The effect of scientific inquiry learning model and scientific attitude on students' science process skills

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Abstract. This study aims to analyze how science process skills use scientific inquiry, to analyze how science process skills with high scientific attitude and low scientific attitude, to analyze the interaction between scientific inquiry and scientific attitude. This type of research is a quasi experiment with a pretest-posttest control group design. Data analysis was performed using descriptive analysis which aims to be able to explain and predict the symptoms that apply on the basis of data obtained in the field. Based on the results of the study it was found that the science process skills using scientific inquiry on the temperature and heat material experienced a significant increase, the skills that had a high scientific attitude were better than the science process skills which had a low scientific attitude, and there was an interaction between scientific inquiry and scientific attitude.

Keywords: science process skills, scientific inquiry, scientific attitude.

1. Introduction
The teaching and learning process is a process that contains a series of actions by the teacher and students on the basis of a reciprocal relationship. Interaction or reciprocal relationship here is not just a relationship between teachers and students, but in the form of educational interactions. Meanwhile, the problem faced by our education world is the problem of the weakness of the learning process. Factors that influence the low quality of education in Indonesia include issues of effectiveness, efficiency and standardization of learning.

The main component in the world of education is the teacher. Teachers are required to be able to encourage, guide and provide learning facilities for students to achieve the expected learning objectives. So that the teacher has the responsibility to see everything that happens in the classroom to help the student development process. The delivery of subject matter is only one of the various activities in learning as a dynamic process in all phases and processes of student development (Slameto, 2010). However, the facts in the field show that teachers tend to use conventional methods, such as lectures. The use of the lecture method is still very high in use, although several innovative methods such as class discussion learning methods, experiments, demonstrations, observations are also used.

Based on the results of interviews and observations conducted by researchers at a high school in Medan, several problems were found as follows: (1) students are less active in the teaching and
learning process, (2) students have difficulty mastering the material provided by the teacher, (3) in the implementation The teaching and learning process is still centered on the teacher, meaning that the teacher is more active than students, so that the students' process skills and student scientific attitudes are limited, (4) student learning outcomes are still below the minimum completeness criteria.

To overcome the problems faced, it is necessary to have a way out in the learning process so that it can improve performance and have a positive impact on students. One solution to improve student performance and activeness is using the scientific inquiry learning model. Where the inquiry process gives students the opportunity to have real and active learning experiences so that students are trained in solving problems when making decisions. The phases in this model are (1) students present their research field, (2) students create problems, (3) students identify problems in the research, (4) students speculate to clarify problems Joyce (2009).

Joyce (2009) states that the learning model is a pattern or plan that has been planned in such a way and is used to compile a curriculum, compile subject matter, and provide instructions to teachers in class. The use of innovative learning models can make learning more enjoyable and meaningful. One of the innovative learning models is the scientific inquiry learning model. This learning model can be used to develop scientific attitudes and improve students' science process skills.

Trianto (2013) and Siregar (2019) states that process skills are directed scientific skills (both cognitive and psychomotor) that can be used to find a concept or principle to develop a pre-existing concept or to deny an invention. In this way these skills become a driving force for the discovery and development of facts and concepts as well as the growth and development of attitudes and values.

The scientific attitude is as a stance (tendency) towards a certain stimulus which is always oriented to science and the scientific method (Sujanam, 2002; Ulfah et al. 2018). This attitude develops through support and can be done by forming a scientific attitude consisting of aspects of curiosity, wanting to get something new, an attitude of cooperation, not giving up, not being prejudiced, honest, responsible, free thinking and self-discipline.

The objectives of this study were (1) to determine whether or not there were differences in students 'science process skills taught using the scientific inquiry learning model and conventional learning models, (2) to determine whether or not there was a relationship between scientific attitudes and students' science process skills, (3) know the interaction of scientific inquiry learning models and scientific attitudes in improving students' science process skills.

2. Research Methods

This research is a quasi-experimental research, which aims to determine the effect of "something" imposed on the "subject", namely students. This study involved two sample classes that were given different treatments. The experimental class uses the scientific inquiry learning model while the control class uses the conventional learning model. The research design was a Two Group Pretest-Posttest Design.

The variables in this study in terms of their role, consist of independent variables, dependent variables and moderator variables. The independent variable in this study is the learning model, namely the conventional learning model and the Scientific Inquiry learning model. The moderator variable in this research is scientific attitude. The dependent variable in this study is science process skills.

