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Development and Application of Physics Learning Video Based on Problem Based Learning with Canva Application to Improve Process Skills

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Abstract. This study aims to develop and apply Problem Based Learning (PBL)-based instructional videos using the Canva application and to determine the extent of the improvement in students' process skills on the topic of quantities and measurements, as well as to understand students' responses to the physics instructional videos. The research method used was Research and Development (R&D) with the 4D model (Define, Design, Develop, Disseminate). The research subjects consisted of 33 tenth-grade students from class X9 at SMAN 3 Bengkulu Tengah. Product validation by experts indicated moderate to high validity in the aspects of visuals, audio, content, and language, suggesting that the instructional videos are suitable for development. The implementation results showed an improvement in students' process skills, with an N-Gain score of 0.60, categorized as moderate. Students' responses to the instructional media were categorized as very positive, with an average score of 88.44%. This media is expected to provide an innovative solution for more engaging and effective physics learning.

Keywords: problem based learning, instructional videos, process skills

1. Introduction

Learning media is needed to make the teaching and learning process effective, interactive, and interesting [1] because the application of media in learning can attract interest, motivate, and have a psychological influence on students [2]. Learning media is a device that can be used to explain learning material, which is abstract and difficult to explain verbally. In the context of learning, learning media can be in the form of graphics, photography, or electronics that function to capture, process, and reconstruct visual or verbal information [3]. In addition, learning media such as learning videos can overcome learning style differentiation and can explain natural phenomena found in everyday life. Learning videos can also be used to increase interest in learning, mastery of physics material, and student process skills [4].

The preliminary study was conducted through interviews with physics teachers at SMAN 3 Bengkulu Tengah, followed by distributing questionnaires to find out the needs of students in the learning process of physics material. Based on the interview results, physics teachers have used learning media, such as learning videos from the YouTube platform and PowerPoint. In the learning process, the approaches used by physics teachers include Project Based Learning (PjBL), Problem Based Learning (PBL), and differentiated learning approaches.

Based on the results of the needs questionnaire that has been filled by 129 class X students at SMAN 3 Bengkulu Tengah, it is known that 74% of 129 students have difficulty in learning physics, 20% of students gain learning experience through learning media, 72% of students stated that it is easier to understand physics lessons through varied, interactive, and interesting learning media, and 85% of students support the use of ICT-based learning media.

PBL is a learning model that presents a variety of problem situations that are authentic, contextual

and meaningful to students. The problem situation serves as a starting point for investigation and inquiry. PBL helps students develop process skills and problem-solving skills [5] by using everyday problems to train critical thinking skills in problem solving and acquiring knowledge [6].

The steps of learning activities with PBL in this study were adopted from Mudlofir [7] which consists of orienting students to the problem, organizing students to learn, guiding individual or group investigations, developing and presenting work, and reflection and evaluation. The implementation of PBL activities in the classroom has advantages and disadvantages but there are differences among experts about the advantages and disadvantages of PBL.

Based on the literature review, the advantages of PBL according to Kurniasih and Sani [8] are (1) Improve problem solving skills, (2) Increase learning motivation, (3) Help students receive new knowledge, (4) Improve critical thinking skills, foster work initiatives and develop interpersonal relationships in group work. Conversely, according to Abidin [9] the disadvantages of PBL are (1) Students who are accustomed to teacher-centered learning find it difficult to solve problems during group discussions, (2) Students who lack confidence in solving problems will experience obstacles in problem solving, (3) If students do not know why they are solving problems, students will not gain learning experience. To minimize the weaknesses of PBL in number 1 and 2, the purpose of this research is to develop and apply PBL-based learning videos in physics learning.

Video as an ICT-based learning media that is a combination of images, audio, video, and animation that can be utilized in the learning process. Learning videos can be used to understand teaching materials including abstract and complex concepts, so that students can get interesting learning. Learning videos (educational videos) can be downloaded from the YouTube platform with open access but teachers are encouraged to develop their own videos that are relevant to the characteristics of teaching materials, learning objectives and the level of development of students' thinking [10].

The development of educational videos by teachers requires skills and applications to design and edit videos. Canva is an online application that teachers can use to design and edit graphic designs such as brochures, posters and presentations that are available in web, android and iPhone versions. Canva is widely used by educational video developers because it provides various templates and features to make teaching materials in videos more communicative and fun. Thus, the results of the learning video design produced with Canva can make students more interested in the teaching material presented in the video [11].

