DESCRIPTION OF STUDENTS LEARNING DIFFICULTIES IN THE BASIC LAW OF CHEMISTRY

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Abstract: This study aims to determine the percentage of learning difficulties and describe the factors that cause learning difficulties for class X students in the 2021/2022 academic year at SMAN 15 Padang studying the fundamental law of chemistry. The research was descriptive. This research gave a four-tier diagnostic test of 19 questions representing seven learning indicators. In addition, to reveal the causes of students' learning difficulties, a questionnaire consisting of 28 questions was given that represented nine aspects of the causes of students' difficulties, both from internal and external factors. The data obtained in this study were analyzed using descriptive analysis. The results of the research data analysis showed that the students of class X 7 SMAN 15 Padang had learning difficulties, with a high category of 71.1%. And the results of the questionnaire data analysis that caused students' learning difficulties were 62.2%. The highest level of student learning difficulties is found in the 4th indicator of 83.3%, with a very high category. Meanwhile, the lowest level of student learning difficulties is found in the 6th indicator, 52.8%, with a reasonably high category. The factors that cause students' learning difficulties in the basic law of chemistry are seen from internal and external factors, which consist of 9 aspects. The most influential aspect is the family environment of 70.3%, and the lowest aspect is student learning time of 50.0%. The most influential internal factors are the aspects of students' motivation and interest in learning, which are 66.7% and 61.8%, respectively. Family and social environment are the most influential external factors on student learning outcomes, amounting to 70.3% and 64.6%, respectively.

Keywords: *Basic Laws of Chemistry, Learning Difficulties, Diagnostic Tests*

INTRODUCTION

Learning is an activity that can be done as long as humans are still alive. Learning is a process that occurs internally within each individual [1]. Learning is a process or effort carried out by an individual to achieve an increase in quality and quantity as a result of the experience of interacting with the environment [2].

In the learning process, there are obstacles experienced by students, one of which is obstacles in the problem of student learning difficulties. Learning difficulties are deficiencies that do not appear scientifically [3]. Learning difficulties can be defined as a child's inability to cope with the tasks given by the teacher [4]. The existence of learning difficulties and obstacles experienced by students will have an impact or can be seen from the learning achievements achieved by the students concerned [5].

One of the branches of natural science taught in high school (SMA) is chemistry. Chemistry is a part of natural science that studies the composition and properties of matter [6]. Chemistry is one of the natural science subjects that seem complicated because some concepts in chemistry are abstract, so it requires a correct understanding of the basic concepts of chemistry that play a role in higher-level concepts [7]. Chemistry learning is more focused on mastering very many concepts. The main difficulty faced by many students is the demand to master abstract concepts [8]. Many factors make chemistry difficult, including the lack of students' understanding of chemical concepts and many abstract chemical concepts [9].

Basic Law of Chemistry is one of the materials in the chemistry subject studied in the even semester of class X SMA/MA. The characteristics of the basic concepts of chemistry are concepts that are concrete to abstract concepts [10].

Based on the results of interviews conducted with chemistry teachers at SMAN 15 Padang, it is stated that the learning material in class X that students have the most difficulty understanding is the Basic Law of Chemistry material. It can be seen from the results of student learning on the basic law material of chemistry in the following 2020/2021 academic year.

Table 1. Average Daily Test Results of Chemical Basic Law Students of Class X SMA N 15 Padang TP 2020/2021

No	Class	Average UH Value	% of Students below KKM
1.	X IPA 1	72.82	58.97%
2.	X IPA 2	66.94	87.5%
3.	X IPA 3	67.88	69.32%
4.	X IPA 4	68.49	50%
5.	X IPA 5	70.45	58.97%
6.	X IPA 6	53.42	73.68%

(Source: Chemistry teacher at SMAN 15 Padang)

Based on student learning outcomes in the basic law of chemistry, as shown in Table 1. students still

do not meet the specified Minimum Completeness Criteria (KKM), which is 80. 66.52% of class X students at SMAN 15 Padang in the 2020/2021 academic year did not meet the Minimum Completeness Criteria (KKM) standard on the daily test of basic chemical law. The number of students who score below the KKM indicates that students have learning difficulties, so student learning outcomes become less than optimal, which causes students' scores to be below the KKM.

Several factors cause the difficulties experienced by students in the learning process. It can be seen that two factors cause learning difficulties in students, namely internal and external factors [11]. In addition, the factors that cause student learning difficulties are viewed from internal factors, namely interest, and motivational factors. In contrast, external factors are family, school, community, and chemical material [12]. The factors that cause students to experience difficulties are internal factors, namely the lack of interest and motivation in learning for students. In contrast, external factors are the lack of variety of media and learning methods [13].

One of the methods that can be used to identify learning difficulties in students is to use diagnostic tests. A diagnostic test is a test to detect the presence or absence of signs in learning (understanding concepts, misconceptions, not understanding concepts) [12]. Diagnostic tests are used to find out what learning difficulties are being faced by students, one of which is in understanding the concept of error [14]. A questionnaire can be used to determine the causes of students' learning difficulties from internal and external factors [15]. Questionnaires have similarities with interviews, but what distinguishes questionnaires from interviews lies in their implementation. Questionnaires were written, while interviews were conducted orally [16].

