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The Effectiveness of Video-Assisted Problem-Based Physics Learning Devices to Improve Students' Problem-Solving Ability on Elasticity Materials

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Abstract: This development research aims to produce an effective video-assisted problem-based physics learning tool to improve students' problem-solving skills on elasticity material. The research design used is a 4D model consisting of defining, designing, develop and disseminating. The products developed are syllabus, Lesson Plans, Student Worksheets, videos, and problem-solving ability questions. Data collection techniques using validation sheets and problem-solving ability questions. Product validity was assessed by six validators consisting of three expert validators and three practitioner validators. Furthermore, the effectiveness was obtained from a limited trial by providing problem-solving skills questions in the form of pretest and posttest which then the results were analyzed using N-Gain. The results showed that problem-solving abilities had increased with the average N-Gain test result being 0.61 in the medium category. Students show a positive response to online learning. So, it can be concluded that video-assisted problem-based physics learning tools are effective for improving students' problem-solving skills on elasticity materials during online learning.

Keywords: Device effectiveness; problem-based learning; videos; problem-solving abilities.

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Introduction

Physics is a part of science which essentially consists of product and process aspects. Physics as a product aspect is a collection of knowledge containing facts, concepts, theories, principles and laws of physics. In addition, physics is a series of scientific processes carried out in finding knowledge (Azmi, 2016). According to Gunada, (2015) physics is part of the field of science that provides experience in understanding a concept and solving problems. This shows the importance of developing problem-solving skills possessed by students. Therefore, physics learning activities must direct students to improve problem-solving abilities.

Problem solving ability according to Wijaya, (2018) is the ability of students to find solutions to solve a problem systematically. Problem solving ability is one of the higher orders thinking skills that directs students to gain knowledge and skills (Venisari, 2015). Therefore, a learning model is needed that can facilitate students to improve problem-solving abilities. According to Jiniarti, (2017) the learning model that can be used is a problem-based learning model.

Problem-Based Learning is a learning model that presents real-life problems to be solved by students through a scientific approach (Hastuti, 2016). In addition, according to Saharsa, (2018) problem-based learning directs students to solve problems through seeking and finding information from various sources. Problem-based learning models can direct students to

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collect, investigate and integrate new knowledge obtained through learning activities with the knowledge they already have (Hardiyanto, et al, 2015). Therefore, teachers can take advantage of existing media to optimize the implementation of learning activities using a problem-based learning model. One of the media that can be used is learning video (Mutia, 2017).

Video according to Anshor, (2015) is one type of media in the form of audio-visual, video media can combine sound and images, so that students can see facts and hear explanations related to a material simultaneously. Video media is a sound, image and animation-based learning media that is used as an illustration of an event, with the aim of providing a real picture of the material being studied by students (Rozie, 2013). This is supported by Aisah, (2017) who says that video media is a learning medium that can attract the attention of students during learning activities, this is because videos accompanied by pictures and writing can make it easier for students to understand and apply a concept. Thus, video is said to be a very effective medium used in learning activities.

Based on the results of observations, researchers found various problems during learning activities at SMAN 1 Mataram. The problem is that learning is still teacher-centered, this causes students to tend to be passive and afraid to ask questions related to the material being taught. This is supported by the results of the researcher's interview with the physics teacher of SMAN 1 Mataram who said that learning activities did not lead students to develop problem-solving skills. In addition, learning activities do not use a particular learning model, because the teacher uses a self-made learning model.

Therefore, this is a consideration for researchers to develop an effective video-assisted problem-based physics learning tool to improve students' problem-solving skills on elasticity material. The learning tools that will be developed consist of a syllabus, learning program plans, Student Worksheets, videos, and problem-solving ability questions. Previously, research conducted by Hastuti (2016) stated that problem-based learning models with the help of virtual media made learning activities more effective. In addition, Hasanah's Research, (2019) states that the Video-assisted Problem Based Learning Model can help students to improve their problem-solving skills.

These problems are the background of the researchers conducting this research. The learning activities carried out are expected to help students learn, especially in the midst of the covid-19 pandemic which causes learning to be carried out online. Thus, teachers can maximize the use of technology, especially the use of videos in learning activities. Therefore, this is a consideration for researchers to develop an effective video-assisted problem-based physics learning tool to improve students' problem-solving skills on elasticity material.

