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**ANALYSIS OF PRIMARY SCHOOL STUDENTS' MISCONCEPTION THROUGH SIX TIER DIAGNOSTIC TEST ABOUT THE CONCEPT OF WATER CHARACTERISTICS**

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**Abstrak**

Sains adalah pengetahuan yang terdiri dari kumpulan konsep. Pemahaman konsep yang salah akan menyebabkan kesalahpahaman pada siswa. Tujuan utama dari penelitian ini adalah untuk menganalisis kesalahpahaman siswa sekolah dasar melalui tes diagnostik enam tingkat tentang konsep karakteristik air. Penelitian ini menggunakan pendekatan kualitatif deskriptif. Data dikumpulkan dengan menggunakan uji diagnostik enam tingkat. Subjek penelitian ini adalah siswa kelas lima sekolah dasar. Berdasarkan hasil analisis data, peneliti menemukan bahwa hampir setengah dari siswa mengalami kesalahpahaman pada konsep karakteristik air termasuk air memberikan tekanan, air sabun membersihkan kotoran berminyak, dan air melarutkan berbagai zat. Instrumen tes enam tingkat diagnostik menunjukkan kesalahpahaman siswa sekolah dasar pada konsep karakteristik air. Beberapa faktor yang menyebabkan kesalahpahaman pada siswa adalah pengetahuan siswa sebelumnya, kesalahan guru, dan kesalahan dalam buku teks.

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**Abstract**

*Science is knowledge consisting of a collection of concepts. The wrong concept understanding will lead to misconceptions in students. The main purpose of this research is to analyze primary school students' misconception through six tier diagnostic tests about the concept of water characteristics. This research used descriptive qualitative approach. Data were collected by using six tier diagnostic test. The subjects of this study are the fifth grade students of primary school. Based on the results of data analysis, researchers found that almost half of the students experience the misconceptions on the concept of water characteristics including water gives pressure, soapy water cleans oily dirt, and water dissolves various substances. The six tier diagnostic test instrument show the primary school students' misconception on the concept of water characteristics. Some factors that cause misconceptions in students are students' prior knowledge, teacher mistaken, and errors in textbooks.*

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## 1. Introduction

Science is an inseparable science in human life. Everything related to human life is always related to science. Science is the study of natural phenomena and material that is arranged systematically and the truth can be accounted for because it can be proven empirically, through the results of observations and experiments [1] [2]. Study about natural symptoms and materiality can produce concepts that are discussed in science learning at school. One natural phenomenon that is the subject of study in science learning is the concept of water.

In science learning, students can have different conceptual understandings. The wrong concept understanding can affect the misconception of the next concept [3]. This misunderstanding is what is called misconception. Misconception is a misunderstanding of the concept that someone has with the real theory. Someone experiences "misconceptions" when they can be meaningfully distinguished from common accepted scientific explanations [4].

Researchers have done a lot of research related to misconceptions that occur in junior and senior high school students [5] [3] [6] [7]. But in this study, researchers focused more on research conducted on primary school students. This research begins with conducting a preliminary study with results showing that students experience misconceptions in the science subject.

The results of the preliminary study indicate that students experience many misconceptions in understanding the concept of water characteristics. Hence, the purpose of this study is to analyze students' misconception in more depth by using a six tier diagnostic test about the concept of water characteristics i.e water gives pressure, soapy water cleans oily dirt, and water dissolves various substances.

There are several methods that can be used to analyze students' misconception [8], namely concept mapping [9], interviews [10], and multiple-choice questions [11] [12]. Beside of the three methods above, researchers can also use questionnaires [13] to analyze students' misconception.

Multiple-choice questions are often more preferable in science classes since they are easy to apply and evaluate students' understanding of the related subject; however, multiple-choice questions have some limitations in applying such as determining whether a student gives a correct response to a test consciously or just by a chance [14]. However, multiple-choice questions have one fundamental weakness: they cannot differentiate correct answers due to correct reasoning from those which are due to incorrect reasoning [15].

Related to that statement, the multiple-choice questions have been developed by researchers to be diagnostic levels of several levels i.e two levels (two tiers) [16] [17], three levels (three tiers) [14], four levels (four tiers) [15] [18] [19], and five levels (five tiers) [20]. Four-tier diagnostic tests are a form of development of multiple choice questions three levels and two levels. Test development is found in increasing the level of confidence and reason students answer [15]. Furthermore, it was developed into a five-tier diagnostic test consisting of multiple-choice test and open reason with three confidence levels, confident, doubtful, and uncertain [20].

The weakness of using five-tier diagnostic tests is researchers can only see students' answers in the form of multiple choice selection, reasoning, and representation of the level of confidence in the answers. While the researcher can obtain data of students' conceptual understanding in a heuristic manner when the students' answer patterns are equipped with answers in the form of image representation. Therefore, the researchers considered the need for additional tiers in the tests given to be a six tier diagnostic test.

In this study, researchers aim to analyze primary school students' misconception by using six tier diagnostic tests. The first level is a multiple choice question with one correct answer. The second level represents students' beliefs in answering. The third level is the explanation of the reason by the student in relation to the answer chosen. The fourth level represents students' beliefs in giving reasons. The fifth level is a representation of

students in the form of images. The sixth level represents students' beliefs in providing image representation.

