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Analysis of The Ability to Understand the Basic Law of Chemistry for Science High School Students

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Abstract

This study aimed to describe the student's capability of grade XI Science at SMA 3 Palu in understanding Fundamental Chemical Laws. This study was a qualitative descriptive study. The sample was students in the class XI Science 7, which amounted to 29 students, and XI Science 8, which amounted to 31 students. The sample was determined based on non-probability sampling with a purposive technique based on the suggestions from the chemistry teacher that the two classes were homogeneous. Data were obtained from the six tests of students' understanding of fundamental Chemical Laws consisting of six essay questions and supported by the interview results. Respondents for the interview were six students based on the categorization of high, medium, and low scores, which were obtained from calculating the average score of students and standard deviation. The results showed that the capability to understand fundamental Chemical Laws of students of grade XI Science at SMA 3 Palu, which was included in the high category, was the ability to interpret as much as 79.58%, and included in the excellent category was the ability to classify as much as 56.25%. In contrast, those in the low category could exemplify, conclude, compare, and explain, with as much as 30%, 24.58%, 32.08%, and 40.42%, respectively.

Keywords: Students' understanding, fundamental chemical laws

Introduction

The primary purpose of education is to improve student achievement. According to constructivism, learning is a cognitive process and occurs through the construction of knowledge in the mind of the learner (Bodner, 1986). Learning is a series of activities carried out consciously by a person and results in changes in him in the form of additional knowledge or semi-permanent skills (Ristiyani & Bariah, 2016). Studying chemistry emphasizes mastering concepts and solving chemistry problems and calculations ((Aulia et al., 2017).

Chemistry is one of the branches of Natural Sciences that is very important, has a direct relationship, and contributes to the development of other sciences (Allo et al., 2010). Chemistry is a science whose primary purpose is to describe and explain chemical changes ((Hesse & Anderson, 1992). Chemistry studies the structure, properties of matter, the evolution of one material into another, and the energy that accompanies these changes (Kurniawati et al., 2017). The chemistry study covers many things, including the properties of substances, the structure of meanings, and changes in substances, which are chemical reactions, laws, principles, concepts, and theories. The study material consists of ideas that are interconnected with each other (Norjana et al., 2016)

Chemistry learning is directed at a scientific approach where science process skills are carried out through experiments to prove a truth. Based on experience, they directly form the concepts, principles, and theories that underlie them (Magdalena et al., 2014). According to Zidny et al. (2015), chemical phenomena can be explained by three levels of representation: macroscopic, sub-microscopic, and symbolic. An in-depth understanding of chemistry will be obtained by connecting each level of these representations (Jansoon el at., 2009).

Ishartono et al. (2015) said that some of the factors of learning chemistry seem challenging to learn; namely, the concepts in chemistry are abstract, and the concept of learning chemistry has a unique vocabulary where studying chemistry is like learning a new language. Wasonowati et al.

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(2014) explained that these difficulties could impact students' understanding of various chemical concepts because abstract facts are explanations for facts from concrete concepts. Therefore, learning chemistry requires a basic understanding of the material to solve chemistry problems.

Stylianides & Stylianides (2007) said that in learning, the ability to understand is a part that is increasingly being considered by many academics and is a goal (goal) for all students/students in each subject or course. Chemistry is considered complex, abstract, mathematical, and only for bright students because chemistry has a unique vocabulary, mathematical calculations, and representations unique to the discipline (Lansangan et al., 2018). It can be an obstacle for students in studying chemistry. Nirmalasari (2011) said that the existence of learning barriers is an obstacle experienced by a person, so it is challenging to understand learning and unable to achieve the learning objectives.

