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Understanding of physics concepts by Samudra Langsa University students

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A B S T R A C T

Understanding becomes the main basis for self-improvement in using various methods to create ideas. There are several levels of understanding, namely primitive cognitive, Image Making, Image Having, Noticing Properties, formalizing, observing, structuring, inventing c developed by Pirie and Kieren. This study is a type of research with a descriptive qualitative approach. The selection of research objects is based on a purposeful sampling technique, with the number of research objects as many as 10 students. The data collection technique used in this study was an open, unstructured interview and a concept understanding test. The analysis used in this research is descriptive qualitative analysis. The results showed that subject I had the ability to understand concepts and was in the formalizing stage. There are as many as 35% of students who are in the formalizing stage. Subject 2 is still at the stage of image making. As many as 65% of students are in the stage of image making. This study also found that there are still students who make mistakes in the algorithm, this is because students have difficulty constructing a scientific conceptual understanding of physics caused by misconceptions that develop in students based on perceptions obtained from everyday life.

INTRODUCTION

Learning to successfully solve problems in a scientific domain, such as physics, requires the construction of knowledge in understanding concepts (Hung & Jonassen, 2006; Rahmawati, Suparmi, & Sunarno, 2018). Understanding the concept when viewed from Bloom's point of view which divides the cognitive level into six, understanding only requires a minimum level of understanding and is considered a low-level cognitive skill (Jensen, McDaniel, Woodard, & Kummer, 2014). However, it is the initial problem of confusion of thought. Conceptual understanding of physics has proven to be one of the most difficult challenges faced by students (Kulkarni & Tambade, 2013; Nadhor & Taqwa, 2020; Taqwa, Priyadi, & Rivaldo, 2019), while the demands of learning in the 21st century are that every student has the ability to develop self-understanding (Kavanagh & Raftery, 2017; McComas, 2017; Reichstein et al., 2019).

Students who understand the right concept will be able to present the material presented in a form that is easier to understand so that they are able to interpret and apply it (Bilal & Erol, 2012; Wicaksono, Wasis, & Madlazim, 2017). Understanding the concept refers to a person's ability to understand the meaning scientifically, both theoretically and in its application in everyday life. Concept understanding is in a cognitive area that emphasizes intellectual aspects, and this area has a hierarchical order (Anderson & Krathwohl, 2001). Anderson has outlined Bloom's conceptual ability to grasp. He explained that the ability to understand concepts is the ability to construct the meaning of various types of problems, be it in writing, orally, graphically, or activities such as interpreting, exemplifying, analyzing, summarizing, concluding, comparing, or re-explaining (Anderson, 1999; Wilson, 2016).

Understanding is the main basis for self-improvement in using various methods to create ideas, create new and valuable ideas, as well as explain, revise, analyze, and evaluate their own ideas in order to increase and maximize creativity (KOLA, 2017; Piirto, 2016). Comprehension is often associated with the ability to answer questions (Caleon & Subramaniam, 2010; Sagala, Umam, Thahir, Saregar, & Wardani, 2019). But the question that arises is: is it that simple to see comprehension abilities? We someone cannot answer a question correctly, they can be considered as having no understanding? The answer is no. Understanding is more than that. Each individual has differences in understanding and processing the information provided to them (Kade, Degeng, & Ali, 2019). This study wants to see the ability of understanding from a different perspective. Because when we talk about understanding, we are talking about something complex (Pirie & Kieren, 1989).

Concept understanding also includes the association, comparison, assimilation, and reorganization of new knowledge with existing knowledge and transferring it to solve new problematic situations (Saricayir, Ay, Comek, Cansiz, & Uce, 2016). Conceptual understanding is based on the reorganization of existing knowledge as posited by constructivist cognitive learning theory to some. The understanding described in this study is an understanding of the concepts developed by Pirie and Kieren, namely Primitive cognitive, Image Making, Image Having, Property Noticing, formalizing, observing, structuring, inventizing c.

Research on understanding the concept has often been done. An example of research conducted by Shidik (2020) that looks at the relationship between motivation and the ability to understand concepts. His research only explains the relationship between the two variables and the direction of the relationship (Shidik, 2020), not in detail describing the understanding of physics concepts. On the other hand, Yana, et al (2019) conducted an analysis of understanding the concept of physics in mechanical wave material using multiple choice questions (Yana, Antasari, & Kurniawan, 2019). Assessing concept understanding by using multiple choice questions cannot detect the ability to understand concepts clearly. Meanwhile, this study wants to describe the understanding of physics concepts in more detail based on the levels developed by Pirie and Kieren.

