use. The statements corresponding to each variable are detailed in Table 1.

**Table 1**. Acceptance questionnaire using the TAM model

| **Perceived Usefulness** |
|---|
| The video explanations can help improve my grades in mathematics. |
| The texts, graphics, animations, and effects in the video enhance my ability to understand the subject. |
| The language used in the video helped me learn mathematics better. |
| The order in which the contents are presented helps me have greater control over how I learn. |
| Overall, I believe the examples and comparisons presented in the video are very useful for learning mathematics. |
| The video allows me to access more information on the topic. |
| Using videos in learning mathematics has more advantages than disadvantages. |
| **Perceived ease of use** |
| Using videos to complement my math classes would be easy for me. |
| The video motivates me to learn what I want to learn in an easy way. |
| The video explanations are clear and understandable. |
| I think I can easily interact with the texts, graphics, animations, and effects of the video. |
| I believe it is easy to learn mathematics if the video contents are specific and stay on topic |
| Overall, I find the video content easy to understand for learning mathematics. |
| The combination of images and sounds in the video does not confuse me. |
| **Attitude toward using** |
| It's a good idea to use videos for learning mathematics. |
| Videos should be used more frequently in math classes with easy-to-understand language. |
| I believe that using videos containing texts, graphics, animations, and effects would make math classes more enjoyable |
| **Intention to use** |
| I intend to use math videos to improve my knowledge. |
| I will use videos more often to better understand mathematics. |

I believe I will use math videos for my classes in higher grades in the future.

From now on, I will use math videos to complement what I learn in class.

### Data Analysis

The data analysis employed both qualitative and quantitative methods to provide a comprehensive understanding of the findings. For the qualitative data from the semi-structured interviews, MAXQDA software was used to process and analyze the data. Specific codes were assigned to text segments relevant to each interview question (VERBI Software, 2021), allowing for the identification and analysis of recurring themes and responses. The interpretation of the data was based on the frequency of these codes, which facilitated the identification of key difficulties, challenges, and suggestions from the interviewees. These insights informed the development of the educational videos.

For the quantitative analysis of the Likert scale questionnaire data, basic descriptive statistics were applied to perform an exploratory analysis. This included calculating frequencies and percentages of the responses, which provided a descriptive overview of the students' acceptance levels regarding the educational videos.

## RESULTS AND DISCUSSION

### Diagnosis of Teaching-Learning Difficulties in Eight-Grade Students

Table 1 presents a detailed overview of the primary challenges and recommendations concerning the teaching and learning of mathematics for eighth-grade students. This data was extracted from semi-structured interviews with teachers, addressing various dimensions such as instructional methodologies, content-related difficulties, underlying causes of low performance, and potential strategies for enhancing mathematics education. The interview transcripts were systematically coded to identify and quantify responses relevant to each inquiry, as illustrated in Table 2.

**Table 2**. Relevant responses from the interviewees

| **Q1 – Difficulties related to the teaching and learning of mathematics** | | |
|---|---|---|
| **Coding** | **Frequency** | **%** |
| Teaching methodology | 7 | 12,1 |
| Excessive curriculum content | 4 | 6,9 |
| Lack of teacher preparation | 10 | 17,2 |
| Dislike or fear of mathematics. | 13 | 22,4 |
| Low development of mathematical reasoning | 8 | 13,8 |
| Low previous basic knowledge | 11 | 19,0 |
| Lack of resources in the institution | 5 | 8,6 |
| **Q2 – Difficulties related to content teaching** | | |
| Many students. | 1 | 5,6 |
| Low support from parents. | 1 | 5,6 |
| Abstract knowledge. | 10 | 55,6 |
| Insufficient didactic resources. | 3 | 16,7 |
| Low interest in delving into the subject. | 1 | 5,6 |
| Inappropriate use of methodologies. | 2 | 11,1 |

