Interactive Learning Videos Based on Problem-Based Learning in Mathematics for Eighth Graders

Shelfy Nasfovi[1*], Desak Putu Parmiti[2] iD

[1,2] Program Studi Teknologi Pendidikan, Universitas Pendidikan Ganesha, Singaraja, Indonesia

A R T I C L E   I N F O

A B S T R A K

Pembelajaran di sekolah masih berpusat kepada guru dan masih menggunakan bantuan media konvensional menjadikan siswa kurang aktif serta minat dan hasil belajar menurun. Tujuan penelitian ini yaitu mengembangkan video pembelajaran interaktif berbasis problem based learning pada mata pelajaran Matematika siswa kelas VIII. Model pengembangan yang digunakan adalah model ADDIE. Subjek penelitian ini merupakan 28 siswa kelas VIII dengan menggunakan metode kuesioner dan tes. Teknik analisis data menggunakan analisis deskriptif kualitatif, kuantitatif, dan statistic inferensial. Hasil penelitian menunjukkan bahwa hasil validitas pada uji ahli (isi, desain dan media) mendapatkan skor rata-rata 94,82% (kualifikasi sangat baik), uji perorangan, kelompok kecil dan lapangan mendapatkan skor rata-rata 88,66 (kualifikasi baik). Hasil uji-t menyatakan bahwa terdapat perbedaan yang signifikan hasil belajar siswa sebelum dan sesudah mengikuti pembelajaran dengan menggunakan video pembelajaran interaktif berbasis problem based learning. Video pembelajaran interaktif ini mampu membuat siswa lebih aktif serta meningkatkan minat dan hasil belajar siswa juga membuka wawasan dan mengasah kemampuan guru untuk memanfaatkan teknologi dalam pembuatan media pembelajaran yang menarik, efektif dan bervariasi.

A B S T R A K

Learning in schools is still centred on the teacher and uses conventional media to make students less active, decreasing their interest and learning outcomes. This study aims to develop problem-based learning interactive learning videos in the Mathematics subject of eighth-grade students. The development model used is the ADDIE model. The subjects of this study were 28 eighth-grade students using questionnaires and tests—data analysis techniques using descriptive qualitative analysis, quantitative, and inferential statistics. The results showed that the results of the validity of the expert test (content, design, and media) obtained an average score of 94.82% (very good qualification), and individual, small group and field tests obtained an average score of 88.66 (good qualification). The t-test results stated significant differences in student learning outcomes before and after participating in learning using problem-based learning and interactive video learning. This interactive learning video can make students more active and increase student interest and learning outcomes, as well as open insights and hone teachers' abilities to utilize technology in making learning media interesting, effective, and varied.

1. INTRODUCTION

The field of education science and technology continues to grow rapidly in line with changes in curriculum and the progress of the times. With the development of technology, the world of education is getting better with the marked development of learning media (Seels & Richey (dalam Situmorang et al., 2019); AECT, 1944) argues that learning technology is formulated based on five fields of work, Design, Development, Utilization, Management, and Evaluation. In this case, development can be done as an effort to solve problems in learning. Technological developments in education have a significant influence on teacher-student interaction patterns. Teachers in the learning process play an important role in improving the teaching and learning process quality and student learning outcomes. The reality is that currently,

*Corresponding author.
E-mail addresses: shelfy@undiksha.ac.id (Shelfy Nasfovi)

