

The Application of Contextual Physics Teaching Materials Assisted by Android-Based Virtual Labs to Improve Students' Science Process Skills During the Learning Activities in Covid-19 Pandemic

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ABSTRACT

This paper discusses the application of contextual physics teaching materials assisted by android-based virtual labs to improve students' science process skills during the learning activities in the Covid-19 pandemic. These contextual physics teaching materials are applied to students from two classes, model and implementation class. Based on the research data, the comparison of students' pre-test and post-test results in the model and implementation class was comparable. Students in those classes experienced an improvement in science process skills. The research data signify that the application of contextual physics teaching materials assisted by android-based virtual labs can improve students' science process skills during the learning activities in the Covid-19 pandemic.

Keywords: Teaching materials, Contextual physics, Virtual lab, Android, Science process skills, COVID-19.

1. INTRODUCTION

A good learning activity uses learning methods that effects can be felt directly by the students. As we know, learning methods can help achieve the learning objectives. However, that does not mean that the learning method focuses on achieving learning objectives only. Learning methods also focus on the relationship between teachers and students during the learning activities. This relationship will bring up chemistry between teachers and students that can help them to get more into the learning objectives. Learning methods often change or adapted based on the period when the learning activities take place. The period referred to here is the Covid-19 pandemic period.

The Government of the Republic of Indonesia has implemented regulations to maintain social distancing to reduce the spreading of Coronavirus that caused the Covid-19 pandemic since the beginning of March 2020. These regulations have impacts in various sectors, one of them is the education sector. Indonesian

Minister of Education decide to implemented online learning. It means teachers and students are need to adapt to this situation. There are many obstacles that they experienced in the implementation of online learning. One of the constraints referred to is learning to focus on the teacher (teacher center), not on students (student center) which is the hallmark of the 2013 curriculum. This characteristic is known as the scientific approach (scientific method). A scientific approach can be applied in various situations, including the limited learning support resources. Teachers who have problems in applying it are required to be creative in innovating teaching materials.

Teaching materials are means to support learning activities. It contains things such as limitations, methods, learning materials, and ways of conducting evaluations that are structured and attractive to achieve competency objectives to learning sub-competencies with all their complexities [1]. The availability of physics teaching materials under the rules in the

learning environment is still lack. Most of them have not involve technology yet. So, an analysis of physics books that are often used in the learning activity was implemented [2]. The results of this analysis show that the books contain many elements of knowledge. The results of this analysis also signify that there is very little correlation between scientific activities and thinking activities.

Learning activities will be less effective if it is done without involving teaching materials. It means teaching materials have impacts on learning actors, both teachers and students [3]. Teaching materials can encourage students to increase their literacy of learning materials because of their relevance to the context of everyday life. This statement is proven by a finding that students' attention to the literacy of learning materials such as physics tends to improve when they are taught with interesting teaching materials [4].

There has been much study regarding the expansion of contextual teaching materials. Some of them are modules. There's a study that finds that the average value of the learning outcomes of students before and after utilizing the contextual physics module was different [5]. There is also a study that finds the contextual physics module integrated with the developed web was adequate to be applied in the learning activities [6]. Other finding shows that physics teaching materials with contextual learning models that integrated with computers is worth it [7]. Two other studies that have implemented have resulted in findings that a contextual approach can stimulate students' reasoning to think creatively [8] in arranging their experiences with learning materials such as physics [9].

The contextual approach tends to be more attractive if integrated with learning media. Campaigns for the use of learning media have been conducted but their application itself is still lacking. This fact is supported by a finding that most teachers view the available learning media are not adequate to use and if they have to develop one by their selves, it can take a lot of time [10]. It is also in line with a finding that the number of teachers using learning media that are integrated with technology is still small [11]. Whereas, there are also other findings that show learning media has a great effect on increasing the effectiveness of learning activities [12].

The implementation of online learning during the Covid-19 pandemic requires teachers to work harder in preparing learning activities. Teachers have to face challenges to create engaging learning situations so students can still concentrate on learning even though

they are in a hard time. This challenge also comes from the finding that young people of school age access entertainment such as games or online video streaming services more than access learning materials [13].

The Indonesian Ministry of Education regulation requires students not to attend directly at school during the covid-19 pandemic. School laboratories are also not used because students cannot perform practical activities as usual there. It is very influential in the students' science process skills because they cannot do their experiment or practical learning activities directly. Practical learning activities that use learning media can stimulate students' interest in these learning activities. There are finding that shows learning media can improve students' interest in learning materials which they are not liked at first [14]. One form of learning media that is suitable for this kind of situation is virtual labs.