Method

This study uses research and development research to produce certain products and test the effectiveness of these products. This study uses a 4D development model consisting of define, design, develop, and disseminate (Sugiyono, 2013). In the define stage, an analysis of physics learning activities in schools is carried out, in order to obtain information about the problems encountered during learning. The information was obtained through observation sheets and teacher interview sheets. The design stage aims to produce an initial draft of the developed learning device. Learning tools developed in the form of syllabus, Learning Program Plans, Student Worksheets, videos, and problem-solving ability questions. Furthermore, at the development stage, validation of learning devices is carried out by the validator. The learning tools were then revised according to suggestions from the validator and tested on a limited basis. The final stage is the disseminate stage, this stage aims to disseminate research products in the form of learning tools. The research subjects were 25 students of class XI MIPA 7 at SMAN 1 Mataram.

The data analysis technique used to measure the effectiveness of the learning device is using the N-Gain generated through the pretest and posttest. The effectiveness of the device can be seen from the improvement of students' problem-solving abilities through the problem-solving abilities given. The N-Gain analysis is shown in equation 1.

$$\text{N} - \text{gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{min}} \quad \ldots\ldots (1)$$

Description:
S_{post} : Post-Test Score
S_{pre} : Pre-Test Score
S_{max} : Maximal Score
S_{min} : Minimal Score

Based on the results obtained using N-Gain, the device effectiveness categories are grouped according to Table 1.

Tabel 1. Interpretasi Indeks N-Gain

N-Gain Score (g)	Category
0.70 < g < 1.00	High
0.30 < g < 0.70	Medium
0.0 < g < 0.30	Low

(Sundayana, 2014)

Result and Discussion

Define stage

At this stage, an initial analysis was carried out in the form of observations and interviews with physics teachers at SMAN 1 Mataram in order to get an overview of the characteristics of students and learning activities in class. Based on the results of observations made at SMAN 1 Mataram, there are various problems found in physics learning, namely students who tend to be passive, and learning that is still teacher-centered. Meanwhile, based on interviews conducted with physics teachers at SMAN 1 Mataram, it was found that learning in the classroom was in accordance with the demands of 21st-century education but not all students were able to take part in learning well. The use of media is rarely used in the classroom due to the teacher's lack of mastery of technology, as well as learning in the midst of the covid-19 pandemic, causing teachers to find it difficult to measure the problem-solving abilities of students. Based on the initial analysis, then a task analysis is carried out which is adjusted to the basic competencies and indicators of competency achievement in the elasticity material. Furthermore, concept analysis and formulation of learning objectives were also carried out.

Design Stage

At this stage, the design of the product to be developed is carried out. The syllabus developed is a modification of the existing syllabus and adapted to the problem-based learning model. The preparation of the Learning Program Plan is adjusted to the core competencies and basic competencies contained in the syllabus. Meanwhile, the Student Worksheet is adapted to the Problem-Based Learning model, so that the Student Worksheet is given questions that can be solved by searching for information or conducting simple experiments. Furthermore, the problem-solving ability question consists of 8 questions in the form of a description, where each question includes four indicators of problem-solving ability, namely recognizing problems, planning strategies, implementing strategies, and evaluating solutions. (Sujarwanto, 2014).

Development Stage

At this stage, validation is carried out by expert validators and practitioner validators through a device validation sheet. Furthermore, improvements were made based on the comments given by the validator. The revised product was then tested on a limited basis in class XI MIPA 7 at SMAN 1 Mataram as many as 25 people. The purpose of conducting a limited trial is to determine the effectiveness of the developed device in improving students' problem-solving abilities. The data obtained is an increase in problem-solving skills through pretest and posttest with the N-gain test. The average gain of N-Gain for students of class XI MIPA 7 which amounts to 25 people can be seen in Table 2.

Table 2. Average Obtaining Problem Solving Ability Test with N-Gain

$\bar{X}$Pre	$\bar{X}$Post	$\bar{X}$Post - $\bar{X}$Pre	X_{max} - $\bar{X}$Pre	N-Gain	Category
13.54	66.12	52.58	86.46	0.61	Medium

Table 2. shows the increase in problem-solving abilities of students in class XI MIPA 7 in the medium category with an N-Gain of 0.61. To find out the achievement of increasing the highest problem-solving ability indicator, the following describes the results of the N-Gain test for each indicator which can be seen in Table 3.

