Analysis of Students’ Misconception Based on the Use of Learning Objectives in Classification of Materials and Their Properties

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Abstract. The objectives of this study are to: (1) know the percentage of students’ misconception on materials and their properties in terms of the use of learning objectives at junior high school, (2) know the flaws of learning objectives that lead to students’ misconception and (3) be the supportive material from learning objectives. This study was carried out using descriptive-quantitative research method. The technique of collecting data was done by interview. The conclusions of this study were: (1) percentage of student’ level of understanding of classification of material and their properties was 38.43% for distinguishing elements, compounds, and mixtures indicator; 52.31% for distinguishing homogeneous and heterogeneous mixtures indicator and 48.71% for distinguishing physical or chemical changes indicator, (2) the components in the book were not complete because there was no indicator of competency achievement and (3) there is a conceptual error in writing hydrogen elements as a semilogical element, some confusing sentences lead to different interpretations and less depth in material presentation of learning objectives lead to students’ misconception as students’ concepts different from experts from material and language content.

1. Introduction

Education in Indonesia at its time requires a discussion in the field of learning in order to improve the quality of education and anticipate the weaknesses of conventional learning, so the combination of learning methods, learning resources, and learning media should be better. Learning is something that are external and intentionally designed to support the occurrence of internal learning processes in individuals. This is in line with the explanation who stated that learning is a process that is intentionally designed to create learning activities in individuals in certain condition and environment [1]. Teaching materials as learning objectives are an important requirement in the teaching and learning process because the presence of proper teaching materials can lead to good learning so that proper and correct can be held. Teaching materials can be interpreted as all forms of material arranged systematically that allow students to learn by designing according to the applicable curriculum [2]. Technically, learning objectives can be designed as a representation of the explanation of the teacher, lecturer, or instructor in front of the class in addition to acting as a guideline for learning activities including targets and means to be achieved. Information, descriptions, and messages that should be delivered and information that should be presented can be collected in learning objectives. Teaching and learning objectives have various types, both printed and non-printed. Printed teaching materials that are often encountered include handouts, books, modules, brochures, and
student worksheets. Teaching and learning objectives must contain proven experience as well as students’ interests and needs. The latter gives the implication that schools need to create emergency curriculum to meet students’ interests and needs. Learning objectives for students cannot be taken solely from textbooks classified in the form of strict disciplines and provide stimulation to children to experiment. One of the subjects in the teaching and learning objectives is science subjects. Science learning aims to develop curiosity and a positive attitude towards science, technology and society. In science learning, there are still many students who do not understand the contents of the material that already exists in the book, even many science books are still incomplete. It is not clarified with images so that students experience problems in understanding the material and there is still material that is not in accordance with the concepts described, giving rise to misconceptions in the material. These students are said to experience misconceptions, if the conceptions students have are not in accordance with the conception of scientists [3]. Misconception is the source of students’ difficulties in learning science. Learning that does not consider students’ initial knowledge lead to more complex and more stable misconceptions. Misconceptions are seen as important inhibiting factors for students as equal as teachers in learning and teaching science [4]. The importance of the misconception problem is the solution by analyzing teaching materials so that students further enhance their broader insights. If we observe today, there are so many teaching books that are widely circulated, whether they are books published by the government or the private sector. But currently there has never been a deeper study of the content in the teaching materials.

2. Experimental Method

This study was carried out using descriptive-quantitative research method to know the percentage of students’ misconception on materials and their properties in terms of the use of learning objectives at junior high school, know the flaws of learning objectives that lead to students’ misconception and be the supportive material from learning objectives. This type of research was a case study. This study used descriptive-quantitative analysis techniques. Descriptive-quantitative analysis was done by analyzing and presenting facts systematically so that it was easier to understand and conclude. By giving a review or interpretation of the data obtained, the results become clear and meaningful compared to just the numbers. In this study, researchers only use primary data. Primary data is data that is obtained or collected directly from the object of research by the person conducting the research. Primary data is also called original data or new data. The primary data to be obtained were data on the analysis of teaching materials as well as data on the percentage level of students in understanding the concept. The research subjects in this study were students’ learning objectives of class VII SMP / MTs in Natural Science subjects published by the Ministry of Education and Culture 2016 within 3rd chapter namely classification of material and their properties.

2.1 Data collection technique

2.1.1 Interview

The interview is a method of collecting answers or information that is done by giving respondents direct questions related to the problems [5]. Interviews were conducted on classroom teachers who taught Natural Sciences subjects to obtain information on the quality of Natural Sciences teaching materials as learning objectives. Interviews were noted through the documents during the process as the results.