Understanding can be defined as the ability to absorb/capture the meaning and meaning of the material/material being studied (Nirmalasari, 2011). According to Sudjana (1995), understanding is the result of learning; for example, students can explain in their sentences what they read or hear, give examples from what the teacher has exemplified, and use application instructions in other cases. Understanding the material is the main requirement for a student to master learning (Surgandini & Sulistiawati, 2018). Understanding can be abstracted as a basis for obtaining problem solving skills, creative and critical thinking, and decision-making (Elisa et al., 2017). Understanding is the basis for students to build their insight. From the description, it can be seen that the understanding process is very important in understanding chemistry, which is mostly abstract.

Lamalat et al. (2018) revealed that the fundamental law material of chemistry is one of the materials that is still considered difficult for students to understand because this material is abstract and mathematical. The subject matter of the fundamental laws of chemistry is material in the form of combining mathematical concepts and calculations, so a high way of thinking and analysis is needed to build and relate the given legal concepts. Carolin et al. (2015) said that the fundamental law of chemistry is one of the abstract and mathematical materials of chemistry, so understanding the basic rule of chemistry students is still considered difficult for students. This material is essential because the concepts in the fundamental laws of chemistry will be used to study the material for chemical calculations.

Susanto et al. (2012) argued that the fundamental laws of chemistry are problematic for students because they are abstract, concrete, and mathematical. They were indicated by 47.48% of class X students of SMAN 2 Karanganyar in the 2010-2011 academic year who did not complete the daily test of the fundamental laws of chemistry. Observations made at SMA Negeri 3 Palu during the Introduction to the Schooling Environment (PLP), the fundamental law of chemistry is also considered difficult for students. Based on the test scores for the fundamental law of chemistry class X MIA 5 SMAN 3 Palu for the 2016/2017 academic year, the completeness of the material is only 65.35%. As many as 20.58% of students are incompleteness; the data is still below the KKM, 71.

Based on the description above, it is crucial to analyze students' ability to understand chemistry learning materials. A basic understanding of students is needed to know the characteristics of student learning and help educators formulate how to instill good chemical concepts in students. One of the materials that require a good understanding of students in chemistry is the material of the fundamental laws of chemistry because this material is one of the foundations of stoichiometric calculations in chemistry.

This paper is intended to describe the ability to understand the primary legal material of chemistry in class XI MIA SMA Negeri 3 Palu.

Methods

The type of research used in this research is descriptive qualitative. The population in this study were all class XI MIA SMA Negeri 3 Palu students in the 2018/2019 academic year who had followed the fundamental law of chemistry. At the same time, the sample is class XI MIA 7, totaling 29 students, and XI MIA 8, counting 31 students. Sampling in this study was determined based on non-probability sampling with a purposive sampling technique in which the sample of data sources with specific considerations. This consideration is based on the chemistry teacher's suggestion to choose classes XI MIA 7 and XI MIA 8 because they have homogeneous abilities (Sugiyono, 2017).

The technique for determining interview respondents is obtained from the conceptual understanding test results by dividing the respondents into the following three value categories.

Table 1. Category of determining interview respondents

Value Category	Value Range
High	Score >$\bar{x}$ + SD
Currently	$\bar{x}$ – SD ≤ score ≤ $\bar{x}$ + SD
Low	Score <$\bar{x}$ – SD

(Sudjana, 1995)

Then two students were taken randomly from each category of the high, medium, and low scores for interviews. The interview technique in this study is a guided interview.

The data in this study were obtained through a test of understanding the fundamental law of chemistry. The test is in the form of an essay with six questions and has been validated. The test is prepared based on the understanding indicators by Anderson et al. (2001) Bloom's Taxonomy revision. Those indicators are; interpreting, exemplifying, classifying, inferring, comparing, and explaining. The research data are processed or analyzed using descriptive analysis methods.