The topic of quantities and measurements is one of the topics studied in class X (odd semester). The demands of the material are to be able to develop understanding, observation, skills and connect material concepts to everyday life. The topic of quantities and measurements requires measuring instruments so that students can master how measuring instruments are operated [12].

Research by Sari et al. [13] stated that the purpose of the measurement teaching material is to equip students with knowledge about quantities and their units, and the use of measuring instruments for length, mass, and time, and mastering how to read measurement results as an indicator of process skills. process skills are the ability of students to use scientific methods to understand, develop science, and discover knowledge [5]. Process skills help students in learning and gaining discovery, as well as knowing how and methods of researching so that students become more active [14].

Based on the background that has been described, a PBL-based physics learning video has been developed and applied in physics learning with the topic of measurement to improve the process skills of grade X students. The objectives are to (a) develop a valid PBL-based learning video so that the video can be applied in physics learning with the topic of measurement to improve the process skills of grade X students, and (b) identify student responses to the application of PBL-based learning videos.

2. Method

The development of learning videos uses the research and development (R&D) method with the 4D model, which consists of four stages: defining, designing, developing, and disseminating. The 4D model is a scientific way to research, design, produce, and test the validity of developed products [15]. The process skill indicators used to develop process skill test items are summarized in Table 1.

Table 1. Process skill indicators [16].

No.	Indicators	Definition
1.	Observe	Learners are able to optimize the potential to use a variety of tools to make measurements and observations.
2.	Questioning and Predicting	Learners are able to question and predict based on observations.
3.	Plan and conduct an investigation	Learners identify the background of the problem, formulate objectives, and use references in the investigation/research.
4.	Process, analyze data and information	Learners prepare appropriate equipment/instruments for scientific research, use measuring instruments carefully and correctly, recognize the limitations and advantages of the measuring instruments used.
5.	Create	Learners are able to use the results of data and information analysis to create solution ideas or designs to solve a problem.
6.	Evaluate and reflect	Learners are courageous and polite in asking questions and arguing, developing curiosity, and having concern for the environment.
7.	Communicating results	Learners prepare a written report of the research results and communicate the research results.

The defining stage is to get the information needed related to the problems faced by students in learning physics and the needs of grade X students in physics learning. Data and information are obtained through interviews with physics teachers and questionnaires filled out by students to find out the opinions of grade X students about the learning media needed. The design stage is to design learning media based on data and information obtained at the defining stage, especially the type and design of media needed. Literature review is also carried out to determine the media design that suits the needs of grade X students so that they are helped to master the skills and knowledge gained from the topic of teaching material. The development stage is the process of making learning media and validation by three validators. The stages of the 4D model are shown in Figure 1.

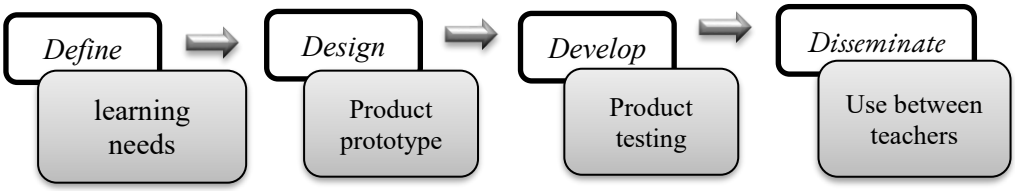


Figure 1. Stages of R&D research, 4D model.

This research was conducted at SMAN 3 Bengkulu Tengah which is located in Pasar Pedati, Pondok Kelapa District, Bengkulu Tengah Regency. This research was conducted in the odd semester of the 2024/2025 academic year. The research subjects were 33 students of class X9 at SMAN 3 Bengkulu Tengah and the object of this research was PBL-based learning video as physics learning media.

The instruments to collect research data are (a) teacher interview sheets, in the form of open interviews and student needs questionnaires used at the defining stage; (b) expert validation sheets for material, presentation, and language aspects at the development stage; (c) student response questionnaires to obtain data on student responses to the use of learning videos and process skills tests at the limited dissemination stage.

