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DEVELOPMENT OF CONTEXTUAL LEARNING VIDEOS TO IMPROVE MATHEMATICAL REASONING ABILITY

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Abstract

In the context of 21st-century pedagogy, leveraging information technology through mediums such as interactive videos is instrumental in elevating learning quality. The present study was conducted to ascertain the levels of validity, practicality, and effectiveness of an instructional video based on the Contextual Teaching and Learning (CTL) approach, developed using Macromedia Flash 8 to foster students' mathematical reasoning abilities. A Research and Development (R&D) design, following the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) framework, was utilized for this study. Data collection instruments included validation sheets, observation sheets for learning implementation and student activities, response questionnaires for teachers and students, and a mathematical reasoning ability test. The participants were eighth-grade students of class VIII.1 at SMPN 2 Watansoppeng. The results indicated that the learning media achieved a 'very valid' category with a validator score of 3.79. In terms of practicality, the media received a 'very positive' response rate of 88.46%, and the learning implementation was 'fully implemented' with a score of 1.87. The effectiveness was demonstrated by a positive student response rate of 82.36%, a 'good' student activity level of 71.66%, and a 'good' category score of 79% on the mathematical reasoning ability test. Therefore, it is concluded that the developed Contextual Teaching and Learning based video for eighth-grade students at SMP Negeri 2 Watansoppeng is a valid, practical, and effective instructional tool.

Keywords: Development; Learning Video; Mathematical Reasoning

Abstrak

Pemanfaatan teknologi informasi, khususnya penyajian pengetahuan melalui video interaktif, dapat meningkatkan mutu pembelajaran di abad ke-21. Penelitian ini bertujuan mengetahui tingkat kevalidan, kepraktisan, dan keefektifan pengembangan video pembelajaran berbasis pendekatan Contextual Teaching and Learning (CTL) berbantuan macromedia flash 8 untuk meningkatkan kemampuan penalaran matematis peserta didik. Jenis penelitian ini adalah penelitian Penelitian dan Pengembangan dengan model pengembangan ADDIE (Analysis, Design, Development, Implementation, and Evaluation). Instrumen yang digunakan adalah lembar validasi, lembar observasi keterlaksanaan pembelajaran, lembar observasi aktivitas peserta didik, angket respon guru, angket respon peserta didik serta tes kemampuan penalaran matematis. Subjek penelitian adalah peserta didik kelas VIII.1 SMPN 2 Watansoppeng. Hasil penelitian menunjukkan pencapaian analisis validasi oleh tim validator adalah 3.79 dengan kategori sangat valid. Kriteria kepraktisan 88,46 % dengan respon sangat positif dan observasi keterlaksanaan pembelajaran 1,87 dengan kategori terlaksana seluruhnya. Hasil kriteria keefektifan 82,36% dengan respon positif, hasil analisis observasi aktivitas peserta didik 71,66% dengan kategori baik, dan kemampuan penalaran matematis peserta didik 79% berada pada kategori baik. dapat disimpulkan video pembelajaran berbasis pendekatan Contextual Teaching and Learning berbantuan Macromedia Flash 8 pada peserta didik kelas VIII di SMP Negeri 2 Watansoppeng yang telah dikembangkan dinyatakan valid, praktis, dan efektif.

***Kata kunci**: Pengembangan; Video Pembelajaran; Penalaran Matematis*

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INTRODUCTION

One of the fields that has felt the significant impact of the internet of things on modern society is education (Nastiti & Abdu, 2020). The development of high-quality human capital is contingent upon a robust educational system that imparts the essential knowledge and skills necessary for individual success. Within this framework, mathematics is an indispensable component. Consequently, student achievement is benchmarked against the proficiency standards set forth by the National Council of Teachers of Mathematics (NCTM). These standards include problem solving, multiple representations, mathematical connection, reasoning and proofs, and mathematical communication (Pourdavood et al., 2020). Mathematical reasoning is one of the abilities included in mathematical literacy (Ambarwati & Ekawati, 2022). Therefore, the ability to reason mathematically is a very important compe-tency for the classroom in the 21st century.

