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Improving student's science process skills through inquiry model on material elasticity subjects

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Abstract. This study aims to improve science process skills of high school students through inquiry model on material elasticity subject. The experimental design of learning applied by using one group pre test - post test design tested on XI MIA5 and XI MIA4 classes with a total sample of 30 students. The data collected includes science process skill data, observation data, and student response data. Data analysis techniques used include; 1) qualitative descriptive analysis of skills of science processes, students' activities and responses. 2) parametric statistical analysis of normality test, homogeneity test, and t-test. The result of the research indicates that: 1) there is a significant improvement of science process skill in every indicator of students' science process skill including determining variables, interpreting, summarizing, formulating problems, and formulating hypotheses. 2) experiment is the most prominent students' 'activities, and 3) The students' response after taught using the inquiry model is very positive, with the highest percentage of student response is with teacher guidance when working on the students worksheet. Based on the results of this study, inquiry model can improve science process skills of students of senior high school 5 Ambon on the subject of elasticity material.

1. Introduction

The result of observation in senior high school 5 Ambon indicates that class was still conducted in monotonic condition; there was almost no simple practice in physics learning; it did not involve full students in the learning process and the teacher developed partial learning tools. Lesson plan was developed in reference to the content standards, yet the students' manuals and books generally referred to the existing package of publications. In addition, students' ability in solving daily test for elasticity material of the academic year 2016/2017 was low. Many students' score were under the minimum standard score, only 25% of students scored above the minimum standard of 66.

The results of TIMSS and PISA studies reveal that students' ability in high-level thinking in Indonesia, especially in the field of science, is still relatively low. Students do not have ability to solve problems required to think higher or High Order Thinking. Higher thinking ability is a one of science process skill. Data obtained for each scientific process skill indicator studied by the researcher at senior high school 5 Ambon include: (1) formulating problem 0%, (2) formulating hypothesis 0%, (3) defining research variable 0%, (4) interpreting data 0 %, and (5) making conclusion 0%. The data indicate that students' at senior high school 5 Ambon were not trained in science process skills. Meanwhile, problems on international level such as the Program International Student Assessment

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(PISA) and Trends International Mathematics and Science Study (TIMSS) include science process skills.

In order for process skill to run optimally, inquiry learning is required. The word inquiry comes from word to inquire which means participating, or engaging in asking questions, seeking information, and conducting investigations. Inquiry learning (self-learning) is one of the right models to help students to more actively discover and spur the ability to think. Inquiry model is a model that emphasizes the search process or the discovery of information. Through inquiry learning, students can think systematically, logically, and critically so that students are able to develop intellectual abilities as part of mental processes [1]. In addition, According to Bruner in [1], inquiry learning allows students to become active in seeking knowledge so that it will enhance the meaning of what they learn. The purpose of this research is to improve students' science process skill through inquiry model on the subject of material elasticity.

2. Method

This research uses quantitative and qualitative descriptive research. Descriptive research is intended to collect information about a matter based on existing facts [2], thus, it aims to describe a phenomenon. In this research, improvement of students' science process skill through inquiry model on the subject of material elasticity is measured. The research trial was conducted on 15 students in class XI MIA5 and XI MIA4 in senior high school 5 Ambon, odd semester of academic year 2017/2018. The design uses one group pre test-post test design test as it uses one group without any comparison group. Device test was performed to see the suitability of learning and student characteristics. This design is written as follows [3]:

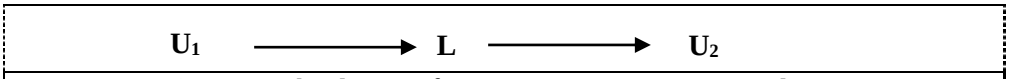

Figure 1. The design of one group pre test-post test design

Description: **U_1:** Pre test ; **U_2:** Post test; **L:** Learning using the Inquiry learning model.

In this research, data collection method is used to obtain relevant and accurate data, and can be used appropriately according to research objectives. Data collection methods used in this study include: 1) students' science process skills; 2) student activity; and 3) student response.

3. Result and Discussion

3.1 Skills of the Science Process

Pre test and post test results of the science process skills are analysed by qualitative descriptive analysis by calculating the average pre test and post test values, the mean value of pre test and post test are used to calculate the normalized N-gain score. Normalized N-gain scores were used to determine the category of students' science skill skills between before and after learning using inquiry learning models. The average N-gain score obtained by the MIA5 XI class is 0.60 - 0.94 in medium to high category [4]. The average score of N-gain class XI MIA4 is 0.68 - 0.94 in medium to high category [4]. Both classes had moderate-to-high N-gain scores because at the time of the study both classes were very active and enthusiastic in learning. Based on the value of N-gain, there is an increase in the science process skills in class XI MIA5 and XI MIA4.