many teachers still apply conventional learning, which impacts student learning outcomes and decreases student learning motivation, especially when learning activities demand reducing the lecture method and replacing it with the use of many learning media. It is related to the interviews and observations conducted on March 24, 2021, at SMP Negeri 10 Semarang. It is known that teachers are more likely to use conventional methods, lectures, and use print media assistance such as textbooks and simple videos from Youtube, and tests using quiz assistance. It makes students bored with the use of such media, which will result in learning objectives that are not achieved and decreased motivation and student learning outcomes with evidence that the average learning outcomes in the midterm exams get a score of 66.12, which is below the minimum standard of completeness criteria. In addition, students need to be faster in collecting assignments because learning motivation decreases. Based on this, the previously applied methods must be supported and complemented by other methods to be varied, effective, and interesting. One solution is to develop an interactive learning video. Interactive learning videos are suitable for improving student learning outcomes (Marjuki et al., 2021). Interactive learning video is a learning video media that combines text, images, sound, animation, or graphics that can connect users/users to be able to interact in the video media used (Pastowo (dalam Wardani et al., 2018); Niswa (dalam Wardani et al., 2018)). Interactive video requires users to be actively involved in the video (Yasa (dalam Wardani et al., 2018); Seels & Glasgow (dalam Tambunan et al., 2021)). Interactive learning videos have advantages because of two elements, audio and visual, so that in the learning process, more learning experiences are obtained by students with audio-visual than audio or visual only (Dale (dalam Karmila, 2021)).

This interactive learning video is made using a Problem-Based Learning (PBL) approach because this learning model can help students to be more active and independent in developing critical thinking skills to solve problems through searching data (Riyanto (dalam Sari, 2012); Arends (dalam Sari, 2012)). It is supported by research conducted by (Zulhelmi et al., 2017; Astriawati, 2020) that interactive learning videos can improve students' critical thinking skills and learning motivation. This learning model was also chosen based on the characteristics of mathematics in junior high school. At the junior high school level, adolescents can already think logically, use symbols and think flexibly (Piaget (dalam Baharuddin et al., 2007);. With the characteristics of these junior high school students, learning mathematics using symbols has been accepted by students, which means students are ready to accept mathematical material such as the gradient concept. Previous research findings state that interactive instructional video media is appropriate for various subjects, including mathematics (Andriani et al., 2019; Anwar et al., 2020; Mahadhir et al., 2022 dan Fitria et al., 2022). Interactive learning videos are effectively used in learning with very good expert reviews (Wardani et al., 2018; Anwar et al., 2020, Tambunan et al., 2021; Rahmawati et al., 2021). Previous research findings state that interactive instructional video media can improve student learning outcomes (Rahmawati et al., 2021; Putra et al., 2021). This study aims to create interactive learning videos that can increase student motivation and learning outcomes and help make teaching and learning more varied, interesting, and effective. The reason for choosing interactive learning videos is that they are also based on field problems. After all, learning videos have various combinations, and some interactions can make students play an active role in learning so that learning objectives are achieved and motivation and learning outcomes increase. Besides that, interactive learning videos can help teachers be more varied, effective, and interested in using media when learning.

2. METHOD

This type of research is research and development (Research and Development/R&D). The R&D research model is a model that is used to produce a particular product (output) that is used in learning and validation of the product is carried out (Seonarto (dalam Tegeh et al., 2017); Borg & Gall (dalam Tegeh et al., 2017)). This research was conducted at SMP Negeri 10 Semarang, located in Mugassari, South Semarang District, Semarang City, Central Java Province. The subjects in this study included 1) individual tests, 2) small group tests, 3) field tests, and 4) effectiveness tests. The individual test subjects were three eighth-grade students at SMP Negeri 10 Semarang consisting of 1 student each with high, medium, and low abilities. The small group test subjects were 12 eighth-grade students at SMP Negeri 10 Semarang consisting of 4 students each with high, medium, and low abilities. Field test subjects and effectiveness were 28 eighth-grade students of SMP Negeri 10 Semarang with different ability levels, high, medium, and low. This research model uses the stages of the ADDIE model, which can be evaluated at each stage, improving the product. This model consists of 5 stages, (1) analysis (analyze), (2) design, (3) development (development), (4) implementation (implementation), and (5) evaluation (evaluation) (Tegeh dan Jampel, 2017). The methods used in this research are (1) questionnaire/questionnaire method (Agung, 2018), how to obtain or collect data by sending a list of questions/statements to respondents/research subjects to be answered in writing, (2) test methods, (Sudijono, 2009) the method

