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WRS Nurwidodo
Doctoral Education Technology, Universitas Negeri Surabaya, Surabaya, Indonesia.

Siti Masitoh
Doctoral Education Technology, Universitas Negeri Surabaya, Surabaya, Indonesia.

Yatim Riyanto
Doctoral Education Technology, Universitas Negeri Surabaya, Surabaya, Indonesia.

Fajar Arianto
Doctoral Education Technology, Universitas Negeri Surabaya, Surabaya, Indonesia.

Correspondence:
Fajar Arianto
Doctoral Education Technology, Universitas Negeri Surabaya, Surabaya, Indonesia.

Improving Problem Solving Ability with Problem-based Learning in Vocational Education

WRS Nurwidodo, Siti Masitoh, Yatim Riyanto, Fajar Arianto

Abstract
The purpose of this study was to test the effect of problem-based learning on students' problem-solving abilities. This research uses a quantitative approach and this research is designed using the method used in this study is the quasi-experiment method. The research subjects were 100 high school vocational students which were divided into two groups, of which 50 students were the experimental group. Data analysis technique used by comparing the two groups with statistics. The results of the analysis test show that there is an effect of problem-based learning on problem solving ability in the control and experimental classes with a significant level of 5% (0.000 < 0.05). This proves that there is an increase in the experimental class that has been given treatment with problem-based learning assisted on problem solving ability. Thus, it can be concluded that the problem-solving ability of students in the experimental group is higher than the control group. students who get problem-based learning are more effective and efficient in problem solving. Problem-based learning has a positive effect on students' problem-solving abilities.

Keywords: Problem-based learning, problem solving, vocational.

1. Introduction
During learning process, teachers must help students to actively discover concepts, principles and facts for themselves, not only by giving lectures and supervising lessons (teacher centered). This allows students to build their own knowledge (Hikmawati, 2015). Based on the results of observations, the teacher-oriented learning process is still ongoing. The learning process that is still focused on the teacher can cause students to become passive and do not understand the material. As a result, students' problem-solving abilities in physics subjects are low.

On the other hand, many theories and learning have been put forward by experts who have offered a variety of student-centered learning. Student-centered learning involves problem-based learning that can apply knowledge in sophisticated ways to solve real-world problems efficiently (O'Toole, 2012). This learning encourages a lot of creativity in learning, both individually and in groups. Almost every step requires learner activity, while the role of the learner is more of a stimulus that directs the learner's activities and determines which direction the learner should go (Mustaji, 2017). To overcome this, proper learning is needed. One of the lessons that can be used is problem-based learning which is supported by learning videos.

The purpose of this study was to examine and analyze the effect of problem-based learning on students' problem-solving abilities. The benefits of this research are to provide guidelines and a basis for learning problem-based learning and problem-solving abilities during research and can be used as a reference when learning.

2. Methods
This type of research uses the method used in this study is the quasi-experiment method that is by reason of this design there are two study groups, namely the experimental group and the control group. This type of nonequivalent control group design uses existing classes as a group, with the selection of classes that are estimated to be in the same state and condition

(homogeneous).

The subjects of this study were taken from two groups, namely the experimental class group (50 students) and the control class group (50 students) through cluster random sampling technique (Fraenkel & Wallen, 2009). Considering that it is impossible for this research to be carried out using random or random techniques, by taking classes that have homogeneous abilities in the implementation of learning (Cohen, Manion, & Morrison, 2007).

In this study, two categories of independent variables were used, namely problem-based learning and then for the dependent variable in this study was problem solving ability in physics subjects at Vocational High Schools. Analyzing of the data used in this study is a hypothesis test to determine the impact of problem-based learning on students' problem-solving abilities. The hypothesis test will be carried out using the t-test by looking for the differences between two samples. The t-test in this study was conducted twice to determine the differences in test results in the experimental and control groups. The first t-test was conducted to find out the similarities in the pretest of the experimental group and the control group, while the second t-test was conducted to determine whether there was a difference in the posttest of the experimental group and the control group

3. Results & Discussion

The experimental class is given treatment in the learning process by using problem-based learning, while the control class in learning uses online. These data were obtained using research instruments that have been carried out using validity tests. The description of the data in this study provides an overview of the results of the research that has been carried out. The description of the data was carried out using univariant descriptive data analysis including the mean, standard deviation and graphs. The description of the data for the dependent variable of competence to understand the concept was carried out on the pretest and posttest data.

Table 1: Problem Solving Ability Difference Test Results.

Group	N	Mean	Std. Deviation	Std. Error Mean
Experiment	50	74.0164	8.15576	1.04424
Control	50	59.2623	10.44175	1.33693

Based on table 1, it can be seen that the average value of problem solving ability in the experimental class is 74.01 while in the control class is 59.26. When viewed from the average, the experimental class has a higher average problem-solving ability than the control class after being given treatment. To find out whether the difference is significant, the following independent samples t-test was conducted:

Table 2: Test Results Independent Samples T-test.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	7.214	.008	8.697	120	.000	14.75410	1.69641	11.39532	18.11287
Equal variances not assumed			8.697	113.352	.000	14.75410	1.69641	11.39331	18.11488

Based on the results of the independent samples t-test in table 2, it can be seen that the significance value or p-value is 0.000 <0.05, so it can be concluded that there is a significant difference in the average value after being given treatment for problem solving skills between classes. experimental and control classes.