| | | |
|---|---|---|
| **Q3 – Causes of low performance and lack of interest** | | |
| Lack of teaching support during the pandemic. | 1 | 5,6 |
| Insufficient class hours. | 1 | 5,6 |
| Family - personal related problems. | 1 | 5,6 |
| Limited use of ICT. | 2 | 11,1 |
| Nutrition-related issues. | 1 | 5,6 |
| Students' misuse of technology. | 4 | 22,2 |
| Negative perception of the subject. | 7 | 38,9 |
| Lack of support from parents. | 1 | 5,6 |
| **Q4 – How videos can help solve teaching-learning issues** | | |
| They are a didactic support. | 7 | 36,8 |
| They create interest in the subject. | 4 | 21,1 |
| They contextualize the topic. | 5 | 26,3 |
| They graphically represent abstract concepts. | 3 | 15,8 |
| **Q5: Strategies to improve teaching and motivate students** | | |
| Teaching vocation. | 3 | 14,3 |
| Use of audiovisual material. | 6 | 28,6 |
| Flipped Classroom methodology. | 6 | 28,6 |
| Give a more practical approach to the subject. | 6 | 28,6 |

The data reveal several critical issues and recommended actions identified by interviewees concerning the teaching and learning of mathematics. Table 1 illustrates these insights, while Table 2 presents the frequency of responses.

For Q1, the most frequently cited challenge was "Dislike or fear of mathematics," reported by 22.4% of respondents. This was closely followed by "Low previous basic knowledge" at 19.0%. These factors underscore the psychological and foundational barriers that students encounter, exacerbated by "Lack of teacher preparation" (17.2%) and "Low development of mathematical reasoning" (13.8%).

In response to Q2, the predominant issue identified was "Abstract knowledge," noted by 55.6% of interviewees. This suggests that the abstract nature of mathematical concepts significantly hinders student understanding. Additionally, challenges are compounded by "Insufficient didactic resources" (16.7%) and "Inappropriate use of methodologies" (11.1%). Furthermore, Q3 highlights factors contributing to low performance and interest, with "Negative perception of the subject" being the most significant factor at 38.9%. This was followed by "Students' misuse of technology" (22.2%) and "Limited use of ICT" (11.1%).

Regarding Q4, the potential benefits of educational videos are well-recognized. The most frequently acknowledged advantage was "They are a didactic support" (36.8%). Educational videos also help to "Contextualize the topic" (26.3%) and "Create interest in the subject" (21.1%). These benefits are crucial for making abstract and challenging topics more engaging and comprehensible. Finally, Q5 suggests several strategies for enhancing teaching and student motivation, with equal recognition given to the "Use of audiovisual material," "Flipped Classroom methodology," and "A more practical approach to the subject," each receiving 28.6% acknowledgment.

While numerous difficulties were identified, 'Dislike or fear of mathematics,' 'Low previous knowledge,' and 'Abstract knowledge' were particularly prominent (Figure 2). This indicates that these

issues are deemed most critical for intervention. The study focused on how videos could serve as a pedagogical strategy to address these challenges, given their potential to offer didactic support, foster interest in the subject, and contextualize abstract content.