Table 3. Average gain per indicator of Problem-Solving Ability with N-Gain

Indicator	$\bar{X}$Pre	$\bar{X}$Post	$\bar{X}$Post - $\bar{X}$Pre	X_{max} - $\bar{X}$Pre	N-Gain	Category
Recognizing Problems	15.17	73.00	57.83	84.83	0.68	Medium
Planning Strategy	15.67	73.33	57.67	84.33	0.68	Medium
Implementing Strategy	12.00	59.83	47.83	88.00	0.54	Medium
Evaluating Solutions	10.83	58.83	48.00	89.17	0.54	Medium

Table 3. shows that the indicators of problem-solving ability to identify problems, plan strategies, implement strategies and evaluate solutions show the N-Gain value in the medium category. Furthermore, from 25 students it was found that the highest increase in problem-solving ability was experienced by 11 people, then 12 people in the medium category and 2 people in the low category. The details of the data can be seen in Table 4.

Table 4. Specifications for Problem Solving Ability Category with N-Gain Test

N-Gain Score	Category	Number of students	Percentage (%)
0.70<g<1.00	High	11	44
0.30<g<0.70	Medium	12	48
0.0<g<0.30	Low	2	8

Based on these percentages, it can be said that the learning tools developed are effective in improving the problem-solving abilities of students in class XI MIPA 7, although the increase is not too significant as seen from the N-Gain score which is in the medium category. This is due to the limited time to do the pretest and posttest, so there are some students who collect the results of the pretest and posttest past the specified time limit.

The increase in problem-solving abilities is also due to the existence of learning videos which are used as a source to obtain information. The developed video contains concepts, principles, and procedures for the problem-solving process on elasticity material. The display of the developed learning video can be seen in Figure 1.

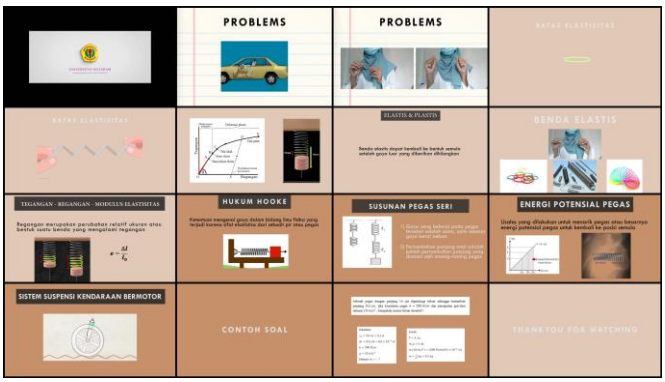

Figure 1. Video Display with Problem-Solving Ability Model

In addition, from the four problem-solving ability indicators used in this study, it can be seen that the indicators of recognizing problems and planning strategies are indicators of problem-solving abilities that have the highest increase with an N-Gain of 0.68. Meanwhile, the indicator of implementing strategies and evaluating solutions has an N-Gain of 0.54 with a medium category. The increase in indicators of recognizing problems can be seen from the ability of students to write down facts or write down quantities based on illustrations, pictures, tables and graphs given to the questions correctly. Furthermore, the increase in indicators for planning strategies can be seen from the ability of students to write down the quantities asked in the questions. While the indicators of implementing strategies and evaluating solutions can be seen from the increase in the ability of students to determine the equations used, calculate to the end with the right answer. In addition, students can explain and conclude with the right concepts about the problems given.

The students' posttest results showed that the highest improvement was in the indicators of recognizing problems and evaluating solutions, where this could be seen from the ability of students to write symbols of quantities that were known and asked correctly. Meanwhile, on the indicators of planning strategies and evaluating solutions, some students write equations that are less precise or explain the solution to a problem that is not in accordance with the concept of elasticity and Hooke's law. For example, in the question about the arrangement of combined springs, there are only a few students who can solve the problem. This is because, students have difficulty in illustrating the shape of the combined spring arrangement into the picture, so that students answer incorrectly.

Based on the results of the pretest and posttest of class XI MIPA 7 students, the four indicators of problem-solving ability have increased with the N-Gain value of each indicator in the medium category. So, it can be said that the developed device is effective in improving the problem-solving ability of students. This is also supported by research conducted by Hidayani, (2016) which states that the development of problem-based learning tools can improve students' problem-solving abilities. Furthermore, research conducted by Hastuti, (2016) states that problem-based learning models with the help of virtual media make learning activities more effective. Astra's research (2013) also shows that the problem-based learning model assisted by instructional video media can improve students' problem-solving abilities. In addition, Hasanah's Research, (2019) states that the Video-assisted Problem Based Learning Model can help students to improve their problem-solving skills.

Conclusion

The video-assisted problem-based physics learning device developed is effective for improving students' problem-solving skills on elasticity material.

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