The Effectiveness of Learning Materials of Inquiry Models to Practice Science Process Skills in Simple Harmonic Motion’s Matter

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Abstract. This research aims to know the effectiveness of learning materials of inquiry learning models to practicing science process skills in simple harmonic motion’s matter. This research was conducted on 60 tenth grade students at Muhammadiyah 1 Gresik Senior High School. The effectiveness of this research is seen from science process skills tests, learning achievement, and student response. Science process skills data were obtained from pre-test and post-test. Learning outcomes data were obtained from affective and psychomotor assessment through observation methods and cognitive assessment through the post-test method. While student response data were obtained from the questionnaire method. N-Gain values were obtained from average to high range for each class from the results of pre-test and post-test, this showed the increase in process skills of students. The data analysis of learning achievement indicated that all students have final results that meet the minimum completeness criteria (>75). The data analysis of student responses showed positive results, the highest positive response was the use of student worksheets (LKS) that eases students in learning. Thus, based on the results obtained it can be concluded that this research learning instrument is effective for practice the science process skills in simple harmonic motion’s matter.

1. Introduction

Education is an important factor in character building of personal, family, community and nation. The purpose of national education is to develop the potential of a student becoming a human being who believe and fear God, have good moral, knowledgeable, creative, independent, and become a responsible citizen. The cult of technological development requires teachers to continue to plays an active role not only in providing knowledge but also to teach students how to solve problems around them in preparation for the future. Hence special skills in problem solving must be embedded, these skills are nothing but process skills. Science subjects, especially physics aim to develop science and concepts related to daily life, develop student’s curiosity, produce positive attitudes, and realize that there is a connection between science and the environment as well as being able to develop student’s science process skills.

One of the subject matter of physics that is of concern to researchers is simple harmonic motion. Simple harmonic motion studies the phenomenon of objects that move periodically to their equilibrium position. Mathematical calculations in simple harmonic motion material are one of the factors causing
students to avoid this material [1]. The mistakes made by students in working on problems on this topic are allegedly caused by students still having difficulty identifying the quantities used to determine the spring period or determine the swing period, from the test instruments given, students assume that the greater the mass give the greater the swing period [2]. Students also have difficulty in determining the change in the direction of objects that vibrate [3]. Another difficulty occurs when students have to interpret a graph [4]. In addition, this material is also suitable for training science process skills with an inquiry-assisted inquiry model according to Basic Competence 4.11, namely conducting experiments on the simple harmonic motion.

As said before, the cult of technological development requires teacher to continue to play an active role so that the learning process runs smoothly and shared goals are achieved. But the learning process does not always depend on the existence of the teacher (educator) as a manager of the learning process. This is based on the nature of the learning process, namely the interaction between students and the object being studied. Every learning process requires a learning materials. Learning materials are competencies that refer to actions that are rational and meet certain specifications in the learning process [5]. Learning materials are a product of development research that must meet several conditions, one of which is the effectiveness of these materials. The materials is said to be effective if it gives results in accordance with the goals set by the developer.

Researchers assume that students need to have science process skills to solve problems related to everyday life. In fact, the science process skills in our country are still below average. Learning in the classroom is still centered on teacher (teacher-centered), teacher in the same direction teaches concepts to students without involving students to be active in the learning process [6]. In addition, the results of literature studies on the ranking of natural sciences in Indonesia still show a low level. It is based on PISA (International Student Assistance Program) 2015 which focuses on literacy reading, Mathematics, and Science which ranked Indonesia 69th out of 76 countries. The relatedness of science-focused PISA with skills of science process lied in indicators of skills of science process such as observing, interpreting, etc [7].

The science process skills were an approach to learning, where students get the opportunity to interact in real objects to find their concepts [6]. Science process skills were physical and mental skills related to fundamental abilities that are possessed, mastered, and applied in scientific activities, so scientists can discover something new [8]. The science process skills encouraged students to discover the facts, concepts of knowledge and develop the attitudes and values requested [9]. The science process skills need to be trained on students in science learning, particularly physics. revealed that science process skills are important competencies that must be achieved in the learning process of science. To realize such desire learning in a classroom should actively engage students [10].

