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Identifying Pupils' Mental Model of the Day and Night Concept

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Abstract

Many students and even teachers still cannot recognize the relevance of the model to build physical knowledge. The study of mental representations built by students in their interactions with the world, phenomena and artifacts, is an important line of research in science education. Therefore, it is not surprising that analogies play an important role in science education, because the construction of students in mental models of abstract phenomena must be rooted in some existing or previous experiences, to interpret more complex ideas. The purpose of this study is to investigate mental models elementary school students against the phenomenon of day and night. This research is quantitative descriptive. The research subjects were 20 students in grade six. The results showed that 20% of students had a low mental model (LMM), 45% of students had a moderate mental model (MMM), and 35% of students had a high mental model (HMM). Based on the results of the study it can be said that, (1) 20% of students cannot explain the concepts scientifically and students' understanding is at the level of symbolic representation. (2) 45% of students cannot explain the causes of a phenomenon, student understanding is at the level of macrocospic representation, (3) and 35% of students have concepts with understanding based on real-life observations with scientific concepts learned at school and students' understanding is at the level of representation of microcosms.

Keywords: *Mental model, analogy, mental representation*.

1. MAIN SECTION

Children get a lot of knowledge about the world around them during childhood (Carey, 1985). For example, the knowledge of a child with an understanding of their body, or a falling down body, or just looking at a movie about the weight of astronauts in space. The fundamental question about each of their domains of knowledge is these forms of coherent theories and consistent ideas (Vosniadou and Brewer, 1992; Straatemeier et al., 2008), and what their knowledge from a topic can be fragmented until they learn scientific concepts (Vosniadou et al., 2004). The role of mental models here is to explain individual reasoning both when they try to understand and try to explain and predict the behavioral of the physical world. The mental model provides a powerful mechanism for storing knowledge in the human mind. Because the way these structures can affect

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human behavioral, they have a significant impact on almost all forms of human activity (Fazio, 2013). Whereas according to C, C, Silva (2007) states that "Mental models play a core role in science because they are representations of ideas, objects, phenomena or systems. They are also important in teaching science because they are usually assumed to be modelling to build relationships between theory and objects or phenomena that students must learn.

Individual mental models are not easily achieved because individuals may behave inconsistently, but unique mental models to be observed because mental models as mental representations to interpret personal experiences in understanding the physical world of students (Coll 2003). According to Khasanah, Wartono, and Yuliati (2016) said that "Students' learning abilities and difficulties can be identified through descriptions of how students think by analyzing the way a person faces a problem, that person will model in his mind how to conquer problems." Furthermore, Seel et al (2008) say "mental models can be developed by diagnosing the development of mental models. There are eight principles that must be considered in developing mental models, namely: 1. This is embedded in complex problem situations; 2. This is applied in different subject domains; 3. This allows the construction, modification, and reorganization of mental models; 4. Data collection on mental models in elongated designs; 5. Able to show the development of successive mental models to perfect from beginner to expert; 6. Referring to the characteristics of the expert model; 7. It provides valid and reliable quantitative or qualitative data. "

Bao and Warnakulasooriya (2002) state that "complex problems for diagnosing mental models can be presented in the form of isomorphic problems," Furthermore De Cock (2012) states that "Isomorphic problems are problems that have different features but use the same physics concept to solve problems. This isomorphic problem can be presented in several forms of material. "The material in science learning that will be given to students, in the learning process is oriented to the problems of everyday life. The subject of science includes complex problems to diagnose students' ability to solve problems. One of the mental models of the students studied was the phenomenon of day and night.

Singh (2008) said that "Problems can be presented in terms of open items, namely a problem that is seen based on a complex problem, for example about the way someone kicks a ball or throws a stone. The method depends on the individual's level of expertise. "This open item has the ability to reveal a mental model without limiting student expression and thinking of students." night, the mental model will be later obtained from the level of expertise based on the understanding and concepts that the person has.

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Furthermore, Fazio et al (2013) stated that the mental model category was divided into;

Table 1. Categories of mental models

Practical or everyday	Descriptive	Who explained
Reflections on the creation of situational meanings that come from practical, everyday contexts. students use other situations to try to explain what is proposed	Students explain, the characteristics of the process are analyzed by remembering relevant variables, or remembering from the memory of their relationships, revealing in different language ways (verbal, iconic, mathematical). They don't explain the causal relationship of physical parameters involved on the basis of function models (microscopic or macroscopic).	students propose models (qualitative or quantitative) based on the effects of the relationship, and provide a clear hypothesis by introducing a model that can be seen at a theoretical level

Furthermore, in categorizing mental models need to see one's understanding based on the level of representation. Johnston in (Chittlebourough & Treagust, 2007: 274-275) said that "the characteristics of Natural Sciences are based on the level of chemical representation which includes the levels of symbolic, macro, and micro-representation."

1. Macroscopic representation, which can be seen through phenomena that can be seen and seen as a daily experience of students. The nature of the macroscopic representation is real.

2. Microscopic representation, is a level of representation that provides particulate levels. The sub-microscopic is closely related to the theoretical underlying the explanation of dynamics models. Representation models at the level of express can use simple words, two-dimensional images, three-dimensional images either silent or moving (animation) or simulation.