Data collection methods consist of tests and non-tests, Tests are used to determine the mastery of process skills through pretests and posttests. Non-tests are interview guides, needs questionnaires, and student responses, and validation sheets in the form of questionnaires, Data analysis techniques are carried out qualitatively and quantitatively. Data analysis was analyzed using quantitative data. To translate the data into qualitative data or to convert quantitative data into qualitative data, namely by using a Likert scale. The Likert scale can be used to change the variables measured, translated into variable indicators. Data analysis techniques are carried out quantitatively and translated into qualitative

data using the MS Excel application. Validation data by content validity experts was calculated using Aiken's formula [17] as formula (1).

$$V = \frac{\Sigma S}{n\,(c-1)} \qquad (1)$$
$$S = R - L_o$$

The Aiken Index (V) is a measure used to assess the validity of an item based on evaluations by validators. The score provided by the validator minus the lowest assessment score (S) is part of this calculation. The score given by the validator (R) is compared to the lowest assessment score (LO), which is 1, and the highest assessment score (c), which is 4. The total number of validators (n) is also a crucial component in the calculation of the Aiken Index.

The results of the calculation by formula (1) are the Aiken V index as an indicator of content validity for aspects of teaching material contained in the learning video, aspects of the language used in the learning video, aspects of the presentation of teaching material through PBL-based learning videos. The Aiken V index is consulted with the criteria contained in Table 2 as criteria for the validity of learning videos in terms of visual, audio, language, content / teaching material aspects.

Table 2. Content validity criteria [17].

Interval	Criteria
> 0,8	High Validity
0,4 – 0,8	Medium Validity
< 0,4	Low Validity

The validation of the learning video was carried out by three validators, namely, two lecturers with a master's degree in Physics and Physics Education, and a physics teacher with teaching experience >15 years and a bachelor's degree in physics education. The three validators conducted the validation separately without communicating so that they did not influence each other's scoring. The validation process used a validation sheet in the form of a questionnaire consisting of four alternative answers: Very Relevant (SR=4); Relevant (R=3); Not Relevant (TR=2); Very Not Relevant (STR=1) with a total of 20 assessment items distributed to four aspects to validate the product. The validation questionnaire sheets that had been filled in by the three validators were collected by the author to determine the Aiken V index using formula (1) and the help of the Microsoft Excel program.

The validation process was continued to calculate the agreement between validators (Inter-Rater Reliability or IRR) using validation data from the three validators. IRR is a statistical calculation to determine the consistency of scoring between validators as an indicator that the assessment of a product is objective, valid, and reliable. According to Koto and Safhira [18], percent agreement is one of the techniques used to determine IRR and can be calculated by formula (2).

$$\%\ \text{Agreement} = \frac{\sum(S_1 - S_2)}{\sum n} \text{x}\ 100\% \qquad (2)$$

where $\sum(S_1 - S_2)$ is the number of ZEROs from subtracting validator 1's score from validator 2's score and $\sum n$ is the number of assessment items (variables).

The percent level of agreement between validators was determined using the data in Table 3.

Table 3. Interpretation of level agreement [18].

Level of agreement	% Reliable data
None	0 – 3%
Minimal	4 – 14%
Weak	15 – 34%
Moderate	35 – 63%
Strong	64 – 81%

Almost Perfect	82 – 100%

The analysis of student response questionnaire data was done descriptively quantitatively to describe students' responses to the developed learning video. Because the information presented in the questionnaire is qualitative, student responses in the questionnaire were converted into quantitative data through a Likert scale. Likert scale allows changing the measured variables into variable indicators. Data processing used MS Excel application to calculate the average score and percentage of answers from 39 students of class X9 on each questionnaire item. The results of the calculation are in the form of a percentage of the average value [19]. The results of the calculation of the average value are consulted with the assessment criteria in Table 4.

Table 4. Assessment criteria for the student response questionnaire [19].

Interval	Criteria
76 % - 100 %	Excellent
51 % - 75 %	Good
26 % - 50 %	Poor
0 % - 25 %	extremely poor

The calculation of the average N-gain was carried out to determine how much change in science process skills after the physics learning process with PBL-based learning videos. The N-gain index (Normalized-gain) was calculated with equation 3 [20] and the criteria for how much change in process skills occurred in students on a class average using Table 5.

$$\text{N-Gain} = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score} \quad (3)$$

Table 5. N-gain Calculation Criteria [20].

