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PHY-01358

## The Need Analysis Development of Test Instrument Based on Inquiry for Uncovering Students Higher-Order Thinking Skills

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### Abstract

Kurikulum Tingkat Satuan Pendidikan (KTSP) stated that the implementation of learning physics is not just a theoretical mastery, but also growing the thinking skill and scientific attitude. The higher-order thinking skills could be widen through thinking practice process by answering the question which high-order skills oriented. But, the fact in the purview showed that test instrument was used only applied for low-order skills. The purpose of this study was to describe the needs analysis development of physics learning test instrument based on inquiry. This study used Borg and Gall development research method, which limited on three steps, they were: research and collecting data, planning, and product developing. Collecting data technique was done by spreading the questionnaire and literature review. The result of this study showed that; 1) inquiry learning model could promote higher-order thinking skills; 2) test instrument was used did not apply the inquiry learning model and the question was still on low-order; 3) instrument test based on inquiry needed to uncover students' higher-order thinking skills. The presentation of the phenomenon and the higher-order question which integrated with inquiry learning steps could be used to train inquiry skills so that it could reveal the students' higher-order thinking skills.

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## INTRODUCTION

Thinking skills become a skill that is very important to be developed at this time. Richmond (2007), in his research states that good thinking skills can be a powerful capital for students in Asia to be able to face the complex problems that exist in the development of the modern era.

The development of students thinking skills can not be separated from their lessons. As stated in the Kurikulum Tingkat Satuan Pendidikan (KTSP), that the implementation of physics learning is not just a theoretical mastery, but also growing the thinking skills and scientific attitude. One of learning models that can be used by teacher is inquiry.

Inquiry is a learning model that emphasizes the process of thinking critically and analytically, helping student build their own knowledge and dock with the knowledge initially (prior knowledge). This learning model can provide a valuable opportunity for students to improve their achievement learning outcomes. Through inquiry, students are given the opportunity to explore their answer, formulate explanation using the data that they collect, connect with daily life, and presents the results of learning (Khan et.al, 2011; Shih et.al, 2010; Supasorn & Lordkam, 2014; Thaiposri & Wannapiroon, 2015). Inquiry model can be used to promote students higher-order thinking skills and enable them to develop their knowledge, understanding of the content and scientific concepts (Power, 2012; Rooney, 2012). Inquiry model has six principle steps, which were presenting problems, making hypotheses, designing experiments, conducting experiments, collecting

data, analyzing the data and making conclusions (Eggen & Kauchak, 2012).

Higher-order thinking skills are very important for students to be able to express their opinions, to think critically, make decisions and solve the problems after being in society (Ramirez & Ganaden, 2008). Higher-order thinking skills are defined as the use of a person's thoughts more widely to find new challenges, take and apply new information or prior knowledge and manipulate the information to achieve the goal of reaching a possible answer in a new situation ( Heong et.al, 2011; Lewis & Smith, 1993). When viewed from the six levels of Bloom's taxonomy of cognitive thinking skills revisions, higher-order thinking skills characterized by the top three levels (analysis, evaluation , and creation ), namely C4, C5, and C6. At that level , students are engaged to hypothesize, invent, criticize, compare, assess and organize (Duron et.al, 2006; Peter, 2012).

Assessment is an integral part of a learning (Lissa et.al, 2012). Assessment instruments in the form of a written test can be used as a way to train the student's ability to think on a higher level. The questions were used contain some questions that train students in terms of problem solving, critical thinking and creative thinking (Rofiah et.al, 2013 ). According to Yildirim and Ozkahraman (2011), thinking skills can be developed through a process of thinking exercises by answering the questions that higher-order thinking skills oriented, so that students are able to follow developments in science and technology.

Test instruments used by teachers in physics teaching often not help students develop higher-order thinking skills. Based on the results of questionnaire that given to teachers and students at SMAN 1 Pesisir Tengah, note that 100,0% of students and teachers or all of respondents stated that the questions provided are in lower-order, just in knowledge and understanding level. Similar results were also obtained by Lissa et.al (2012), the research also found that the assessment instruments that used in the schools, only measure aspects of memorization and understanding concept. Based on the Bloom taxonomy are in C1 and C2. This condition would not be better to train the students higher-order thinking skills. Moreover, although in the learning process are already using the model of inquiry learning, but teachers have yet to implement the inquiry-based questions in the test instrument. According to Gautirez (2015), one of the challenges in implementing inquiry-based learning is the excessive emphasis on assessing learning content rather than learning through inquiry. Therefore, we need a test instrument based inquiry to uncover students' higher-order thinking skills.

This study aimed to describe the needs analysis of the development of test instruments inquiry-based learning physics to uncover students' higher-order thinking skills . The results obtained in this study can be used by other teachers or researchers to develop a test instrument that is students' higher-order thinking skills oriented.