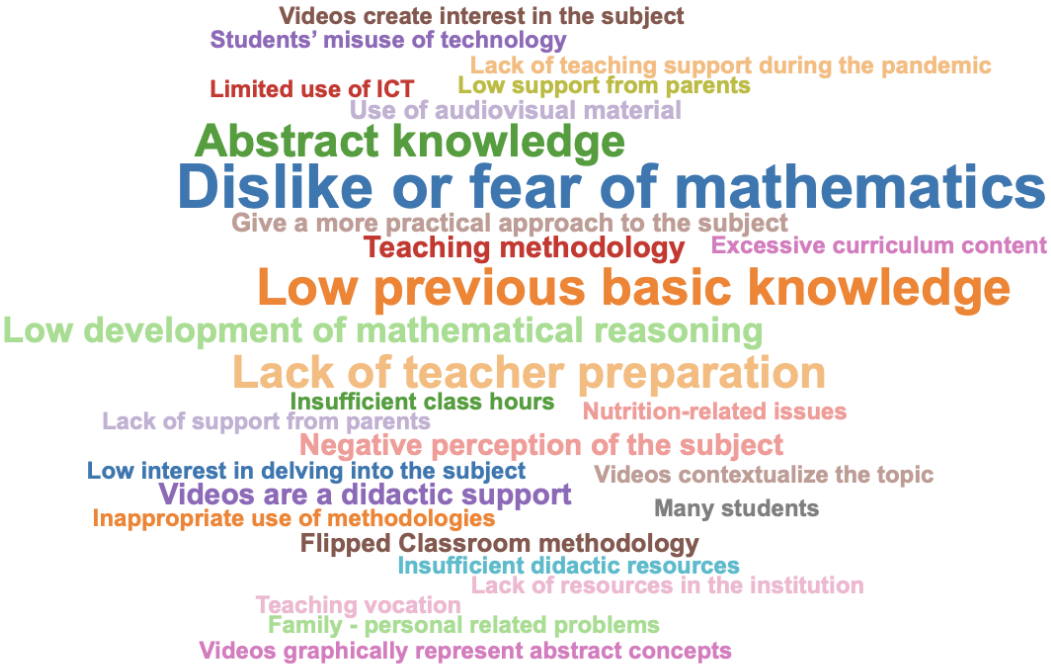


**Figure 2**. The strategies for addressing the teaching-learning challenges identified by eight-grade mathematics teachers

The following excerpts from teacher interviews provide insight into the utilization of videos in addressing teaching and learning issues:

> Teacher # 5: *"Well, for me, videos, depending on how we choose them, are very beneficial because they help reinforce knowledge. So, if there's a gap in the students' understanding, we choose the right video with the appropriate methodology."*

> Teacher # 8: *"The students we have now come from a different era, from a time where they learn through audiovisual tools; therefore, presenting a class without audiovisual instruments doesn't make much sense to them and doesn't motivate them."*

> Teacher # 11: *"The videos are simply supporting material; they are not the entire complement to education. What we should do as teachers is provide guidance along with the material we are using."*

## Production of Audiovisual Material

The audiovisual material was developed in response to the findings from the diagnostic assessment conducted with mathematics teachers. Key aspects identified in the diagnosis, including methodological and didactic considerations, were integrated into the video production process. This development

adhered to a structured approach consisting of three stages: preproduction, production, and postproduction. This methodology was informed by the guidelines and recommendations outlined by Cook (2022), Imania et al. (2021), and Lesmes et al. (2022).

### *Preproduction*

We chose one topic from each of the six units written in the book of mathematics published by the Ministry of Education of Ecuador (Ministerio de Educación del Ecuador, 2018) as shown in Table 3.

**Table 3**. Topics selected for the preproduction stage according to the unit of study

| Unit | Topic |
|---|---|
| Integer numbers | Exponents |
| Rational numbers | Simplification of fractions |
| Geometric bodies and plane figures | Polyhedra |
| Similarity and measurement | The Pythagorean theorem |
| Statistics and probability | Arithmetic mean |
| Laws of logic and functions | Functions |

The storyboarding for the audiovisual material was structured as follows: a) Introduction, b) Contextualization of the topic, c) Development of theoretical aspects (including examples and concept introductions), d) Exercises, e) Class summary, and f) Summary – conclusion. During this stage, approximately 280-300 JPEG images were created to facilitate the subsequent video editing process. These images were sequenced to serve as a guide for the video presenter, ensuring alignment with the script. Additionally, all audio effects and background music incorporated into the videos were sourced from copyright-free resources.

### *Production*

Filming was conducted at the Universidad Técnica del Norte TV studio in Ibarra, which was equipped with a lighting system, noise insulation, a lapel microphone, a video camera, and a green screen for subsequent editing. The narrative elements of the script were integrated with the sequence of JPEG images prepared during the preproduction stage. Throughout the filming process, these images served as a visual guide, ensuring that the dialogues from the script were appropriately aligned with the visual content, as illustrated in Figure 3.