3. Symbolic level (icon) representation to identify entities using symbolic language.

The purpose of this study is to examine the mentality of students against the phenomenon of day and night, by looking at the categorization of mental models.

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2. METHODS

The method that will be used in this research is quantitative descriptive method. The study was conducted on class VI SDN Babussalam students in Pekanbaru city by referring to the 2013 curriculum science learning theme "My Earth" about "Day and Night Phenomena. The question used to identify mental models is with open isomorphic questions. Quantitative data is obtained by categorizing students' answers in three mental models, namely high mental models (HMM), Moderate mental models (MMM), and Low Mental Models (LMM). Classification of mental model categories is seen from the category by fazio et al (2013).

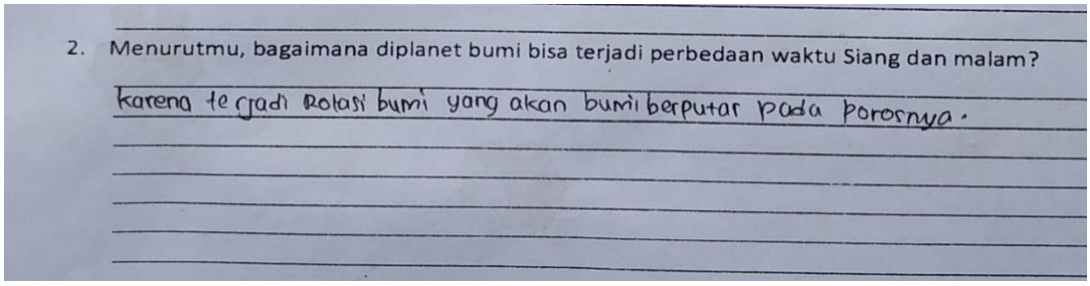
3. RESULTS

Data was collected on class XI students from SD Babussalam Pekanbaru with a sample of 20 students, the topics of the problems studied were related to the 2013 curriculum, theme 8 "My Earth", sub-theme 1 "Differences in time and influence." , the answers to students' understanding.

The results showed that (1) as many as 20% of students with the LMM category, wherein the students' understanding process was at the symbolic level of representation, (2) as many as 45% of students with the MMM category, students who cannot explain the causes of macrocospic representation, and (3) as many as 35% of students with the HMM category, where students can explain the concept scientifically based on observations, this means students have reached the level of microcospolic representation, and concepts in real life.

a. Low Mental Model (LMM)

Student responses to problem solving using LMM are shown in Figure



Translation: 2. Based on your opinion, how can there be a difference in the time of day and night on earth?
because of the rotation of the earth so that the earth rotates on its axis

Figure 1. An example of student's answer in the LMM category

Students who use LMM tenders to respond by giving explanations. However, their explanation is not based on the macrocospic concept. The explanation for answers to students in everyday life. In picture.1 students'

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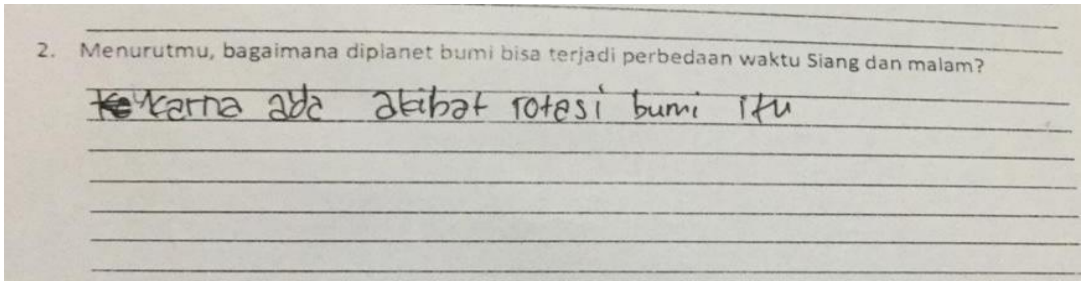
understanding is based on the form of a scientific concept, which is not able to explain the process of the phenomenon.

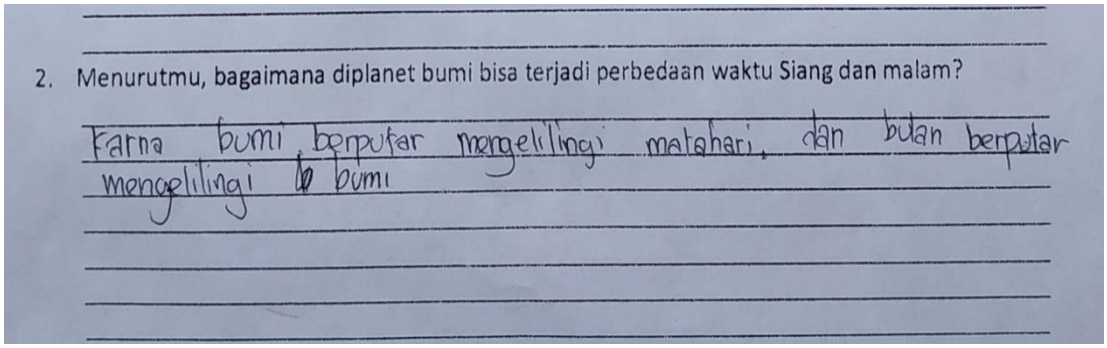


Translation: 2. Based on your opinion, how can there be a difference in the time of day and night on earth?
because there is a result of the rotation of the earth.

