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## THE DEVELOPMENT OF TEACHING MATERIALS BASED ON GUIDED INQUIRY MODEL TO IMPROVE CRITICAL THINKING SKILLS OF SENIOR HIGH SCHOOL STUDENT

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**Abstract** - The Design of this research aims to develop teaching materials of physics learning based on guided inquiry model to improve student's critical thinking skills in material Fluid Mechanics. This research method is research and development (R & D) with the 4D stages (define, design, develop, and disseminate). Define phase by studying literature and field. Stage design by creating a draft teaching materials with guided inquiry learning model, by developed and validate it to the experts. Stage design with a limited test and large scale trials. Phase disseminate by disseminating to a wider scale. Limited test is done by taking a sample class with pre-experiment research methods. Limited test results later revised. Wide scale trial with a true experimental method with randomized pre test-post test control group design. The Methods data collection in this research is a test that measures the shape of the description of students' critical thinking skills with indicator interpretation, explanation, analysis, evaluation, inference and self regulation. The syntax of the model guided inquiry (1) open and immerse; (2) explore; (3) identify; (4) gather; (5) create and share; and (6) Evaluate. Teaching materials with guided inquiry learning model developed is expected to enhance the critical thinking skills of high school students on a senior high class in material Fluid Mechanics.

**Keywords:** teaching materials, guided inquiry, and critical thinking

### 1. INTRODUCTION

Physics is one branch of science that underlies the development of advanced technology and the concept of living in harmony with nature. Management of natural resources and the environment and reducing the impact of natural disasters do not run optimally without a good understanding of physics. Physics at the high school level is considered essential to be taught separately for physics aiming (Depdiknas, 2006): (1) awareness of beauty and order of nature for increased our faith to God; (2) foster scientific attitudes that include; honest and objective of data, receptive to an argument based on evidence of a specific, critical of the scientific statement and can work together with others; (3) gives the experience to be able to propose and test hypotheses through experiments; design and assemble the experimental instruments, collect, process and interpret the data, prepare reports, and communicate the results of an experiment in writing and orally; (4) develop the ability to think analytically inductive and deductive using the concepts and principles of physics to explain natural events and resolve problems both qualitatively and quantitatively; (5) the acquisition of knowledge, concepts and principles of the facts, as well as having the knowledge, skills and scientific attitude. Based on these objectives, physical education has a very important role in the formation of personality and intellectual development of children.

In connection with the purpose of learning physics, then in physics learning is not only done by giving facts and concepts, but it should be noted also how students are trained to find the facts and concepts. So the physics learning can encourage students to develop the ability to think, solve problems through scientific methods to imitate the way scientists work to find the fact.

Physics learning objectives require learning meet all three domains (cognitive, attitude and skills) in developing products, processes, attitudes and equipment science lessons. This is all possible with learning activities that used teaching materials. Teaching materials are all kinds of materials that are used to help teachers / instructors in carrying out the teaching and learning activities. Material in question can be material written or unwritten material. Teaching materials tailored to the learning model is also a determining factor learning process that occurs in the classroom. The use of teaching materials that are still centered on the teacher makes student activity decreases. Low student

activity also resulted in the saturation of the students and the low enthusiasm in learning physics which resulted in lower cognitive achievement of students. The need for the use of teaching materials in accordance with the scientific method possible is an important concern in itself.

Teaching materials that support student activity is a teaching material based on guided inquiry that can develop the ability to think critically and independence of students with principles of the method or scientific work in discovering concepts or principles. The teaching materials is used to train critical thinking skills with some indicator. The process of finding these concepts through a process of investigation directionally namely, formulating problems and hypotheses, identify problems and find ways to address the problem. This fact is supported by a research (Damayanti, D.S., Nur, N., Eko, S, 2013) that show us that critical thinking skills could be developed.

Preliminary studies indicate that the ready-made teaching materials or teaching material in circulation is still diverse qualities, one of which is the lack of teaching materials to develop the potential of their students' demands thinking in physics learning objectives.

Thinking is a mental activity that can not be separated from human life. Critical thinking skills each individual is different from one another so that should be nurtured from an early age. Thinking occurs in every human mental activity serves to formulate or solve problems, make decisions and look for excuses.

