CRITICAL THINKING SKILL OF STUDENT THROUGH TOP DOWN APPROACH IN PHYSICS LEARNING

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Abstract. This article was a research which describes student's critical thinking skills in learning physics through top down approach. In top down approach, student learned how to solve a challenge which was given by a teacher in classroom. To finish the challenge, student identified physical quantities which they need to solve it. After they had identified the quantities, they thought how to collect data then they conduct an experiment to find it. The experiment result was used to conclude the answer of the challenge. Learning by top down approach guided the student in thinking processes. They learn from the challenge and identify what they need to solve it. They learn how to analyze the data and conclude it as an evidence to answer the challenge. The test of critical thinking skills showed that the students were some proficiency where they able to identify data and information that counts as evidence but fault to thoroughly evaluate its credibility.

Keywords: top down approach, critical thinking skills.

INTRODUCTION

Physics aims to foster students' critical attitude, capable of reasoning, and use the concepts and principles of physics to explain natural events (BSNP, 2006). To achieve this, the government has set the standard graduation in physics that requires students to experiment with, among others, to formulate the problem, propose and test hypotheses, determine the variables, designing and assembling the instrument, collect, process and interpret the data, draw conclusions, and communicate the experiment results orally and in writing (BSNP, 2006). This goal reflects the educational products in Indonesia will produce students who have a good understanding, is able to argue, and take a decision based on a critical assessment. But this goal turned out to be very different from the results of existing research

From the observations the authors concluded that students' ability to apply knowledge of physics was still very low (Rusli, 2010), this was in line with the latest research results TIMMS on learning achievement of science, especially physics that put Indonesia on the order of 3 lowest of the 42 countries where the achievement of learning outcomes physics was significantly below average with cognitive domain which included knowledge, application and argument also was significantly below average (TIMMS, 2011).

The results of this study were the greatest challenges for education in Indonesia, especially in the teaching of physics to improve the implementation of teaching in class for learning-oriented students' thinking skills based on the concepts and principles of physics in taking decisions, actions and implementation

Thinking is the process of forming a new mental representation through the transformation of information by the complex interaction of mental attribution that includes consideration,

abstraction, reasoning, drawing, logical problem solving, concept formation, creativity and intelligence (Solso et al., 2008). Thinking involves manipulating and transforming information in memory (Santrock, 2009). There are three basic ideas about thinking: (1) think is cognition internally in thought, but the decision was taken through behavior, (2) thinking is a process that involves some manipulation of knowledge in the system of cognition, (3) thinking is direct and produce behavior " solve "the problem, or go directly to the solution (Solso et al., 2008).

In lessons, students are faced with a new problem, then they will choose the proper techniques to address these issues and relate to the information that is important, both facts and principles. This situation is called "critical thinking" by some experts, "by Dewey called" reflective thinking "and others call" problem solving "(Bloom, 1956). According to Ennis (1996) critical thinking is reflective thinking, unreasonable or based reasoning to determine what will be done and believed. the essence of critical thinking is evaluation (Ruggiero, (2012). Critical thinking can be defined as a process where we examine the claims and arguments and determine which one has the benefit and which do not. In Jeevanantham (2005), Lipman says that critical thinking is skillful thinking responsible for facilitating good judgment, because it (a) depending on criteria, (b) a self-correcting, and (c) are sensitive to the context. Splitter expressed the view that in learning to think critically, we give structure to the experience with the (a) reflective and correction-self, (b) governed by reason and criteria, (c) directed the decision-making about the world. he added that critical thinking is thinking normative: a critical thinker is someone who is ready to make a judgment reasoned about the quality of what he had seen , hear or think. From the above authors conclude that a critical thinkers able to decide to believe or do something based on what you observe, observe, and think with the logical reasoning

To realize the learning-oriented thinking skills, education must be optimized through a challenging learning for students so that the process of assimilation and accommodation can produce intellectual growth (Hergenhahn & Olson, 2009). One theory of information processing can be applied in building students' prior knowledge to think through a constructivist approach is top-down processing. Top-down processing is a theory that proposes that the process initiated by the introduction of an hypothesis about the identity of a pattern, followed by the introduction of the parts of the pattern based on the assumptions that have previously been made (Solso et al., 2008). According to Sun, Merrill, and Peterson in (Sun & Zhang, 2004), top down learning is defined as learning that begins from explicit knowledge to implicit knowledge. Explicit knowledge is knowledge that is easy to remember and are described, while implicit knowledge is knowledge that is difficult to remember or explain but affects behavior (Ellis & Ormrod, 2012)

The research found that critical thinking can be developed through hands on activities, guided inquiry, guided experimentation and problem solving (Triwiyono 2011; Yuliati et al., 2011; Setyorini et al., 2011; Sochibin et al., 2009;). Referring to the above description and research, the study should involve prior knowledge students starting from a problem that will be solved by the students through hands on activities, experiments, as well as the review of the literature. The role of the teacher in the classroom is no longer the main source of information, but rather as a facilitator who is always ready to assist students in overcoming obstacles in solving the problem. Such learning is an illustration of a top-down processing based scaffolding, where learning starts from a complex problem then broken down into a few concepts that will be explored by students through several methods, such as lab and library research. While teachers will provide scaffolding based on the needs of students. Seeing the importance of teaching students who are able to construct knowledge, the authors conducted learning through a top down approach to determine students' critical thinking skills.