The learning process was an activity in which students are given the opportunity to develop, both in terms of knowledge, skills, and character. The learning model is said to be effective if students can be engaged actively in the learning process, the learning model must be adapted to the material and abilities of students and facilities at school [11]. The problem that has occurred so far because students are not able to analyze existing information and tend to receive what information is submitted or written in the books, students tend to be passive in the learning process. The inquiry model encourages students to observe, classify, make guesses, explain, measure, make conclusions, and so on. The inquiry learning model refers to the development of students in the material by collecting data. Whereas the development of process skills needs to be based on working, designing or other things that produce something. The process of collecting data can be obtained in various ways one of them by conducting experiments.

The experimental method is a method that provides opportunities for students either individuals or groups to be trained in performing a process or experiment [12]. By this method students are expected to fully engage in experiments, conduct experiments, find facts, collect data, and solve problems they encounter in real time. Students are motivated when they work together to solve physics problems [1]. By conducting experiments, it eventually makes students going to do science activities in groups and will be trained in process skills and then students can search for knowledge and truth in science concepts that they understand from experiments.
Previous research that revealed the application of inquiry learning was positively responded to understanding students' abilities especially in science learning [1][13]. Previous studies have also shown that the application of inquiry models can improve science process skills and learning achievement [14][15][16]. Based on the reasons that have been presented and see the successful implementation of inquiry learning beforehand, it is important to know the effectiveness of the tools designed based on inquiry models to foster students' science process skills. The materials used in this learning are materials that have gone through the validation process first of 3 validators and have been tested valid. In this study, researchers wanted to see the effectiveness of learning materials of an inquiry model in training process skills on simple harmonic motion’s matter. In addition, researchers also want to see the effectiveness of learning materials used based on learning achievement and student response to learning with these materials.

2. Research Methods
This study used one group pre-test – post-test design with 3 replications. This research was conducted on 60 tenth grade students at Muhammadiyah 1 Gresik Senior High School. The effectiveness of learning materials seen from 3 aspects: science process skills, learning achievement and student responses. Retrieval of research data was done through a preliminary test (pre-test) and a final test (post-test) for aspects of knowledge and science process skills, observation of student attitudes during learning and student skills during conducting experiments, as well as questionnaires for analysis of student response during learning.

To find out whether students have trained science process skills could be seen from the N-Gain increase between pre-test and post-test. Student learning results could be seen from the cumulative calculation of 50% aspects of knowledge, 30% aspects of affective and 20% aspects of psychomotor [17]. Student response could be seen from the percentage of student's interest in learning. On this research also conducted parametric statistical tests because 3 replications were conducted. As for statistical tests conducted were normality, homogeneity, ANOVA’s test and paired samples T-tests.

3. Result and Discussion
To find out the normality and homogeneity of the three replication samples, it is necessary to do a statistical test with the following hypothesis:

H₀: There were no significant differences in the 3 samples

H₁: There are significant differences in 3 samples

Statistical test results showed that the samples used in normal and homogeneous distributed research indicated by significance values of > 0.05 (H₀ accepted) as in table 1 and table 2 below.

Table 1. Results of Normality Test

|                        | Kolmogorov-Smirnova | Shapiro-Wilk |
|------------------------|---------------------|--------------|
|                        | Statistics  | Df   | Sig.  | Statistics | Df   | Sig.  |
| Pre-test of MIPA 1 Class | 0.178       | 20   | 0.098 | 0.928      | 20   | 0.144 |
| Pre-test of MIPA 2 Class | 0.169       | 20   | 0.138 | 0.934      | 20   | 0.184 |
| Pre-test of MIPA 3 Class | 0.149       | 20   | 0.200* | 0.925      | 20   | 0.124 |

