

Improving problem-solving ability in physics through android-based mobile learning application

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Abstract. The purpose of this study is to know the improvement of problem-solving ability in physics material (light reflection on concave and convex mirrors) before and after being taught by using Android-based learning media. The subjects of this study were the students of class XI MIPA 2 at MAN 2 Yogyakarta which consisted of 27 students. The design of this study is one group pretest-posttest and includes a Pre-Experiment study. Data collection techniques using problem-solving tests and technical data analysis using inferential and descriptive analysis. The inferential analysis shows that pretest and posttest come from homogeneous and normally distributed populations. The results of the study obtained that the improvement of students' problem-solving abilities is in the category of low and medium N-gain.

Keywords: *android, high school physics, problem-solving ability*

1. Introduction

Technological development in the 4.0 era continued to develop rapidly in various midwives. Education has an important role in preparing students to be able to face the demands of the evolving era of the 4.0 era. The education role must be more evident in improving the ability of students to learn, do and utilize innovation and be creative in using information technology to support learning [1], [2]. Mobile Learning became a phenomenon in the 4.0 era in supporting the learning process in the classroom. Learning using M-Learning is far more optimal, flexible, innovative, interactive and effective [3]. Utilizing M-Learning is very appropriate because it follows the development of the 4.0 era where the use of smartphones (android) is dominated by teenagers [4].

Using Android can improve the learning process and knowledge of students [5], and can create opportunities for students to improve their problem-solving abilities [6]. Android-based learning in addition to saving paper can also be accessed anywhere without limited time and space [1], [7]. Learn by using Android in line with one of the demands of the 4.0 era is the problem-solving ability [8]. Problem-solving is a way to solve a problem systematically [9]. Supporting students to describe what they have already known, and to integrate their previous knowledge with new knowledge when they learn in collaborative groups to solve problems to achieve the goals set and succeed [10]. Problem-solving ability of students can be improved if the stages in solving a problem are controlled by students. Stage in problem-solving: directing students to the problem, organizing students to learn, helping group and independent investigations, developing and presenting data, analyzing and evaluating the problem-solving process [8], [11].



Problem-solving abilities are the main part of physics learning [12] which purposes to produce competent problem solvers [13]. In essence, physics learning must be able to facilitate students to be able to develop problem-solving skills. The attitude of students towards problem-solving skills in learning physics can influence their motivation to learn and to develop the abilities needed [14].

2. Research method

2.1. Time and place of research

This research was conducted at MAN 2 Yogyakarta on April 18th, 2019. The research subjects were carried out in class XI MIPA 2.

2.2. Research subject

The subjects of this study were class XI MIPA 2 with 27 students in total.

2.3. Data analysis technique

This study was pre-experimental study with the design research of the one group pretest-posttest [15]. Data analysis techniques used descriptive analysis, standard deviations, variances and normality tests using inferential analysis. Analysis of improving problem-solving abilities using N-gain.

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (1)$$

Information, S_{post} is score final test, S_{pre} is score preliminary tests and S_{max} is maximum score that may be achieved. The following are criteria for categorizing the level of N-gain in table 1 [1].

Table 1. N-gain categories.

N-gain	Category
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Medium
$g < 0.3$	Low

3. Results and discussion

The analysis in this study uses SPSS version 20 software to know whether or not there is an improvement in students' problem-solving abilities before and after learning to use Android. Based on the results of the output displayed by SPSS version 20 shows that the results of the descriptive show in table 2 below.

Table 2. Descriptive statistics results.

	N	Minimum	Maximum	Mean	Std. Deviation
Pretest	27	10	60	34.44	13.397
Posttes	27	30	60	46.67	8.321
Valid N (listwise)	27				

Descriptive statistics results in table 2 show the differences in the improvement of students' problem-solving abilities before and after learning by using Android media. Before learning to use android the minimum score that can be achieved by students is 10 and the maximum score is 60. The average score between the minimum and maximum scores of students is 34.44 with a standard deviation of 13.397. These results are different after being treated with learning to use android media. The minimum score that can be achieved by students improves from 10 to 30 with the achievement of the maximum score is still the same as before learning to use Android that is 60. The average score between the minimum and

maximum scores is 46.67 with a standard deviation of 8.321. The results of the frequency description show in table 3 below.

