Effect of inquiry learning methods on generic science skills based on creativity level

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Abstract. This study aims to determine the effect of inquiry learning methods on generic science skills that based on the level of creativity of Senior High School students. The study uses a quantitative approach, a quasi-experimental method, and the design of two groups pretest and posttest. The population target is all students of grade ten at Senior High School, while the sample is randomly selected by 2 classes, grade ten-1 as an experimental group (30 students) and grade ten-2 as a control group (30 students). Generic science skills data collected by multiple choice tests, while data collection on students' creativity levels uses essay tests. Both tests were developed by researchers with high levels of validity and reliability, difficulty indexes and different power included in the medium category. The results of data analysis using SPSS shows that students who have a high level of creativity will have a significant effect on the increasing students' generic science skills. Inference from these results, teachers are expected to be able to distinguish students who have high levels of creativity when applying inquiry learning methods.

1. Introduction
Science process skills are obtained through a number of discovery activities that are produced. Therefore, the application of the concept of process science skills is very suitable to be used with the Inquiry method (discovery). The method of inquiry is more emphasized in the process of finding information through investigations so that students can find their own solutions to problems scientifically through teacher guidance. In addition, the discovery method reflects the behavior of scientists in the field of science and is very effective in helping students understand concepts and improve science process skills [1].

This method is designed to bring students directly in the scientific process through the exercises provided by being able to condense the scientific process into a short period of time. In addition, inquiry learning methods also focus more on efforts to find something so that students play a role as learning subjects not as objects. In this case students will be more instrumental in finding themselves about the subject matter of the lesson being studied [2]. Based on the description above, it is clear that inquiry-based learning is ideal to be carried out in physics learning activities, to train students' independent thinking in finding answers to the problems they face. Many studies that have been carried out provide an overview of the success of this learning method, such as the results of research conducted by Wirtha...
which states that the Inquiry learning method applied in the teaching and learning process has had a significant influence on student physics learning outcomes [1]. The method of developing generic science skills (SGS) has been carried out in various ways, including through: science teacher field practice [5], pursuing the compulsory general studies courses [6], integrated projects [7], teacher teaching approaches [8], research-based university education [9], utilization of modern technology [10], through classroom activities [11], and the Teaching and Learning Environment [12].

The problem that arises at this time is the physics learning outcomes is still low in high school students especially in Pidie district, one of reason of this problem is the low quality of physics teacher. This can be seen from the results of the teacher competency test in 2015 where the requirement for graduating nationally was only 5.5 but more than 80% of 154 physics teachers in Pidie District did not graduate, only 2 people had good score [3]. The impact of this condition continues on students, where the 2016 National Examination results for physics lessons in Pidie district on average are only 36.75 with category D (bad) [4]. Likewise, the same condition also happens in State High School 2 Sigli Pidie district.

Based on primary research in State High School 2 Sigli Pidie district have shown that the outcomes of student physics learning at this school are low. This can be seen from the daily results obtained by students, generally under the minimum completeness criteria. Furthermore, the enthusiasm and motivation to learn physics is also low. The main reason is that the generic ability of students' knowledge in this school is lacking, which has implications for the motivation to learn physics. This can be seen from report card and the results of this school entrance examination specifically physics is very low. This situation was also reinforced from the initial interview that the author did with a teacher in the field of physics studies at this school, in February 2016 it was known that generally students in this educational institution had low basic abilities. This can be seen from the low daily test scores obtained by students in physics, especially in grade ten students who score an average of 5.25. Furthermore, the results of preliminary observations show that students less participated in learning activities, especially in asking question or answer the question from the teacher.

Another problem that arises when solving a problem, students often mistakenly distinguish symbols such as the focal point between f and F for force symbol, the distance between objects with shadow distance and others. Furthermore, if the teacher presents a phenomenon to students such as the teacher asks students to observe the direct sunlight coming in through the window and asks how the process occurs, all students are silent because no students dare to answer. This shows the level of student's generic science skills is very low. If the red thread is drawn, this less exciting learning condition is also caused by the learning process designed by the teacher is less attractive. Physics teachers at this school still apply more conventional learning methods such as lectures, discussions, discussing questions. Even if practicum is implemented, it is only limited to certain lessons that are easy to implement. Practicum carried out by the teacher has no attempt to design innovative and creative tools or steps to attract and make it easier for students to understand the physics concepts that they want to learn. The low creativity of teachers in compiling teaching aids and learning steps is believed to contribute to student learning outcomes. Especially for lesson in the category of high difficulty levels.

One lesson that is considered difficult in grade ten is optical devices. This lesson is actually more emphasis on the use of optical instruments, so students can properly utilize optical instruments. But in the implementation of learning in class, this lesson is often the teacher conveying through references or reading books available to students, then the teacher tries to explain it through lecture and discussion methods. Literature or books that students use as references are only textbooks available in the library. Students rarely see in detail the parts of optics.