The percentage of science process skill based on science process skill indicator in both classes shows significant improvement. Improved science skills skill indicators in class XI MIA5 and XI MIA4 is shown in Figure 2 and Figure 3.

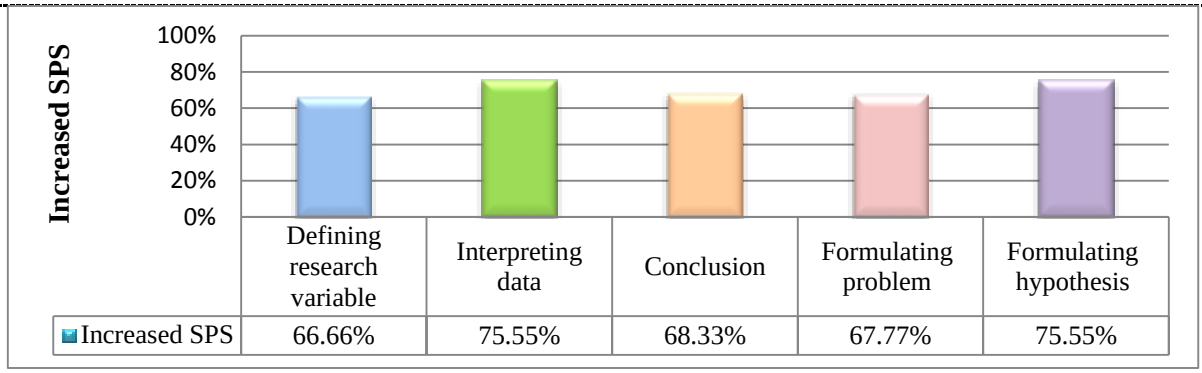

Figure 2. Increased SPS on pretest and posttest XI MIA-5

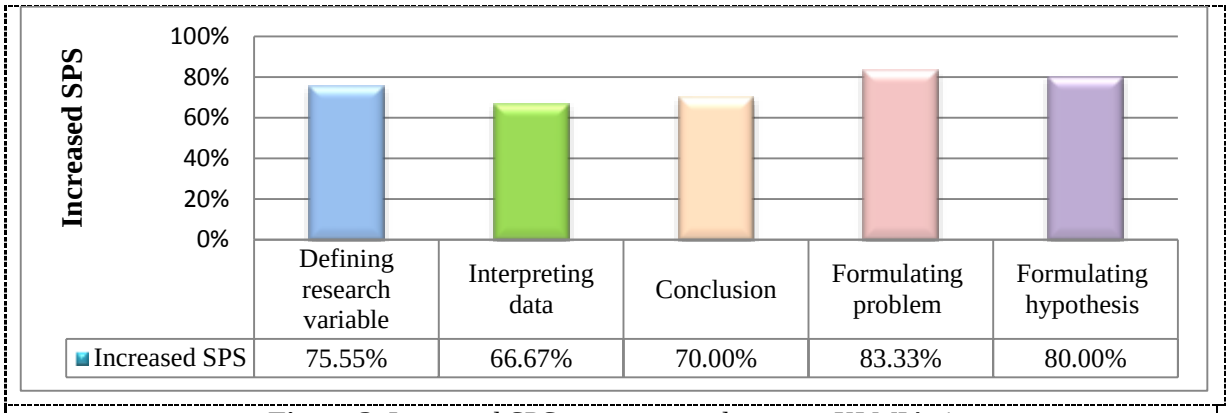

Figure 3. Increased SPS on pretest and posttest XI MIA-4

Figure 2, the highest improvement on indicator of science process skill is interpreting data 75.55% and formulating hypothesis of 75.55%. The lowest improvement is defining research variable by 66.66%. Based on Figure 3, the highest improvement on indicator of science process skill is formulating problem by 83.33%. The lowest improvement is interpreting data by 66.67%.

