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Students' Understanding of Physics in Science Process Skills using Inquiry-Link Maps: A Preliminary Study

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Students' Understanding of Physics in Science Process Skills using Inquiry-Link Maps: A Preliminary Study

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Abstract. The inquiry-link maps in learning physics can help students to improve their science process skills. Science process skills can be identified through students' understanding of physics. This study aims to describe the profile of students' understanding of physics and its relationship with science process skills through inquiry-link maps. The profile of students 'understanding of physics is known based on the results of the students' initial test scores on physics material which is also accompanied by filling out a questionnaire response. The results on students' initial understanding of physics are shown in quantitative and qualitative data. Based on the results of the study, students have adequate specific knowledge of physics ability, especially on several material. Physics materials that are considered difficult is thermodynamics because the teacher does not give examples, and the student is never doing laboratory activities. The results show that students have difficulty in applying scientific methods which is one of the indicators in science process skills.

1. Introduction

Improving the quality of human resources can be initiated through the process of education that includes both cognitive abilities and psychomotor skills. Cognitive and psychomotor aspects are included in the component of scientific skills that are directed to find concepts, develop concepts that have been there before, or make a detail of these concepts called scientific process skills [1]. Science process skills show that students can discover and develop their facts and concepts, foster, and develop scientific attitudes. Students who have excellent process skills can more easily understand concepts and be sensitive to problems that occur [2, 3]. Good mastery of concepts enables students to understand and solve problems and be able to apply concepts in different situations. Therefore, mastery of concepts can be used as an indicator of the measurement of science process skills for students.

Cognitive abilities consist of the process of selection, organization, integration, and retaining that need to be developed to gain maximum mastery of concepts. The method of maximizing the mastery of concepts, especially in physics, is expected to support the realization of meaningful learning. Meaningful learning is the process of linking new information to relevant concepts contained in cognitive structures [4]. Meaningful learning processes can make students not only memorize concepts or facts but also try to connect these concepts to produce a complete understanding.

Link map is a form of assignment that can identify the suitability of relationships between physical concepts. Link Maps emphasizes the relationships and interrelationships between the main ideas in Physics, provides a stimulus to student memory and helps build student knowledge schemes [5]. Through the link maps, will be identified as the structure of knowledge so that it can be known the

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existence of a misconception in students. The effectiveness of implementing link maps in physics learning has been proven through Futihat research [6], namely by applying link maps through inquiry learning in class. The results of the study stated that the inquiry-link maps learning combination could be used to identify students' conceptual changes. Conceptual change is the process of students organizing and structuring students' knowledge systematically according to the correct concepts. Knowledge management in the form of link maps makes cognitive burden can be processed simply by linking between problem-theory concepts so that the material becomes meaningful, easier to understand, and easier to remember.

The Inquiry-Link Maps Learning Model forms have five characteristics for students. The characteristics that are developed include: interpersonal, understanding, inquiry, link maps, and construct. The relationship between the five characteristics formed is shown in Figure 1.

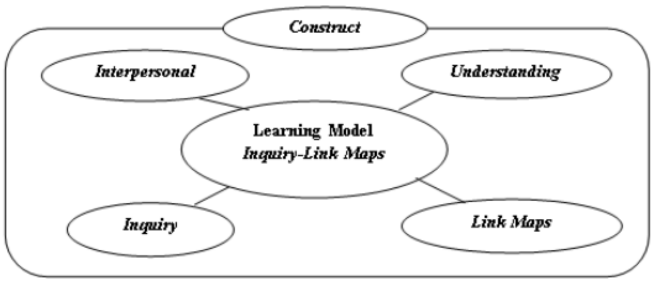

Figure1. The Characterictis of Learning Model Inquiry-Link Maps

The first characteristic of the Inquiry Link-Maps Learning model is interpersonal. Interpersonal orientation to foster relationships (relationships) between students or with the community. The knowledge construction process occurs because of the interaction of thinking between students, such as group activities. The second characteristic of the Inquiry Link-Maps Learning model is understanding. Understanding develops curiosity so that it uses logic to discuss and find ideas based on the concepts learned. The third characteristic of Inquiry Link-Maps Learning model is an inquiry. Students construct knowledge through questioning and inquiry activities that are carried out in a structured manner. The fourth characteristic is the link maps. The characteristics of link maps are important in the application of the Inquiry Link-Maps Learning model, especially in forming knowledge schemes. The fifth characteristic in the Inquiry Link-Maps Learning model is constructed. Knowledge construction occurs, among others, through individual construction and the construction of social interaction processes [7]. So it can be concluded that learning inquiry-link maps can facilitate the development of students' thinking abilities and skills in interacting scientifically.