## METHODOLOGY

This study used Borg and Gall (2003) development research methods, namely: 1) research and collecting data; 2) planning; 3) product developing; 4) preliminary trial; 5) improvement of primary products; 6) the main test; 7) improvement of operational products; 8) operational trials; 9) improved final product; 10) dissemination and distribution. However, this study limited in three steps, they were: 1) research and collecting data; 2) planning; 3) product developing.

## RESULTS AND DISCUSSION

Here are the results and discussion for each step that has been done .

### Planning and Collecting Data

At this step, needs analysis and literature study done. The needs analysis questionnaire was given to 30 students and 3 physics teachers at SMAN 1 Pesisir Tengah. The questionnaire results showed that the implementation of learning, teachers are already using inquiry learning model. However, as many as 85% students and 83.5% teachers said that test instruments used were not based on inquiry. The questions in the test instrument is still same as a matter of physics in general. Based on the results of questionnaires also showed that all of the students stated that the question is still at the lower-levels of Bloom's Taxonomy, namely the level of knowledge and understanding. Furthermore, only 63% of students stated that the questions in application level. For higher-level questions, as many as 17% of students stated the question at analysis level, and as much as 7% of students stated at evaluation level. While the results of a questionnaire that given to teachers, showed the similar results. The question is still at the knowledge and understanding level. Furthermore, 67% of teachers stated that the questions provided are at the application level. As for the question of higher-level, only 33% of teachers who provide analytical level questions.

The same tendency results obtained Kocakaya and Gonen (2010), in their study showed that 72.5% are lower order question, with details 6.3% at knowledge level, 13.9% at comprehension level, and 52,3% at applications level. Only about 27.5% of questions are in higher-order cognitive domain, such as analysis, synthesis, and evaluation.

The questionnaire results were indicating that it is required an inquiry-based instruments to express students' higher-order thinking skills. All respondents, or as much as 100,0% of the respondents expressed the need for such instruments and they are willing to use it.

According to Madhuria et.al (2012), inquiry-based learning is better than conventional learning. This model can promote higher-order thinking skills and applied in disciplines such as mathematics and physics. The results of research conducted by Hugerat & Kortam (2014) and Sohibin et.al (2009), indicates that inquiry significantly can improve conceptual understanding, critical thinking and students higher order thinking skills.

### **Planning**

At this steps, the researcher plan to develop a test instrument with the form of multiple choice questions. According to Paul & Nosich (1993), the type of question which can be used to assess the ability to think critically, namely multiple choice, multi-storied, and essays. According to Kominski (2012), multiple choice is one of the type of structured test. The excess of structured test are comprehensive knowledge which is considered to be more efficient, faster scoring, can be analyzed with statistics, and can use comparative data.

Based on basic competencies which is analyzed by researcher, following some high school physics bacis competencies planned will be content in the test instrument, they are: 1) analyzing the regularity of planetary motion in the solar system based on Newton's laws; 2) analyze the effect of force on the elastic properties of the material; 3) analyze the relationship between effort, energy changes with energy conservation laws of mechanics; and 4) analyzing the laws relating to the fluid static and dynamic as well as their application in daily life.

The test instruments are planned to be evaluated using the Rasch model. According Sukor et.al, (2013), applying Rasch Modeling in the development of test items can be a powerful tool for the evaluation and repair items.

### **Product Developing**

The results at this step, in the form of test instruments that required plans based on the results obtained in the previous step. This test instrument is planned in the form of

questions based on inquiry that when viewed from Bloom's Taxonomy is at a higher level, which is the realm of C4, C5, and C6.

Thought not driven by the answers but with questions. Questions stimulate the mind so that students can practice thinking through information or ideas, or generate new questions for further study. Consequently, it is important that teachers know how to develop a real assessment that can test the students higher-order thinking skills. Brain researchers showed that teachers should use a variety of high-level questions in a supportive environment to strengthen the brain (Paul & Elder, 1999; Cardellichio & Field, 1997).

The questions presented will include six-steps of inquiry learning, covering presents a problem, making hypotheses, designing experiments, collecting data, analyzing the data and making inferences. This inquiry presented are six steps in sequence, by giving phenomena in everyday life firstly that related to learning materials.

Inquiry can significantly improve conceptual understanding, critical thinking and students higher-order thinking skills (Hugerat & Kortam, 2014; Sohibin et.al, 2009).

### CONCLUSION

Based on the need analysis by spreading questionnaire and literature review, it is known that: 1) inquiry learning model could promote higher-order thinking skills; 2) test instrument was used did not apply the inquiry learning model and the question was still on low-order; 3) instrument test based on inquiry needed to uncover students' higher-order thinking skills. The presentation of the phenomenon and the higher-order question which integrated with inquiry learning steps could be used to train inquiry skills so that it could reveal the students' higher-order thinking skills.

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