Improvement of science process skills in both classes is due to the use of inquiry learning model as a vehicle to help students practice the science process skills. The improvement of these science process skills via inquiry learning model is also reported by Nworgu dan Out [5]. It is concluded that the implementation of guided inquiry learning model can improve the junior high school students' science process skills in Nigeria. At the stage of formulating problem, formulating hypotheses, identifying variables, designing experiments, conducting experiments, analysing data, and making conclusions, teachers grouped students into learning groups. This grouping made students more active and courageous in expressing their opinions. This is in accordance with the social constructivism theory of Vigotsky stating that students learn through interaction with more capable adults and peers. One of the stages that made students very enthusiastic in learning is doing experiment because the physics teachers never had experiments- only monotonous learning. Monotonous learning is in contrast to the modern psychology saying "If teachers want to teach children to get fish, do not give the fish, simply give them the hook." This metaphor actually has the meaning that the student must be self active and the teacher only gives a reference or tool [6]. Therefore, the task of educators is to guide, direct, motivate, and provide conditions in such a way that students can develop talent and potential. According to Piaget, children think when he does something. Without action means the child is not thinking [6]. This is in a line with Abruscato [7] who states that "Inquiry process which makes knowledge explored by using different group of skills is very important. These skill are known as science process skills. These skills are not only important for scientist but also it is important to be

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applied in developing and designing learning in the classroom where the inquiry is focused on learning". According to [8], science process skill involves cognitive or intellectual skills, psychometric skill as well as social skill. Cognitive skill is applied when students use their thinking, while psychometric skill is involved during students using instruments, doing measurement and setting up the instruments. Social skill is performed during students communicating and sharing their ideas to others in learning process. Moreover, the use of inquiry model can improve students' science process skill in formulating problem and hypothesis, defining research variable, interpreting data, as well as making conclusion. The result of normality test, homogeneity test, and paired t-test is shown in Table 1.

Table 1. Result of normality test, homogeneity test, and paired t-test

Sample	α	Normality test		Homogeneity test		Paired t-test		
		Sig	Ket	Sig	Ket	t	df	Sig (2-tailed)
Class XI MIA5	0.05	0.128	Normal	0.182	homogeneous	-19.566	14	0.000
Class XI MIA4	0.05	0.126	Normal	0.182	homogeneous	-29.476	14	0.000

The results of normality test using Kolmogrov Smirnov test is shown in Table 1. Based on testing hypothesis H_0 and H_1, sig> α then H_0 is accepted, it means that the data came from normally distributed population. It means that the condition of the sample taken is similar to the actual population.

The result of homogeneity test using Levene test is shown in Table 1. Based on hypothesis test of H_0 and H_1 , sig> α then H_0 is accepted, it means the data comes from homogeneous population variance. It shows that all students have the same knowledge ability at the beginning of learning.

The result of paired t test is shown in Table 1. Based on testing hypothesis H_0 and H_1, sig <α then H_0 is rejected or $t_{table} < t_{count}$, then H_0 is rejected, meaning that there is significant difference in pre test result and post test result [9]. It shows inquiry model affect the increasing significance of students' science process life skill.

3.2 Student Activity

Students' activity is measured using students' activity observation sheet instrument. Student activities observed include observing teachers explaining, observing demonstrations, formulating problems, formulating hypotheses, identifying variables, conducting experiments, collecting experimental data, analysing experimental data, discussing with group mates, drawing conclusions, presenting the experimental results, and providing insert, as shown in Table 2.

Table 2. Observation of student activity

No	Student Activity	Class XI MIA5			Class XI MIA4			Average
		Meeting I	Meeting II	Meeting III	Meeting I	Meeting II	Meeting III	
1	Watch the teacher's explanation.	10.01	9.02	8.96	8.56	9.75	10.26	9.42
2	Watch the demonstration.	9.05	9.5	9.05	8.49	9.59	8.64	9.05
3	Formulate the problem	6.69	6.78	6.28	6.13	5.46	6.07	6.24
4	Formulate the hypothesis	6.47	6.78	6.08	6.13	5.25	6.07	6.13
5	Identify variables.	6.69	6.30	6.28	6.13	5.47	5.90	6.13
6	Experiment	13.83	11.77	6.28	6.13	17.92	15.28	11.87

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Table 2. Observation of student activity

No	Student Activity	Class XI MIA5			Class XI MIA4			Average
		Meeting I	Meeting II	Meeting III	Meeting I	Meeting II	Meeting III	
7	Collect experiment data	6.69	6.78	9.70	9.54	6.35	6.07	7.52
8	Analyze experiment data	8.41	9.16	9.7	9.54	5.86	5.64	8.05
9	Discuss with group mates.	8.21	8.97	9.01	10.51	10.44	14.13	10.21
10	Draw a conclusion.	8.61	9.02	9.18	8.14	9.75	8.65	8.89
11	Group representatives present the results of their discussion.	8.24	8.76	7.09	7.45	7.36	6.62	7.59
12	Each group gives the insert.	6.69	6.78	6.28	7.56	6.35	6.07	6.62
13	Irrelevant behavior.	0.38	0.21	0	0	0	0	0.10

In Table 2, students were active in learning, student-centered, and students were happy to follow the learning by using inquiry models to improve the science process skills. However, during the lesson there were activities that were not relevant by 0.38% in meeting I, 0.21% in meeting II and decrease to 0% in meeting III, thus the average percentage is 0.1%. It shows that there is still a lack of inquiry learning to improve students' science process skills. There was no irrelevant activities in class XI MIA4, because this class is more calm and quite enthusiastic in learning.