Table 3. Frequency description results.

		N
Posttest - Pretest	Negative Differences ^a	1
	Positive Differences ^b	20
	Ties ^c	6
	Total	27

^aPosttest < Pretest

^bPosttest > Pretest

^cPosttest = Pretest

Table 3 shows that there was 1 student who got a score of problem-solving skills decreased after being given treatment using Android-based learning. Meanwhile, 20 students increased their scores after being treated and 6 students got the same score between before and after learning using Android. This shows that android-based learning cannot give significant meaning to 7 students in their problem-solving abilities.

Table 4. Significant test results.

Test Statistics ^a	
	Posttest - Pretest
Exact Sig. (2-tailed)	.000 ^b
Sign Test	

The results of the significant test shown in table 4 upper. If $\text{sig} > 0.000$ then there is an increase and if $\text{sig} < 0.000$ then there is no increase after treatment. The level of sig (significance) used is 5%. Significant test results indicate there is an improvement in problem-solving abilities after being treated with android-based learning. This can be seen in the result of $\text{sig} > 0.000$. Where the sig value is $0.05 > 0.000$, so it can be concluded that there is an increase in students' problem solving abilities.

Figure 1 shows the difference in achievement scores before and after learning to use Android. The frequency of student achievement before being treated is with a score of 10 as the minimum score that can be achieved by students. This shows that the ability of problem-solving 7% of 27 students get a score with a frequency of 10-20. 15% of students get a score with a frequency of 21-30. 22% of students get scores with a frequency of 31-40. 26% of students get scores with a frequency of 41-50. 30% of students get a score with a frequency of 51-60. After being given the treatment the minimum score that can be achieved by students increases to 30 and the maximum score of 60. 33% of the 27 students get with a frequency of 30-40. 55% of students get a score with a frequency of 30-40. 11% of students get a score with a frequency of 51-60. The ability of students to solve problems at the frequency of 30-40 after being given android-based learning has increased by 11% from the previous 22% and the frequency of 41-50 experienced the largest increase of 29% from the previous 26%. Whereas at the frequency of 51-60 it decreased by 19% from the previous 30%. Increased student problem solving only occurs at frequencies 30-50. From these results, it can be concluded that the ability of students only increases to the minimum score limit, while the ability to the maximum score limit does not increase. To know how much improvement in the problem solving ability before and after it is given treatment can be analyzed using moralized gain.

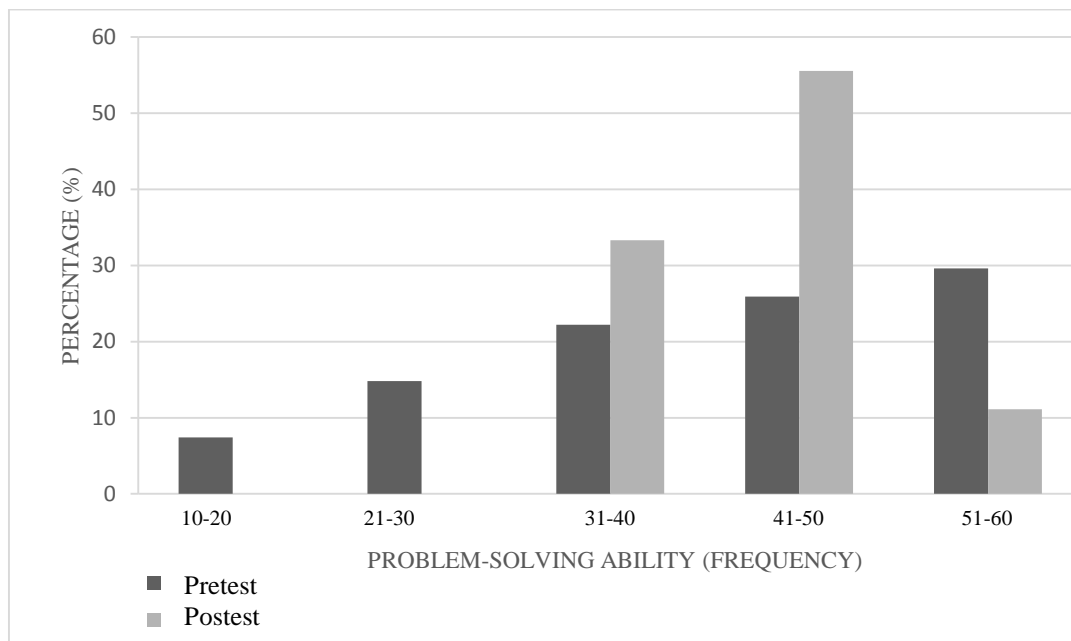


Figure 1. Graphic distribution of the percentage of students' problem-solving scores (pretest-posttest).