Reasoning ability is one of the most important mathematics competency standards (Ariati & Juandi, 2022). One can improve reasoning skills through math lessons and vice versa, it can be said that the two go hand in hand (Cresswell & Speelman, 2020). If students have strong reasoning skills and can communicate mathematical concepts effectively, they will more easily understand mathematical symbols (Palinussa, Molle, & Gaspersz, 2021) Reasoning ability is a foundation that can be used to build mathematical knowledge. In fact, students' mathematical reasoning ability is still a problem in Indonesia. Indonesian students' mathematical reasoning ability is only 17%, according to TIMSS 2011, lower than the global passing rate which reached 30% (Jelita & Zulkarnaen, 2019). There are still many students whose mathematical reasoning skills are still lacking, students still have difficulty in drawing conclusions, collecting evidence, proving the validity of solutions, and describing the process to solve problems (Izzah & Azizah, 2019).

Students' mathematical reasoning skills are still inadequate, especially in SPLDV material, based on field facts collected from interviews with one of the mathematics teachers at SMPN 2 Watansoppeng said that student achievement results are still below standard. Teachers have not maximally utilized learning media to assist student learning, which is one of the problems that arise. The media and learning methods used are still less varied because the teacher mostly uses lecture and question and answer methods, while the media uses Power Point. Students' reasoning skills have not developed and students' interest in learning has decreased, so that student learning outcomes are not good. One of the math teachers at SMPN 2 Watansoppeng said that students make various kinds of mistakes when solving SPLDV problems. These errors include students not understanding the problem at all, formula errors, calculation operation errors, and difficulties in providing written evidence. However, the biggest problem is that students do not understand SPLDV so they cannot express their opinions mathematically when asked to understand the problem. Developing a mathematical model of the given problem is still a challenge for students, especially if the question is in the form of an essay. Students lack the ability to manipulate mathematics, which is an indicator of mathematical reasoning.

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The implementation of instructional media presents a viable solution to the aforementioned challenges. This approach is supported by learning theories which posit that information delivered in an engaging manner significantly enhances student retention and recall (Laili et al., 2022). Among various instructional tools, learning videos are particularly noteworthy for their utility in the classroom. Their effectiveness is supported by findings from Marni et al. (2023), who assert that videos motivate students and thereby enhance learning outcomes. Moreover, specific cognitive skills can be targeted with this medium, as Rahma et al. (2022), demonstrated that learning videos are an effective means of improving students' mathematical reasoning abilities. Students' attention and memory can be stimulated and increased through the use of learning videos (Lu et al., 2021). Accordingly, the use of learning videos represents a strategic approach to support the enhancement of mathematical reasoning abilities in students. Teachers in the modern industrial 5.0 era need to be technologically literate in order to keep up with the latest innovations in this field and utilize them to improve student learning (Marni et al., 2023).

Macromedia Flash 8 is one of the best programs available for creating interactive learning videos and animations. The Macromedia Flash 8 program is an indispensable tool for creating engaging and dynamic video content (Khalisa et al., 2021). Incorporating learning videos into pedagogical strategies is another option to address the media consumption issues mentioned above (Fadhilah et al., 2021). The Contextual Teaching and Learning (CTL) approach is a pedagogical framework where educators link academic content to students' real-world situations, encouraging them to connect theoretical knowledge with its practical application in their lives (Mukhtar et al., 2022). A key tenet of this approach is the requirement for active student engagement, which transitions the learning environment from a traditional teacher-centered model to a more dynamic, student-centered one. By involving students actively in learning, it is expected that students' mathematical reasoning skills can be well trained (Chen et al., 2020).

Prior studies have demonstrated that combining digital media with contextual methodologies is an effective strategy for improving learning outcomes in mathematics. Deliana et al. (2022) proved that CTL-based Macromedia Flash-assisted media can improve students' visual thinking skills. In line with that, Alyusfitri et al. (2020) showed that Macromedia Flash 8-based media with a CTL approach was considered very valid and practical to use in learning mathematics. Meanwhile, research by MoHa et al. (2023) reported that the use of digital application-based learning videos was effective in improving student understanding. However, these studies have not specifically developed CTL-based learning videos assisted by Macromedia Flash 8 which are directed at improving students' mathematical reasoning skills, especially on flat-sided space building material. Therefore, this research comes to fill the gap by integrating CTL, Macromedia Flash 8, and video media in order to improve students' mathematical reasoning skills.