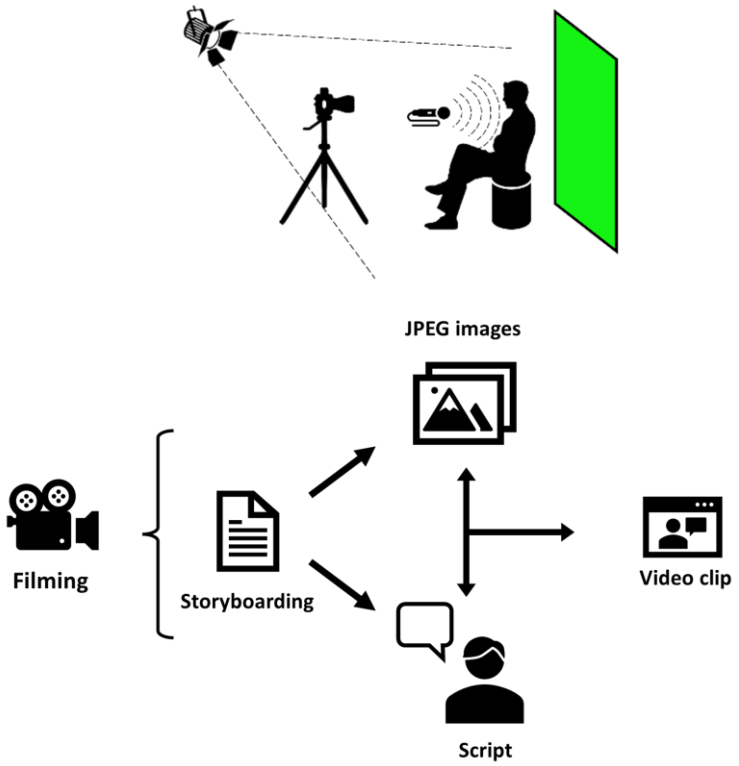


**Figure 3**. Filming setting and combination of script and images.

### *Postproduction*

All images and audio components were integrated into the video clip using Adobe Premiere Pro 2019 (see Figure 4). The editing process involved importing files, arranging images and audio on the timeline, cropping elements, adding transition effects and animations, and inserting background music. After completing and reviewing the edits, the final videos were uploaded to a YouTube channel: https://acortar.link/0zjLea

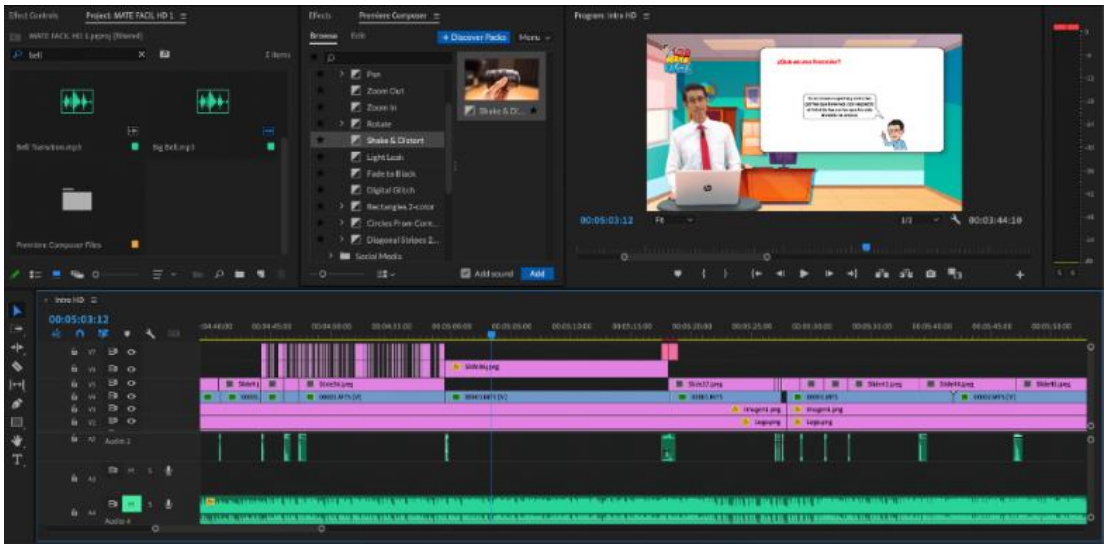

**Figure 4**. Editing details. The pink and light blue blocks represent the video's graphic components. Audio elements are displayed in green

## Acceptance of the Audiovisual Material

This section presents a descriptive statistical analysis of the data collected from the questionnaire based on the TAM. The survey evaluated four key variables related to the use of educational videos in mathematics: perceived usefulness, perceived ease of use, attitude toward using, and intention to use. The analysis provides an exploratory overview of students' perceptions across these dimensions, offering valuable insights into how students view the effectiveness and usability of audiovisual materials in enhancing their mathematical learning experience, as detailed in Table 4.