Figure 2. An example of student's answer in the LMM category

Students in the LMM are at the level of symbolic representation, where students have not associate their daily problems with the scientific concepts they learn. Mental model Students in the LMM category obtained 20% of 20 samples.

b. Moderate Mental Model (MMM)



Translation: 2. Based on your opinion, how can there be a difference in the time of day and night on earth?
because the earth rotates around the sun and the moon rotates around the earth

Figure 3. An example of student's answer in the MMM category

Categorization of Moderate Mental Models (MMM) is seen based on the category of students explain, the characteristics of the memory process are important variables, or remembering from their relationship memory ,

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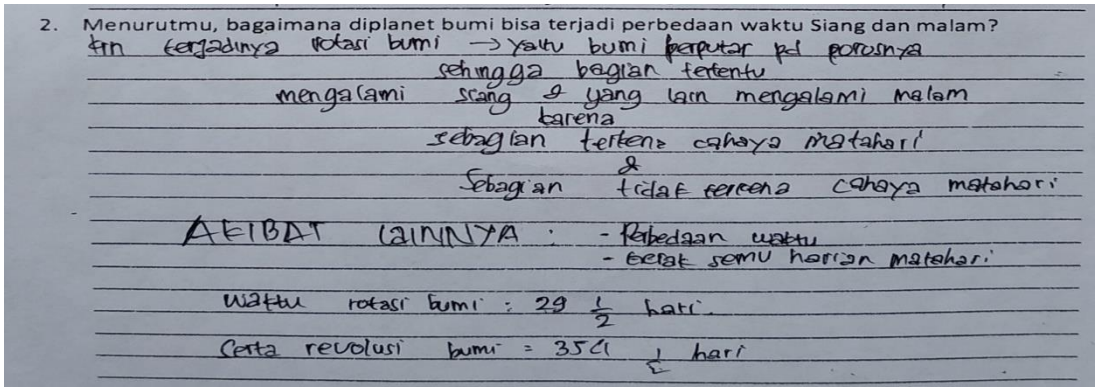
revealing in different language ways (verbal, icon, math). They do not explain the causal relationship of the parameters involved on the basis of function models (microscopic or macroscopic). It can be concluded that students in the MMM category cannot explain the causes and effects of a phenomenon, but they can remember the relations hip between scientific concepts and daily life, but they are not able to explain the causation that occurs. From 20 samples, it was found that 45% of students who had moderate mental models (MMM) were at the macrocospic representation level.

c. High Mental Model (HMM)



Translation: 2. Based on your opinion, how can there be a difference in the time of day and night on earth?
because of the rotation of the earth, that is, the earth rotates on its axis so that it experiences day and others experience night because some are exposed to sunlight and some are not exposed to sunlight.

other consequences : 1.time difference
2.the daily apparent motion of the sun

Figure 4. An example of student's answer in the HMM category

The characteristics of the HMM are: Fazio et al. (2013). Students who have HMM provide information through observation of the concepts learned. Students can explain the scientific answers by linking causation, this means that students have an understanding that connects the pre-concepts they have with scientific concepts learned in their schools so that they are able to solve problems based on scientific concepts.

The response pattern as shown in Figure 4 shows that students can analyze the problem well, students' mental models can be developed (Seel, 2006, Darabiet al, 2009). Isomorphics of problems presented by students can be influenced by mental changes in student models because they are considered

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equivalent by experts (Fazio et al, 2013). In this category, 35% of students have a high mental model (HMM). Students have a scientific concept based on new concepts from the combination of pre-concepts and scientific concepts they have.

4. DISCUSSION

The response pattern as shown in Figure 4 shows that students can analyze the problem well, students' mental models can be developed with mental models from experts when obtaining complete information (Seel, 2006, Darabiet al, 2009). Isomorphics of the problems presented can affect the mental changes in student models because students can use different mental models in response to a series of circumstances or problems that are considered equivalent by an expert (Fazio et al, 2013). In this category, there were 35% of students who had the m model. Conclusions were based on the results of the study, seen from students who had the LMM category, their understanding had not linked the pre-concept of everyday life with the scientific concepts studied in the school, so students could only symbolic remembering the scientific concept without being able to explain it up to the microscopy. Whereas for students who have the MMM category, students can explain the process of a phenomenon scientifically, but students cannot mention the cause and effect based on the parameters that are the function of the model (macrocospic or microcospic). While students in the HMM category, students have been able to explain microcospically, this means that students already have a mental model with new concepts derived from observations with scientific concepts learned in their schools.

5. CONCLUSSION

It is expected that further research students can understand students are able to have an understanding based on microscopic level, so that later students who have LMM can develop into HMM.

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