used or the procedure adopted in the framework of measurement and assessment in the field of education in the form of giving assignments or a series of tasks either in the form of questions that must be answered or orders that must be carried out. The instruments used in this study were (1) questionnaire sheets to collect review data from expert tests (subject content experts, instructional design experts, and learning media experts) and individual, small group, and field trials. (2) test used to collect the data needed to determine the effectiveness of the pre-test and post-test. The expert instrument grids in this study are presented in Table 1. Subject content expert instrument grids, Table 2. Learning design expert instrument grids, and Table 3. Learning media expert instrument grids. The instrument grids for individual, small group, and field tests are presented in Table 4. The individual, small group, field test instrument grids, and test instrument grids for effectiveness tests are presented in Table 5.

Table 1. Subject Content Expert Instruments

No	Criteria		Indicator	Total
1.	Learning Aspects	a.	Suitability of goals with indicators	2
		b.	Learning objectives according to the ABCD format	
2.	Material Aspect	a.	Material systematization	6
		b.	Suitability of presentation of media material with learning objectives	
		c.	Clarity of presentation of the material	
		d.	Sample availability	
		e.	The suitability of the illustration images with the material	
		f.	Material breadth	
3.	Grammatical Aspects	a.	Grammatical accuracy	3
		b.	Spelling accuracy	
		c.	Correct terms and punctuation	
4.	Evaluation Aspects	a.	The questions given are by the learning objectives	2
		b.	The questions given are easy to understand and not ambiguous	
			Total Item	**13**

Table 2. Instructional Design Expert Instruments

No	Criteria		Indicator	Total
1.	Aspects of visual appearance	a.	The attractiveness of media appearances	4
		b.	Clarity of components (text, images, audio, animation) on the media	
		c.	The accuracy of the components (text, images, audio, animation) in the media	
		d.	Matching font and background colors	
2.	Aspects of learning	a.	Appropriateness of learning objectives with learning indicators and materials	2
		b.	Learning objectives according to the ABCD format	
3.	language aspect	a.	language used	3
		b.	Accuracy of spelling and punctuation	
		c.	Clarity of description and discussion	
4.	Aspects of interest/concern	a.	Media can motivate students' interest in learning	3
		b.	Media can increase students' attention	
		c.	The ability of the media to increase students' knowledge and understanding	
5.	Aspects of the stages of learning	a.	The stages of the material are given sequentially	3
		b.	The stages of the material are given systematically	
		c.	Each stage of the material has relevant examples	
			Total Item	**15**

Table 3. Instruments of Learning Media Experts

No	Criteria		Indicator	Total
1.	Text	a.	Clarity and readability of the text	4
		b.	Text rendering accuracy	
		c.	Appropriateness of font selection, font size, and spacing	

No	Criteria		Indicator	Total
		d.	Matching the colour of the letters with the background	
2.	Picture	a.	Image alignment	5
		b.	Image quality	
		c.	Background suitability	
		d.	Compatibility of color composition	
		e.	Image attractiveness	
3.	Audio	a.	The clarity of the narrator's voice	4
		b.	The narrator's voice is in sync with the text and graphics	
		c.	intonation accuracy	
		d.	Compatibility with sound effects	
4.	Accessibility	a.	Ease of use of media	2
		b.	Ease of doing quizzes	
			Total Item	**15**

Table 4. Individual, Small Group, and Field Test Instruments

No	Criteria		Indicator	Total
1.	Material	a.	Ease of understanding the material	5
		b.	Clarity of delivery of material	
		c.	Compatibility of examples with material	
		d.	Examples are easy to understand	
		e.	The language used is easy to understand	
2.	Image	a.	Image attractiveness	2
		b.	image clarity	
3.	audios	a.	Clarity of presenter/narrator's voice	2
		b.	The choice of words is easy to understand	
4.	Media	a.	The attractiveness of the video view	3
		b.	Video text legibility	
		c.	Interesting color composition	
5.	Evaluation	a.	The questions presented are by the material	2
		b.	The questions presented are easy to understand	
6.	Accessibility	a.	Ease of using media	2
		b.	Ease of doing quizzes	
			Total Item	**16**

