The Analysis of Students' Concept Mastery Levels on Hydrostatic Pressure at SMAN VII Mataram: An Introduction Study

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Abstract - Prior knowledge is one of the important factors that can affect the effectiveness of absorbing new information or concepts that students will learn. This research aims to know the mastery profile of students' concepts (prior knowledge) on hydrostatic pressure material. Descriptive research is applied in this study to realize these goals. This research was conducted at SMAN VII Mataram with a total sample of 44 students spread over four classes. Samples were taken using a simple random sampling technique. The data collection tool in this study was a concept mastery test instrument consisting of 14 questions. This test instrument measures students' mastery of concepts from cognitive level C1 (remembering) to cognitive level C4 (analyzing). Data on test results were analyzed by calculating the average percentage of students who could answer questions correctly according to the cognitive level being tested. This percentage is used as an indicator to measure the student's mastery of concepts on hydrostatic pressure material. Based on the results of data analysis, it was found that the level of student's mastery of concepts for cognitive level C1 (remembering) was 70.45%, cognitive level C2 (understanding) was 31.36%, cognitive level C3 (applying) was 27.73%, and cognitive level C4 (analyzing) was 18.94%. It can be concluded that students' mastery of concepts, especially at cognitive levels C2-C4, is still very low.

INTRODUCTION

The human quality of a nation can be seen in the quality of education. According to Sudradjad, quality education is education that can produce graduates who have the ability or competence, both academic competence and vocational competence, which are based on personal and social competence, as well as noble moral values, all of which are life skills (Miftachurrohman & Atika, 2018). Quality education is a requirement to make social life advanced and prosperous because it is through education that human qualities are formed. Countries not rich in natural resources can develop and prosper because they have quality education and human resources.

Improving the quality of education means improving the quality of learning. Learning is a system in which various components are interrelated and related (Harjono et al., 2020). These components include learning objectives, students, educators, learning resources, teaching (learning approaches or methods), learning media, learning resources, and learning evaluation (Slameto, 2010). These learning components form a unit whose existence is interrelated and synergizes with each other in achieving the learning objectives that have been set.

Learning is a process or effort made by each individual to get changes in behaviour, both in the form of knowledge, skills, attitudes, and positive values as an experience from various materials that have been studied (Djamaluddin & Wardana, 2019). In cognitive theory, learning can be viewed as processing information from interactions with the environment. This

process is not separate but a continuous process. In the learning process, the processing of new information with prior knowledge already exists in a person's cognitive structure. Processing new information with this initial knowledge can occur through assimilation and accommodation (Rahayu & Winarso, 2018).

Assimilation is a cognitive process that occurs when a person integrates new perceptions, concepts, or experiences into existing prior knowledge in their cognitive structure (Putri et al., 2022). If the new experience does not meet the initial knowledge, accommodation will occur. Accommodation is a cognitive process when new information or knowledge does not follow prior knowledge, so individuals change or adjust their initial knowledge to understand these new things (Moreno, 2010). In both the process of assimilation and accommodation, it is clear that in every learning process, prior knowledge is always associated with thinking activities. Therefore, for adherents of cognitive learning theory, the position of this initial knowledge is very important and influences the effectiveness of absorption or adjustment of new information being studied.

So far, research in Indonesia has focused more on looking at the influence or effectiveness of a model, strategy, or approach to student learning outcomes (cognitive, affective, psychomotor). We rarely find research that tries to review the interaction of learning models with the level of students' initial knowledge of the achievement of learning outcomes. It needs to be done because prior knowledge helps students understand and master the learning given by the teacher. Students with little initial knowledge will have difficulty making knowledge connections, so it takes longer than students with sufficient initial knowledge (Salkind, 2008).

Several studies on prior knowledge show a relationship between prior knowledge and the ability to solve and investigate concepts. The higher the student's initial knowledge level, the higher the relationship. Students with high initial knowledge are more able to discover and investigate concepts. Students who do not have sufficient initial knowledge will have difficulty understanding or applying this new knowledge (Maulidya & Saputri, 2016).