**Table 4**. Students' acceptability of the videos based on the TAM model variables

| Variable | None-adoption | | Neutrality | | Adoption | |
|---|---|---|---|---|---|---|
| | Freq. | % | Freq. | % | Freq. | % |
| Perceived usefulness | 32 | 5,9 | 101 | 18,5 | 413 | 75,6 |
| Perceived ease of use | 39 | 7,1 | 126 | 23,1 | 381 | 69,8 |
| Attitude toward using | 18 | 7,7 | 42 | 17,9 | 174 | 74,4 |
| Intention to Use | 35 | 11,2 | 68 | 21,8 | 209 | 67,0 |

The results provide valuable insights into the factors influencing technology adoption among participants. Perceived usefulness emerges as a critical determinant, with 75.6% of participants expressing acceptance, 18.5% showing neutrality, and 5.9% leaning towards rejection. The frequency of 413 responses supporting perceived usefulness indicates a strong positive perception of the videos' utility among respondents.

Regarding perceived ease of use, 69.8% of participants accepted the audiovisual material, with 381 occurrences reflecting this acceptance. This suggests that a significant portion of participants found the videos user-friendly. However, 23.1% remained neutral, and 7.1% rejected the material, indicating a notable proportion of participants were either neutral or rejected the ease-of-use of the videos.

In terms of attitude towards using the videos for enhancing comprehension, 74.4% of participants showed acceptance, 17.9% were neutral, and 7.7% rejected the videos. The frequency of 174 responses reflects a generally positive attitude towards integrating mathematics videos into learning routines.

Regarding the intention to use the videos, 67.0% of participants expressed acceptance, 21.8% were neutral, and 11.2% rejected the use of the technology. The frequency of 209 responses indicating an intention to use the technology demonstrates substantial interest and readiness to adopt it. Overall, the results highlight a predominant acceptance of the videos as didactical tools among eighth-grade students, with varying levels of neutrality and rejection across the measured variables.

## What are the Primary Learning Difficulties in Mathematics Perceived by Eighth-Grade Teachers?

The issues of dislike or fear of mathematics and lack of prior knowledge are prominently identified as significant barriers in the teaching-learning process. López (2014) supports this observation, linking these problems to the generally low skill levels observed among middle-level students in mathematics. Teacher readiness is also a critical concern, as noted by Arpi (2020) and Wampash Antuash (2018), who attribute students' disengagement from mathematics to inadequate didactic resources and a shortage of innovative methodologies.

Abstract knowledge poses another significant challenge in teaching mathematics. Žakelj and

Klancar (2022) highlight that when abstract concepts are introduced, students are expected to generate visual representations to facilitate problem-solving. The absence of effective visual aids complicates this process for teachers. Furthermore, insufficient teaching materials and inappropriate methodologies exacerbate these difficulties. Papadakis et al. (2021) emphasize that instructional and methodological elements should integrate content into authentic contexts and connect positively with students' daily lives. Failure to address these considerations can lead to diminished engagement with the subject and impede the understanding of knowledge and development of skills beyond the classroom.

Low performance and disinterest in mathematics, as discussed by Mazana et al. (2019), result from a combination of factors, including inadequate teaching strategies, lack of instructional clarity, insufficient support from parents and peers, negative past experiences, low grades in previous years, and a lack of self-confidence. The attitude students hold towards the subject significantly affects their academic performance and self-motivation (Huda, 2018). A noteworthy finding of this study is that teachers recognize videos as a valuable didactic resource capable of sparking interest in mathematics and providing contextual support for teaching abstract concepts.

The diagnostic interview corroborates findings from previous research concerning issues in mathematics education. Major difficulties include students' dislike or fear of mathematics and their lack of prior knowledge (Lima et al., 2019; Namkung et al., 2019; Nelson & Powell, 2018; Stoehr, 2017; Tomasetto et al., 2020), which critically impact teaching and learning processes. The low skill levels among middle-level students are identified as a related issue. Teacher readiness, particularly in employing effective didactic resources and innovative methodologies, is essential for fostering student engagement and comprehension (Manasia et al., 2019). The challenge of teaching abstract concepts underscores the need for visual aids and strategies to enhance conceptual clarity. Integrating mathematical content into authentic contexts relevant to students' lives is crucial for promoting engagement and meaningful learning (Rif'at, 2018; Vos, 2018). Factors such as inadequate teaching strategies and lack of support contribute to students' low performance and disinterest in mathematics (Fitzmaurice et al., 2021; Guner, 2020; Haddar & Novianti, 2019; Mazana et al., 2019). Additionally, videos are identified as effective didactic resources that can stimulate interest and aid in contextualizing abstract concepts. These findings underscore the importance of addressing both instructional and contextual elements to improve mathematics education effectively.