The effect of using virtual labs in learning activities has been demonstrated in various studies, such as simulations [15], microcomputer-based laboratories [16], remote laboratories [17], and augmented reality [18]. There is a study that results in findings that the use of virtual labs in learning activities can support students' inquiry experiences and constructive science processes [19]. Also, there are findings that virtual labs can be a solution for some limitations such as time, but in this case, it is covid-19 pandemic [20]. These findings suggest that virtual labs are suitable for studying physical materials during these hard times. It can be a solution to overcome the lack of students' abilities in the context of cognitive psychomotor. It is very influential in the students' science process skills even though they cannot do practical learning activities directly in the physical laboratory at their school.

Science process skills are known as the abilities to find solutions to solve the problems that were found in the practical learning of science [21]. The skills referred to include problem understanding skills, hypothesis formulation skills, experimental design skills [22], hypothesis proving skills, data collection skills, and conclusion formulation skills [23].

This paper discusses the innovation in learning activities to overcome the above problems. The innovation is contextual physics teaching materials assisted by android and virtual labs to improve students' science process skills. This innovation recommends a student-centered method with a control function by teachers through online learning. It means students can still do practical physics learning activities though they are not in school.

2. RESEARCH METHODS

This study uses a quantitative approach. It was conducted through quasi-experiments to determine the application of contextual physics teaching materials assisted by android-based virtual labs to improve students' science process skills [24].

The study involved students from class XI IPA 4 (modelling class) and XI IPA 6 (implementation class) in the second semester of the 2019/2020 academic year at SMAN 1 Muntilan as the study subjects. The subject's determination was using a purposive sampling technique [25]. The number of study subjects in the study were 36 students from class XI IPA 4 and 36 students from class XI IPA 6. They were not taught about reflection and refraction of light before.

The form of preliminary research implementation is pre-experimental with a one-group pre-test post-test [26] research design shown in Figure 1.

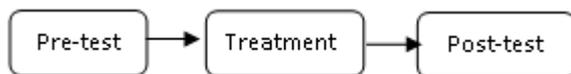


Figure 1 One group pre-test post-test

The study subjects are treated the same in the implementation of their learning activities. The treatment given to them was initiated by conducting pre-research (observation of classroom learning), synthesizing research problems based on pre-research results, designing learning tools (Learning Implementation Plans, Student Worksheets, and Android-based virtual labs) regarding light reflection --and refraction, designing assessment instruments, designing validation of learning devices and research instruments, and evaluating learning tools and research instruments.

This paper presents results from the study using quantitative and qualitative analysis techniques. The instrument data for the assessment of science process skills of research subjects from both classes, the pre-test and post-test sections, were analyzed using descriptive statistical methods and the Sign Test assisted by the SPSS application.

The following data of science process skills measurement is based on model class student's pre-test and post-test scores. Then it was analyzed using descriptive statistical methods. Table 1 describes the data based on the treatment they received.

Table 1. Descriptive statistics of students' science process skills

	Pretest	Posttest	Valid N (Listwise)
Subject	36	36	36
Min	25	67	
Max	38	92	
Min	32.1667	77.3611	
Std. Deviation	4.48808	6.61666	

The students' mean pre-test score was 32.16, while their mean post-test score was 77.36. This data shows that there are differences in students' science process skills before and after the learning activities are carried out with the given treatment. After that, to make the conclusions more convincing, the data were analyzed using the Sign Test method. The analysis result showed in Table 2.

Table 2. Frequency of students' science process skills

		Subject
Posttest - Pretest	Negative Differences (Posttest < Pretest)	0
	Positive Differences (Posttest > Pretest)	36
	Ties (Posttest = Pretest)	0
	Total	36

Based on the data, the students as study subjects have higher post-test scores than their pre-test scores. The data showed that students' post-test scores in this study are improved. The students' scores in learning activities that assisted by an android-based virtual lab have improved. The statistical tests result from these data can be seen in Table 3.

Table 3. Statistical results of students' science process skills sign test

Statisticsa Test	
	Posttest - Pretest
Z	-5.833
Asymp. Sig. (2-tailed)	.000

3. RESULTS AND DISCUSSION

The output of the statistical test using the Sign Test shows the α value of 0.00. The $\alpha < 0.05$ value tells us that the hypothesis is rejected. This data signifies that the science process skills of students from the model class improved after the application of contextual physics teaching materials assisted by android-based virtual labs [27].