LITERATURE REVIEW

Concepts understanding is the ability possessed by a person in understanding a concept (Nadhor & Taqwa, 2020). Understanding of concepts usually grows and develops according to the experience gained by the object during the process of problems solving it has (Çepni & Şahin, 2012; Docktor & Mestre, 2014; Radovanović & Sliško, 2013). Anderson said the ability to understand concepts is the ability to construct meaning from various types of problems, whether in writing, verbally, graphically or in activities such as interpreting, exemplifying, classifying, summarizing, concluding, comparing, or re-explaining (Anderson, 1999; Wilson, 2016). There are also those who argue that the ability to understand concepts is possessed if a person can use various methods to create ideas, create new and valuable ideas, and explain, revise, analyze, and evaluate their own ideas in order to increase and maximize creativity (KOLA, 2017; Piirto, 2016). Everyone has a different level of understanding of the concept. B. Coştu categorizes them into five levels: (1) Sound understanding if responses that included all components of the validated response; (2) Partial understanding if responses that included at least one of the components of validated response, but not all the components; (3) Partial understanding with specific misconception if responses that showed understanding of the concept, but also made a statement, which demonstrated a misunderstanding; (4) Specific misconceptions if responses that included illogical or incorrect information; (5) No understanding if repeated the question; contained irrelevant information or an unclear response; left the response blank (Costu, 2008). The understanding described in this study is an understanding of the concepts developed by Pirie and Kieren, namely Primitive cognitive, Image Making, Image Having, Property Noticing, formalizing, observing, structuring, inventizing c (Pirie & Kieren, 1989).

METHOD

This study is a type of research with a descriptive qualitative approach and will be carried out in 2021. The study subjects are all students of the Physics Education Study Program at Samudera Langsa University. The selection of research objects is based on a purposeful sampling technique. This technique was chosen because of the conditions and phenomena to be disclosed in this study. The objects of research are 10 students of the Physics Education Study Program at Samudera Langsa University, three people with high abilities, 4 people with moderate abilities, and 3 people with low abilities. High, medium, and low abilities are based on the IPK scores obtained by students. The data collection technique used in this study was an open, unstructured interview and a concept understanding test. The problem understanding ability test questions are given as many as 3 questions that have been tested for validity, reliability and distinguishing power so that they are feasible to be used repeatedly. The analysis used in this research is descriptive qualitative analysis which consists of six steps, namely (1) preparing and organizing the data; (2) explore and code data; (3) build descriptions and themes; (4) constructing the representation; (5) make interpretations; and (6) propose validation for theme accuracy.

RESULTS AND DISCUSSIONS

Researchers provide instruments to research subjects that contain instructions for making sample questions along with answers to measure the ability to understand concepts. From the research results:

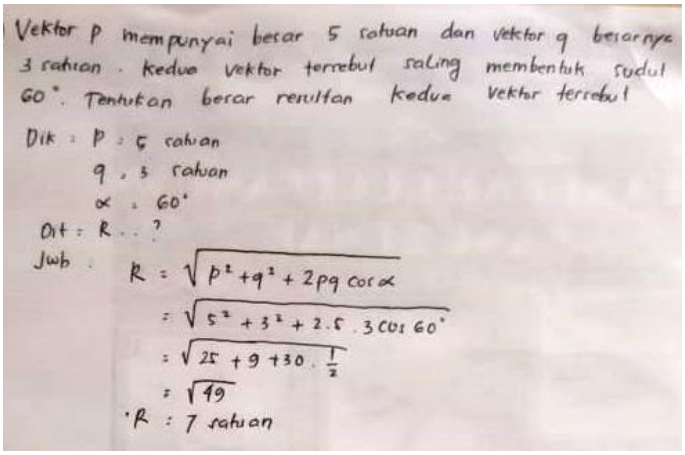

Figure 1. Results of the subject's answer 1

From the Figure 1, it can be seen that Subject 1 is already in the formalizing stage, namely the stage where students have been able to make a concept related to the definition relationship in vector material. This can be seen from Subject 1 having answered the questions correctly. Even though in the final process of solving the questions, Subject 1 did not make or make conclusions on the answers he had made. Is this a mistake? The answer is no. If we mention that subject 1 does not have the ability to understand the concept, it is only because it does not draw conclusions from the answer results like the domains mentioned by Anderson (1999). Because drawing conclusions is one way for someone to evaluate the problem that has been resolved. The indicator of the ability to evaluate which can be seen by drawing conclusions is the level (C5) of the Higher Order Thinking Skill (Kusuma, Rosidin, Abdurrahman, & Suyatna, 2017). So, it is unfair to say that the first subject does not have the ability to understand concepts. So, it can be concluded that the first subject already has the ability to understand concepts and is in the formalizing stage.

There are as many as 35% of students who are at this formalizing stage. Most of them do not classify the answers they make. Some are because of the belief in the answers that have been made, there are those who say that they think that checking the answers they make is a waste of time, there are also those who argue that making a conclusion does not have to be with a statement that begins with the word "so ..." but enough with a dash under the answer is sufficient. This shows that the ability to understand concepts affects the level of student confidence in the answers made (Saputra, Kade, & Hatibe, 2017).

