The analysis of scientific communications and students' character development through guided inquiry learning

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The analysis of scientific communications and students' character development through guided inquiry learning

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Abstract. This research is setting by the condition of students who have difficulty in ideas delivery, written scientific communication, and still need the development of student character. The objectives of the research are to determine the improvement of concept understanding, to analyze scientific communication skills and to develop the character of the students through guided inquiry learning. The design in this research is quasi experimental control group pre-posttest, with research subject of two group of grade X Senior High School in Semarang. One group of controller uses non tutorial and treatment group using tutorial in guided inquiry. Based on result of gain test analysis, obtained $\langle g \rangle = 0.71$ for treatment and control group $\langle g \rangle = 0.60$. The t-test result of mean mastery of concept of quantity and unit using t-test of right side is t count = 2.37 (p=0.003) while t table = 1.67 ($\alpha = 5\%$), which means that the results of the study differed significantly. The results of the students' scientific communication skills analysis showed that the experimental group was higher than the control, with an average of 69% and 63% scientific communication skills. The character values are effective developed through guided inquiry learning. The conclusion of the study is guided inquiry learning tutorial better than guided inquiry non tutorial learning in aspect understanding concept, scientific communication skills; but the character development result is almost the same.

1. Introduction

Physics is a product and a process. During the process of physics learning, students should be physically and mentally involved in problem solving. In the learning of physics required interaction with real object and learning environment, so that obtained experience meaningful for student self. It is able to encourage the cognitive development and operational thinking skills of students. The purpose of physics high school learning is that students have the ability to master the concept and principles of physics and scientific communication skills. Understanding the concept of physics means students are not just know and memorized about the concepts of physics but make students able to understand the concepts and able to connect a concept with another concept [1].

Based on the observation of Senior High School (SHS) in Semarang, especially grade X, many students cannot distinguish the function of long measuring instrument between sliding and micrometer screw. This fact indicates that the students' understanding of the long measuring instrument is low. In addition, based on the results of interviews on physics teachers and classroom observation, it is known that students are still less active and enthusiastic about learning activities and students' abilities are still not in accordance with regulated standards. Many students experience difficulties in conveying ideas when given problems both orally and in writing. It can be stated that students' scientific communication skills are still low.

One way to improve conceptual understanding, development of scientific communication skills and student character, using appropriate learning models. Selection of learning models and appropriate methods and media in accordance with the material taught will produce optimal learning process. Based on these problems it is necessary to apply the learning model that can enable students and improve students' conceptual understanding. One of the learning models that can be applied is guided inquiry learning which is one of the suggested model types in Curriculum 2013.

Guided inquiry instructional model is a learning model with students working to find answers to problems assigned by teachers, and students trying to solve problems under the teacher's intensive guidance. The teacher's job is to 'raise' the students to do something. Teachers come with problems to solve by students, then they are led to find the best way to solve the problem [2]. Furthermore, it has asserted that guided inquiry effectively facilitates to develop critical thinking and logical thinking skills [3].

The stages of guided inquiry learning involve formulating problems, developing hypotheses, designing experiments, conducting experiments, collecting data, analyzing data, drawing conclusions, and communicating results. Guided inquiry learning is effectively applied in learning activities so that students are able to communicate their thoughts both orally and in writing. This research was carried out on Physics study of matter and measurement. The purpose of this research is to explain guided inquiry learning with effective tutorial to improve concept comprehension, scientific communication skill development, and character development of high school students.

2. Methods
The research was conducted at Senior High School in Semarang Central Java. The study population is all students of grade X Senior High School in Semarang 2016. The sample used in this study consisted of two groups namely grade X MIA A as control group and X MIA B as experimental group. Quasi Experimental Design Pretest-Posttest Control Group type has been used in research. In the experimental group applied guided inquiry instruction with tutorial, while in the control class was applied learning guided inquiry non tutorial. The dependent variables in this study include conceptual understanding, scientific communication skills, and students' character development; while the independent variable is the application of guided inquiry learning.

The concept mastery scores were obtained by the test explanatory instrument, obtained from the pretest and posttest designs. Score of scientific communication skills and character development is obtained by observation sheet instrument. Data processing of pretest and posttest score using two-way difference test is right-sided t test and test of N-gain or gain factor <g> test [4]. Right-sided t test is used to test the hypothesis of truth while the N-gain test is used to find out the greatest improvement in mastery of the concept of students before and after treatment. Skills of scientific communication and character of students are analyzed by descriptive percentage.