Table 5. Test Item Instruments

Learning objectives	Material	Cognitive Level						Number of Questions
		C1	C2	C3	C4	C5	C6	
1. After participating in the learning process in online mode and self-study and using the discussion and question and answer method Students can correctly determine the slope of a line/gradient from a straight-line equation.	Straight Line Equations Gradient Sub-Chapter		1,3	2, 4 6, 7, 8, 9, 10, 11, 16, 17, 21, 23, 24, 25, 26				17
2. Students can correctly determine the slope of the equation of a straight line through the center point 0 (0,0).			5	12, 13, 14, 15, 18, 19, 20, 22, 27, 28, 29, 30				13

Data analysis methods and techniques in this development research used three data analyses, : (1) qualitative descriptive analysis, (2) quantitative descriptive analysis, and (3) inferential statistical analysis. (1) Qualitative descriptive analysis technique, a method of analyzing/processing data by

systematically compiling in the form of sentences/words, categories regarding an object (objects, symptoms, certain variables) so that a general conclusion is finally obtained (Agung, 2017). (2) Quantitative descriptive analysis technique, which is a way of processing data that is carried out by systematically compiling in the form of numbers and or percentages regarding an object studied so that general conclusions are obtained (Agung, 2017), and (3) Inferential statistical analysis technique, the field of statistics that studies how to conclude the state of the population, based on the results of data on the part of the population called the sample (Agung, 2017). The data analysis techniques used in this study for the first and second research objectives were the process of product development and validity, using questionnaires/questions given to experts (subject content, instructional design, and learning media) and tested on students (individual, small group, and field tests) which produced scores/values that could be converted. The third research objective is product effectiveness, using tests given to students to determine the effectiveness of using problem-based learning interactive video media products with the help of pre-test and post-test.

3. RESULT AND DISCUSSION

Results

The results of this development research are discussed in three main parts: the process of developing interactive learning videos and the validity and effectiveness of using interactive learning videos. The development of media products in this study uses the ADDIE development model, which includes analysis, design, development, implementation, and evaluation. In developing interactive learning videos, the five stages of the ADDIE model are used with the following explanation. The analysis stage (analyze); (1) performance analysis, (2) needs analysis, and (3) facility and environment analysis. Performance analysis is used to discover the problems faced during the learning process and determine the solution. Based on interviews with the eighth-grade mathematics teacher, information was obtained that learning was still conventional and still used the help of textbooks, simple videos from Youtube, and pdf. Needs analysis is used to determine what is needed from students to improve the quality of learning and learning outcomes. Based on the observations, it was found that students felt bored with the media used by the teacher and needed interesting media, being given interactive learning video solutions focused on Basic Competency straight line equations knowing gradients. Facility and environment analysis determines available facilities and the learning process environment. Based on the observations, it was found that the available facilities were adequate, such as the availability of LCD projectors to support learning and the school environment being renewed/renovated to make it better.

In the design stage, the activities carried out at this stage: (1) determining Basic Competency and learning objectives, (2) making storyboards, and (3) compiling validity instruments for interactive learning videos. Making storyboards is intended to provide an overview of the design in developing products and simplify the flow of material to be explained. The preparation of the video validity instrument is intended to prepare the instrument before being assessed at a later stage. In the development stage, the activities carried out at this stage are divided into two activities, (1) the production stage and (2) the post-production stage. During the production stage, the following activities were carried out: (1) choosing and determining the application for developing interactive learning videos. The application used was Loomie Live, Edpuzzle, Camtasia Studio 9, OBS Studio, (2) application settings, (3) selecting colors, images, graphics, and text used, (4) entering material along with supporting images, (5) recording the narrator's voice, (6) editing and mixing processes. After the interactive learning video has been produced, it can be seen in Figure 1. Initial display, Figure 2. Display of learning objectives, Figure 3. Display of content, Figure 4. Display of mid-material quizzes, Figure 5. Display of evaluation, Figure 6. Closing display, then proceed to the post-production stage, a review of experts consisting of subject content experts, learning design experts, and learning media experts, with the results of the score obtained presented in Table 6. The results of the validity of the experts.