The study was then continued by carrying out learning activities in the implementation class to obtain more convincing data. This learning activity is carried out with the help of a physics teacher to accompany the students in that class.

The data from the analysis of students' scores in the implementation class through the pre-test and post-test assessment instruments are shown in Table 4. The students' mean pre-test score was 31.80, while their mean post-test score was 84.61. This data shows that there are differences in students' science process skills before and after the learning activities are carried out with the given treatment. After that, to make the conclusions more convincing, the data were analyzed using the Sign Test method [28]. The analysis result showed in Table 5.

Table 4. Descriptive Statistics of Students' Science Process Skills

	Pretest	Posttest	Valid N (Listwise)
Subject	36	36	36
Min	21	72	
Max	49	100	
Min	31.81	84.61	
Std. Deviation	6.76	7.87	

Table 5. Frequency of students' science process skills

		Subject
Posttest – Pretest	Negative Differences (Posttest < Pretest)	0
	Positive Differences (Posttest > Pretest)	36
	Ties (Posttest = Pretest)	0
	Total	36

Based on the data, the students as study subjects have higher post-test scores than their pre-test scores. The data showed that students' post-test scores in this study are improved. The students' scores in learning activities that assisted by an android-based virtual lab have improved [29]. The statistical tests result from these data can be seen in Table 6.

Table 6. Statistical results of students' science process skills sign test

Statistics Test	
	Posttest - Pretest
Z	-5.833

Asymp. Sig. (2-tailed)	0.000
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Table 7. Science process skills assessment criteria

Science Process Skills Intervals	Category
$X \geq 76$	Excellent
$71 \leq X < 76$	Good
$65 \leq X < 71$	Moderate
$59 \leq X < 65$	Not Good
$X < 59$	Bad

The output of the statistical test using the Sign Test shows the α value of 0.00. The $\alpha < 0.05$ means that the hypothesis is rejected. This data signifies that the science process skills of students from the implementation class improved after the application of contextual physics teaching materials assisted by android-based virtual labs [30].

The results of the analysis using the observation sheet showed that 88.89% of the total students had science process skills at an excellent category, while the rest 11.11% of the students had science process skills scores at a good category. It means the application of contextual physics teaching materials assisted by android-based virtual labs can improve students' science process skills [31].

The learning activities begin by recording student attendance. Student attendance data is collected using the WhatsApp voice note feature. The students mention their name and state that they are present and ready to participate in the learning activity. After that, researchers ensured that students had installed all the teaching materials applications provided on their respective androids. Then, the researcher and the teacher persuade the students to read the instructions for use in the teaching material application. This teaching material has the advantage of helping students to learn physics materials even though they are far from their teacher and school laboratories [32]. It makes their learning activities easy to do anytime and anywhere when using their respective androids.

The android-based contextual physics teaching materials that have been install on students' androids have components that are more or less the same as physics teaching materials in general. This android-based teaching materials contain several elements such as the front page, instructions for use, preface, table of contents, materials, worksheets, practice questions, bibliography, and author profile. The thing that distinguishes this android-based teaching materials from teaching materials in general is the

practical learning concept [33]. The practical learning concept in this teaching materials is closer to the daily lives of today's students who spend most of their time with their gadgets.

This teaching material can help students to learn physics material in terms of the results of their learning responses. It is also accompanied by background music to provide comfort in learning for those students who are accustomed to focusing when listening to music. Meanwhile, students who are usually focusing on if the atmosphere is quiet can reduce the volume of the music. This teaching material has a futuristic look with a material design that is concise, sturdy, and clear. It was designed using the PhET Simulation platform and can also be used by the students when they are offline. It means they don't need to spend a lot of internet quota to study the material that is already in it. This teaching material also contains material that is related to its implementation with everyday life so that its concept can be accepted and implemented by the students. Thus, it improves students' science process skills. Other findings also show that virtual labs are feasible to use [34] and are proven to be effective in improving students' science process skills in learning activities [35].

4. CONCLUSION

The conclusion obtained from this research data includes: the comparison of students' pre-test and post-test scores in the model and implementation class was comparable. Students from both classes experienced improved science process skills. In conclusion, the application of contextual physics teaching materials assisted by android-based virtual labs can improve students' science process skills.

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