METHODS

This study employed a Research and Development (R&D) methodology structured around the ADDIE model,

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which consists of five phases: Analysis, Design, Development, Implementation, and Evaluation (Sudikan et al., 2023). The primary objective was to produce an instructional product and subsequently assess its validity, practicality, and effectiveness. The resulting product is a learning video based on the contextual teaching and learning (CTL) approach, developed using Macromedia Flash 8. This video covers the topic of Systems of Linear Equations of Two Variables (SPLDV) and is designed to enhance students' mathematical reasoning skills. The research participants were 28 eighth-grade students from class VIII.1 at SMPN 2 Watansoppeng.

The analysis phase involved the collection of information to identify specific subject matter that both students and teachers perceived as challenging during the instructional process. After finding problems that were in line with the needs of students and teachers in the previous analysis stage, the next step was to implement the design.

The design stage, conducted by the researcher, focused on creating the foundational framework for the learning video. Key activities included developing the storyboard, drafting the script, and planning the sequence of visual assets and interactive components.. The media to be developed is an instructional video using the contextual teaching and learning approach with the help of Macromedia Flash 8 (Atika et al., 2022). At this stage, a video design is created, starting with making an initial video framework in accordance with the learning approach used, then designing the concept and flow to be used in making the video. In addition to creating a video design, at this stage, instruments to be used in the research are also created.

The development stage entailed the production of the learning video as specified in the design phase. All planned components were assembled to create the initial version of the learning media. Following production, this prototype and its related instruments underwent expert validation by specialists in media and content. The feedback gathered from this validation was then used to iteratively revise and refine the product, addressing any identified shortcomings prior to its use with student participants.

The implementation phase consisted of a field trial designed to assess the practicality and effectiveness of the developed learning video. The instructional video, which is based on the Contextual Teaching and Learning (CTL) approach and developed using Macromedia Flash 8, had undergone expert validation prior to this stage. The trial was conducted with a cohort of 28 eighth-grade students from class VIII.1 at SMP Negeri 2 Watansoppeng, utilizing the previously validated research instruments.

This evaluation stage was conducted in relation to unmet video development needs. In the final stage, revisions were made after conducting field trials, and only minor revisions remained because each step had undergone evaluation, so there were no significant changes to the developed video.

The data collection methods used include questionnaires, observations, interviews, and tests. Data for this study were collected using several instruments, namely validation sheets, observation sheets for student activities and learning implementation, questionnaires for teachers and students, and mathematical reasoning ability tests. The data analysis technique used in this research is related to validity,

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practicality, and effectiveness data. The validity level was reviewed from the validation sheet. All instruments and products are said to have a good level of validation if the average validation for all aspects is at least in the valid enough category. The data analysis technique used in this research is related to validity, practicality, and effectiveness data. Specifically, practicality was evaluated through observation of learning implementation and teacher response data. Effectiveness was measured by analyzing three data sources, namely student activity observations, student response questionnaires, and mathematical reasoning ability test results.

RESULTS AND DISCUSSION

Results

The development of this learning video media is based on the stages of the ADDIE development model. The analysis stage includes problem analysis, material analysis and product manufacturing tool analysis. In analyzing the problem, researchers identified the problems faced by students and teachers. It was found that students' difficulties in understanding SPLDV material led to the selection of learning videos as learning media, so that students can further explore their abilities and are expected to be able to make learning more innovative and increase students' enthusiasm for learning. The material of the system of linear equations of two variables is material that requires reasoning so that students have difficulty solving problems of the system of linear equations of two variables related to everyday life. Then, in the analysis of product creation tools, there are several video maker applications that can be used such as canva, animaker, kinemaster, capcut, macromedia flash 8, filmora and many other applications. One of the dynamic and interactive tools that can help learning and solving math problems is Macromedia Flash 8.