This condition also has an impact on learning outcomes obtained by low students. This can be seen from the results of the test data given by the teacher, generally students have not reached the minimum completeness criteria, so most students must attend or are required for remedial. Therefore, it is deemed necessary to apply a creative learning method to improve students' science skills, so that it affects the mastery of subject matter and the results to be achieved by students. One learning method that is suitable to be applied in studying optical instruments according to the analysis of the author is the Inquiry
learning method. It is seen that the Inquiry-based learning method is able to increase the attractiveness of students to learn, so that generic skills towards physics will also be good. Thus, the atmosphere and quality of learning physics will be more meaningful for students. For this reason, the inquiry learning will suitable to improve the physics learning quality especially for improving students’ generic science skills.

2. Research methods

2.1. Research approach
This research is a qualitative study using the quasi-experimental method with the design of the 2 x 2 Anova analysis, that is, with the study design treating the experimental group and comparing it with the control group. The effect of treatment can be seen from the results of the pre-test and post-test of both groups, both the experimental group and the control group. This study was conducted for three meetings, focusing on the learning process using the Inquiry method and conventional methods in the experimental class and the control class. The research was carried out in three stages, namely: (1) giving pretest before learning began both for classes to be taught with the inquiry method and the control class as well as creativity tests, (2) learning implementation for the experiment class applied inquiry methods and control classes using conventional methods (lectures, discussions and question and answer), (3) last did post good test for class experiment and control.

2.2. Research sample
The number of samples in this study were 30 people, students of grade ten-2 as the experiment class and 30 students of grade ten-3 as the control class. The selection of this sample is done by sampling. The data in this study were collected based on two test instruments, namely, tests of generic science skills and creativity tests in the two classes. Creativity tests are conducted to determine the level of creativity of students in the experimental class and the control class.

2.3. Data analysis
While the data analysis of the results of the pre-test and post-test both in the class given treatment using the inquiry method and conventional method is to measure the influence provided by the application of learning methods to improving students’ generic science skills.

3. Result and discussion

3.1. Generic science skills
This study wanted to know the effect of the application of the inquiry method based on the level of student creativity towards generic science skills. Based on the test results of generic science skills of students both pretest and posttest in either the experimental class or the control class, the descriptive statistics were obtained for each group as follows:

| Class               | Pretests and postes | Average | Standard deviation |
|---------------------|---------------------|---------|--------------------|
| Pre-test of control class | 27.33               | 7.16    |                    |
| Post-test of control class | 70.67               | 11.04   |                    |
| Pre-test of experiment class | 28.67               | 8.19    |                    |
| Post-test of experiment class | 75.83               | 14.21   |                    |

Based on Table 1, the results of analysis of generic science skills in both experimental and control class students, then the average pretest scores of the control class were 27.33 and 28.67 for the experimental class. Then the two classes were treated according to the planning, so that the student's
posttest average output was 70.67 for the control class and 75.83 for the experimental class. Furthermore, the standard deviation for the pretest values of the control class students is 7.16 and 8.19 for the experimental class.

Based on the results of generic science skills in the two groups can be displayed in the diagram comparison results post-test generic science skills using inquiry learning model and learning conventional can be seen in the figure 1.

![Comparison Post-test score of Inquiry and Conventional learning on generic science skills.](image)

**Figure 1.** Comparison Post-test score of Inquiry and Conventional learning on generic science skills.

### 3.2. Students creativity

The creativity value of each sample group will be categorized into high creativity and low creativity which is seen based on the average value of creativity. Based on the results of tests of creativity, the result as shown in Table 2.

Based on Table 2 it can be seen that the average value of creativity for the experimental class is 71.00 while for the control class is 67.73. The standard deviation for the experimental class is 13.61 and the control class is 13.98. In accordance with this value, the next step is to classify students in the experimental class and the control class. The grouping results obtained the number of students for high creativity categories as many as 16 people for the experimental class and 15 people for the control class while the low creativity group amounted to 14 people for the experimental class and 15 people for the control class.

The results of testing the creativity were conducted by students in both groups can also be seen based on indicators of creativity. Each question in the creativity instrument contains the creativity indicators. The results of students' answer on creativity can be seen in the table 2.

| No. | Experimental class creativity value | Control class creativity value |
|-----|-----------------------------------|---------------------------------|
| Experimental class creativity value | Control class creativity value |
| No. | Value of creativity | Frequency | Criteria | No. | Value of creativity | Frequency | Criteria |
| 1   | 92                  | 1        |         | 1   | 85                  | 2        |         |
| 2   | 90                  | 2        |         | 2   | 84                  | 3        |         |
| 3   | 88                  | 1        |         | 3   | 83                  | 1        |         |
| 4   | 87                  | 1        | High    | 4   | 81                  | 1        |         |
| 5   | 86                  | 1        | creativity | 5   | 80                  | 2        | N = 16 |
| 6   | 85                  | 2        | N = 16  | 6   | 79                  | 1        |         |
| 7   | 80                  | 1        |         | 7   | 78                  | 1        |         |
| 8   | 79                  | 1        |         | 8   | 76                  | 2        |         |
| 9   | 78                  | 1        |         | 9   | 72                  | 1        |         |
Table 3. Percentage of student creativity in the experiment class and the control class for each indicator.