3. Result and Discussion
Concepts Understanding
Hypothesis testing on differences in mastery of students' concepts between experimental and control groups using right-side t test. The results of the analysis can be seen in Table 1. The contents of Table 1 gives information that at the 5% level, for the posttest value obtained t count of 2.37 (p=0.003); While t table price equal to 1.67. The result of calculation in table 1 shows the price of t count > t table

then H_0 is rejected so that it can be concluded understanding of the concept of experimental group students using guided inquiry tutorial better than guided inquiry non tutorial learning.

Table 1. Results of right-side t test of students' score

Data	Control	Experimental	Criteria
Average (%)	75	81	Accept H zero if t
t count	2,37	2,37	count < t
t table	1,67	1,67	table

Improved mastery of student concepts for experimental and control groups was analyzed using an N-gain test. The greater the value of N-gain, the greater the student achievement. The resulting N-gain test results for the experimental and control groups are shown in Table 2.

Table 2. N-gain test results for improved mastery of measurement and quantity concepts

Data	Control	Experimental
Pretest	37	34
Posttest	75	81
<g>	0,60	0,71
Criteria	fair	high

Based on the N-gain test, obtained <g> value for the experimental group is 0.71 (high), while the control group is 0.60 (medium). The results of this study are in line which states that the application of guided inquiry learning model can improve students' concept comprehension maximally [5]. The results obtained by the control group were <g> = 0.66 (moderate) and the experimental group was <g> = 0.70 (height). Ulya et al. concluded that the experimental group experienced a higher understanding of the concept than the control group [5]. Andriani also stated that the application of guided inquiry learning can increase students' enthusiasm in the implementation of learning activities and students become the focus in the implementation of learning [6]. Maria states that inquiry-based learning although required to think deeply by solving the problems given by teachers, inquiry-based learning can actually improve the test results [7].

According to Brunner, as quoted by Sarwi states that trying to solve the problem and the knowledge that accompanies it produces knowledge that is really meaningful. In addition, in the guided inquiry learning tutorial students work together in groups to find ways to solve problems through discussion. Sarwi also stated that the discussion is the ability to develop cognitive growth, so through guided inquiry learning with the tutorial students are able to develop their cognitive abilities [8].

From the result of the research, the students who are in the experimental class treated with guided inquiry tutorial have a higher concept comprehension than the control class treated with guided inquiry non tutorial. This result is because teachers and students play an important role in the process of asking, answering and constructing knowledge, where teachers direct how students gain knowledge and students seek to explore knowledge with teacher guidance. This is what makes the students become enthusiastic to learn so that the concept of student understanding increases.

Scientific Communication Skills
The results of the scientific communication skills assessment of experimental class and control class students are presented in Table 3. Based on the results of the analysis of the observation sheet scores in Table 3, the average scientific communication skill of the experimental class has good criteria and the control class has enough criteria. Table 3 shows that students' scientific communication skills in the experimental class using guided inquiry tutorial and control class using guided inquiry non tutorial

indicate that both classes have advantages and weaknesses in the mastery of every aspect of scientific communication.

Table 3. Scientific Communication Skills of Experiment Group and Control Group

Aspect	Treatment		Average (%)	Control		Average (%)
	stage 1 (%)	stage 2 (%)		stage 1 (%)	stage 2 (%)	
Experiment Title	51	96	74	50	94	72
Objective	68	72	70	79	96	88
Basic theory	58	69	52	61	64	63
Tools & material	56	60	58	63	59	61
Way of working	69	76	68	51	60	56
Observation	81	83	82	81	84	83
Data analysis	71	68	70	63	58	58
Conclusion	57	69	58	47	50	49
Chart	58	74	64	44	64	54
Attachment	77	97	88	71	77	44
Average	68	74	71	60	69	65
Criteria	good	good	good	fair	good	fair

Based on the result, the students' scientific communication skill in the experimental class applying guided inquiry learning with the tutorial has good criteria, because in the guided inquiry learning activity with the student tutorial more intensively under the guidance of the teacher to make the practice report so that the result is more focused While in the control class that apply non tutorial guided inquiry learning has enough criteria. The Sarwi's findings states that guided inquiry instruction is effective for developing the scientific communication skills of physics teacher prospective students [9]. University students as prospective teacher in junior and freshman level performed higher preference in visual (V) and aural (A) than others, depicted higher confident in read or write (R/W) for senior student, and in sophomore level performed less confident in both visual and aural [10].