## How can Audiovisual Materials be Designed to Effectively Address These Identified Learning Difficulties?

The integration of pictures, graphics, animations, and other visual aids with text has been shown to significantly enhance learning by aiding students in organizing and integrating information into meaningful knowledge (Mayer, 2002). The findings from this research suggest that multimedia materials have the potential to improve students' recall and understanding of new concepts by creating connections between text and images (Mayer, 2002). However, multimedia alone is insufficient to address learning challenges effectively; it must be combined with strategies that promote active engagement with the material (Zourmpakis et al., 2022). Therefore, incorporating teaching methodologies that reactivate prior knowledge through multimedia can facilitate the coherent integration of new information (Frick & Schüler, 2023), thereby enhancing knowledge construction.

To address learning difficulties effectively, audiovisual materials should be designed to captivate the observer's interest by carefully considering narrative components, presentation methods, and the criteria for implementing audiovisual elements (Wijnker et al., 2019). One of the primary advantages of

audiovisual materials is their ability to provide graphical contextualization when introducing abstract content (Bonafini & Lee, 2021; Cruse, 2007; Koumi, 2015; Žakelj & Klancar, 2022). Thus, educational videos must integrate dialogues, content, and audiovisual tools in a manner that makes complex abstractions, such as mathematical concepts, more accessible. Compared to traditional teaching methods that lack audiovisual resources, multimedia materials have the potential to transform learning into a more engaging and purposeful activity, ultimately fostering students' autonomy and altering their perspective on learning mathematics (Russo et al., 2021).

In summary, addressing learning difficulties through audiovisual materials requires a multifaceted approach to video design. Educational videos should follow a structured framework with clear design guidelines and methodologies tailored to achieving specific learning objectives. Modern video production technology has streamlined this process, enabling the creation of high-quality educational content without substantial financial investment, thus allowing educators to produce engaging materials efficiently and economically (Moussiades et al., 2019). Incorporating a preparation phase, including pre-production, production, and post-production stages, is crucial to ensure the final product's quality. Effective educational videos should consider content scope, technical aspects such as lighting and sound, and overall organization (Castillo et al., 2021). This approach allows teachers with limited technical expertise to produce high-quality educational videos swiftly (Bakkay et al., 2019). Additionally, video production projects should align with instructional goals and include strategies to evaluate learning outcomes and the impact on students, such as analyzing the video creation process and assessing the final quality and effectiveness (Snelson, 2018). By considering these factors, educational videos can be designed to improve content comprehension, engagement, and learning outcomes, making abstract and challenging subjects more accessible and enjoyable for students.

## What is the Level of Acceptability and Perceived Effectiveness of These Educational Videos among Eighth-Grade Students?

The data indicates that a majority of surveyed students (75.6%) perceive videos as a valuable audiovisual resource for learning mathematics. This positive perception is attributed to various video features, including narrative elements, content sequence, examples, graphics, animations, and other audiovisual components. Such features are deemed effective in enhancing content comprehension. The adoption of innovative pedagogical techniques, such as the flipped classroom model, is highlighted as particularly beneficial, as it emphasizes student autonomy, advanced contextualization of content, and effective use of technology (Cid et al., 2018).

Furthermore, 69.8% of students reported that they found the videos easy to use, suggesting that the produced audiovisual material is generally clear and motivating for learning. The clarity of explanations, examples, and audiovisual components contributes to the overall ease of understanding the mathematical content. Effective contextualization of mathematical concepts, demonstrating their applicability in real-life scenarios, is another crucial pedagogical strategy. Students' disinterest and demotivation can increase when they fail to perceive the practical relevance of their learning, particularly when content is presented as purely theoretical (Castro-Velásquez & Rivadeneira-Loor, 2022).