2.1.2 Data analysis technique

Interpretation of data in this study was started from the beginning until the end of data collection. Interpretation of data was needed to help researchers to describe the events or situations that take place in the class overcome by researchers when conducting research. Data from the results of research in the field were processed and analyzed descriptively and qualitatively using statistics and numerical interpretation.
3. Result and Discussion

3.1 Results

Table 1. Students’ Learning Achievement

| No. | Indicator                                                   | Percentage (%) |
|-----|------------------------------------------------------------|----------------|
| 1   | Distinguish elements, compounds and mixtures               | 38.43          |
| 2   | Distinguish homogeneous and heterogeneous mixtures        | 52.31          |
| 3   | Distinguish physical / chemical changes from changes in substances | 48.71          |

Table 1 showed that students’ learning achievement on materials and their classification were defined through three sub-chapters, including: distinguish elements, compounds and mixtures; distinguish homogeneous and heterogeneous mixtures; and distinguish physical / chemical changes from changes in substances. Based on the results, the highest percentage of students’ learning achievement was on sub-chapter distinguish homogeneous and heterogeneous mixtures.

3.2 Discussion

This study was carried out to determine students’ misconception. Misconceptions were caused by several things: 1) students, 2) teachers, 3) textbooks, 4) contexts, and 5) teaching methods [6]. It can be seen from the results of the learning outcomes based on students’ learning achievement percentage. In this study, the causes of misconceptions in terms of teaching materials used in learning. Teaching materials used in schools that are observing by researchers are students’ book published by the Ministry of Education and Culture in 2016.

In the students’ book published by the Ministry of Education and Culture in 2016, it does not contain indicators developed so that it cannot be compared between the ones in the book with the curriculum 2013 curriculum due to the main competence and fundamental competence contained in the syllabus. Regarding the material contained in the book, it is in accordance with the syllabus, only the material contained in it is not very deep in the explanation so that sometimes the concepts listed in the book do not reach the reader who are students. This is also reinforced by interviews with teachers who explained that the book used as a learning resource was less profound in discussing the concept of classification of materials and their properties so that students often experience misconceptions in certain sub-sections which is to distinguish elements, compounds and mixtures.

Concept is a series of statements, ideas that are interrelated about various events and become the basis / guidance in conducting research. Based on Table 1, it is known that there are several indicators on material classification and changes that students still do not understand the concept or can experience misconceptions in it [7]. To be able to find out about misconceptions or not concept understanding, researchers interviewed a number of students to ensure that these students really experienced misconceptions. These indicators include the following:

3.2.2 Distinguish elements, compounds and mixtures

In this section, it is known that only 38.43% of students have completed the indicator while the rest still do not understand or experience misconceptions. 52% of students have still experienced misconceptions due to the concept of distinguishing elements, compounds, and mixtures [8]. In this book, there is a sentence that makes students experience misconceptions in distinguishing between elements and compounds, namely in terms of compounds, meaning that it is a single / pure substance that can be broken down into two or more simpler substances. This understanding indicates that compounds with elements are the same, namely the same and single substance together, this is what often makes students experience misconceptions in distinguishing the two. To make students not confused in distinguishing it, it can be written that elements are substances that cannot be broken down into simpler substances, whereas compounds are substances that consist of two or more elements [9]. Eliminating a single word from the previous understanding can make students understand more. The concepts in chemical science materials are presented in three levels, namely
macroscopic, submicroscopic, and symbolic levels [10]. According to Johnstone, a proper understanding of the concept on chemistry can be achieved if students are able to link the three levels of understanding [11]. If not, students will experience confusion in understanding a concept and do not rule out the possibility that students will construct alternative concepts to make it easier to understand the real concept. The formation of alternative concepts shows that there are real differences in the individual in understanding reality and experience [12]. There are also fewer examples in the book. In this part of the book, especially in the periodic part of the element, there are conceptual errors, namely the element hydrogen is a semi-metallic element. Semilogam elements are elements that have a suffix between metals and non-metals. In this case the element hydrogen is a nonmetallic element because hydrogen is gas and does not have metal properties in it [9]. This concepts error or alternative concepts are very dangerous because it includes a basic concept. If students experience misconceptions in one of the basic concepts, then the possibility of the emergence of misconceptions in more complex concepts will be even greater as long as they learn science both in contextual way or theoretical [13].