Because there is a significant average difference in problem solving ability (after being given treatment) between the experimental class and the control class, the experimental class using Problem-based learning shows a higher average problem solving ability than the control class using conventional learning. The final conclusion of Problem-based learning has an impact on students' problem solving abilities.

Problem solving is not a separate topic but is integrated into learning process. There is currently strong pressure in education to make problem solving a key component of the physics curriculum (Redish & Kuo, 2015). The demand for students to be able to solve problems well has become a central topic in physics lessons. Physics learning must include problem solving as a core part of all aspects of its activities. The teacher should give students everyday problems and problems that will challenge and motivate them. Problem solving is an effective way to explore new mathematical ideas. According to Funke (2001, in the early 1900s, problem solving was seen as mechanistic, systematic, and often associated with abstract concept activities. In this context, the problem to be solved is a problem that has a single answer obtained through a process that involves one method or some method s (convergent reasoning). In line with the development of cognitive learning theory, problem solving is seen as a mental activity that involves complex cognitive skills. This is also in accordance with the opinion of (Foshay & Kirkley (2003) which states that problem solving requires high-level reasoning skills such as visualization, association, abstraction, manipulation, reasoning, analysis, synthesis, and generalization. There are several different definitions of problem solving.

Problem solving is a process that involves the use of certain steps (heuristics), often referred as or problem-solving steps, to find a solution to a problem (Atkinson, Renkl, & Merrill, 2003). Heuristics are general guidelines or steps to solve a problem. However, these steps do not guarantee individual success in solving problems. problem solving as the process of synthesizing various concepts, rules, or formulas to solve problems (Sumirattana, Makanong, & Thipkong, 2017). The definition of problem solving given above shows that obtaining a solution to a problem is a prerequisite for the problem solving process to be considered successful. This is different from the opinion of Brownell (McIntosh & Jarrett, 2000) which states that a

problem cannot be solved simply because a solution to the problem has been found. He assumes that a new problem is really solved when the individual has understood what he is doing, namely the problem solving process, and knows why the solution found is appropriate. According to Nakin (2003), problem solving can also be viewed as a process of acquiring or forming knowledge. In other words, students learn physics through problem solving activities. In this case, the problem acts as a trigger for students to construct their knowledge. This learning is called problem-based learning.

Learning with the problem-based learning model is supported by the use of interactive video media. Through interactive video learning media, students show concrete performances in the form of videos about the material taught in this way that students are more interested in learning. Therefore, the spirit of learning will emerge from the students and is then supported by the enthusiasm and effort of the teacher so that it is hoped that the students' attention will motivate students to learn to make learning objectives can be achieved optimally.

The problem-based learning creates a lively, independent and meaningful learning atmosphere (Aufa, Rusmansyah, Hasbie, Jaidie, & Yunita, 2021). The application of this problem-based learning model will be better if using supported learning media, including through the use of video media (Andriyani & Suniasih, 2021). Video is a learning media that can display audio and visual elements to facilitate student learning (Nonthamand, 2020). Video media is used to convey authentic problems to students (Alten, Phielix, JeroenJanssen, & LiesbethKester, 2019). Video media makes it easier for students to analyze problems and others easily express ideas and ideas in writing in a coherent way in a way that students participate more enthusiastically in learning activities (Kamelia, 2019). The results of previous studies also said that educational videos would help students learn ((Priantini, 2020). Other research also shows that the problem-based learning model will increase students' enthusiasm for learning to improve student understanding (Silwana, Subanji, Manyunu, & Rashahan, 2021). Lack of in-depth investigation of problem-based learning models supported by video learning can improve critical thinking and problem solving during learning. The purpose of this study was to analyze the problem-based learning model supported by video. The strength of this research lies in learning activities because at the time of learning activities take place and students actively participate in discussions of a group of friends to solve problems presented by the teacher. This is because the characteristics of the Problem-based learning Model can be a fun and useful learning environment for students. Due to the implementation of Problem-based learning, students first raise problems related to the real world and then find solutions to different information obtained through interactive videos prepared by the teacher.

4. Conclusions

The conclusion in this study is that problem-based learning assisted by video learning has an impact on problem solving ability. Learning problem-based learning involves students actively in solving the problems found. Students can gain knowledge about problems and have skills to solve problems. Learning Problem-based learning will help students develop problem solving thinking skills so that they learn to be independent and confident. Learning with problem-based learning using learning videos helps present students with authentic problems that exist in the surrounding environment. This medium updates the actual state of a process, phenomenon, or event so that it can enrich the presentation of the material to be taught by the teacher. Learning video is one of the most interesting learning media for students because it displays images and sounds simultaneously so that students feel they are in the same place as what is shown.

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