The Effectiveness of Guided Inquiry Learning Model to Improve Science Process Skill on Heat Matter

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Abstract. This research aimed to describe the effectiveness of guided inquiry learning model to trained science process skill. Research conducted in SMA Kemala Bhayangkari 1 Surabaya at grade XI on heat matter by using one group pre-test and post-test design. Data collecting techniques consist of tests and questionnaires. The effectiveness of the guided inquiry model is obtained based on the science process skill test, learning achievement of knowledge test and student responses. Science process skill test and learning achievement of knowledge test obtained based on the results of the pre-test and post-test. Student responses are obtained based on the results of the questionnaire that includes the student responses to learning. The data analysis using n-gain score to determine the improvement of science process skill and learning achievement of knowledge while descriptive quantitative to describe student’s response. Result of this research shows that (1) indicators of science process skill improved with high category (2) learning achievement of knowledge improved with middle category (3) student responses to learning are highly positive. Based on those results indicates that guided inquiry model is effective to improve science process skill on heat matter.

1. Introduction
Learn is the process of effort intentionally conducted to acquiring new behavior alteration entirely, consciously, and that alteration is relatively settled, also bring positive effects and advantages for student in interaction with their environment [1]. Teaching and learning process will be success if it results bringing changes on knowledge, understanding, skill, and norm of attitude within student self. The success of student in learning process is also affecting by teacher role as educator. An educator should able to create conditions that enable students learning activity occurred. Mentioned conditions can be task assignment, motivates student to dare to ask and express opinion, motivate student curiosity on learning material. These conditions may be conducted by teacher through sequence setting of learning activities entirely, start from making learning design, conducting learning activity, and performs learning evaluation including learning process and learning achievement in form of change of learning effect itself [2].

By formed of Curriculum 2013 expected that new spirit and innovation will be created in Indonesia education world. Curriculum 2013 implements scientific approach within learning through activities of observation, questioning, experiencing, reasoning, and communicate. Curriculum should base on reasoning affirmation more, not only on memorization anymore. This change decided by referring to the results of international study on performance of Indonesian student. The reason of Indonesian
Ministry of Education and Culture compiled Curriculum 2013 was education curriculum must be adapted to the demand of times. One reference of mentioned study result is “Trends in International Math and Science” that conducted every four years performed by International Association for the Evaluation of Education Achievement (IEA) that is an international association for achievement evaluation in math and science centered in Lynch School of Education, Boston College, USA. Achievement obtained by Indonesian students in 2003 ranked on 34 of 46 participant countries, in 2007 Indonesia achieved rating 36 of 49 participant countries, in 2011 Indonesia ranked on 36 of 43 participant countries, and in 2015 Indonesia ranked on 45 of 48 participant countries [3]. These results shows average score of science skill of Indonesian student is below the international average score year by year.

To improve the reasoning capability of physic subject, students have to self-learning regularly and learn to find their own understanding. All this time, student accustomed to receive material from teacher explanation, with no searching other learning resources, so their learning is teacher centered and student are less active role in the finding of their knowledge. The obstacle besides learning model applied by teacher in school, there is another obstacle that make student learning was less meaningful, that is about learning instrument used by student within learning activity.

The wise teacher will give chance to student to search and find information by their self or if giving information, teacher only gives basic information as foundation for student in search and find other information by their self. This teaching style will grow student confidence about their done [4]. Besides that, this teaching style may change learning that was passive become active learning, because student will trains their thinking skill and reasoning skill independently in finding learning concepts.

Based on result of performance test of science process skill in SMA Kemala Bhayangkari 1 Surabaya, students were yet to solve questions of science process skill well. Test result obtained using multiple choice questions which loads some indicators of science process skill. Test result shows that 40 % of students can identify variable, 41% of students can state hypothesis, 37% of student can defined operational variable, 42% of students can designed research, and 38% of students can describe and interpret data. This test result shows that science process skill of student is still in lower classification.

Physic teaching and learning process should emphasize more on process skill approach so that student can finding facts, construct concepts, theories, and scientific attitude by their self, which finally can affect positively on the quality of education process or education product. One of process skill can be developed is science process skill. Mukhlis [5] stated that science process skill is skills needed by student to develop their potentials. This potential development can be student skills in problem formulation, proposing question, conducting experiment, processing data, and drawing conclusion [6].