Interval	Criteria
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$0 < g < 0,3$	Low
$g \leq 0$	Failed

3. Results and Discussion

3.1. *Define Stage*

The purpose of the defining stage is to define the learning needs of 33 students in class X9 in the physics learning process. Based on questionnaire data filled out by 129 class X students at SMAN 3 Kota Bengkulu Tengah, it is known that 72% of 129 students stated that physics lessons would be easy to learn if teachers used varied, interesting and interactive learning media. Videos available on the YouTube platform and developed by teachers have the characteristics of media that can be displayed varies such as still or moving images. Based on interviews with teachers, YouTube videos have been used by physics teachers to explain physics teaching materials but learning videos from YouTube for measurement teaching materials are not yet available. Through interviews it is also known that teachers have implemented PBL on certain teaching materials but learning activities for measurement teaching materials have not been carried out either in the classroom or in the laboratory. The limitation of measuring instruments is a major obstacle in learning so that student teachers explain measurement teaching materials through demonstrations. The development and application of PBL-based learning videos are designed and made to help students of class X9 master the concept of measurement and the skills of using measuring instruments, such as a vernier caliper, scruple micrometer, and analytical balance.

3.2. *Design Stage*

The design stage is the process of designing learning videos as an alternative answer to the physics learning problems faced by 33 students in class X9. The product designed is a PBL-based learning video with Canva application. At this stage, the developer designs the storyline in the learning video. The storyline in the learning video includes the actions that occur in the PBL-based learning video between each action in each scene.

Learning videos are made as learning media by grade X students. Therefore, the video design is adapted to the school environment and the characteristics of grade X students. Figure 2 is an example (sample) of the PBL-based learning video storyboard developed by the research team.

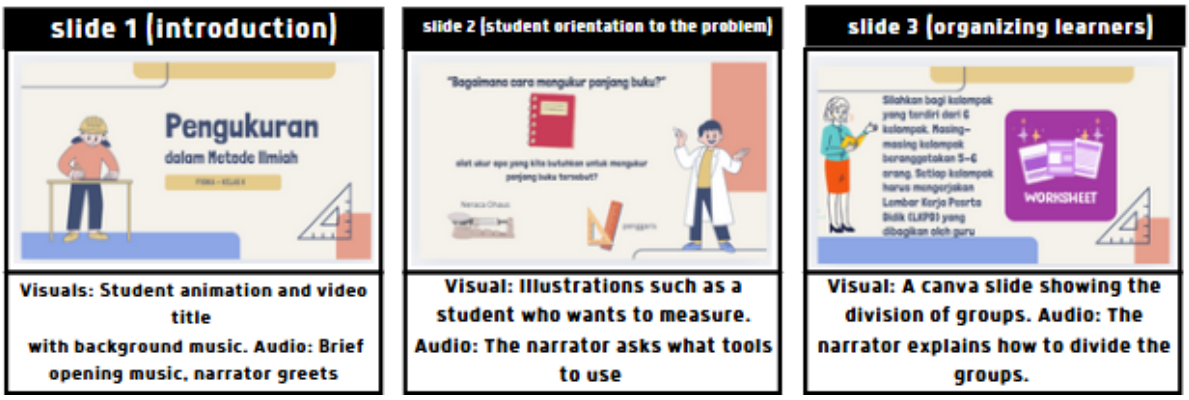


Figure 2. Sample of learning video.

The process of designing PBL-based learning videos with measurement material with the Canva application is described below: The first step is to design the content of teaching materials (content knowledge) and learning evaluations based on the Learning Objectives (TP), (1) Identifying various kinds of measuring instruments based on the quantities measured, (2) Identifying quantities based on their dimensions, (3) Using measuring instruments that are suitable for the object to be measured, (4) presenting measurement results and processing data with the rules of significant figures, (5) communicating the results of experiments orally and in writing, At the end of phase E, learners have the ability to be responsive to global issues and play an active role in providing problem solving. These abilities include observing, questioning and predicting, planning and conducting investigations, processing and analyzing information data, evaluating and reflecting, communicating results in the form of simple projects or visual simulations using applications of technology, biotechnology, chemistry in everyday life, utilization of waste and natural materials, pandemics due to viral infections. All these efforts are directed towards achieving sustainable development goals (SDGs). Through the development of a number of knowledge, noble morals and scientific attitudes such as honesty, objectivity, critical reasoning, creativity, independence, innovation, cooperation and global diversity are also built as shown in the video. Based on the TP and CP fragments, the developer identified measurement concepts that needed to be included in the video, namely, basic concepts of measurement, measuring instruments, international units (SI), and how to read measurement results.