This research was a quantitative research that aims to describe the thinking skills of students after participating in learning physics through a top-down processing. The research used posttest only control group design. Data was collected by using test method to obtain students' critical thinking skills. The data were analyzed using the rubric of critical thinking skills developed by Illinois University, divided into 4 categories, (1) the unskilled; (2) somewhat skilled; (3) skilled; (4) highly skilled (Frank, 2004)

DISCUSSION

Data obtained from the results of the implementation of learning physics through a top-down approach to processing is as follows

TABLE 1. The average score of critical thinking skills

No	Indicator	Average score
1	skills in basic clarification	3.375
2	The basis for deciding	2.5
3	Inference skills	2.28
4	Advance clarification	1.875

The above results show that for the aspect of clarification base, which students analyze an argument to identify the reasons that have been selected and summarized, the students are in the category of skilled, while for the basic category to decide, by collating data and assessing the results of observations, students are in the category of slightly skilled , Likewise, the inference, the ability of students to interpret through logical statements that are in the category of slightly skilled, while further clarifying the ability of students to integrate the ability or knowledge to determine decisions still less skilled.

These results indicate that in order to analyze an argument based on the data or facts, students have demonstrated their skills, but when they have to take a decision through two stages of analysis, namely, a basic clarification to know the data and then use it in deciding, apparently students are still weak. Students are not able to decide the logical reasons more precise in explaining a problem. As a result they only review one reason only in making decisions, while others are overlooked reason turned out to have a stronger case. It is clear that students are still constrained in making a decision or the right choice when confronted with problems of physics involving two concepts of physics. This situation is seen during the learning process takes place

Implementation of learning physics through a top-down approach to processing at the first meeting seem that students find it difficult to solve the problem. This happens because the students' mental set is different from what they earn through top-down processing. In other words, culture and education has a stronger influence on the development of children (Santrock, 2008). During this time of learning physics teaches only example problems and exercises that involve the concept of physics. As a result, students who take the top-down processing of learning through experience difficulty in explaining a fact that involves some of the concepts and laws of physics. Rather say that they had a scheme issue, or knowledge about certain issues and troubleshooting steps, which they use to classify problems (Ellis & Ormrod, 2012). Set mental cause difficulties students tried to approach or solution that is better and more efficient (Wade & Tavris 2008)

Thus, to reach the critical thinking skills based on the content of physics, the first students should know the knowledge about concepts related to a given problem. The fact of critical thinking skills test results can not be separated from the influence of learning in schools. Based on interviews with students, as long as this information was obtained that physics is taught through example problems with exercise. Thus, the mental set that is embedded in students considered physics lesson only teach equations and calculations as well as examples and problem solving from the teacher. Giving examples of questions, with the completion of a culture of learning physics. As a result, the teacher determines the absolute truth as well close the opportunity for students to think critically (Tyler et al., 2008)

This situation does not mean that students can not be taught to think critically, but students need to be taught to think critically (Ruggiero, 2012). The low increase in critical thinking skills gained from this research may be due to several factors. Among these are: learning through top-down processing approach that's new to the students, so it took habituation. In addition, the given problem generally requires a conceptual understanding and procedural to draw conclusions while the previous learning is more focused on students' ability to solve problems procedural questions with examples of existing

Vygotsky beliefs about the importance of social influence is reflected in the concept of Zone of proximal development (ZPD). ZPD captures the cognitive skills of children who are in the process of maturity and can only be achieved with the help of someone more skilled (Santrock, 2008). If the ZPD is a zone of potential where students can achieve it with the help of a friend who is more skilled, then the zone of current development (ZCD) is the degree to which students can achieve troubleshooting without the help of others (Wass et al., 2011). To assist teachers in preparing the way to optimize the ZPD, the scaffolding is used as a guide in the completion of the task. Bruner says (Wass et al., 2011) scaffolding means changing levels of support. When students are learning a new task, the more skilled can perform direct teaching. With the increasing competence of the students, the guidance given less. Horowitz said that the scaffolding is often used to help students reach the upper limit of their zone of proximal development (Santrock, 2008)

The results of this study indicate that to practice critical thinking skills to students who have a set of mental and cultural inhibiting critical thinking is not enough in just a few meetings, but it takes time to familiarize and train the students' critical attitude. This is supported by research Burbach et al. in (Burris & Garton, 2007) which states that it takes 10 to 16 weeks to familiarize students in improving critical thinking skills. In addition, the results Wass, Harland, and Mercer (2011), which states that it takes two to three years so that students are able to integrate their ideas and apply critical thinking to new things. Meanwhile, research by the author only 4 meetings only. Therefore, more research is needed with a longer time by using a top down approach to processing. Because with this learning, students have the interest and motivation to follow the teaching of physics

CONCLUSION

Based on the description of the above results it can be concluded that the implementation of learning physics through a top-down processing show high student critical thinking skills in aspects of basic classification, whereas in advanced clarification, the student's skills are still low. These results indicate that in the learning process, students can be trained to think critically skilled in stages so that the learning design needs to involve an element of decision-making by reviewing the various arguments

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