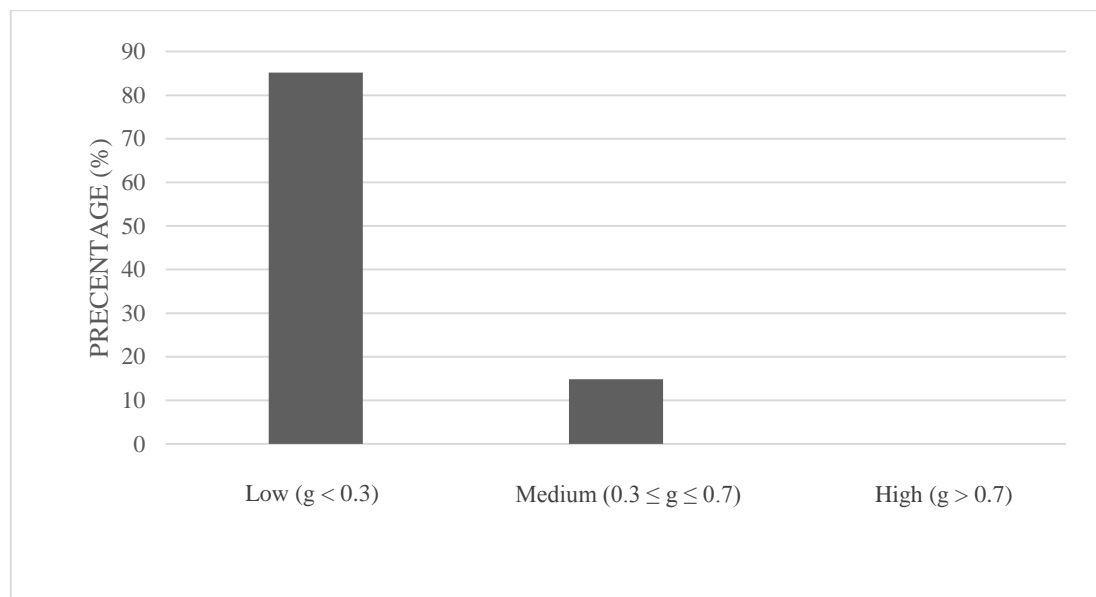


Figure 2. Distribution of N-gain problem-solving for students.

Figure 2 shows how much an increase in students' problem-solving abilities. The results of increasing the ability of students with low and medium categories. While the high category does not, this could be due to the short time spent in research. So that students have not been able to optimally absorb learning using the applied android. Improvement of students' problem-solving abilities in the low category reached 85% from 27 students and for the moderate category by 15%. To achieve the problem-solving ability of students in the high category, the factor that must be considered is the time in the learning process using Android. This is because the problem-solving ability of students must have mastered the stages of problem-solving starting from formulating the problem to concluding.

The improvement of students' problem-solving abilities that can be seen from the results of the analysis above is inseparable from the role of the Android-based learning media and the systematic

stages of problem-solving. Then, the selection of material is also very appropriate because students often encounter it in daily life. These results are in line with research [7] which states that using android-based learning media can improve students' problem-solving abilities. Also, the role of the systematic stages of problem-solving ability affects the improvement of problem-solving abilities. Where, students are easy in defining the problem, formulating to analyze and draw conclusions [12]

4. Conclusion

Based on the analysis above it can be concluded that there is an improvement in the problem-solving ability of students with low categories and is being seen from the N-gain. Improving students' problem solving is inseparable from the role of android-based learning media, systematic stages of solving the problem and the selection of material that is very appropriate because they often encounter it in everyday life. To get an increase in problem-solving students in the high category that needs attention is the length of time in the learning process that needs to be extended with a long time the students' problem-solving skills can improve in the high category because learning is delivered optimally and meaningfully to students.

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