Critical thinking is a series of cognitive skills and intellectual dispositions necessary to identify, analyze and evaluate arguments effectively to find and overcome personal prejudices, can formulate and present a convincing argument in favor of the conclusion and can make rational decisions and precise about what to do and believed (Brookhart, 2010; Moon, 2008;). Thus, critical thinking skills is the ability to think for someone to make decisions that are reliable and responsible that affect a person's life. The importance of developing students' critical thinking skills has been the goal of education at lately (Tsapartis & Zoller, 2003 and Phillips & Bond, 2004).

A person who has critical thinking skills has a special character that can be identified by looking at how he addressing a problem. Information or argument these characters appear in the habit of thinking, argue and utilize their intellectual and knowledge. The figure below will identified the 6 indicator of critical thinking skills.



Figure 1. Critical Thinking

Skills According (Facione, 200 there are six major critical thinking skills involved in critical thinking process. These skills is the interpretation, analysis, evaluation, inference, explanation and self-regulation.

For students, critical thinking skills are needed, especially to understand the concepts in physics learning being studied. With critical thinking skills, students will be able to clarify matters, making inferences and interpretations, and evaluate.

One model of learning which provides opportunities students to have the experience of finding a concept and develop critical thinking skills are guided inquiry learning model. Guided Inquiry learning is a model of inquiry learning, the implementation of the teacher providing guidance or instructions spacious enough to students. Most of the planning was made by the teachers and students did not formulate the problem. Inquiry in guided learning, the teacher is not simply remove the activities undertaken by students. Teachers should provide direction and guidance to students in conducting activities that slow thinking so that students or students who have the ability to think lower

still able to follow the activities that are being implemented and the students have a high intelligence does not monopolize activities. The syntax of guided inquiry learning model will be shown on the table below.

Table 1. Model Syntax Guided Inquiry

Phase	Teacher Behavior
1. Opening (Open) and the introduction (Immerse)	<ul style="list-style-type: none"> <li>❖ Designing investigation process</li> <li>❖ Introduce problems / questions / inquiry</li> <li>❖ Observing to form initial knowledge of students</li> </ul>
2. Exploration (Explore)	<ul style="list-style-type: none"> <li>❖ Search Guiding interesting idea</li> </ul>
3. Identify the problem (Identify)	<ul style="list-style-type: none"> <li>❖ To guide the discussion and make hypotheses</li> </ul>
4. Gather information (Gather)	<ul style="list-style-type: none"> <li>❖ Guiding students gather the information necessary to test hypotheses</li> </ul>
5. Create a presentation and present (Create and Share)	<ul style="list-style-type: none"> <li>❖ Guiding data analysis process for the preparation of presentation</li> <li>❖ Guiding process</li> <li>❖ Presentation</li> </ul>
6. Rating (Evaluate)	<ul style="list-style-type: none"> <li>❖ Evaluate the results and the learning process</li> </ul>
7. Rating (Evaluate)	<ul style="list-style-type: none"> <li>❖ Evaluate the results and the learning process</li> </ul>

(Kulthau, 2012)

Design of the study aims to develop a teaching materials based guided inquiry learning model to enhance the critical thinking skills of high school students on the material Fluid Mechanics.

## 2. METHOD

This study uses the R&D through the steps 4-D, namely: the definition (define), designing (design), development (develop) and dissemination (disseminate) with the necessary adjustment (Thiagarajan, 1974).

Definition phase was conducted to analyze the need to collect a variety of information related to the products that will be developed. The collection of information is done with a preliminary study through literature studies and field studies.

Stage designing is done by designing the initial draft teaching materials developed based learning model guided inquiry to improve the critical thinking skills of students on the material Fluid Mechanics. Procedures product development of teaching materials can be explained as follows: (1) Preliminary Study, at this stage will be conducted research and the collection of data relating to the preparation of teaching materials such as needs analysis, analysis of literature through literature and observation through field studies. Literature, in this study the theory and research results that are relevant to the research conducted. Field studies, including surveying, assessing the character of the subject of research and look into the possibility if the product is applied research; (2) The planning, this phase will be done if a preliminary study has been carried out. At this stage that need to be considered in the preparation of teaching materials are curriculum or syllabus and lesson plans as a guide competency to be achieved.

The development phase is done with the first step in preparing or developing a worksheet to review the teaching materials: (1) Formulating objectives; (2) Formulate a grain-based experiments guided inquiry activities; (3) Develop gauges success as a critical thinking test; (4) Writing the content of teaching materials based on the instructional objectives in the curriculum of physics; (5) The test script on a small scale and large scale.