Canva app provides video templates to visually design videos. Make sure to choose colors, fonts, and design elements that are attractive but still professional, so that the video is easy to understand and not boring. Ways to incorporate content into the video: (a) add explanatory text, illustrative images of relevant measuring instruments, graphs, or tables to strengthen the explanation; (b) use the animation feature in Canva to make text or image transitions more dynamic; (c) add voice recordings or upload audio files to Canva; and (d) ensure that each scene runs with a time duration that suits the characteristics of grade X students.

3.3. *Development Stage*

In the development stage, the learning video prototype was produced based on the video design done in the design stage with Canva application. The prototype was evaluated by three experts (validators) who have experience and expertise in content, linguistic aspects, and audio and visual aspects to obtain

assessments and suggestions for improvement. The three validators used a validation sheet in the form of a questionnaire as a guide to provide an assessment. Two validators have a master's degree in physics education and a senior physics teacher with a bachelor's degree in physics education. Quantitative assessment data was used to determine validation criteria and qualitative data (suggestions) for video revision.

Table 6 is a summary of the assessment data processing from the three validators. The data was processed using the Aiken V formula (formula 1) and processed with Microsoft Excel.

Table 6. Media validation results. Number of items for visual aspects (8); audio (2); content/material (5); language (5).

Aspect	Validator			∑ S	n (c-1)	Aiken Index (V)	Criteria
	I	II	III				
Visual	27	28	27	58	72	0.80	Medium
Audio	8	7	8	17	18	0.94	High
Material	15	17	16	33	45	0.73	Medium
Language	17	17	18	37	45	0.82	Medium

Based on the results of the calculation of the Aiken V index, the audio aspect includes high validity criteria because the Aiken index (0.94) >0.80 (Table 2) so that the three validators for the audio aspect do not provide suggestions for revision (improvement). The language aspect used in the video also did not require revision because the Aiken index (0.82) > 0.80 so that the validity of the language aspect included high criteria. But the other two aspects (visual, language) require revision because the Aiken index of 0.80 (visual aspect) and 0.73 for the content/material aspect are in the interval 0.40 - 0.80 (Table 2) on the criteria of moderate validity. Suggestions from the validator are that at the beginning of each sub-chapter the material should be added to the definition of the material in general on the Canva slide and the definition of freezing point and expansion should be clarified and the language used is not ambiguous.

Consistency among the three validators in the assessment (validation) of learning videos needs to be determined by counting the number of items that are the same (consistent) for each aspect contained in the validation sheet used by the three validators. The importance of inter-rater reliability is to ensure that the three validators are objective and not influenced by the subjectivity of individual assessors [21]. Table 7 is a summary of the agreement data between the three validators [22].

Table 7. Results of the agreement between validators on media validation.

Aspect	Total Agreement	Mean	Criteria
Visual	6 from 8	0,75	Strong
Audio	4 from 6	0,66	Strong
Material	10 from 12	0,83	Almost perfect
Language	13 from 15	0,86	Almost perfect

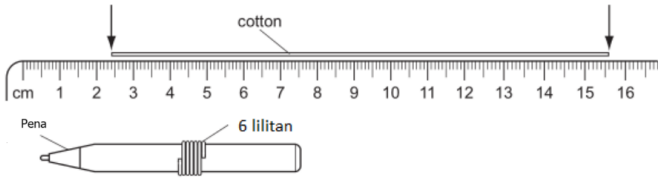
Based on Table 7, the results of the calculation of assessment agreement between the three validators for the content/material aspects (83%) and language (86%) are at the level of almost perfect agreement (see Table 3). In other words, the three validators have almost identical perceptions of the content/material and language aspects contained in the learning video so that the assessment results are very consistent. In addition, the validation questionnaire used is very clear, and the assessment criteria can be interpreted in an identical way by the three validators. The level of agreement for the visual (75%) and audio (66%) aspects is strong. This means that the three validators had very identical perceptions of the visual and audio aspects. Strong agreement indicates that the assessors have very similar perceptions of the assessed learning videos, but not completely identical. It still shows a high level of consistency. Therefore, the level of agreement between the three validators provides certainty that the assessment results are reliable and valid, although there is a probability of 14% to 17% unreliable assessment for language and content/material aspects and 34% to 25% unreliable or subjective assessment for audio and visual aspects.