The procedure in this study consists of three stages, namely the preparation stage, the implementation stage and the completion stage. In the preparation stage, everything related to research is planned and arranged well, including the research schedule, learning tools, learning media, teaching materials and questions. At the implementation stage, learning activities are divided into three learning activities, namely the preliminary stage, core activities and closing activities. Learning activities carried out in the two sample classes began with apperception and motivation. In the exploration activities in the experimental class, the scientific inquiry learning model is applied while in the control class conventional learning is applied.
Instruments are available to collect research data according to research needs. The instrument used in this study was a science process skills test. This study consisted of 10 questions in the form of LKPD which were given at the beginning and end of the study for the experimental group and the control group. To assess the scientific attitudes of students, this study used an assessment sheet for each student. The assessment sheet was given at the beginning of the lesson along with the pretest. This is intended to group students into students who have a high scientific attitude and a low scientific attitude.

The first instrument used in the cognitive domain is validity. A test can be said to be valid if it is able to measure the final objective in accordance with the material and content of the lesson. In the preparation of the test must be adjusted to the curriculum and indicators in accordance with the subject matter.

Technique data analysis scientific attitude and the results of science process skills in this research is analysis descriptive. Descriptive statistics are needed to find the mean, median, std. deviation, variance, range, data frequency, graph data and other information needed.

Furthermore, the data is tested for normality to see whether the sample is normally distributed or not, after the data is said to be normal, it is continued with the homogeneity test, which aims to determine whether the data has a homogeneous variance or not. After that, the data hypothesis test is carried out to test whether the hypothesis proposed in the study is accepted or rejected. This analysis was carried out using the SPSS 20 program.

3. Results and Discussion
3.1 Research result
At the beginning of the study, both classes were given an initial ability test (pretest) which aims to determine whether the initial abilities of students in both classes are the same or not. Based on the data from the research results, it was obtained that the pretest average value of students in the experimental class before being treated with the scientific inquiry learning model was 25.39 with a standard deviation of 6.86 while in the control class it was obtained that the students’ pretest average value was 24.38 with a standard deviation 6.08. The data on the pretest scores for experimental and control science process skills (KPS) are shown in Table 1.

| Table 1. Results of KPS Pretest Experiment and Control Class |
|---------------------------------------------------------------|
| Experiment Class | Control Class | |
| No. | Value Interval | Frequency | Average | No. | Value Interval | Frequency | Average |
|-----|----------------|-----------|---------|-----|----------------|-----------|---------|
| 1   | 1-9            | 0         |         | 1   | 1-9            | 1         |         |
| 2   | 10-20          | 8         |         | 2   | 10-20          | 7         |         |
| 3   | 21-30          | 15        | 25,39   | 3   | 21-30          | 20        | 24,38   |
| 4   | 31-40          | 10        |         | 4   | 31-40          | 4         |         |
|     | Σ              | 33        |         |     | Σ              | 32        |         |

After obtaining data from the pretest students from the experimental class and the control class, the normality test and the pretest data homogeneity test were carried out first to determine their feasibility before being given treatment.

Based on the results of the normality test above, the data significance value of the pretest value for the experimental class was 0.052 and the control class was 0.200. Both of these significance values are greater than 0.05. Based on the decision making criteria, $H_0$ is accepted. This means that the samples from the experimental class and the control class come from a population that is normally distributed.

Based on the results of the normality test, it was found that the data were normally distributed, then the data had to be tested for homogeneity. The results of the homogeneity test obtained a significance value of 0.220. Because the significance value is greater than 0.05, based on the decision-making
criteria, it can be concluded that the variance between the experimental class and the control class is homogeneous.

Based on the hypothesis test, the significance value with the t-test is obtained is 0.528. Because the significance value is greater than 0.05, based on the criteria for decision making, Ho is accepted. This shows that the science process skills of students who are taught with the scientific inquiry learning model are not better or the same as conventional learning, in other words the two classes have the same initial ability.

After the experimental class applied the scientific inquiry learning model and the control class applied conventional learning, the two classes were then given a posttest with the same questions as the pretest questions. The results obtained by the experimental class were 66, 12 with a standard deviation of 11.57, while the control class was 58.47 with a standard deviation of 8.27. The posttest data for the experimental and control classes are shown in Table 2.

| No. | Value Interval | Frequency | Average | Value Interval | Frequency | Average |
|-----|----------------|-----------|---------|----------------|-----------|---------|
| 1   | 40-50          | 4         |         | 1              | 40-50     | 6       |
| 2   | 51-60          | 6         | 66,12   | 2              | 51-60     | 13      |
| 3   | 61-70          | 11        |         | 3              | 61-70     | 11      |
| 4   | 71-80          | 9         |         | 4              | 71-80     | 2       |
| 5   | 81-90          | 3         |         | 5              | 81-90     | 0       |
| ∑   |                | 33        |         | ∑              | 32        |         |

The posttest data was also tested for normality and homogeneity. Based on the results of the normality test above, the data significance value of the post-test value for the experimental class is 0.098 and the control class is 0.200. Both of these significance values are greater than 0.05. Based on the decision making criteria, Ho is accepted. This means that the samples from the experimental class and the control class come from a population that is normally distributed.

