Guided inquiry learning model to improve the conceptual understanding and scientific work skills of high school students in Central Java

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Abstract: This research aims to know the effectiveness of increase the conceptual understanding and scientific work skill of senior high school students content of conservation character values. The method used in this research is experimental method with Pretes-Posttest one Group Design. The research subjects are three schools comes from SMA X, SMA Y, and SMA Z in Central Java. Sampling was determined using purposive sampling technique. Data analysis techniques used one-tail t test, one sample t-test and gain normality test. Data collection techniques were used the tests and observations. The result of gain factor test of the concept of temperature and expansion has been obtained three High School is 0.56 (enough), 0.72 (high), and 0.63 (enough). The guided inquiry learning by applying the values of conservation characters to effective improve understanding of the concept of high school students in Central Java. Scientific work skills of high school students have been developed with the result shown the test of the gain factors are 0.50, 0.62, and 0.44 the three results are in sufficient category. Inquiry guided learning by applying the values of conservation characters is to effective develop their scientific work skills.

1. Introduction
At the high school level of some public schools in Central Java, the results of the study inform that many students actually like physics, but lack the mastery [1]. Students assume that physics is a difficult subject to learn because of the number of formulas and is mathematical. Students tend to memorize formulas and unfortunately they lack to understand the concept. In addition, not on any material but only certain material students do experiments. When conducting an experiment the students are given the freedom to form groups, the groups they make are members of students who are accustomed to gathering together. But not all group members participate actively [2].

Learning that facilitates the provision of hands-on experience can produce knowledge that is easy to remember and last long. One of the efforts is to use guided inquiry model in the form of experimental activities by applying multiple intelligences theory combined with conservation character values. Guided inquiry is used to challenge students' understanding of concepts and skills, to develop creativity, to discover a deeper and broader understanding of the subject, and to gain some skills from experimenting [3][4]. With the experimental activities are expected students can be motivated to learn physics and no longer assume that physics is difficult, so the science obtained students will be more durable. Multiple intelligences theory combined with conservation character values is used to arrange students in one group.

The view that one's intelligence can be seen based on intelligence quotient (IQ) test results is no longer relevant because the IQ test only limits the logic and language intelligence [5]. Allegedly low understanding of student concepts about physics one of them influenced by the character of students.
According to the results states that all this time people thought that character education is only related to the effort to foster human personality. Everyday reality, character education is not only related to the development of human personality, but also has a significant influence on one's academics [1]. Based on literature tracking, research has discussed the effectiveness of improving the understanding of scientific work concept and skill of high school students in Central Java.

2. Methods
The method used in this research is experimental method with Pretest-Posttest one Group Design. The independent variable in this research is the application of guided inquiry model by applying conservation character values. The dependent variable of this research is understanding the concepts and skills of scientific work through the application of guided inquiry model which has the value of conservation character. The population in this study is all SMA in Central Java; while the sample is determined three schools comes from SMA X, SMA Y, and SMA Z. Sampling was determined using purposive sampling technique.

Data collection techniques were used the tests and observations. The test is used to collect students' concept comprehension data. Observational methods are used to observe scientific work skills that content of multiple intelligences with conservation character values. Data analysis techniques on mastery of students' concepts were used which contained conservation character values used one-sample t-test, one sample t-test and gain normality test. Score data of students' scientific work skills are processed by descriptive analysis percentage and gain factors test.

3. Results and Discussion
3.1 Concepts Understanding
The application of learning "guided inquiry" by applying the values of conservation characters has a positive impact on the learning process. Implementation of conservation character values can evoke and then students share their understanding, help group members, and discuss to find the best answers. By conducting guided inquiry experimental activities, learning activities are not centered on teachers, but students are proportionally active in self-learning. This is because the students are able to understand the material that the students are practicing directly.

Once given the temperature and expansion of learning materials, the inquiry learning student outcomes experimental class and control class is measured using a test instrument description. From the result of post test data analysis got the average score of experiment class 73 and control class 68; obtained also 82% classical completeness for the experimental class and 60% for the control class. The results of data analysis are presented in Table 1.

Table 1. Students' Understanding on Temperature and Expansion Concepts

| Statistics Test | Treatment SMA X | Treatment SMA Y | Treatment SMA Z |
|-----------------|-----------------|-----------------|-----------------|
| Pre Test        | 39              | 36              | 35              |
| Post Test       | 73              | 82              | 76              |
| <g>             | 0.56            | 0.72            | 0.63            |

The combination of multiple intelligences with conservation character values that influence the improvement of conceptual understanding is logical-mathematical intelligence. Students with logical-mathematical intelligence are happy to carry out experiments to deepen the material. The fun of carrying out experiments leads the students to an understanding of the purpose of their activities, so that they can analyze the experimental data logically and correctly [6][7].

Guided inquiry is used to investigate the process of understanding concepts and skills, to develop creativity, to find a deeper and broader understanding, and to gain experiential experience[4]. It differs slightly from Wenning's[8] statement in the inquiry process that students can investigate, collect evidence from various sources, develop explanations, and communicate and argue conclusions.
From result of t-test analysis one right side obtained that $t_{\text{count}} = 2.60$ and $t_{\text{table}} = 1.66$, which means $t_{\text{count}} > t_{\text{table}}$. The decision of the test result is $H_0$ is rejected so that it can be concluded that the improvement of students' understanding of the experimental group is higher than the students' understanding of the concept of the control group.