The effort can be conducted to trained science process skill is by using learning instrument based on a learning model allows supporting teaching and learning activities. A learning model that supports within trained science process skill is guided inquiry model. Inquiry strategy is a sequence of learning activities that involving all student skill maximally to find and investigate systematically, critical, logic, analytical, so they able to formulate their finding with confidence. Inquiry learning emphasizes on investigating and finding process [7]. The main plans within inquiry learning are to determining goals and problem identification properly [8].

Rismawati [9] stated that one of learning model can make student active and develop science process skill optimally is by using guided inquiry model. Guided inquiry learning model is an instruction model where the teacher provides guidance for student by giving opening question about concepts will be studied and direct it into discussion topic. This is accordance with research conducted by Mukhlis [5] which stated that guided inquiry regarded as effective way to improve student achievement and science process skill by involving student directly within learning process and resulting meaningful learning more. Along the research, learning process conducted with practice using guided inquiry model, thus student involved in finding process directly and allows student science process skill developments.

This inquiry model is supportive toward Physic learning, because by conducting mentioned activities, student able to find actively their knowledge independently. Thus, in order to improve learning quality, teacher needs to give the chances for student to conducting observation, questioning,
proposing hypothesizes, collecting data, and make conclusion independently. Thinking well naturally means able to produce questions to do investigation, developing reasonable hypothesis, designing controlled experiment, collecting and presenting data correctly, using evidences to support the conclusion, and presenting experiment process effectively [10]. Juhji [11] shows that to improving science process skill, student should familiarize to be more self learning in order to find concepts, scientific principles, also develops creativity in science problems solving which in realization is guided by teacher intensively. With supported by some elements, those are qualified learning instrument and proper learning model, expected to support and trained science process skill to the student. Based on mentioned problems above, researcher interested to do research with title “The Effectiveness of Guided Inquiry Learning Model to Improve Student Science Process Skill on Heat Matter”.

2. Research Methods
This research conducted in SMA Kemala Bhayangkari 1 Surabaya academic year 2018/2019 at grade XI on subject of Physic on material of heat. Test design was using one group pre-test and post-test design. Pre-test is test conducted before learning, while post-test is test conducted after entire process of learning activities. Based on pre-test and post-test, we can determine how about learning achievement obtained by student before and after conducting learning by using guided inquiry model. Data collecting technique used are test, which used to measure or determine the presence of inquiry learning model contribution in trained science process skill and disseminate response questionnaires which are used to know response of student toward guided inquiry learning model.

Results data of pre-test and post-test of science process skill and learning achievement of knowledge analyzed descriptive quantitative, that is N-gain analysis. Gain indicates the difference of student process skill and psychomotor skill before and after treatment is given. Normalized gain score indicates level of treatment effectiveness than obtained score. N-Gain formulated as follows.

\[
N - Gain = \frac{Post \ test \ score - Pre \ test \ score}{Maximum \ score - Pre \ test \ score}
\]

Category:
- high = score g > 0.70
- middle = score 0.30 < g < 0.70
- low = score g < 0.30

Data of student response obtained from questionnaire of student response toward learning activities then analyzed by using descriptive quantitative, that calculates percentage of statements given by student. Equation to calculate data of student response is following.

\[
P = \frac{\sum K}{\sum N} \times 100\%
\]

Explanation:
- \(P\) = percentage of student response
- \(\sum K\) = Total of student response score
- \(\sum N\) = Total of all student response score

Data were collected is processed then interpreted with criteria as follows.

- PRS \(\geq\) 85\% = highly positive
- 70\% \(\geq\) PRS < 85\% = Positive
- 50\% \(\geq\) PRS < 70\% = less positive
- PRS < 50\% = negative
- PRS = Percentage of Student Responses
3. Result and Discussion

3.1 Science Process Skill

The effectiveness is success action of student to obtain certain goals that bring optimum learning achievement. To know the success of learning process, students are given science process skill questions on pre-test and post-test. Pre-test conducted before learning activity while post-test conducted after student participated in all learning activity. Test was made refer to some indicators of science process skill that trained at learning activities, they are 1) problem formulation, 2) writing hypothesis, 3) variables identification, 4) writing definition of operational variables, 5) making table of observation, 6) analyzing data, 7) drawing conclusion.

In order to measure effect of guided inquiry learning instrument toward the effectiveness of teaching and learning activity, it known based on improvement result of science process skill indicators and the completeness of student learning achievement. The following presented improvement results of each indicator of science process skill before and after participated within learning.