In addition, based on research conducted by Payung et al. (2016), Astuti (2015), and Muammar et al. (2015) show that prior knowledge has a significant influence on achievement and student learning outcomes in science. Other studies show that prior knowledge has significant knowledge of process skills, concept mastery, and student problem-solving in physics learning (Hanin et al., 2017 & Fatwa et al., 2018). In addition, research conducted by Hikmah (2018) & Dewantari et al. (2021) showed that initial knowledge positively and significantly influenced student learning outcomes. This research found that prior knowledge helped students train their thinking skills (Susilo, 2016).

Therefore, as a first step to improving students' physics learning outcomes, it is necessary to conduct a study to determine students' prior knowledge. This study aims to determine how far the average mastery of hydrostatic pressure materials is. So to overcome this, the teacher must know the prior knowledge of students that occurs as a step to determine the right learning method (Hadiyanti & Widodo, 2018). Hydrostatic pressure material was chosen as learning content because it is considered quite difficult and complex, so misconceptions often occur.

RESEARCH METHODS

This research aims to find out the description of students' concept mastery profile on hydrostatic pressure material. Descriptive research is applied in this study to realize these goals. This research was conducted at SMAN VII Mataram with a total sample of 44 students spread over four classes. Samples were taken using a simple random sampling technique. The simple random sampling technique is one in which each member of the population has the same opportunity to be selected as the research sample (Sugiyono, 2012).

The data collection tool in this study was a concept mastery test instrument consisting of 14 questions. This test instrument measures students' mastery of concepts from cognitive level C1 (Remembering) to cognitive level C4 (analyzing). The analysis of mastery of the concept in this study is limited only to the C4 cognitive level because it refers to the Basic Competency of hydrostatic pressure material determined nationally and listed in the syllabus.

Data from the test results were then analyzed by calculating the average percentage of students who could answer questions correctly according to the cognitive level being tested using the following equation.

$$P = \frac{X_{true}}{X_{total}} \; x \; 100\% \qquad (1)$$

Information:
P   = Percentage (%)
X_{true} = number of students who answered correctly
X_{true} = Total Number of students

RESULTS AND DISCUSSIONS

Based on the results of data analysis, the percentage of student's mastery of hydrostatic pressure in terms of cognitive level is obtained as follows.
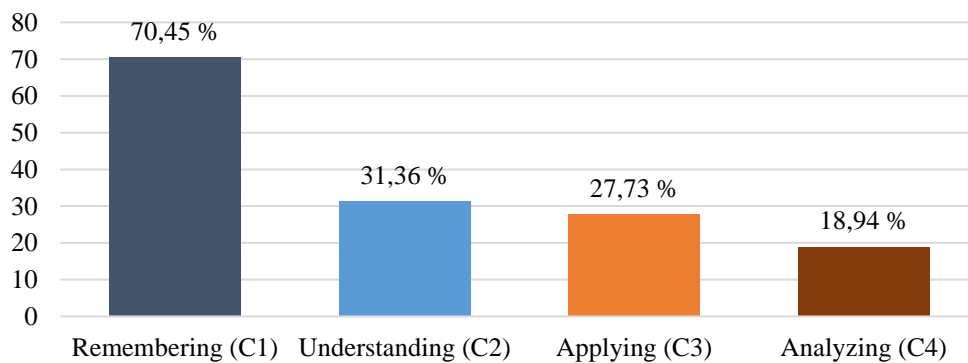

Figure 1. Percentage of students who can answer questions correctly for each cognitive level

The data in Figure 1 above shows the percentage of students who can answer each question correctly according to the cognitive level being tested. The percentage of students who can answer correctly is used as an indicator of completeness or the level of achievement of student learning outcomes for cognitive aspects. Based on the picture above, it can be seen that, for cognitive level C1, student learning achievement reached 70.45%.

The C1 cognitive level is related to the student's ability to remember every concept in hydrostatic pressure material. Remembering is an effort to retrieve knowledge from memories or memories, both those that have just been obtained and those that have been obtained for a long time. This ability requires memorization and memory of things that have been learned. Remembering includes identifying and recalling activities. Recognizing is

comparing the required knowledge from long-term memory with information that has just been received. While recalling is a cognitive process that requires knowledge of the past quickly and precisely.