Based on the gain factor test, the improvement of students' concept understanding in the treatment SMA Y ($<g> = 0.72$) was higher than the SMA Z ($<g> = 0.63$) and SMA X ($<g> = 0.56$). The results of the analysis can be concluded that inquiry learning is guided by applying the values of effective conservation character to improve understanding of high school students' concept. These are supported researches\cite{9,10} that guided inquiry model can be used as an alternative learning model that can build students' scientific attitude and student learning outcomes.

3.2 Scientific Work Skills

Assessment on scientific work skills have been done by observers using the observation sheet when students carry out experimental activities. The results of the scientific work skill analysis for the experimental group achieved an average score of 76% (good) and the control group 73% (good). This research was conducted two experimental activities in both experimental and control groups.

The eight indicators of students' scientific work skills observed are formulate the problem, prepare the hypothesis, designing an experiment, experiment, collecting data, analyzing data, make a conclusion, and communicate results. The results of data analysis are presented in Table 2 and Table 3.

**Table 2.** The Scores of scientific work skills have been achieved by students come from SMA X, SMA Y, dan SMA Z

| Indicators                  | Treatment SMA X | Treatment SMA Y | Treatment SMA Z |
|-----------------------------|-----------------|-----------------|-----------------|
|                             | initial score (%) | final score (%) | initial score (%) | final score (%) | initial score (%) | final score (%) |
| Formulate the problem       | 48              | 75              | 45              | 82              | 52              | 78              |
| Prepare the hypothesis      | 72              | 89              | 71              | 90              | 75              | 88              |
| Designing an experiment     | 78              | 83              | 65              | 88              | 72              | 85              |
| Experiment                  | 73              | 80              | 73              | 80              | 68              | 80              |
| Collecting data             | 72              | 92              | 70              | 90              | 70              | 90              |
| Analyzing data              | 74              | 89              | 66              | 95              | 74              | 84              |
| Make conclusion             | 72              | 88              | 72              | 84              | 70              | 83              |
| Communicate results         | 74              | 84              | 68              | 84              | 65              | 81              |
| Average                     | 70              | 85              | 66              | 87              | 68              | 82              |

**Table 3.** Recapitulation on Scientific Work Skills by Students of three Schools Experiment

| Recapitulation | Treatment SMA X | Treatment SMA Y | Treatment SMA Z |
|----------------|-----------------|-----------------|-----------------|
| Initial score (%) | 70              | 66              | 68              |
| Final score (%)    | 85              | 86              | 82              |
| Average (%)        | 78              | 76              | 75              |
| $<g>$             | 0.50            | 0.62            | 0.44            |

The combination of multiple intelligences with conservation character values that affect students' scientific work skills is "kinesthetic intelligence" and tough. Students who have "kinesthetic intelligence" and tough can participate during the experiment. Their liveliness in conducting
experiments shows that students do all activities according to work procedures. Student activities as a data source featuring indicators of scientific work skills can be observed[11][12].

Scientific work skills of each indicator achieved by students are presented in Table 2. From the data presented can be understood that the ability to formulate the problem has not been maximized. Students tend to be passive to pose problems from physical phenomena in everyday life. Only a few students dare to pose a problem, though not all that is put forward is true. Improved scientific work skills in the higher experimental group I, group II, and group III are \[ \langle g \rangle = 0.50, \langle g \rangle = 0.62, \text{and} \langle g \rangle = 0.44 \]
are presented in Table 3.

Based on the above description, it is concluded that learning "guided inquiry" by applying the values of effective conservation characters to improve the scientific work skills of high school students. This is supported[11][13] that the inquiry laboratory development model can develop scientific work skills positively through open-inquiry experiments on wave courses with achievement of average score 78 (scale 100).

In the analysis of mixed aspects of multiple intelligences with conservation character values, the experimental group obtained an average of 82% (very good) and in the control group obtained an average of 79% (good). The experimental group achieved "linguistic intelligence" and high courtesy, while the control group on "kinesthetic intelligence" and tough. In the treatment group the students are more actively talking about experiments with clear and understandable language, and more reflective of the subtlety of behavior. Linguistic intelligence is related to the language spoken by a person. Linguistic intelligence is called verbal intelligence, is a person's ability to speak correctly[14].

In the experimental class the students tend to actively experiment without despair and appreciate the fellow group members. The above is supported[13] that bodily-kinesthetic intelligence relates to people who process information through the sensation felt in their bodies. They do not like quiet and want to move on to do something. The activeness of learning in guided inquiry is supported[1][15] that open open inquiry is effective to develop critical and creative thinking ability, and have a commendable character. This lesson provides an opportunity for prospective teachers to freedom of thought, communication, and sharing of experience and knowledge.

4. Conclusion
The result of gain factor test of the concept of temperature and expansion has been obtained three High School is 0.56 (enough), 0.72 (high), and 0.63 (enough). Based on the discussion has been taken the conclusion is guided inquiry learning by applying the values of conservation characters to effective improve understanding of the concept of high school students in Central Java. Scientific work skills of high school students have been developed with the result shown the test of the gain factor is 0.50, 0.62, and 0.44 the three results are in sufficient category. It can be concluded that the inquiry guided learning by applying the values of conservation characters to effective develop their scientific work skills.

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