![Figure 1. Improvement Result of Science Process Skill Indicators](image)

Based on Figure 1 known that mean of student pre-test score is 29 and mean of post-test score is 90 with score of n-gain is 0.87. Score of this n-gain indicates that high improvement occurred on every indicator of science process skill after students were participated in learning by using guided inquiry learning instrument. Based on research conducted by Rismawati [8] shows that learning process which using guided inquiry model is able to improve science process skill. The improvement of science process skill caused by student participation on steps of guided inquiry learning. Scientific activities may give chances toward student in self-finding of facts, concepts, and principles through direct experience so that learning resulted is more optimal.

The effectiveness of learning instrument also can be obtained based on the learning achievement of knowledge that contains indicators remember (C1), understand (C2), Apply (C3) and Analyze (C4).
Figure 2. Improvement Result Learning Achievement of Knowledge

Based on Figure 2 could know that mean of student pre-test score learning achievement of knowledge is 45 and post-test score is 81 with n-gain is 0.64 that categorized middle. This indicates that improvement of learning achievement of knowledge was occurred after learning process by using guided inquiry model conducted and learning instrument were developed is used.

Based on research conducted by Sakdiah [12] shows that students who are taught with guided inquiry have the opportunity to obtain higher learning achievement of knowledge than those taught using conventional learning. Guided inquiry learning causes students to become more scientific and increase understanding of concepts. Guided inquiry learning causes students to actively participate in learning and improve scores better than traditional model.

Results above support and confirm the truth of theory by Jerome Bruner that suggest students to learn through participation actively with their own concepts and principles [13]. Based on this theory, student should able to involved actively within learning activity to find and construct their knowledge independently then appearing meaningful learning in the student mind.

3.2 Response

Learning effectiveness can also be shown based on student response after participating in all learning activities sequence. Student response is responses given by student about teaching and learning activities. Student response measured using instrument in form of questionnaire given after learning process is finished. On response questionnaire, it was giving some statements about anything along learning process as shown in Table 1.

| No. | Response                                    | Percentage (%) | Category  |
|-----|---------------------------------------------|----------------|-----------|
| 1   | Interest in learning activities             | 89,29          | Very good |
| 2   | The renewal of the learning materials       | 88,78          | Very good |
| 3   | The Ease to understand physics learning     | 88,10          | Very good |
| 4   | Teacher guidance during learning            | 92,86          | Very good |
|     | Average                                     | 89,76          | Very good |

Based on Table 1 can know that student assessment toward some components within learning 89.29% of student stated enjoy along participating learning. This is because what implemented by teacher within learning is novel thing for them. It supported by Table 1 that 92.86% stated novelty on learning they participated. Positive response of student surely affected toward the improvement of student learning
achievement which shown in Figure 1 and Figure 2. This is supported based on student responses where stated that science process skill can they understood easily, then it affected positively toward the improvement of learning achievement of science process skill. Positive response given by student also affected by learning model implemented. Guided inquiry may involve student to participate actively within learning through practice activity by trained science process skill so that student being more enthusiastic in every phases and steps within learning they participated.

This is supported based on research conducted by Azis [14] showing that student’s responses to inquiry learning are positive, both in terms of subject matter or content, inquiry learning approaches used, science process skills being trained, learning tools used, learning management, as well as the test results of learning the understanding of knowledge and process skills undertaken.

4. Conclusion
Based on analysis of research result could be concluded that learning instrument of guided inquiry model is able to improve science process skill. This shows by the completeness of science process skill indicators and the learning outcomes with n-gain respectively 0.87 and 0.64 and categorized in high and middle. Besides that, learning effectiveness also supported with the positive result of student response 89.76. This result shows that learning instrument of guided inquiry model is highly effective to improve science process skill. Suggestion for the teacher is that the result of this research can be a reference for implementation of Physic learning in school. Based on those results indicates that guided inquiry learning model is effective to improve science process skill.

Some points are needed to be considered by teacher when implements guided inquiry model to improve science process skill, those are: (a) teacher who used guided inquiry model should prepare and manage time well in order to learn conducted effectively and efficient so that learning syntaxes were planned totally could be realized and learning goals can be achieved. (b) Teacher needs to evaluate every ends of learning in order to correct the disadvantages in the next learning.

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