Activities in Table 2, are in accordance with RPP activities based on the inquiry learning model to improve students' science process skills. The inquiry model emphasizes the activity of seeking and finding information, where students are placed as subjects not as objects at the time of learning. In the learning process students must actively seek and find their own essence of a learning material. The teacher only guides and directs the student when errors or misconceptions occur to students [1]. This is in line with Nur's [10] opinion about the skills of the science process, that is, the skills students learn when they are actively involved in scientific investigation through asking and answering a question, and they use a variety of science process skills.

3.3 Student Response

The result of the students' responses in class XI MIA5 and XI MIA4 on learning using the inquiry learning model shows that the highest percentage is the student's response to the teacher's guidance when doing the student worksheet during the learning activity by 100%. Results of student response analysis can be seen in Figure 4 and Figure 5.

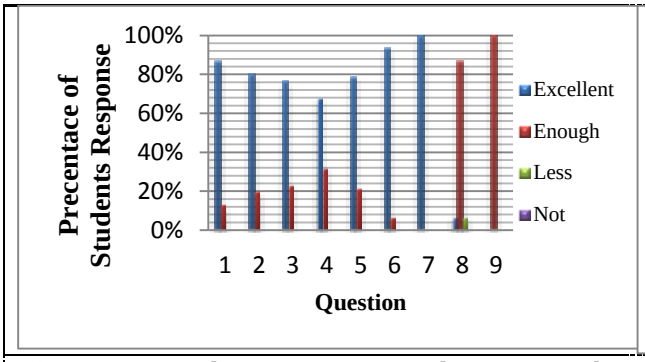

Figure 4. Student response to learning with Inquiry Model In Class XI MIA5

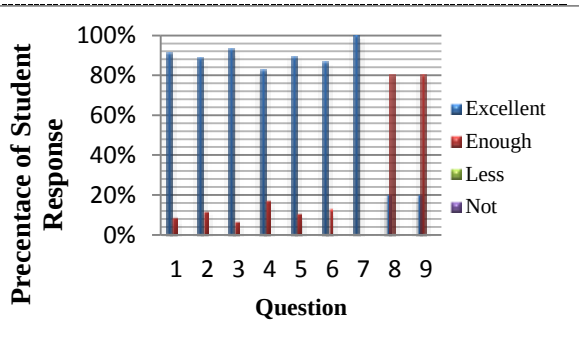

Figure 5. Student response to learning with Inquiry Model In Class XI MIA4

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Based on Figure 4 and Figure 5, the highest percentage is in question number 7 which is the guidance of teachers when working on student worksheets by 100% which falls on very good category. Students can understand students' worksheets because researchers design learning from simple to complex level. This is in line with Ivor K. Davies [11] that one of the roles and functions of the teacher is as a culminate, the teacher designing the lesson from beginning to end from simple to complex, success of learning. To achieve success in learning there must be an element of interest to the learning model so that students are motivated to learn. The existence of motivation in learning will have an impact on learning outcomes. Students who are motivated to learn something will use a higher level of thinking in learning the material, so that students will be able to absorb and absorb the material better.

4. Conclusion

Based on the finding, generally inquiry model can improve the science process skills of senior high school 5 Ambon students on the subject of material elasticity, with the following conclusion: 1)The use of inquiry learning strategy can improve students' science process skill in class XI MIA5 with the highest improvement of interpreting data and formulating hypothesis 75.55% while in class XI MIA4 the highest indicator is formulating problem by 83.33%. 2) In the process of learning the most prominent student activity that is experiment with an average percentage of 11.87%, but still there are activities students are not relevant. This is seen from the average percentage of student activity that is not relevant in both classes by 0.1%. It shows that there is still a lack of inquiry learning to train the skills of the science process in the learning process. 3) By using inquiry model to improve students 'science process skill, the average percentage of students' responses from the two highest classes is obtained from teacher guidance is doing student worksheet by 100% which falls on category of very good.

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