3.2.3 Distinguish homogeneous and heterogeneous mixtures

Indicator to distinguish homogeneous and heterogeneous mixtures has been observed too. Based on the results of the daily test, it is known that the percentage of indicator completeness is 52.31% of students. For this indicator, the percentage is greater than the indicator distinguishing elements, compounds, and mixtures. Approximately 34% of students still experience misconceptions in this indicator [8]. In this section, the contents of the book are still not very detailed, what is a homogeneous mixture and what is a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole. The location of misconceptions that occur here based on interviews with students is that students are still confused in distinguishing between homogeneous and heterogeneous mixtures, as one example of the wrong concept here is that the mixture of water and salt is a suspension. Suspense itself belongs to a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole. The location of misconceptions that occur here based on interviews with students is that students are still confused in distinguishing between homogeneous and heterogeneous mixtures, as one example of the wrong concept here is that the mixture of water and salt is a suspension. Suspense itself belongs to a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole. The location of misconceptions that occur here based on interviews with students is that students are still confused in distinguishing between homogeneous and heterogeneous mixtures, as one example of the wrong concept here is that the mixture of water and salt is a suspension. Suspense itself belongs to a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole. The location of misconceptions that occur here based on interviews with students is that students are still confused in distinguishing between homogeneous and heterogeneous mixtures, as one example of the wrong concept here is that the mixture of water and salt is a suspension. Suspense itself belongs to a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole. The location of misconceptions that occur here based on interviews with students is that students are still confused in distinguishing between homogeneous and heterogeneous mixtures, as one example of the wrong concept here is that the mixture of water and salt is a suspension. Suspense itself belongs to a heterogeneous mixture. It can be further deepened by providing differences from each one so that students here as readers can understand the whole.

3.2.4 Distinguish physical / chemical changes from changes in substances

In this indicator, the percentage of completeness is 48.71%, which means that only about 48.71% of students have completed the indicator. The rest are still do not understand the concept and happen to experience misconceptions. Misconceptions occur because students assume that all changes in the form of substances produce new substances even though this is not true because the changes in the form of substances, the constituent elements remain the same as the original substances, but only change their form. After seeing the location of the misconceptions in this indicator section, the researcher then looked at the contents of the book in the sub section of the physics and chemical changes. It is known that the contents of the material in it are good because they are presented with experiments that require students to conduct the experiment, so the learning process has gone well because here students experience their own learning experiences. It's just that here it is not explained as to why the process of changing matter includes physical changes. Students are sometimes still confused about the concept, they assume that the evaporating process is a change in the form of a substance from water to steam. Students argue that water and steam here are different substances, whereas between water and steam here are the same substances, namely water, it's just a different form, one in the form of a liquid while when it has undergone the process of evaporation into gas.
4. Conclusion
The conclusions of this study were: (1) percentage of student’ level of understanding of classification of material and their properties was 38.43% for distinguishing elements, compounds, and mixtures indicator; 52.31% for distinguishing homogeneous and heterogeneous mixtures indicator and 48.71% for distinguishing physical or chemical changes indicator, (2) the components in the book were not complete because there was no indicator of competency achievement and (3) there is a conceptual error in writing hydrogen elements as a semilogical element. Some confusing sentences lead to different interpretations and less depth in material presentation of learning objectives lead to students’ misconception as students’ concepts different from experts from material and language content.

References
[1] Pribadi, B.A 2010 Model Desain Sistem Pembelajaran (Jakarta: Dian Aksara)
[2] Lestari, I 2013 Pengembangan Bahan Ajar Berbasis Kompetensi : Sesuai dengan Kurikulum Tingkat Satuan Pendidikan (Padang : Akademia)
[3] Tayubi, Y R 2005 Jurnal Mimbar Pendidikan 3 5
[4] Suratno, T 2007 Peranan Konstruktivisme dalam Pembelajaran dan Pengajaran Sains Seminar Internasional Pendidikan IPA FITK UIN Jakarta
[5] Norman K D & Yvonna S L Eds 2000 Handbook of Qualitative Research Terj oleh Dariyatno 2009 (Yogyakarta: Pustaka Pelajar)
[6] Suparno, P 2013 Miskonsepsi dan Perubahan Konsep dalam Pendidikan Fisika (Jakarta: Gramedia Widiasarana)
[7] Handhika J, Cari C, Suparmi S and Sunarno W 2015 Int. Conf. on Math. Sci. and Ed. 4 34-37
[8] Tuysuz, C 2009 Journal Scientific Research and Essay 4 626 - 31
[9] Brady, J 2005 Kimia Universitas (Tangerang: Binarupa Aksara)
[10] Nahum. T.L., Hofstein, A., Naaman, R.M., dan Bardov, Z 2004 Can Final Examination Amplify Students’ Misconception in Chemistry? Chemistry Education: Research and Practice 5 (3): 301-25.
[11] Rahayu, S & Kita, M 2010 International Journal of Science and Mathematics Education (8) 667 - 88.
[12] Marton, F. 1981. Phenomenography – Describing Conceptions of the World Around Us. Instructional Science 10: 177-200.
[13] A’yun, Q., Harjito, Nuswowati, M 2018 Jurnal Inovasi Pendidikan Kimia. 12 : 2108 - 17.
[14] Setyarini, L. W 2012 Jurnal Teknik Pomits 1: 1-5.