Based on the results of the normality test, it was found that the data were normally distributed, then the data had to be tested for homogeneity. The results of the homogeneity test obtained a significance value of 0.059. Because the significance value is greater than 0.05, based on the decision-making criteria, it can be concluded that the variance between the experimental class and the control class is homogeneous.

Based on the data obtained, the average value of scientific attitudes in the experimental class is higher than the scientific attitudes in the control class, namely 68.00 and 67.81 and based on the data then they are grouped into two categories, namely the high level of scientific attitude and low scientific attitude. The grouping of these categories is based on the class average value obtained by the two classes. Students who have scores greater than or equal to the average score are grouped in the high category, and students who have scores below the average are grouped in the low category. The high and low level of students' scientific attitudes is determined from the average scientific attitude of the entire sample, namely 67.91, where the category of the high level of scientific attitude is greater than or equal to 67.91 and the category of the low level of scientific attitude is less than 67.91. The complete categorization of scientific attitudes is made in Table 3.

| No. | Scientific Attitude Category | Average |
|-----|------------------------------|---------|
| 1.  | Tinggi                       | < 67.91 |
| 2.  | Rendah                       | > 67.91 |
Furthermore, the determination of the category of high scientific attitude and low scientific attitude for each sample group based on the full post-test score can be seen in Table 4.

| Table 4. Data on Students' Scientific Attitudes |
|-----------------------------------------------|
| **High Level of Scientific Attitude**          |
| Score  | Frequency | Average | Score  | Frequency | Average |
| 68     | 3         |         | 68     | 2         |         |
| 69     | 5         |         | 69     | 5         |         |
| 70     | 3         |         | 70     | 3         |         |
| 72     | 3         | 70,65   | 72     | 3         |         |
| 74     | 1         |         | 73     | 2         |         |
| 75     | 1         |         | 75     | 2         |         |
| 77     | 1         |         |        |           |         |
| Total  | 17        |         | Total  | 17        |         |

| **Low Level of Scientific Attitude**            |
| Score  | Frequency | Score  | Frequency | Score  | Frequency |
| 67     | 4         | 67     | 4         | 64,19  | 2         |
| 66     | 4         | 66     | 3         | 65     | 2         |
| 65     | 5         | 65     | 2         | 62     | 1         |
| 64     | 1         | 63     | 2         | 61     | 3         |
| 61     | 2         | 61     | 3         |        |           |
| Total  | 16        | Total  | 15        |         |           |

After the scientific attitude data have been grouped into high scientific attitudes and low scientific attitudes, hypothesis testing is carried out to find out the science process skills of students taught by the scientific inquiry learning model are better than conventional learning, the science process skills of students who have a high scientific attitude are better than with students who have a scientific attitude low- and there is interaction between the learning model of scientific inquiry and scientific attitude in increasing the skills of the process of science students. Based on the results of hypothesis testing using the ANOVA 2 x 2 test, data is obtained in table 5.

| Table 5. 2 x 2 Factorial ANOVA Results |
|-----------------------------------------|
| **Source** | **Type III Sum of Squares** | **Df** | **Mean Square** | **F** | **Sig.** |
| Corrected Model | 2855.543² | 3 | 951.848 | 12.905 | 0.000 |
| Intercept | 250933.718 | 1 | 250933.718 | 3402.061 | 0.000 |
| Model | 876.512 | 1 | 876.512 | 11.883 | 0.001 |
| Attitude | 661.941 | 1 | 661.941 | 8.974 | 0.004 |
| Model * Attitude | 1211.447 | 1 | 1211.447 | 16.424 | 0.000 |
3.2 Discussion
Based on the results of research conducted, students who were taught using the scientific inquiry learning model obtained an average score of science process skills higher than students who were taught using conventional learning. The results of this study are supported by research that has been conducted by Anggreani, S.S., Et al (2017) which concluded that the science process skills of students who are taught by a model of scientific inquiry with the media Adobe Flash better than students taught with conventional learning. Hutahean, R., et al. (2017) also said that the science process skills of students taught with the scientific inquiry model using Macromedia Flash were better than students taught with conventional learning. Meliala, EM, et al (2019) said that the science process skills of students who apply the scientific inquiry learning model are better than the science process skills of students with conventional learning. Additionally, Sahyar, Febriani, H.N (2017) also say the same thing, namely Keter Visible science process students use learning model of scientific inquiry is based on a conceptual change is better than using conventional learning.