The student's ability to remember the concept of hydrostatic pressure in this preliminary study was seen from their ability to answer the test questions given. When students were asked questions about what quantities affect the amount of hydrostatic pressure at a point in the fluid, as much as 70.45% of students were able to answer correctly. In other words, 29.55% of students still answered incorrectly. Students who answered questions with wrong answers indicated that these students were unable to remember the information conveyed by the teacher when explaining hydrostatic pressure. This condition can affect students' mastery of concepts or relationships between more complex concepts at a higher cognitive level. The low ability of students to remember information conveyed by the teacher is not only caused by a learning process that is not meaningful but also caused by a lack of attention or concentration of students in participating in each activity in learning. Lack of attention or focus of students in paying attention to explanations from teachers can also be caused by learning activities implemented in a class that is not interesting, boring, and lack of student involvement in learning activities (Teacher Centered Learning).

For cognitive level C2 (Understanding), the percentage of student learning achievement is 31.36%. That is, the average percentage of students who can understand concepts or relationships between concepts in the hydrostatic pressure material is only 31.36%. The remaining 68.74% of students do not understand the concept properly or experience misconceptions. The results of this study are in line with the research results of Chen et al. (2013); Radovanovic & Slisko (2013), which state that the material of hydrostatic pressure and buoyancy is quite difficult for students to understand at all levels; many students experience misconceptions. Further, Pratiwi (2013); Suparno (2013); Franciskus (2016); Late et al. (2017); stated that one of the cases that were difficult to understand and the material often had misconceptions among students included the shape of the container and the amount of substance or volume of fluid affected hydrostatic pressure.

Understanding is the ability to construct meaning from what is spoken, written, and drawn or presented graphically by the teacher. Understanding relates to interpreting, exemplifying, classifying, concluding, comparing, and explaining. To determine the level of students' understanding of the concept of hydrostatic pressure, in this preliminary study, students were given several questions (5 questions). One of the questions given to students is; students were asked to determine the ratio of the magnitude of the hydrostatic pressure at the point located at the bottom of the container from three containers filled with water with the same depth but different sizes or volumes.
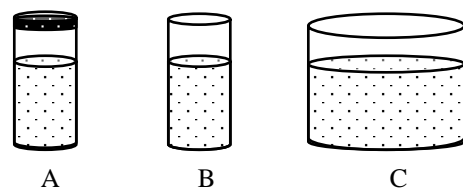

Figure 2. The first question of mastering the concept of cognitive level C2

The number of students who answered this question correctly was only 13.64%. That is; still, as much as 86.36% of students answered with wrong answers. Most students (31.82%) thought that the greatest pressure was at the bottom of container C

because it has the largest cross-sectional area, while the pressure on containers A and B is the same because they have the same cross-sectional area. Another 22.73% of students answered with almost the same answer, that is, the base of container C experiences the greatest hydrostatic pressure because it has the largest cross-sectional area, and the bottom of container A experiences the least hydrostatic pressure because container A is in a closed condition so it does not get pressure from the outside. These answer patterns show a picture of the conceptions in students' cognitive structure. Students assume that the cross-sectional area of the container affects the amount of hydrostatic pressure experienced by a point in the fluid. In addition, the form of students' answers also indicated that some students were still unable to distinguish between hydrostatic pressure and total pressure. This condition is quite surprising considering the percentage of students who can correctly answer when asked questions about the factors that affect the amount of hydrostatic pressure at a point in a fluid is quite large, namely 70.45%. However, it turned out that only 13.64% of the 70.45% of students who memorized the hydrostatic pressure equation understood what they remembered.