| Indicators of creative | Experiment class (%) | Control class (%) |
|------------------------|----------------------|------------------|
| Think fluency          | 75.70                | 76.70            |
| Think gracefully       | 76.80                | 73.30            |
| Original thinking      | 75.00                | 73.30            |
| Elaboration skills     | 75.00                | 63.30            |
| Evaluation skills      | 86.70                | 84.40            |
| Curiosity              | 64.20                | 62.50            |
| Imaginative            | 69.40                | 65.00            |
| Feel challenged        | 70.00                | 66.70            |
| Take a risk            | 70.00                | 65.00            |
| Respect                | 60.70                | 58.00            |

3.3. Effect of level of creativity on generic science skills

Diagram comparison of the average value post-test generic science skills in the group with a high and low level of creativity can be seen in figure 2.

Figure 2. Results of students’ creativity in the experimental and control class.
Creativity is basically the ability of a person to create something new, both in the form of ideas and real work, both in the form of aptitude and non-aptitude characteristics. Creativity includes, both aptitude traits such as fluency, flexibility, and authenticity in thought, as well as non-aptitude traits such as curiosity, pleasure in asking questions, and always wanting to find new experiences. Students who have high creativity tend to be more active than their friends who have low creativity. This is because he has a curiosity about learning and feel happy to explore the concept of learning through asking questions and experimenting. This shows that the generic science skills of students who have high creativity tend to be better than students with low creativity.

The results of student creativity testing can be seen based on the creativity indicator category. Based on it can be seen that the percentage level of creativity is almost every higher indicator owned by the experimental class except in fluent thinking skills. The dominant indicator that appears is the skill rate of 86.67% in the experimental class and 84.44% in the control class, while the least is the value of respect that is 60.67% in the experimental class and 58.00% in the control class. It can be concluded that students in the two dominant sample groups have the skills to assess rather than the other indicators and the least possessed by students is respect.

Based on the results of this study, it was shown that testing the second hypothesis proved that the level of creativity can significantly influence generic science skills where the value of significant is 0.000, so the Sig value is obtained. \( \alpha = 0.005 \). Therefore, the results of the study reveal that the generic science skills of students who have high creativity are better than generic science skills with low levels of creativity.

The results of generic science skills of students at high levels of creativity indicate that students who have a high level of creativity tend to be fast and responsive in solving problems encountered in the experiment. This is in accordance with the constructivism learning theory which states that a child has an innate curiosity and continues to try to understand the world around him. This curiosity can foster creativity in students, so students tend to be responsive in solving problems that have an impact on the results that they get in the learning process [13]. Creativity is the ability to give new ideas and apply them in problem solving [14]. Creativity includes, both aptitude characteristics such as curiosity, love to ask questions, and always want to find new experiences. Creativity can influence the quality of learning outcomes from an individual. The level of creativity is the highest level of the realm of knowledge that mastered by humans.

Based on some the results of research, there is a close relationship between creativity and learning achievement, so there is a close and meaningful relationship between attitudes and learning achievement showing that both variables need attention from class teachers, students in the student field and in fostering, developing creativity so that it can develop and contribute to optimal learning achievement [15-17,25].

The Data showed that there were differences in student achievement with high levels of creativity and low creativity. This is indicated by the average value obtained by students in the experimental class for high creativity is 85.00 while for low creativity is 74.00. In the control class for high creativity is 76.00 while for low creativity is 71.00. Students with higher creativity are more empathetic towards the study group, on time in carrying out experiments and diligent in doing assignments [10,18-20].

Based on the results of testing hypotheses regarding the interaction of learning models with creativity, in accordance with Vygotsky’s learning theory which states that interaction can spur new ideas and improve intellectual development of students. Vygotsky’s statement is related to the interaction between the inquiry learning model and creativity, in this case the inquiry learning model with a level of mutual respect [15,21,22]. This is reasonable because the inquiry learning model trains students to use all the abilities that they have in an effort to achieve learning goals. In addition, the implementation of the inquiry learning model also trains students to get used to working logically and systematically.

The results of the study also show that there is an interaction between inquiry learning methods and creativity towards student learning achievement. In this study it was stated that the inquiry method invites students to experiment with teacher guidance, while creativity plays a role in obtaining solutions
to a problem faced by students. Thus, students who have high creativity do not experience difficulties in conducting experiments, students will more easily understand the lesson [10,23,24].

4. Conclusion
Based on the results that have been obtained in this study so it can conclude that students who have a high level of creativity will have a significant effect in increasing generic science skills and the implementation of inquiry learning can effectively increase students’ creativity in learning physics.

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