2. Method

The research uses descriptive type with purposive sampling. The data in this study were obtained based on the results of a physics concept mastery test which included mechanics, waves, optics, magnetics, electricity, and thermodynamics. It also conducted a survey using a questionnaire response to several students doing physics learning at school. The response questionnaire contained students' interest in experimental physics-based learning. The aim is to find out the science process skills possessed by students.

In this study, learning will be applied using the inquiry-link maps model, which has the following syntax:

a. *Introduction,* introduce material and convey learning objectives
b. *Questioning,* find problems and hypotheses
c. *Planning,* plan an experiment
d. *Implementing,* carry out experimental procedures
e. *Concluding,* formulate learning outcomes and conclusions

f. *Reporting,* report the results of experiments
g. *Assignment: Link-Maps,* assignments through the creation of link maps

3. Results and Discussion

Students' perceptions of difficult physics subjects have not been reduced until now. The fact that physics contains a lot of numbers and formulas is still the top problem in learning. The results of observations at school indicate that learning physics is even less desirable by students. Student responses to the implementation of physics learning in schools are shown in Table 1.

Table 1. Student's Response in Physics Learning

Statement	Precentage (%)	
	Yes	No
Physics is interesting	86.66	13.34
One of the less interesting physical factors is the number of formulas	60.00	40.00
Experiments are interesting methods for physics subjects	76.66	23.34
The teacher does not use worksheet when learning	73.33	26.67
Students agree on the development of worksheet	56.66	43.34
Train students to apply the concepts learned	60.00	40.00
Learners never do practicum	73.33	23.34
Data analysis is a stage of the scientific method that is considered difficult	53.33	46.67
The most common form of assignment given by the teacher is the practice of questioning	93.33	6.67
Students have made the task of mapping the mind mapping model	63.33	36.67

Based on the questionnaire results, it is known that physics is an exciting field to study. This report is evidenced by the results of the response of statement 1 (86.66 %), which agrees that physics is a fascinating subject. However, there were 13.34 % of students who mentioned no interest in physics subjects. The reason is that in physics, some many numbers and formulas are confusing for students. This statement can be the first proof that physics can be more interesting if learning is carried out more contextually. Students will not only deal with numbers but also application in real life. One of the conditions that make it difficult for students to study physics is the lack of student interest in learning which is influenced by the assumption that physics only consists of a collection of formulas and numbers [8].

The application of experimental activities in learning physics can be an alternative to increase the students' motivation. Because as many as 76.66 % of students stated that experiment is an interesting method for physics in school and the students wish that laboratory activities can be carried out on every physics material to make it easier to understand the concepts of physics. Students are also not accustomed to carrying out the flow in the scientific method so that they often still experience difficulties, especially in the stage of analyzing data. Even in several classes, students said they had never practised. This statement can affect the lack of psychomotor skills training for students, also though learning should be able to balance cognitive and psychomotor abilities [1]. Therefore, this condition can be an initial reference to be able to apply inquiry learning that can facilitate both skills to assist students in learning physics at school.

To support the implementation of inquiry map-assisted learning models, students also provide responses related to mapping. As many as 63.33 % of students said that they had done mapping-assisted learning, namely mind maps. Mind maps are a form of concept writing with the method of drawing and describing concepts in a variety of representations, for example, letters, symbols, formulas, and images. The mind maps method is not rigid, so students are free to give colour to the conceptual representation. The weakness of mind maps is the result of concepts written by students sometimes are not sequential, so it will be challenging to find the relationship between the concepts in question [9]. Therefore, in future studies, another mapping technique will be tried, namely the link

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map, which is expected to improve the irregularity of relationships between physical concepts. Figure 2 shows an example of making a link map on physics material. Link map is made to show the relationship between physical concepts with representation methods such as mind maps that can display letters, symbols, formulas, and images.