The second stage is the process of designing learning videos The instructional design of the video is grounded in the Contextual Teaching and Learning (CTL) approach, focusing on the topic of two-variable linear equation systems. Specifically, the video's structure and content incorporate the seven core components of CTL: Constructivism, Inquiry, Questioning, Learning Community, Modeling, Reflection, and Authentic Assessment. Following the finalization of the video design, the research instruments were developed. These included teacher and student response questionnaires, observation sheets for student activity and learning implementation, and a test of mathematical reasoning ability.

Transforming the concept into a working learning video is the core of the development stage. The next step in creating a Macromedia Flash 8 instructional video is to organize the ideas generated during the design stage. The content comes from the system of linear equations. The content comes from the system linear equations of two variables, which is divided into three sessions. the following are the components in the learning video. Some of learning video display can be seen Figure 1 until Figure 9.

Figure 1. Learning video intro display

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Figure 2. Main menu display

Based on Figure 1 and 2, On this page has included a background with the same color theme and school theme The intro page has an initial display (loading) when the learning video is first opened and operated. On this page, a command has been given when loading is complete, it will lead to the main menu page.

Figure 3. CP and TP Display (Contructivism)

Figure 3 shows contructivism displays learning outcomes and learning objectives. This page explain about the basic competencies and objectives.

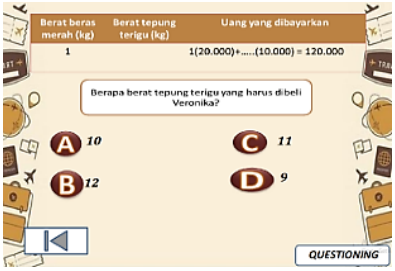

Figure 4. Questioning display

Questioning displays a question related to the Two-Variable Linear Equation System. Before explaining SPLDV material, an initial question is given to help students be active in answering questions. The initial question is made in the form of multiple choice so that students can interact directly to answer the questions.

Figure 5. Inquiry display (determine)

Based on Figure 5, inquiry displays the events of the system of linear equations of two variables in everyday life. Illustrations are given that are related to everyday life to increase learners' knowledge related to SPLDV in everyday life that is often applied.

Figure 6. Learning community display

Based on Figure 6, "Learning Community" explains the content of the material about the system of linear equations of two variables, which consists of

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understanding, general equations of SPLDV, types of solution methods, and steps for solving each SPLDV method.

Figure 7. Modelling display

Based on Figure 7, the "Modelling" part explain about the examples of SPLDV problems and solutions, by describing examples of related SPLDV problems in everyday life.

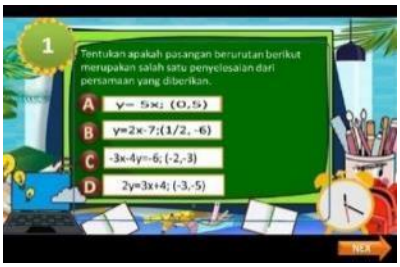

Figure 8. Reflection display

Reflection is displaying questions to students related to what has been mastered and what has not been mastered after seeing the explanation of the learning video to help students recall what material has been learned that day.

Figure 9. Authentic assessment display

Authentic Assessment is an assessment that is carried out based on the exercise questions that have been displayed. Authentic Assessment is a sample problem that covers the material studied to be done by students. Each problem done by students will be assessed directly with the score that appears after students work on the problem or reflection.

During the development stage, a comprehensive validation process was conducted by expert reviewers for the instructional video and all associated research instruments. The instruments submitted for validation included teacher and student response questionnaires, a test of mathematical reasoning ability, an observation sheet for learning implementation, and a student activity observation sheet. The quantitative results of the validation for the video summarized in Table 2.

Table 2. Learning video validation results

Validation Sheet	Indicator	Assessment	Description
Video	Content Aspects	3.83	Very Valid
	Learning Aspects	3.86	Very Valid
	Linguistic Aspects	3.75	Very Valid
	Simplicity Aspects	3.73	Very Valid
	Integration Aspects	3.7	Very Valid
	Emphasis Aspects	3.83	Very Valid
	Balance Aspects	3.87	Very Valid
	Form Aspects	3.75	Very Valid
	Color Aspects	3.83	Very Valid
	Time Aspects	3.75	Very Valid
Total mean validity of Video		**3.79**	**Very Valid**

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Subsequent to their initial revision, the research instruments were subjected to an expert validation process. The outcomes of this validation, which confirmed their suitability for the study can be seen in Table 3.