Table 6. The Results of the Validity of the Experts

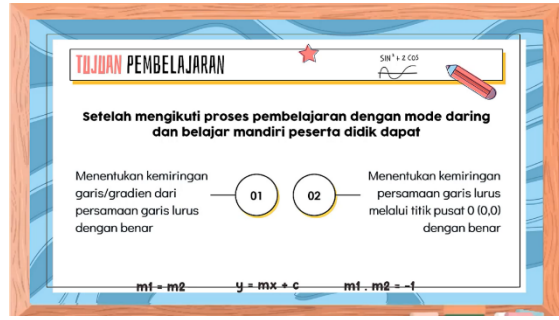| No	The subject of the interactive learning video validity test	Validity Results	Qualification
1	Subject Content Expert Test	93,80%	Very good
2	Learning Design Expert Test	93,33%	Very good
3	Learning Media Expert Test	97,33%	Very good

Figure 1. Initial View

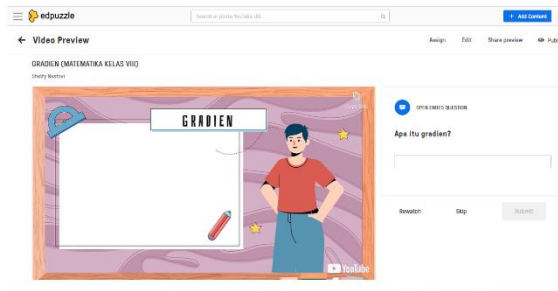**Figure 2.** Display of Learning Objectives
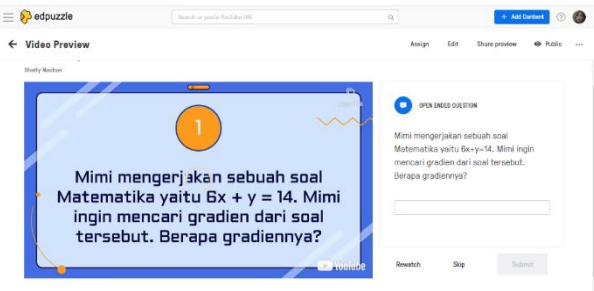
Figure 3. Contents Display

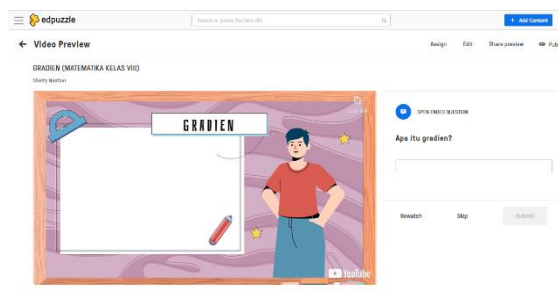**Figure 4.** Middle Quiz Display Materi

Figure 5. Display Evaluation

Figure 6. Cover Display

Based on the table above, it can be analyzed that the results of subject content, experts scored 93.80% with very good qualifications, the results of learning design experts got a score of 93.33% with very good qualifications, and the results of learning design experts got a score of 97.33% with very good qualifications. Based on these data, it was obtained that the average test results from experts obtained a score of 92.82% with very good qualifications. After being reviewed by the experts, it is revised in advance according to the suggestions and comments from the experts and can be continued later.

In t

he implementation phase, the activities carried out at this stage were conducting trials on the eighth-grade students of SMP Negeri 10 Semarang consisting of individual, small group, and field trials. In each trial that was carried out, the results were presented in Table 7. The results of the trials on the following students.