3.4. *Disseminate Stage*

The dissemination stage is the last stage in the 4D research model but the dissemination of PBL learning videos is limited after video revisions are made based on suggestions from the three validators. Video dissemination is limited to X-9 students and physics teachers in class X by providing access via WhatsApp links and embedded video links to the YouTube platform.

Learning was conducted in class X9 after 33 students took a pretest to determine students' initial knowledge of measurement teaching material. The process skill tests used in the pre and post tests were the same and amounted to 15 items. After learning was conducted for 4 face-to-face sessions (45 minutes), students took the post-test for 45 minutes. The test items were developed by the research team based on a test grid that included learning outcomes and objectives and six process skill indicators. An example of the process skills test items is shown in Figure 3.

The cotton rope is wrapped around the pen as shown below



Based on the picture, the perimeter of the pen is....

(a) 2.0 cm (b) 2.2 cm (c) 2.6 cm (d) 13.2 cm (e) 15.6 cm

Figure 3: Example of process skills test questions.

The pretest-posttest data summarized from the process skills test results were calculated using formula (3) to determine the N-g mean (<g>) while the criteria for improvement (gain) were determined using the criteria in Table 5. The results of the calculation of <g> are summarized in Table 8.

Table 8. Pretest-posttest assessment results.

Pretest	Posttest	N-gain	Criteria
45.57	78.54	0.60	Medium

Based on the data in Table 8, the score <g> (0.60) with a total of 33 students is included in the medium criteria. The application of PBL-based learning videos in physics learning with measurement teaching materials and measuring instruments has an effect on improving the process skills of students in class X-9 in the medium category. The factors that cause students' process skills to not reach high criteria are thought to include aspects of visual display that do not stimulate students' curiosity to pay attention to explanations through audio. Because, the right choice of colors and the contrast between the text and the background of each learning video screen can attract the attention of class X9 students and make the teaching material content of measurement and measuring instruments more attractive to students' attention and curiosity. According to Richardson [23], determining the right color for text and background of ICT-based media can increase the readability of text on the screen and can minimize cognitive load and increase retention of teaching materials displayed in learning media.

Table 9 shows the results of the student response questionnaire to the PBL-based physics learning video with Canva application. The questionnaire data was obtained from 39 students after the learning process with the teaching material of magnitude and subtraction was carried out by applying the learning video. Students filled out the questionnaire at the end of the lesson which was distributed by the physics teacher and assisted by the author. Based on the data in Table 9, the average of each aspect of the response questionnaire statement filled out by students of class X9 SMAN 3 Bengkulu Tengah stated

that the PBL-based physics learning video with "very good" criteria (criteria in Table 4). It can be concluded that the learning media in the form of videos made using Canva application is very effective and suitable to support the learning process. The high positive response of students to this learning video shows their satisfaction both in terms of content completeness and display design. This happens because video media has advantages, namely containing interesting images and animations that can help students understand learning materials better. In addition, students are basically more interested in listening to videos [24].

Table 9. Average answer (%) on student response questionnaire to learning video.

Aspect	Mean	Criteria
Students' learning motivation and concept understanding	90.60 %	Excellent
Knowing students' process skills through problem-based learning videos	84.84 %	Excellent
Quality of learning media	89.89 %	Excellent

4. Conclusions

This study successfully developed a PBL-based learning video using Canva application that is valid to improve students' process skills in the teaching material of quantities and measurements. The developed learning video shows high validity criteria (audio and language aspects) and moderate (visual and content/material aspects), and language. The implementation of this learning video is proven to improve students' process skills with an average N-Gain of 0.60 (medium criteria). Student responses to the learning video for motivation and understanding of concepts, skills in using measuring instruments through videos, and the quality of PBL-based videos with very good criteria.

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