However, the control group that is not guided intensively by the teacher but through the discussion activities in making the report of practicum also has high creativity, because students determine the steps to solve problems according to their own ideas and ideas. This is consistent with the findings which states that the steps in guided inquiry learning stimulate students to be actively involved in learning and by using guided inquiry learning, students become more active, enabling students to communicate with each other. In communication can be done through writing, pictures (graphs, charts), reading and speaking (discussion, presentation) [11].

Guided Inquiry Learning
The result of observation of activity score of guided inquiry of student in experiment and control groups is presented in Table 4. From Table 4, it can be seen that the guided inquiry activities of the experimental class and control classes conducted during the two meetings of each aspect experienced an increase and decrease.

All students in both experimental and control class have a guided inquiry activity value with good criteria because most students master the assessed aspect and the teacher guides the students intensively during the learning process. However, the mean value of each aspect of the guided inquiry activity of the experimental group students has an average grade that is superior to that of the control class students. However, both the experimental and control classes also have the advantages and disadvantages of each aspect of the guided inquiry activity assessed. A number of research findings such as assert that students at the beginning of guided inquiry learning because of the many activities they have to do themselves, the skills of students grow and are able to build knowledge own [12-15].

Table 4. Student Activity Score on Guided Inquiry Learning

Aspetcs	Treatment group		Average (%)	Control group		Averag e (%)
	stage 1 (%)	stage 2 (%)		stage 1 (%)	stage 2 (%)	
Formulate the problem	32	63	48	63	75	69
Make a hypothesis	61	80	73	76	76	76
Designing an experiment	50	68	57	59	59	59
Experiment	55	75	67	60	84	72
Collecting data	81	80	80	60	60	60
Analyze data	68	68	68	65	57	61
Make a conclusion	83	81	81	51	63	57
Communicate results	62	61	62	51	63	57
Average	66	72	67	60	67	64
Criteria	fair	good	good	fair	good	good

When the process of guided inquiry takes place, students observe the application of material in everyday life so that it can grow cooperation in solving a problem in the group so as to form a better student character. This results in line with research of the students' character grows because students apply and experience the corresponding problems of matter discussed with reference to the real world [16-18]. The development of students' characters for each character value by observation between the experimental class and the control class is presented in Table 5.

Table 5. Recapitulation of character development of students by observation

Character Values	Experimental Group			Control group		
	stage 1 (%)	stage 2(%)	<g>	stage 1 (%)	stage 2 (%)	<g>
discipline	75	86	0,34	74	83	0,31
comfortable	77	84	0,32	76	83	0,28
curiosity	74	79	0,21	73	77	0,19
responsible	74	84	0,32	72	80	0,30
hard work	71	77	0,19	71	75	0,16
team work	74	80	0,24	73	77	0,22

It can be concluded that students in the experimental class using guided inquiry learning with tutorials can achieve a high level of conceptual understanding, higher scientific communication and stronger character development. Similarly, students in the control class who use non tutorial guided inquiry learning despite having the criteria of understanding the concept that was also found to have good scientific basic skills. Instruction based inquiry with real experiment, invented learning experience of student will last longer and made a conscious process of remembering [19]. The results are in line with Bilgin [20] findings that illustrate guided inquiry as a student-centered approach that has a positive effect on students' academic success and develop scientific process skills as well as students' scientific attitudes.

4. Conclusion

Based on the results of research and discussion, it can be concluded that guided inquiry learning is effective to improve concept understanding, develop scientific communication skills, and character development of high school students. Suggestions that can be given in the research that is important teachers to condition the students to be ready to carry out the guided inquiry learning activities by giving the guidance of the implementation of the activities in a clear and detailed. This is proven because this learning can improve understanding of concepts and develop scientific communication skills as well as student character values.

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GENERAL COMMENTS

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