Table 3. Research instrument validation results

No	Validation Sheet	Indicator	Assessment	Description
1	Learning Implementation	Guidance Aspects	4	Very Valid
		Language Aspects	3.75	Very Valid
		Content Aspects	4	Very Valid
		Average	3.91	Very Valid
2	Teacher Response Questionnaire	Guidance Aspect	4	Very Valid
		Language Aspect	3.5	Very Valid
		Content Aspect	4	Very Valid
		Average	3.83	Very Valid
3	Learner Activity	Guidance Aspect	4	Very Valid
		Language Aspect	3.83	Very Valid
		Content Aspect	4	Very Valid
		Average	3.94	Very Valid
4	Learner Response Questionnaire	Guidance Aspect	4	Very Valid
		Language Aspect	4	Very Valid
		Content Aspect	3.66	Very Valid
		Average	3.87	Very Valid
5	Mathematical Reasoning Ability Test	SPLDV Concept	3	Valid
		Substitution	4	Valid
		Elimination	4	Valid
		Substitution	4	Valid
		Mixed	3.5	Very Valid
		Average	3.7	Very Valid

As indicated in Table 3, the instructional video developed based on the Contextual Teaching and Learning (CTL) approach achieved a 'very valid' rating. This validation confirmed the video's suitability for use in the subsequent implementation phase. During this stage, the video was administered to students to formally assess its practicality and effectiveness using the previously validated instruments. The results of the practicality and effectiveness analyses are presented in Table 4 and Table 5.

Table 4. Results of analysis of practicality levels

Criteria	Data Analysis Result	Score	Category
Practicality	Results of teacher response questionnaire analysis	88.46	Very Positive
	Learning Implementation Analysis Results	1.87	Fully Implemented

The results of the teacher response questionnaire analysis obtained a score of 88.46%, which is in the interval 85% $< p \leq$ 100% with the category ‘very positive’, meaning that teachers responded relatively very positively to the

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learning videos. Meanwhile, the average implementation of learning using video-based learning media with a Contextual Teaching and Learning (CTL) approach assisted by Macromedia Flash 8 was 1.87, which is in the interval $1.5 \leq M < 2$ with the category 'fully implemented', meaning that most aspects and indicators of learning implementation were carried out in classroom learning. Therefore, the instructional video based on the Contextual Teaching and Learning (CTL) approach, developed using Macromedia Flash 8, is concluded to be a practical medium for classroom learning.

Table 5. Results of analysis of effectiveness levels

Criteria	Data Analysis Result	Score	Category
Effectiveness	Results of Analysis of Learner Response Questionnaire	82.37	Positive
	Results of Learner Activity Analysis	71.67	Good
	Mathematical Literacy Test Analysis Results	79	High

The results of the analysis of the student response questionnaire obtained a score of 82.37%, which is in the interval $70\% \leq RS < 85\%$ with a "positive" category, meaning that students responded positively to the videos used in learning. Meanwhile, the average result of the student activity observation was 71.67%, which was in the interval $60\% \leq p < 80\%$ with a "good" category. The results of the mathematical reasoning ability test analysis showed a completion rate of 79%, which falls within the interval $60\% < p \leq 80\%$ and is categorized as "good". The findings of this study demonstrate that the learning video developed with the Contextual Teaching and Learning (CTL) framework is an effective instructional medium.

Discussion

The learning video was specifically designed to enhance students' mathematical reasoning skills within the context of System of Linear Equations of Two Variables (SPLDV). To achieve this objective, the video's design is grounded in the principles of the contextual teaching and learning (CTL) approach and was developed using Macromedia Flash 8. The learning video made before the trial was first validated by a team of validators. The instructional video developed in this study was categorized as 'very valid,' achieving a mean validation score of 3.79. This finding is consistent with research by Alyusfitri et al. (2020), who also developed a Macromedia Flash 8 and CTL-based learning media; their materials similarly achieved a 'very valid' rating with a validation percentage of 93.3%. Furthermore, comparable results were reported by Endang et al. (2022), who developed contextual-based teaching materials assisted by videos for learning about solid geometry, which were also found to be valid and feasible for implementation.