Table 7. Results of trials on students

No	The subject of the interactive learning video validity test	Validity Results	Qualification
1	Individual trials	90.42%	Very good
2	Small group test	90.42%	Very good
3	Field test	85.13%	Good

Based on the table above, it can be analyzed that from the results of the individual trials, a score of 90.42% was obtained with very good qualifications, and from the results of the small group trial, a score of 90.42% was obtained with very good qualifications, and from the field test results a score of 85.13% was

obtained with good qualifications. Based on these data, it was obtained that the average test results for students obtained a score of 88.65% with good qualifications. Then revisions are made according to suggestions and comments from students and can be continued later.

Evaluation stage, the activities carried out at this stage measure student learning outcomes which will be used to determine the effectiveness of interactive learning video media with the help of pre-test and post-test. The pre-test is carried out before learning using interactive learning videos, and the post-test is carried out after learning using interactive learning videos. The pre-test and post-test were conducted on 28 students of class VIII H of SMP Negeri 10 Semarang, and the results are presented in Table 8. The results of the students' pre-test and post-test are as follows.

Table 8. Student pre-test and post-test results

No	Effectiveness test subjects	Result	Qualification
1	Pre-test	55.7	Less
2	Post-test	88.9	Good

Based on the table above, it can be analyzed that the pre-test results get a score of 55.7 with fewer qualifications, while the post-test results get a score of 88.9 with very good qualifications. Student learning outcomes or differences have increased based on the pre-test and post-test results. The t-test, with the conditions for normality and homogeneity tests first, proves this. In the normality test, the results are presented in Table 9. The results of the data normality test are below with the help of SPSS.

Table 9. Data normality test results

No	Data	Kolmogorov-Smirnov	Shapiro-Wilk
1	Pre-test	0.152	0.268
2	Post-test	0.072	0.125

Based on the table above, it can be analyzed that the Kolmogorov-Smirnov and Shapiro-Wilk columns in the pre-test results obtained 0.0152 and 0.268. These results indicate that the results of the significance of the two columns are greater than 0.05 (significance level of 5%), so the data is declared normal. The Kolmogorov-Smirnov and Shapiro-Wilk columns on the post-test results obtained 0.072 and 0.125. These results indicate that the results of the significance of the two columns are greater than 0.05 (significance level of 5%), so the data is declared normal. After the data is declared normal, then its homogeneity is tested. The data from the homogeneity test results from the pre-test and post-test data obtained a significance score in the Based on Mean column, indicating a price of 0.377. These results indicate that the significance is greater than 0.05 (5% significance level), so the data is declared homogeneous. With the normality and homogeneity test results, the t-test can be carried out with the help of SPSS to get results in the significance column (2-tailed) of 0.000. These results indicate that the significance level is less than 0.05 (5% significance level), so H0 is rejected, and H1 is accepted, which means that there is a significant difference in student learning outcomes before participating in learning using problem-based learning interactive video-based learning and after participating in learning using problem-based learning interactive video-based learning.

Discussion

The study results show that interactive instructional video media with a problem-based learning (PBL) approach is appropriate and effective for use in learning. Several factors, including the following, cause this. First, interactive learning video media is feasible to apply because it has received very good qualifications. It is due to the systematic use of the ADDIE model (Tegeh and Jampel, 2017; Romiszowaki (in Tegeh and Jampel, 2017). Developing interactive instructional video media that refers to the ADDIE model is effective and can assist students and teachers' teaching and learning processes. In addition, the results of the development of (Affandi, 2021; Zahtoh et al., 2017) state that interactive learning video media helps in learning and obtains very good responses. The results of other studies state that the use of interactive learning video media can increase student learning motivation (Zulhelmi et al., 2017; Astriawati, 2020) and student learning outcomes (Rahmawati et al., 2021; Putra et al., 2021, Tambunan et al., 2021). Second, interactive learning videos with a Problem-Based Learning approach are appropriate to apply because of the attractive video appearance. The attractiveness of interactive learning video media is an important factor that needs to be considered because psychologically, the use of attractive images helps the development of child psychology so that it has an impact on student's interest and motivation to learn (Supriyono (in Putra et al., 2021;). The suitability of the images with the learning material presented