Based on the results of the research conducted, it shows that there are differences in science process skills between groups of students who have high scientific attitudes and groups of students who have low scientific attitudes, where students who have high scientific attitudes have better science process skills than students with low scientific attitudes. This is in accordance with research conducted by Kartika et al. (2019) which concluded that the science process skills of students with a higher scientific attitude were better than students with a lower scientific attitude. The same thing was concluded by Hannasari, R., et al. (2017) that the science process skills of students who have high scientific attitudes are better than students who have low scientific attitudes.

Based on the results of testing the hypothesis in this study, there is an interaction between the learning model and students' scientific attitudes in influencing students' science process skills. Students who have a low scientific attitude when taught with the scientific inquiry learning model and conventional learning give the same results on science process skills, namely the value of science process skills is low. This is consistent with research conducted by Dian (2014) which states that there is an interaction between the scientific inquiry learning model and scientific attitudes towards student physics learning outcomes where this learning model is better applied to students who have a high scientific attitude. Hannasari, R., et al. (2017) also stated that there is an interaction between the scientific inquiry model using concept maps with scientific attitudes towards science process skills in students. This is also supported by Anggreani, S.S., Et al (2017), there is an interaction between the scientific inquiry model with Adobe Flash media and conventional learning with scientific attitudes in improving students' science process skills.

4. Conclusion
Based on the research results obtained from the analysis and hypothesis testing, it can be concluded as follows:

1. The science process skills of students who are taught with the scientific inquiry learning model are better than students who are taught using conventional learning.
2. Science process skills in a group of students who have a high scientific attitude are better than the group of students who have a low scientific attitude.
3. There is an interaction between the scientific inquiry learning model and scientific attitudes in improving students' science process skills.

References
[1] Anggraini, D.P & Sani, A. R. 2015. Analisis Model Pembelajaran Scientific Inquiry dan Kemampuan Berpikir Kreatif terhadap Keterampilan Proses Sains Siswa SMA. Jurusan Pendidikan Fisika Program Pasca Sarjana UNIMED. Jurnal Pendidikan Fisika, 4(2), 47-54.
[2] Arikunto, S. 2013. Dasar-dasar EvaluasiPendidikan, ed.2.cet.2. Jakarta: PT BumiAksara.
[3] Hannasari, R., Harahap M. B., Sinulingga K. 2017. Effect of Scientific Inquiry Learning Model Using Scientific Concepts Map and Attitudes to Skills Process Science Students. Journal of Education and Practice. 8 (21), 48-52.

[4] Kartika Y, Wahyuni R, Sinaga B, Rajagukguk J. Improving Math Creative Thinking Ability by using Math Adventure Educational Game as an Interactive Media. InJournal of Physics: Conference Series 2019 Jul (Vol. 1179, No. 1, p. 012078). IOP Publishing.

[5] Hutahean, R., Harahap M. B., Derlina. 2017. The Effect of Scientific Inquiry Learning Model Using Macromedia Flash on Student’s Concept Understanding and Science Process Skills in Senior High School. IOSR Journal of Research & Method in Education. 7 (4), 29-37.

[6] Joyce, B., Marshc Well, and E Calhoun. 2009. Models of Teaching (8 th ed). Boston: Allyn & Bacon.

[7] Meliala E. M., Eva Marlina Ginting, Nurdin Siregar. 2019. Pengaruh Model Pembelajaran Scientific Inquiry Terhadap Pengetahuan Konseptual Dan Keterampilan Proses Sains Siswa SMA. Jurnal Pendidikan Fisika. 8(1).79-84.

[8] Siregar E, Rajagukguk J, Sinulingga K. Improvement of Science Process Skills Using Scientific Inquiry Models With Algodoo Media and Quotient Adversity in High School Students. Journal of Transformative Education and Educational Leadership. 2020 Jun 4;1(2):53-65.

[9] Sahyar, Febriani, H.N. (2017). The Effect of Scientific Inquiry Learning Model Based on Conceptual Change on Physics Cognitive Competence and Science Process Skill (SPS) of Students at Senior High School. Journal of Education and Practice, 8(5), 120-126.

[10] Slameto. (2010). Belajar dan Faktor-faktor yang Mempengaruhi. Penerbit Rineka Cipta: Jakarta.

[11] Sujanam, R. 2002. Optimalisasi Pendekatan STM dengan Strategi Berbasis Masalah dalam Pembelajaran Listrik Statis. Singaraja: Penelitian IKIP.

[12] Trianto. (2009). Mendesain Model Pembelajaran Inovatif-Progresif. Kencana: Jakarta.

[13] Ulfah M, Harahap MB, Rajagukguk J. The Effect of Scientific Inquiry Learning Model for Student’s Science Process Skill and Self Efficacy in The Static Fluid Subject. In3rd Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2018) 2018 Dec. Atlantis Press.