a. Lilliefors Significance Correction

Table 2. Results of Homogeneity Test

| Levene Statistics | df1 | df2 | Sig.  |
|-------------------|-----|-----|-------|
| 3.113             | 2   | 57  | 0.052 |
Data analysis of pre-test and post-test on science process skills showed that MIPA 1 class shows the results of N-Gain in the range 0.42-0.91 (moderate-high), for the MIPA 2 class the results of the N-Gain in the range 0.45-0.85 (moderate-high), while for the MIPA 3 class the results of N-Gain ranged from 0.42-0.84 (moderate-high). The results of the N-Gain proved that using the inquiry learning tools are effective for practicing student's science process skills. This is in line with research [5] [18] which concluded that the application of inquiry models had a positive effect on student’s science process skills.

Analysis of learning achievement data is seen from 3 aspects namely knowledge, affective and psychomotor. On those 3 aspects, the results of analysis of learning achievement data for 3 classes showed that after through learning the inquiry model the value of all students meets the minimum completeness criteria (KKM ≥ 75) with an average grade of MIPA 1 class is 77.15, the average grade of MIPA 2 class is 77.60, and the average grade of MIPA 3 class is 77.63.

Analysis of student response data was obtained from the results of the student response questionnaire given after all of the learning processes is complete. The questionnaire contained 11 questions regarding the applied learning process. The results of student response analysis classe MIPA 1 are presented in the student response in figure 1 below.

![Figure 1. Student Response’s Percentage in Class MIPA 1](image)

The results of student response analysis classe MIPA 2 are presented on the student response in figure 2 below.
Figure 3. Student Response's Percentage in Class MIPA 3

Based on the figure 1, figure 2 and figure 3, it could be seen that student response to learning are classified as positive response because the majority of student choose ‘agree' and ‘extremely agree' for the question given. The highest positive response is about the worksheets (LKS) that shared to students as well as many new things students felt in this learning among others formulating problems, identifying problems, formulating variables, formulating hypotheses, designing experimental activities, making table and chart independently, analyzing observational data and concluding experiments based on problems.

ANOVA test results showed a significance value > 0.05 (Ho accepted) indicated a consistency of N-Gain increase in all three classes. For the result of ANOVA test is presented in table 3 below.
Lastly, to compare two samples in pairs, i.e. samples with the same subject but different treatments so it will be seen that there is an effect due to the treatment given, it is necessary to do a paired samples T test with the following hypothesis:

\( H_0 \): there is no effect due to the treatment given
\( H_1 \): there is an effect due to the treatment given

Statistical test results showed that there is an effect due to the treatment given indicated by significance values of \(< 0.05\) (\(H_0\) rejected) as in table 4 below.

### Table 4. Result of Paired Samples T-Test

| Pre–Post test | Mean | Std. Deviation | Std. Error Mean | Lower | Upper | T  | Df | Sig. (2-tailed) |
|---------------|------|----------------|-----------------|-------|-------|----|----|----------------|
| MIPA 1        | -5.17855E1 | 11.26601         | 2.51916         | -57.05815 | -46.51285 | -20.557 | 19 | 0.000          |
| MIPA 2        | -5.392E1   | 8.96651          | 2.00497         | -58.12246 | -49.72954 | -28.896 | 19 | 0.000          |
| MIPA 3        | -5.785E1   | 7.64960          | 1.71050         | -61.43312 | -54.27288 | -33.822 | 19 | 0.000          |

### 4. Conclusion

Based on the results and discussion, firstly, seen that N-Gain from pretest and posttest data shown that student has criteria moderate to high value, so it can be concluded that the materials are effective to practice science process skills of student. Secondly, the accumulation of knowledge test data, affective assessment data, and psychomotor assessment data showed that the learning achievement for all students has final results that meet the minimum completeness criteria. Thirdly, almost all of the students give a positive response with the learning process that uses the learning materials. So can be concluded that learning materials of inquiry model used by researchers are effective to practice student's science process skills in simple harmonic motion's matter.

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