Results and Discussion

Students' answers to the test of understanding the fundamental law of chemistry were analyzed based on the student's understanding level category in **Table 1**. The category of student understanding is calculated based on the formula:

$$\% = \frac{Gain\ score\ per\ indicator}{total\ score\ per\ indicator}\ x\ 100$$

Table 2. Criteria for the percentage of students' understanding indicators

Value Criteria (%)	Student Understanding Category
80-100	Very high
60-80	High
40-60	Enough
20-40	Low
0-20	Very low

(Arikunto, 2009)

The results of the analysis of student answers are presented in **Table 3** and **Figure 1**.

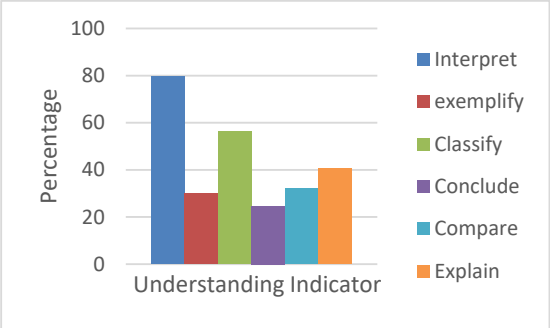

Figure 1. Percentage of student understanding of each indicator

The value obtained from the percentage is used to measure students' conceptual understanding ability by analyzing the achievement of 6 indicators of conceptual understanding. The results of the analysis are presented in **Table 3**.

Table 3. Percentage of students' ability for each indicator of concept understanding

No. Question	Concept Understanding Indicator	Percentage (%)	Ability Category
1	Interpret	79.58	high
2	exemplify	30	low
3	Classify	56.25	good
4	Conclude	24.58	low
5	Compare	32.08	low
6	Explain	40.42	low

This study only took six indicators of student understanding from seven indicators of knowledge that had been revised by Anderson et al. (2001), namely the ability to interpret, the ability to give examples, the ability to classify, the ability to conclude, the ability to compare and the ability to explain. The analysis results regarding students' understanding ability of the primary legal material of chemistry measured based on six indicators of understanding.

Interpreting ability

The interpreting category is presented in question 1; the average student understanding is 79.58%, which shows the ability to interpret students in the high category. Based on the answer sheets and interviews with respondents that have been carried out, it can be seen that students have the ability to understand the concept of interpreting owned by respondents in the high, medium, and low score categories.

Modeling ability

The excellent category is presented in question number 2; the average student understanding is 30%, which indicates that the student's exemplary ability is included in the low category—owned by high-value category respondents.

Classification ability

The classifying category is presented in question number 3; the average student understanding is 56.25%, which shows that the student's ability to classify is included in the excellent category. Based on the answer sheets and interviews with respondents that have been carried out, it can be seen that students have the ability to understand the concept of classifying the respondents in the high and medium grade categories.

Concluding ability

The concluding category is presented in question number 4; the average student understanding is 24.58%, which indicates that the student's ability to conclude is included in the low category. Based on the answer sheets and interviews with respondents that have been carried out, it can be seen that students have the ability to understand the concept of concluding that the respondents are in the high category.

Comparing ability

The comparison category is presented in question number 5; the average student understanding is 32.08%, which indicates that the student's ability to compare is included in the low category. Based on the answer sheets and interviews with respondents that have been carried out, it can be seen that students have the ability to understand the concept of comparing, which respondents own in the high-value category. However, only 4 out of 10 students are pretty correct in giving mass comparisons.

Ability to explain

The explaining category is presented in question number 6. The average student understanding is 40.42%, which indicates that the student's ability to explain is included in the low category. Based on the answer sheets and interviews with respondents that have been carried out, it can be seen that students have the ability to understand the concept of explaining respondents own that in the high-value category.

Conclusion

Based on the analysis results, it can be concluded that the ability to understand the fundamental law material of chemistry in class XI MIA SMA Negeri 3 Palu is included in the high category with the ability to interpret 79.58%. The ability to classify 56.25% is included in the good category. While those included in the low category are the ability to give examples, conclude, compare, and explain, with the percentages being 30, 24.59, 32.08, and 40.42 %, respectively.

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