The Effect of Android-Based Contextual Teaching Materials on Students' Physics Problem-Solving Skills

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Abstract *- The integration of technology into learning needs to be done following the times. Many learning resources are still not integrated with technology that it hinders the attainment of students' problem-solving skills. Therefore, this research aims to determine the effect of android-based contextual teaching materials on students' problem-solving skills. This research is quasi-experimental with a pretest-posttest control group design. The research population was all students of class X of SMAN 3 Mataram. The research sample used class X MIA 3 as the control group and class X MIA 5 as the experimental group. The data collection instrument used a test with several problem-solving indicators. Problem indicators used include solving, planning, explaining solutions and evaluating. Data analysis used t-test and N-gain to see the magnitude of the effect. The results of the t-test showed a data significance value of 0.004. This result is still below the α value (sig. < 0.05), meaning that there is a positive effect from the treatment given. The experimental group got a higher increase than the control group. The difference in the increase occurred for the sub-materials and all indicators of problem-solving skills. Therefore, the conclusion of the study is that android-based contextual teaching materials have a positive effect on students' physics problem solving skills.*

Keywords*: Teaching Materials; Contextual; Android; Problem Solving Skills*

INTRODUCTION

The fourth industrial revolution (Industry 4.0) has an impact in all aspects of life, including education. The learning process that was previously restricted by space and time is no longer limited due to the integration of technology (Efriyanti & Annasz, 2020). The presence of the internet and other digital technologies is useful as an alternative medium in the learning process. The use of technology by educators and students is crucial for quick and easy access for information. This increasingly rapid technological development is what drives new innovations in learning (Verawardiana & Jama, 2018). The role of technology is very important because there are still a lot of problems that need to be solved, including the students' learning problem in physics.

The use of technology for physics lessons in the classroom is still minimal. Most educators choose the learning style that use textbooks with one-way learning model. The method that is often chosen to deliver the material is lecture method. Therefore, the involvement of learning media such as videos, applications and so on is rarely used. This is because the preparation is complicated and requires a long time. Many people believe that the current media (technology) has not been maximally implemented and requires a lot of time (Cooley, Burns, & Cumming, 2014). This is even though the media plays an important role in increasing the effectiveness of a learning (Lau, Yen, Li, & Wah, 2014).

The final competence obtained by students is parallel with the effectiveness of the learning conducted. A less effective learning will tend to produce poor learning outcomes. So far, the students' problem solving skills in physics lessons are still low. According to Brad (2011) and Walsh et al (2007), students still often use the memory-

based and plug-and-chug approach in solving physics problems. This is despite the fact that one of the objectives of learning physics is to create humans who can solve complex problems by applying their own knowledge and understanding in daily-life situations (Walsh et al., 2007). Reading or note-taking is not enough to understand physics (Rahmatullah et al., 2017). There needs to be a treatment by connecting the materials with events happening around us. Therefore, a contextual approach needs to be applied so that physics concept can be emphasized and the students can be facilitated in analyzing a problem.

The curriculum that is currently developed makes students the center of learning. Due to this, the teacher must facilitate students by providing good learning resources. Whether learners obtain good knowledge depends on the content of the teaching materials used (Allchin, 2014). Teaching materials with contextual content have a positive influence on students' mastery of concepts (Oktaviani, et al., 2017). In reality, learning resources available are already plentiful. However, only few of them possess contextual content. Examples of problems with problem-solving structures are also rarely well-presented. Hence, the teacher often re-explains about the process of solving a problem in front of the class.

Some of these problems can be solved by presenting learning resources integrating contextual physics teaching materials with the help of technology. The technology that can be combined with teaching materials can be in the form of android applications. It can be stated that Android provides efficiency and has a positive impact on learning activities (Rahmatullah, et al. 2021). Smartphone has the opportunity to be developed into a tool (media) that can support learning activities in schools so that learning becomes more interactive (Liliarti, & Kuswanto, 2018). The android feature in the form of an application has succeeded in creating independent learning. Many components of the learning media can be inserted so that students can study anytime and anywhere. Therefore, this study attempts to examine the use of contextual teaching materials in improving students' problem-solving skills.

RESEARCH METHODS

This research is quasi-experimental with a pretest-posttest control group design. The objective of the study was to observe the effect of using android-based contextual teaching materials on students' problem-solving skills. The research population was all students of class X MIA at SMA Negeri (State Senior High School) 3 Mataram. The sampling used cluster random technique. The results determined that class X MIA 3 would be the control group, while class X MIA 5 would be the experimental group. The control class was given treatment in the form of printed contextual physics teaching materials while the experimental class used android-based contextual teaching materials. The tools used have passed the stage of validity testing, in which they are deemed as highly decent. The assessment is conducted by media and materials experts.