Phase dissemination is done with a test product instructional materials on a wider scale. Large group trial is to determine the stage of shortcomings that need to be repaired. In the implementation of activities presented by utilizing teaching materials are being developed. Tests performed at several schools that have been determined researcher.

Instruments used in the design development of guided inquiry-based teaching materials are questionnaires, observations, and tests description.

The data obtained in this study consisted of quantitative and qualitative data. Qualitative data in the form of: 1) the analysis team of experts and students on the quality of teaching materials; 2) the effectiveness of the learning model used to increase students' critical thinking skills; 3) a general description of the learning activities of students in the learning process. The quantitative data in the form of test scores of students' critical thinking skills. Qualitative data were analyzed descriptively interpretative. Quantitative data were analyzed using inferential statistics.

### 3. RESULTS AND DISCUSSION

Needs analysis done through a preliminary study at the Methodist School 2 Medan. This activity is intended to get an idea of what is required of students in the understanding of physics and can be met through learning physics at school. How physics learning conditions that had been done, the teaching facilities are available, as well as the background of the students in terms of critical thinking skills.

Preliminary studies carried out with the study of literature and field. Through literature study carried out an analysis of the competence of a teacher in physics and the role of teachers in physics learning, teaching materials used in physics learning, learning model used in the process of learning and critical thinking skills of students. Field studies conducted through observation, interviews, and tests. Through observation and interviews can be analyzed physics learning process that has been done and learning facilities available. Analysis of students' critical thinking skills to physics learning dug through the test. Analysis of the difficulties and the responses of students to the physics learning in the classroom through the interview.

Based on observations in the field, teaching and learning in the classroom tends to decrease, and the application of mathematical formulas. Students try to memorize formulas but less interpret what and how the formula was used. Relates to a method of learning, from interviews and observations, Physics teacher at the school Methodist-2 field usually use a lecture and question and answer with the order explained, giving the example problems, ask questions, exercises, and assign tasks. The reason teachers use this teaching method because this method is very easy to do for a large number of classes and teaching materials that much. Several other teachers reported that they use cooperative learning methods group discussions and assignments.

The problem that the teacher in the form of the problems that exist in the source book is more emphasis on mathematical manipulation, not a contextual problem that exists in everyday life. Students who are weak in mathematics will be very difficult to be able to resolve the matter. Issues presented have not been able to describe the problems physics complete with a student worksheet that can be practiced in everyday student.

Based on the interview, the teacher has never developed a teaching materials that can enhance students' critical thinking skills in particular. Although it has never made a test of critical thinking skills, but the teacher deems it necessary to make such tests in particular.

Preliminary studies were also conducted on learning resources and facilities available. According to the professor, this book is a must for teachers handbook used in physics learning. material. In addition to textbooks, students also take advantage of the text books available in the school library and social media.

Through a preliminary study can be known design teaching materials such as what should be used in physics learning process in the classroom. Instructional materials are expected to improve students' critical thinking skills and integrated with guided inquiry learning model.

Indicators of critical thinking skills that will be developed is by Facione, namely six major critical thinking skills involved in critical thinking process. These skills is the interpretation, analysis, evaluation, inference, explanation and self-regulation. These skills will be integrated in the teaching materials will be developed by the authors. In addition to the teaching materials, critical thinking skills indicator is also used for the preparation of an instrument of students' critical thinking skills, in order to determine the quality of teaching physics in understanding the fluid mechanics.

Instruments used in the design of this study was to measure student critical skills in study fluid mechanics. The instrument used was an essay test.

The data obtained will be processed with inferential statistics to see the validity of questions developed by the authors.

In determining the quality of the teaching materials developed, then the required validation of instruments from various experts, so the instrument is presented as valid in accordance with the government's expectations.

Limited scale trials will be conducted to assess the feasibility of instruments to be used in research.

#### 4. CONCLUSION AND RECOMMENDATION

The conclusion is based on the results of research that has been done is as follows: (1) It has been designed physics-based model of guided inquiry learning to enhance students' critical thinking skills. (2) Indicators of critical thinking skills are developed according Facione, there are six major critical thinking skills, the interpretation, analysis, evaluation, inference, explanation and self-regulation. (3) The teaching materials that will be developed are: a teaching material that can be used to observe, ask questions, formulate hypotheses, predicting, formulating patterns and relationships communicate effectively, to design and create, plan and conduct an investigation, as well as measuring and counting.

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