**2. Method**

This study used descriptive qualitative method to obtain the data on primary school students' misconception about the concept of water characteristics. The subjects of this study are 16 students on grade 5 elementary school consisting of 8 female students and 8 male students. Students chosen to be the subjects of research were students who have got science learning about the material of water characteristics. Data collection was carried out through six tier diagnostic tests. Furthermore, the answers of all students were analyzed and classified into several categories i.e. full understanding, partial understanding, misconceptions, and not understanding.

**3. Results and Discussion**

Students' understanding of the basic concept will influence the understanding of concepts at a higher level. Therefore, it is important for students to have a true and complete understanding of the concept. In science learning, it has been stated that water has various characteristics, three of which are water gives pressure, soapy water cleans oily dirt, and water dissolves various substances.

Analysis of students' conceptual understanding was carried out through the six tier diagnostic tests. Six tier diagnostic test is a form of six-level multiple-choice questions. After giving students a six-tier diagnostic test, the students' answers were coded and classified into four categories (a) understanding the concept: the respondent answered the question correctly, (b) partial understanding: the respondent answered some questions correctly, (c) misconception: the respondent answer with illogical answers with wrong information, (d) not understanding the concept: the respondent gives the wrong answer [20]. Table 1 shows the results of the analysis of students' misconception of water characteristics.

Table 1. Analysis Results of Students' Misconception

No	Indicator	Fully Understanding	Partly Understanding	Misconception	Not Understanding
1	Water gives pressure	18,75%	31,25%	43,75%	6,25%
2	Soapy water cleans oily dirt	12,5%	12,5%	56,25%	18,75%
3	Water Dissolves Various Substances	18,75%	31,25%	43,75%	6,25%
Average Percentage		16,67%	25%	47,92%	10,42%

Based on the average percentage of the table above, it is known that 47.92% of students experience the misconceptions, 25% of students understand the concept partially, 16.67% of students understand the concept fully, and 10.42% of students do not

understand the concept. The average percentage of the results of the analysis of students' misconception can be seen in the pie diagram below.

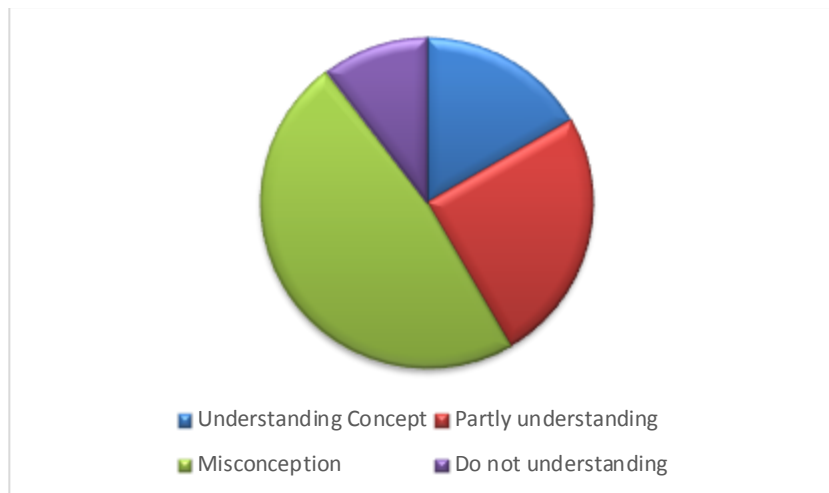


Figure 1. Average Percentage of Result Analysis Students' Misconception

Based on the data analysis performed, the results showed that most students experienced misconceptions. There are factors that cause misconceptions in students, one of which is the personal factor of the student. Children who start learning science in elementary school do not come up with an "empty head", but they have had a lot of prior knowledge based on their experiences in everyday life called the preconception stage [21] [22]. Prior knowledge that students have sometimes tends to be different from the existing scientific concepts, even though some are in accordance with scientific concepts [23] [24]. At the beginning of learning, the teacher is used to asking students' prior knowledge about material that will be studied. From the question and answer activity, it is known that most students have different understanding related to the actual concept. This difference in understanding between knowledge possessed by students and actual scientific concepts is one of the causes of misconceptions. Therefore, it can be concluded that preconception is one of the things that can cause misconceptions in students.

In addition, there are other factors that contribute to the misconceptions experienced by students i.e. the teacher's mistakes to convey knowledge and errors in teaching materials [25] [26] [27]. The teacher's mistakes in conveying the learning material is also one of the factors leading to primary school students' misconceptions. The lack of

using learning model and media in class supports the teacher's difficulties in delivering material, especially related to scientific concepts. Furthermore, textbooks used by students and teachers give the wrong concepts that will make primary school students' experience misconceptions.

"Misconceptions are resistant to change, persistent, well embedded in an individual's cognitive ecology, and difficult to extinguish even with instruction designed to address them" [28]. The lack of understanding and misconceptions that occur in students can have an impact on the misunderstanding of the actual concept at a later stage. Students' misconceptions cause negative results for them to understand scientific facts correctly [29].

**4. Conclusion**

The six tier diagnostic test instrument show the conceptual understanding of primary school students on the water characteristics concept classified into four categories i.e. full understanding, partial understanding, misconception, and not understanding. The results show that almost half of students experience misconceptions on the concept of the water characteristics which includes water gives pressure, soapy water cleans oily dirt, and water dissolves various substances. There are some factors that cause primary school students' misconceptions i.e. students' prior knowledge, teacher's mistakes, and

textbooks. Misconceptions that occur in students can lead to misunderstanding on the next material.

Based on the result and the conclusion, the researchers recommends for further study to identify the factors that cause misconceptions in more depth. The identification process can be done using interview and observation techniques.

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