The results also show that 74.4% of students have a positive attitude towards the use of audiovisual material to enhance their understanding of mathematical content. Additionally, 67% of participants expressed a willingness to use instructional videos more frequently in the future to improve their mathematical knowledge. These findings reaffirm the effectiveness of audiovisual materials as a didactic resource, capable of significantly motivating mathematics learning. To maximize this potential, it

is essential that audiovisual materials are not merely used for information transmission but as tools for transforming knowledge (Schulz & Iskru, 2021). As noted by Cruse (2007), the integration of videos into lesson planning can enhance academic performance and improve the overall teaching and learning process. The ability of videos to visualize abstract problems helps students connect mathematical concepts with real-world contexts (Russo et al., 2021).

In summary, the data suggests that students view videos as a highly effective tool for learning mathematics, appreciating their narrative structure, content sequencing, and audiovisual components. The ease of use and motivational impact of these videos make them valuable in simplifying complex concepts and engaging students (Albert et al., 2021; Brame, 2016; Russo et al., 2021). The positive attitude towards and willingness to use audiovisual materials more frequently highlight their potential to enhance learning outcomes (Galatsopoulou et al., 2022; Hillmayr et al., 2020). Additionally, the contextualization of mathematical content through videos addresses student disinterest and demonstrates practical applicability (Abdulrahaman et al., 2020; Pierce et al., 2005; Saunders et al., 2018). The integration of videos into teaching strategies can therefore contribute to improved student motivation and academic performance.

The findings provide valuable insights into the effectiveness of audiovisual resources in enhancing mathematics education. However, it is important to acknowledge that the analysis is based on descriptive statistics, which may limit the scope of the conclusions drawn. To further validate and strengthen these findings, it is recommended to conduct more detailed analyses using inferential statistics. Such analyses could explore relationships, make predictions, and draw more robust conclusions regarding the impact of audiovisual resources on mathematics learning outcomes. This deeper analysis will offer a more comprehensive understanding of the effectiveness of videos in mathematics education and inform decisions regarding pedagogical strategies and instructional design.

## CONCLUSION

This research makes several significant contributions to the field of mathematics education for eighth-grade students. Firstly, it identifies key learning difficulties as perceived by teachers, including students' apprehension towards mathematics, insufficient prior knowledge, and challenges in comprehending abstract concepts. These findings are consistent with existing literature and underscore the necessity of addressing these issues to enhance educational outcomes (Lima et al., 2019; Namkung et al., 2019; Nelson & Powell, 2018; Stoehr, 2017; Tomasetto et al., 2020).

Secondly, the study investigates the efficacy of audiovisual materials in addressing these identified difficulties. It highlights the potential of multimedia resources to improve student engagement and comprehension through visual aids and contextualization techniques (Bonafini & Lee, 2021; Koumi, 2015; Mayer, 2002). The results suggest that well-designed educational videos can transform the learning experience by making complex mathematical concepts more accessible and engaging.

Additionally, the research assesses the acceptability and perceived effectiveness of these educational videos among eighth-grade students, revealing a notably positive reception. A significant majority of students find the videos beneficial for learning mathematics, appreciating their clarity, motivational impact, and ability to contextualize abstract concepts (Albert et al., 2021; Russo et al., 2021). These findings support the argument that integrating audiovisual resources into teaching strategies can enhance both student motivation and academic performance in mathematics (Galatsopoulou et al., 2022; Hillmayr et al., 2020). The study demonstrates that effective use of multimedia tools can address issues

of student disengagement and improve overall learning outcomes.

From a scientific perspective, this research contributes to the education field by illustrating the potential of audiovisual materials to enhance mathematics learning and providing a basis for educators to adopt innovative pedagogical approaches that incorporate multimedia resources strategically. Nonetheless, the study suggests that future research should employ inferential statistical analyses to more rigorously validate these preliminary findings. Such analyses could explore correlations between video usage and academic performance, predict long-term educational impacts, and identify optimal design strategies for maximizing learning benefits. Furthermore, future investigations could focus on refining video content based on student feedback and exploring the applicability of multimedia resources across diverse educational contexts.

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## Declarations

| | | |
|---|---|---|
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