The research instrument was a written test in the form of long-answer questions. The questions used must first pass validity and reliability test. The questions that passed the test were used in the pre-test and post-test for the experimental and control classes. The questions given consist of eight problems that are adjusted to the indicators for problem solving skills. The problem-solving indicators used include identifying, planning, implementing solutions as well as evaluating.

Data analysis begins with data normality and homogeneity test. The

homogeneity test used the Shaphiro-Wilk test while the homogeneity test used the Box'M test with a significant level of 5%. The data that are declared normal and homogeneous can use the t test to see the difference in the results of the two classes.

This study hypothesized that there is an effect of android-based contextual teaching materials on students' problem-solving skills. The analysis was carried out with the help of SPSS 23 software. The effect of the treatment implemented was tested using the N gain test analysis. The goal is to be able to observe the magnitude of improvement experienced by the experimental and control classes. In addition, the N gain test can be used to show the magnitude of the increase in each indicator of problem-solving skills.

RESULTS AND DISCUSSION

The instrument used in this study was categorized as valid and reliable. The validity test uses product moment correlation equation, while the reliability test uses the Cronbach's Alpha equation with a significance level of 5%. These results indicate that the instrument can be used to measure the effect of the independent variable on the dependent variable. The research instrument was given to the experimental and control classes in the form of an initial (pretest) and final test (posttest). The students' overall test results are summarized in Table 1 below.

Table 1. Problem Solving Skill Test's Average Scores

Class	Test	Number of Students	Highest Score	Lowest Score	Average	Percentage of the Increase
Control	Pre	36	49	21	33.14	69%
	Post	36	94	61	79.78	
Experimental	Pre	36	49	21	32.28	78%
	Post	36	100	70	85.53	

Based on Table 1, the experimental class has improved better than the control class. The experimental class has increased their ability by 78% while the control class has increased by 69%. If viewed from the average score of the post-test obtained by the two classes, it can be seen that the scores of the experimental class are higher than the control class'. Meanwhile, the control class' scores are higher than the experimental class' in pre-test. This means that there is a spike in the increase of the students' ability after being treated with android-based contextual teaching materials.

The entire data obtained from the test given then went through a prerequisite test stage. The goal is to decide which statistics will be used to test the hypothesis. The prerequisite tests conducted encompassed data homogeneity and normality tests. The data obtained were analyzed with the help of the SPSS 23 application. The results of the homogeneity and normality tests are summarized in Table 2. Based on said table, all data fall under homogeneous and normal criteria. This shows that the statistic test that can be used is the parametric test.

One of the parametric tests that is suitable for this research is the t test (independent-sample t test).

Table 2. Data Homogeneity and Normality Testing

Test	Class	Homogeneity			Normality		
		sig.	α	Description	sig.	α	Description
Pre	Control	0.82	0.05	Homogenous	0.39	0.05	Normally distributed
	Experimental				0.08		
Post	Control	0.67			0.28		
	Experimental				0.57		

The t test was used to observe the difference in the results of those given the research treatment. The test results show a data significance value of 0.004. This value is far below the prerequisite value in decision making (α = 0.05). These results can be seen in detail in Table 3. The value of sig. which is less than 0.05 (sig. <0.05) shows that there are differences between android-based contextual teaching materials and text-contextual teaching materials on students' physics problem-solving skills. These results are supported by the findings of Maskur and Safitri (2021) who explain that android-based teaching materials are effective in improving student learning outcomes.

Table 3. Independent-Sample T Test Hypothesis Testing

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
KPM	Equal variances assumed	-2.987	70	.004	-5.750	1.925	-9.589	-1.911
	Equal variances not assumed	-2.987	64.854	.004	-5.750	1.925	-9.595	-1.905

The difference between this research and the other research is placed upon the use of teaching materials that integrate contextuality with an android base. Meanwhile, other research is only based on android without the embedding of contextuality—and it also uses different materials. Other studies also tested contextual teaching materials without using an android base with the research target placed upon concept understanding.

The embedding of contextuality in teaching materials has an added value because it can facilitate students' understanding. The contextual approach in science learning makes it easier for educators to relate the concepts to the environment (Lukman, 2009). Hence, contextual physics teaching materials are able to improve students' conceptual understanding (Oktaviani, et al., 2017).

The contextuality presented in Android-based teaching materials is superior because it can be presented in the form of video. Meanwhile, it can only be in the form of pictures in the textbook. Android presents a variety of features that make in-classroom learning and teaching easier. It is clear how the differences in the use of Android make the learning process easier. The implementation of learning using Android is more effective than that without Android (Muyaroah & Fajartia, 2017).

The improvement of the problem-solving skills is tested in details for each indicator. However, before that, the improvement of the students' problem-solving skills ought to be seen as a whole

through the sub-materials used. These results can be seen in Figure 2. The increase in the experimental class was higher than that in the control class for both refraction and reflection material. Refraction material is of a special interest for the students. This is due it having more contextual life analogies and answer for the students' own curiosity.