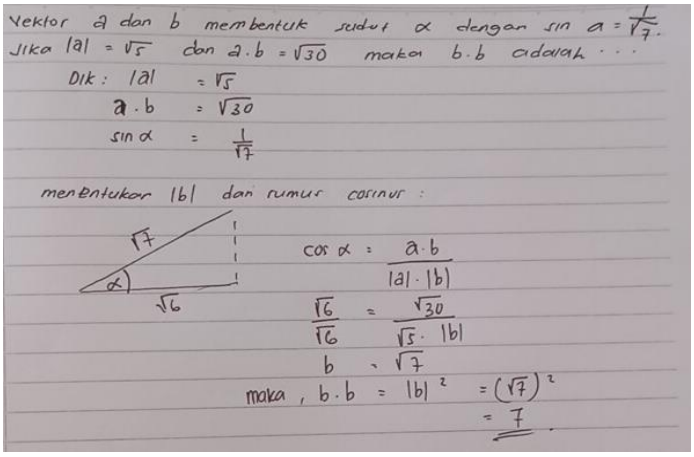

Figure 2. Results of the subject's answer 2

Figure 2 showed that the second object is in the image-making stage. image-making is the stage of someone who has got an idea or image that will be used in solving problems (Pirie & Kieren, 1989). When viewed from the picture, the second object has been able to write what is known and represent the idea in the form of a triangle to determine the values of a, b and c. But the second object does not describe the process of obtaining an a. The second object should write down:

$$b^2 = a^2 + c^2 \rightarrow (\sqrt{7})^2 = a^2 + 1^2 \rightarrow 7 = a^2 + 1 \rightarrow a^2 = 7 - 1 \rightarrow a^2 = 6 \rightarrow a = \sqrt{6}$$

What has been written by the second subject is correct that the value $a = \sqrt{6}$ even though the writing is incomplete. When solving for the second subject makes a mistake in substituting the value $cos\ \alpha = \frac{\sqrt{6}}{\sqrt{6}}$ the answer should be the value $cos\ \alpha = \frac{\sqrt{6}}{\sqrt{7}}$ then the value is obtained:

$$cos\ \propto = \frac{a\ .\ b}{|a|\ .\ |b|} \rightarrow \frac{\sqrt{6}}{\sqrt{7}} = \frac{\sqrt{30}}{\sqrt{5}\ .\ |b|} \rightarrow \sqrt{6}.\sqrt{5}\ .|b| = \sqrt{30}\ .\sqrt{7} \rightarrow \sqrt{30}.|b| = \sqrt{30}\ .\sqrt{7} \rightarrow |b| = \frac{\sqrt{30}.\sqrt{7}}{\sqrt{30}} \rightarrow |b| = \sqrt{7}$$

Even though the answer written by the second subject is correct, but the process of getting the value and multiplication is wrong, we cannot say that the second subject has a good conceptual ability. Because the second object cannot apply the formula according to the procedure in solving the problem. To ensure that the answer made by the second subject was a mistake or did not understand, an interview was conducted. The results of the interview showed that the second object did not understand the concept, and argued that the important thing was that the - answer he made was correct.

This opinion is completely wrong. In solving problems, the most important thing is the process of solving the problem, not the focus on the results (Kotthoff, 2016; Zydney & Warner, 2016). Although there are many algorithms that can be used in solving problems. But the process of selecting algorithms and the process of problem-solving is largely determined by the level of understanding. So that we can conclude that the second subject is still in the image-making stages.

As many as 65% of students are in the image-making stage. This is due to the difficulty of students in constructing a scientific conceptual understanding of physics as well as due to the misconceptions developed by students based on perceptions obtained from everyday life. Errors in solving existing algorithms can be caused by misunderstandings that come from personal experience (Rahmawati et al., 2018). Students' difficulties in constructing a scientific conceptual understanding of physics are also caused by misconceptions that develop in students based on perceptions obtained from everyday life. This confusion of misunderstandings is surprisingly difficult to change even after students receive formal physics education (Hung & Jonassen, 2006).

CONCLUSIONS

There are as many as 35% of students who are at this formalizing stage. Most of them do not classify the answers they make. This shows that the ability to understand concepts affects the level of student confidence in the answers made. the process of selecting algorithms and the process of problem-solving is largely determined by the level of understanding. So we can conclude that 65% of students are in the image-making stage. This is due to the difficulty of students in constructing a scientific conceptual understanding of physics as well as due to the misconceptions developed by students based on perceptions obtained from everyday life. Students' difficulties in constructing a scientific conceptual understanding of physics are also caused by misconceptions that develop in students based on perceptions obtained from everyday life. Thus, it is important to pay special attention to this ability.

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Author's Contributions

All authors discussed the results and contributed to from the start to final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

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