in interactive learning videos can make it easier for students to understand the information presented. In addition, the presentation of interactive learning videos as a result of this development is designed in such a way as to be able to display writing/text, image illustrations, audio/sound, and animations in one unit to provide power a special attraction for students in learning through the presentation of audio-visual material displayed (Ponza et al., 2018; Omer, 2016). Using quizzes on interactive videos can increase student interest and activity because students can interact and actively participate in the learning videos. It is consistent with the characteristics of the learning videos themselves, inviting students/users to participate and interact directly actively (Yasa (in Wardani et al., 2018); Seels & Glasgow (in Tambunan et al., 2021); Daryanto (in Karmila, 2021).

Previous research findings show that learning videos are effectively used in learning (Anwar et al., 2020; Rahmawati et al., 2021; Tambunan et al., 2021; Fitria et al., 2022). Interactive learning videos are also suitable for use in various subjects, including mathematics, research conducted by (Andriani et al., 2019; Fitria et al., 2022; Mahadhir et al., 2022). Interactive learning videos are also suitable for use not only at the elementary, junior high, high school/vocational school levels but can be used in lectures, as was done by (Firmansah et al., 2020; Kasturi et al., 2022) who conducted research at the Elementary School (SD) level with the result that interactive learning video media was appropriate for use, research conducted by (Laksono et al., 2020; Mahadhir et al., 2022) conducted research at the Junior High School level (Laksono et al., 2020; Mahadhir et al., 2022) SMP) by obtaining the result that interactive learning video media is feasible to use, research conducted by (Cresswell et al., 2019; Rohman et al., 2020; Putri et al., 2021) conducted research at the Vocational High School (SMK) level with the result that interactive learning video media is feasible to use. At the lecture level, the results show that interactive learning videos are appropriate for learning and increase learning motivation (Astriawati, 2020; Sudarman et al., 2021) using the RME (Realistic Mathematics Education) method. Interactive learning videos are effective and appropriate for public schools and can be used by schools with special needs or special schools (Zahtoh et al., 2017). The advantages of the interactive learning video media developed are that the video media innovates in terms of attractive design and uses 3D animated people characters with a few additional questions inserted in the middle of the major explanation to be filled in directly by students to know whether students are focused on paying attention or not. Students can do an evaluation quiz directly at the end of the material explanation. This research implies that interactive learning videos can increase student motivation and learning outcomes. Students also become more active and interested in learning. Opening insights and honing teachers' abilities to utilize technology in making learning media that can improve the quality of education and make media interesting, varied, and effective.

4. CONCLUSION

This interactive learning video can increase student motivation and learning outcomes. Students also become more active and interested in learning. Opening insights and honing teachers' abilities to utilize technology in making learning media that can improve the quality of education and make media interesting, varied, and effective. Based on the results of data analysis, interactive instructional video media obtained valid and effective results for use in learning by obtaining an average expert score of 94.82% with very good qualifications and in individual, small group, and field tests obtaining an average result of 88.65% with good qualifications. Interactive instructional video media in learning can make it easier for teachers to explain the material and increase student motivation and learning outcomes, with evidence of obtaining a pre-test result of 55.7 with poor qualifications and a post-test of 88.9 with good qualifications. The data were tested with the t-test and obtained the result that there were significant differences in student learning outcomes before and after using problem-based learning interactive video media in Mathematics for eighth graders of SMP Negeri 10 Semarang. Therefore, interactive learning videos based on Problem-Based Learning (PBL) are appropriate and effective for the learning process. Based on the results of the development research "Development of Mathematical Interactive Learning Videos" material, "Gradient" can be given suggestions to other researchers as follows. 1) The material in interactive Mathematics learning video learning media can be made more broadly; 2) In this study using the Problem-Based Learning (PBL) learning model, it would be better to highlight more for the use of the model. Suggestions are given with the aim that future research will be better.

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