Problem solving skill indicators used in this study include identifying, planning, implementing solutions, and evaluating. The test results for the improvement on each indicator of problem-solving skill can be seen in Figure 3. Based on the results in said figure, it can be seen that all indicators increased higher in the experimental class than in the control class. This shows that the use of Android-based contextual teaching materials has a positive effect on all indicators of problem-solving skills. The use of android in learning improves students' problem-solving skills (Fatma & Partana, 2019).

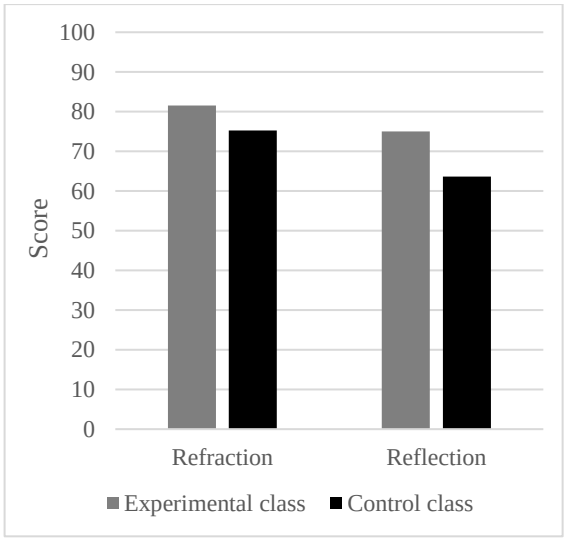

Figure 2. Problem-solving Skill's N-gain Test Results for Each Sub-Material

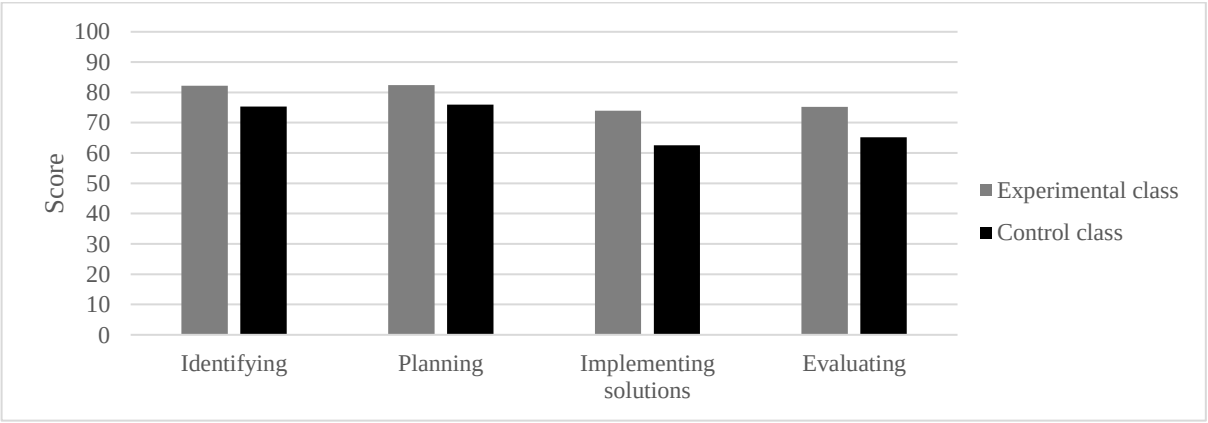

Figure 3. Problem-solving Skill's N-gain Test Results for Each Indicator

There are several things to be noted from the test results of each indicator of the dependent variable. The increase is higher for the indicators of identifying and planning than for the other indicators. The data explains that the students' ability to implement solutions and evaluate is still lacking for both the experimental and the control class. The fundamental reason is that students are still facing problems in using mathematical operations. Some of the students' mathematical representation abilities remain lacking even though they have already understood the information and the completion plan. However, students are hindered when implementing the solution. This affects the results of the students' problem-solving skills.

The use of Android as teaching material provides its own convenience for students. It becomes easier for the students to access and use the material at anytime and

anywhere. This means that the presence of Android omits time and space limitation for learning. Learning activities are not boring and seem interesting (Fatimah & Mufti, 2014). The implementation of learning inside classrooms can also run more effectively and efficiently, especially if the learning implemented is distance learning. The use of Android makes learning activities more organized. Several media can be merged in one platform, for example a virtual laboratory that is merged in an android teaching material (Rahmatullah et al., 2021, Karanggulimuet al., 2021). This forms the difference between Android and printed teaching materials.

CONCLUSIONS

Based on the findings obtained, it can be concluded that the android-based contextual teaching material has an effect on students' physics problem solving skills. The increase in the ability of the students occurs for all indicators used. Overall, the improvement in the experimental class was better than in the control class. These results need to be tested further by several further researchers to strengthen the findings.

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