The next question is; students are asked to determine the ratio of the magnitude of the hydrostatic pressure at the point located at the bottom of the container of three containers filled with water with the same height and volume, as shown in Figure 3 below.
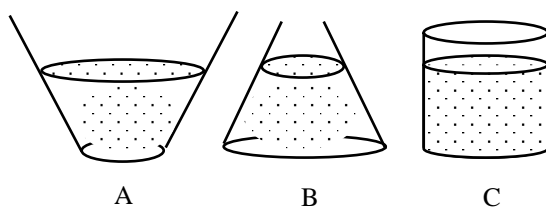

Figure 3. The second question of mastering the concept of cognitive level C2

The percentage of students who can answer this question correctly is quite large, namely 50.00%. This number is almost the same as the number of students who think that the volume of water or the cross-sectional area of the container affects the amount of hydrostatic pressure at a point in the fluid according to the results of data analysis in the previous question (Figure 2)). In this case, the student answered correctly but with the wrong reason. Some students think that the hydrostatic pressure at the bottom of the container is the same because the volume and height of the three containers are the same. This reason is incorrect because the large volume of water does not affect the hydrostatic pressure.

For cognitive level C3 (Applying), the percentage of student learning achievement is 27.73%. That is, the average percentage of students who can apply concepts in solving physics problems is only 27.73%. The remaining 72.17% of students can still not apply the concepts they remember and/or understand. Applying relates to procedural knowledge, which includes carrying out procedures (executing) and implementing (implementing). Carrying out procedures is a cognitive process of students in solving problems where students already know the information and can determine with certainty what procedures must be carried out. If students do not know the procedures that must be carried out in solving problems, students are allowed to modify the standard procedures that have been established. In this preliminary study, students were given several questions (4 questions) to measure students ability to apply the concept of hydrostatic pressure.

One of the questions given to students is; students are asked to determine the amount of hydrostatic pressure at a point at the bottom of the container, as shown in Figure 4.
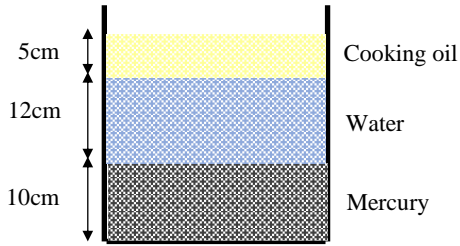
Figure 4. The question of mastering the concept of cognitive level C3

The number of students who answered this question correctly was only 18.80%. That is, as much as 81.20% of students answered with wrong answers. The low percentage of students who were able to answer the correct answers for questions at cognitive level C3 was caused by students' common understanding of the concept of hydrostatic pressure. The common understanding of this concept also impacts students' low analytical skills (cognitive level C4). Based on the data in Figure 2 above shows that only 18.94% of students can answer questions related to the use of analytical skills.

Analyzing is the activity of solving a problem by separating each part of the problem, looking for the interrelationships of each part, and finding out how these linkages can cause problems. Analyzing is related to the cognitive process of distinguishing and organizing. Differentiating involves sorting out the relevant or important parts of a structure. Organizing shows identifying the elements of communication or situation results and recognizing how these elements can produce good relationships. Organizing allows students to build systematic and coherent relationships from the information provided. The first thing students have to do is identify the elements that are most important and relevant to the problem, then proceed to build appropriate relationships from the information that has been provided.

Students were given three questions to measure students analytical abilities. One of the questions given to students is; that students are asked to determine the density of the fluid using the information in the following figure (spring constants and outer cross-section of the piston are known in the problem).
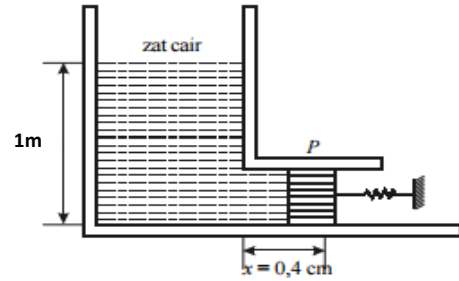

Figure 5. The question of mastering the concept of cognitive level C4

Analytical skills are needed because the solution must combine several relevant concepts to answer the questions above. Only 18.18% of students were able to answer this question correctly. That is, the student's analytical ability is still very low. It needs to be of particular concern to educators who teach in schools.

CONCLUSION

Based on the results of data analysis, it was found that the level of student's mastery of concepts for cognitive level C1 (remembering) was 70.45%, cognitive level C2 (understanding) was 31.36%, cognitive level C3 (applying) was 27.73%, and cognitive level C4 (analyzing) was 18.94%. This student's initial knowledge data can be used to determine the appropriate treatment to optimize the achievement of school learning objectives.

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