The practicality of the learning video, based on the contextual teaching and learning (CTL) approach, was evaluated using a teacher response questionnaire and a learning implementation observation sheet. The analysis of the teacher questionnaire yielded a score of 88.46%, indicating a 'very positive' response. Furthermore, data from the observation sheet showed that the learning process was well-executed, achieving a score of 1.87, which

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corresponds to the 'fully implemented' category. Both of these outcomes exceed the minimum practicality criteria established by Arsyad et al. (2018), which require a 'positive' teacher response and a 'partially implemented' rating. Given that the results from both the teacher response questionnaire and the learning implementation observation meet and exceed the established criteria, the instructional video is concluded to be practical for classroom use. This finding aligns with research by Rambe et al. (2024), who developed a contextual-based learning video and also found it to meet practicality standards with a 'very good' rating. Similarly, a study by Nabila et al. (2023), on an instructional video garnered a 'very practical' response from students, further corroborating the present study's findings.

The effectiveness of the learning video was evaluated based on student activity levels, student responses, and performance on a mathematical reasoning ability test. The analysis revealed positive outcomes across all measures. Observations indicated that student activity was consistently in the 'good' category across three meetings, and student response questionnaires yielded a 'positive' rating. Furthermore, the mathematical reasoning test results achieved a classical completeness score corresponding to the 'high' category, confirming the video's positive impact on learning outcomes. These findings are substantiated by previous research. For instance, studies by Atika et al. (2022), Avania and Sholikhah (2021), and also Rachmawati and Sumargiyani (2021), have all similarly demonstrated the effectiveness of learning media developed with contextual and/or digital frameworks. Therefore, the learning video developed in this study has successfully met the predetermined criteria for validity, practicality, and effectiveness. Based on these comprehensive findings, the CTL-based learning video is concluded to be a high-quality educational resource, suitable for implementation in classroom activities to enhance students' mathematical reasoning skills.

Learning by using learning videos based on the contextual teaching and learning approach aided by Macromedia Flash 8 can be said to be proven to have an influence on students' mathematical reasoning. Learning with learning media can help in the learning process compared to only focusing on using textbooks and conventional methods so that this can also increase student interest in learning. Shafa & Yunianta (2022) in his research explained that interactive media improves students' mathematical reasoning skills. Learning using interactive media is still rarely applied in schools, so this method affects student learning motivation. The existence of student interest and motivation causes student learning activities to also be better and learning is not monotonous. The utilization of video learning media can also help students understand the material more easily, provide a clearer visual experience in understanding mathematical concepts, and can improve students' mathematical reasoning in achieving learning objectives.

CONCLUSIONS

This research successfully developed an instructional video based on the Contextual Teaching and Learning (CTL) approach to improve students' mathematical reasoning skills, following the five stages of the ADDIE model. The evaluation results confirmed the product's quality across the three

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key criteria of validity, practicality, and effectiveness. The video was determined to be valid, achieving a mean score of 3.79 from expert validators, which corresponds to a 'very valid' category. It also demonstrated high practicality, evidenced by a 'very positive' teacher response (88.46%) and a learning implementation score of 1.87, indicating that lessons were 'fully implemented'. Finally, the video proved to be effective, as shown by a 'positive' student response (82.37%), 'good' student activity levels (71.67%), and a 'high' category score (79%) for mathematical reasoning ability. Therefore, the CTL-based learning video developed for eighth-grade students at SMP Negeri 2 Watansoppeng is concluded to be a valid, practical, and effective educational resource

The broader educational implication of these findings is the importance of developing this contextual approach-based learning video to improve students' mathematical reasoning skills so that mathematics learning is more meaningful. Teachers can create more interesting and relevant learning experiences, which can improve students' mathematical understanding and skills.

This study makes a significant contribution to teaching practice by offering a more interactive and relevant learning solution. However, this study is limited to SPLDV materials. For future research, it is recommended to develop learning videos with more diverse topics and test their applicability across different levels of education. In addition, the development of more creative and diverse learning videos in contextual teaching and learning-based contexts can further enrich students' learning experiences and improve mathematical reasoning more broadly.

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