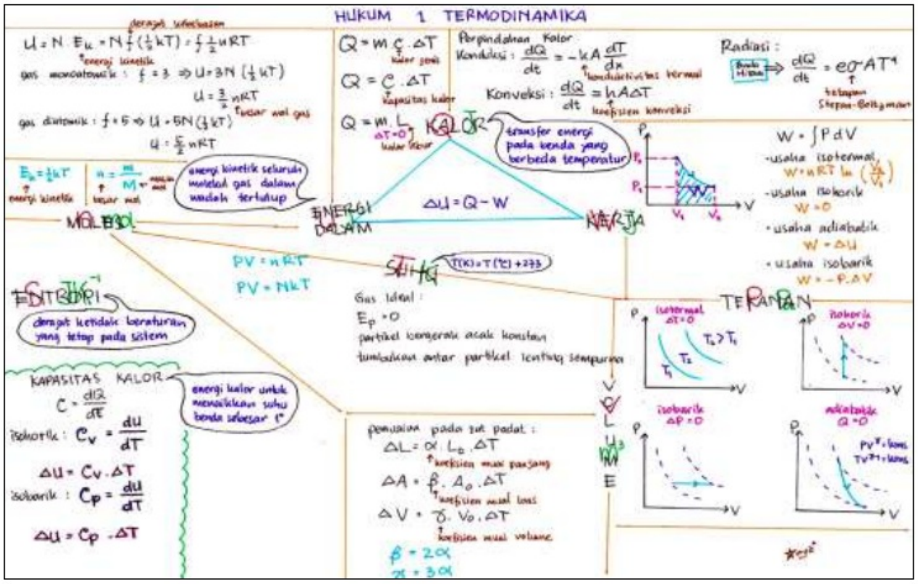

Figure2. Example of Link Maps

In addition to filling out the questionnaire responses, students are also asked to follow the introduction of learning using practical methods. It aims to determine the fundamental skills of students when doing a practicum. The selection of materials used in the practicum method is based on the results of the students' physics concept mastery test. Based on the test results, it is known that the best score is obtained in the wave topic, especially in the harmonic vibration. A good understanding of physics concepts becomes one of the references to determine the level of science process skills of students. This statement is consistent with Hasanah's [1] opinion that science process skills are related to concept mastery. The following are the results of observations of science process skills in students while practising.

Table 2. Indicators of Science Process Skills

Indicator	**Score**	**Criteria**
Observing	68	adequate
Interpreting the data	68	adequate
Asking questions	70	adequate
Communicating	85	good
Using Equipment and Materials	70	adequate
Experimenting	68	adequate

Observing

The process of using sensory devices to gather information about objects or events. Based on observations, students still experience difficulties in this observing stage, especially when asked to mention research variables consisting of independent/manipulation variables, response/dependent variables, and control variables. So this stage needs to be better trained.

Interpreting the data
The process of using words, graphics, symbols, and other written or oral representations to describe and exchange information from one person or system to another. The data writing stage can be done quite well by students. The difficulty is related to writing the measurement results of research data, which must be adjusted to the measurement guidelines that should be supplemented by the uncertainty of the measuring instrument.

Asking questions
States the relationship between the variables and verifies the expected results in the experiment or the problem to be solved. Student weaknesses in identifying research variables affect the ability to formulate problems. As a result, there are still many students who write incorrect problem statements.

Communicating
The process of using words, graphics, symbols, and other written or oral representations to describe and exchange information from one person or system to another. The ability of students to communicate the results of experiments is quite good. Some students can explain the flow of the experiment well, although there are also students who still have difficulty in interpreting the results of the experiment.

Using Equipment and Materials
The process of using standard and nonstandard measurements or estimates and appropriate instruments to describe the dimensions of an object, substance, or event in quantitative terms. Students need to be given specialised training in the use of practical tools, including how to read the correct measuring tools. Errors in reading the measuring instrument cause most cases of data retrieval errors, so it needs to be corrected immediately [10].

Experimenting
The process of determining and implementing procedures to test an idea or hypothesis through observation, identifying and controlling variables, collecting and interpreting data, measuring, and manipulating material. The experimental stage is carried out rigidly because students are not yet accustomed to practising, so they still need guidance from the teacher.

To support the improvement of students' science process skills, the teacher must also master the implementation of practical activities. This fact becomes one of the findings in the initial observation, where practicum is not possible because the teacher has not mastered the practicum process. The statement is consistent with the opinion that the factors that influence the implementation of practicum in terms of teachers are the will and ability [11].

4. Conclusion
Based on the results of the study, it can be concluded that students still consider physics to be a difficult subject because of the lack of practicum when carrying out learning in class. As a result, students' scientific process abilities related to the implementation of scientific methods still need to be trained. Also, to develop the motivation of learning physics, students need to do learning that can show the relationship between concepts to increase mastery of physics material for students. Therefore, the implementation of link map-assisted learning will be conducted on students in the inquiry model to increase knowledge of physics concepts and science process skills.

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