Based on this, the researchers were interested in describing the learning difficulties experienced by class X students at SMAN 15 PADANG on the basic law of chemistry, so that appropriate solutions could be found to help students overcome their learning difficulties. Therefore, the researcher intends to make it happen by conducting a study entitled "Description of Student Learning Difficulties in Basic Law Materials for Chemistry Class X SMAN 15 Padang".

RESEARCH METHODS

The type of research used in this study is descriptive research, which describes the learning difficulties experienced by class X students at SMAN 15 PADANG on basic chemical law material. This study has only one research variable, namely the independent variable (independent variable). The independent variable in this study is

the learning difficulties of class X students of SMA 15 Padang regarding the basic law of chemistry.

The research instrument used in this study is a four-tier diagnostic test that previous researchers have made. A closed-ended questionnaire in which the respondent can put a checkmark on one of the four answer choices provided to obtain data on the difficulty of learning chemistry experienced by class X students of SMAN 15 Padang in the basic law of chemistry material in 2021/2022.

The research data will be analyzed using descriptive analysis. To determine the percentage (%) of learning difficulties experienced by students can be determined using the following formula

$$P = \frac{\text{Total Score}}{\text{Maksimum Score}} \times 100\%$$
$$\%K = 100\% - P$$

Description:

P = percentage of students who do not have learning difficulties for each question indicator

%K = percentage of students who have learning difficulties for each question indicator [17].

Table 2. Criteria for Learning Difficulties

Criteria	Percentage
Very high	81-100%
High	61-80%
Fairly high	41-60%
Low	21-40%
Very low	0-20%

[18]

Table 3. Guidelines for determining the level of understanding students

Category	Answer Type			
	Answer	CRI	Reason	CRI
Understand Concept	Benar	≥3	Benar	≥3
Not Understand Concept	True	≥3	True	<3
	True	≥3	False	<3
	True	<3	True	≥3
	True	<3	True	<3
	True	<3	False	<3
	False	≥3	True	<3
	False	≥3	False	<3
	False	<3	True	<3
	False	<3	False	<3
Misconceptions	True	≥3	False	≥3
	True	<3	False	≥3
	False	≥3	False	≥3
	False	<3	False	≥3
Error	False	≥3	True	≥3
	False	<3	True	≥3

Description: ≥3 = Sure, <3 = Not Sure [19]

The results of student answers can be grouped using a combination of instrument answer formats

diagnostic test four-tier multiple choice. This combination is measured by reviewing students' answers and confidence levels that have been adjusted according to the Arikunto criteria scale as follows (table 3).

The questionnaire used in this study has four categories, namely Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). Score on the questionnaire results in a positive score based on a Likert Scale ranging from 4 to 1. And a negative score on a scale of 1 to 4 [20].

Quantitative analysis of the questionnaire expressed the results as a percentage by comparing the number of scores obtained by respondents with 100%. Processing research data using statistical analysis using the percentage formula as follows:

$$P = \frac{\sum F}{\sum N} \times 100\%$$

Description: P = Percentage
$\sum F$ = Respondent's Answer Score
$\sum N$ = Total Score [21].

RESULTS AND DISCUSSION
Description of Research

Data on student learning difficulties were obtained based on the results of diagnostic tests given to students of class X 7 SMA N 15 Padang, totaling 36 students. The results of student diagnostic tests are categorized into four groups, namely 1.) Students who understand the concept; 2.) Students who experience misconceptions; 3.) Students who do not understand the concept; and 4.) Students who experience errors (errors) on the diagnostic test questions.

The collection of research data was also accompanied by filling out a questionnaire by students. This questionnaire aims to determine the factors that cause learning difficulties experienced by students in the basic law of chemistry, which consists of 9 aspects. Internal factors are interest, talent, motivation, and student study habits, as well as external factors on how teachers teach study time, school facilities, family environment, and students' social environment. The questionnaire used has four categories, namely Strongly Agree (SS), Agree (S), Disagree (TS), and Strongly Disagree (STS). Scores on the questionnaire result from positive scores based on a Likert Scale ranging from 4 to 1.

Results of Analysis of Student Answers to Diagnostic Test Questions

The percentage of students' learning difficulties in the four-tier multiple choice on the basic chemical law material is analyzed by giving test questions to students who have studied the material, namely in class X 7 SMA N 15 field. To determine the level of learning difficulties experienced by students by giving 19 questions representing seven learning indicators. The analysis of student learning

difficulties for each indicator can be seen in the Table below.

Table 4. Analysis of Learning Difficulties for Each indicator

Indicator	% Learning Difficulties (TPK+Mi+E)	Category
1 indicator	55.6%	Fairly High
2nd indicator	78.5%	High
3th indicator	79.2%	High
4th indicator	83.3%	Very High
5th indicator	80.6%	Very High
6th indicator	52.8%	Fairly High
7th indicator	68.1%	High
Average	71.1%	High

Based on the data in table 4. It can be seen that the students of class X 7 SMA N 15 Padang have learning difficulties, with a high category of 71.1%. Learning difficulties in the very high category are found in the 4th indicator, namely applying the concept of the Law of Comparison of Volumes (Gay-Lussac) to complete chemical calculations of 83.3%. Meanwhile, the lowest for students with learning difficulties is in the 6th indicator, namely applying the concept of relative molecular mass to complete chemical calculations of 52.8%, with a reasonably high category.

Based on the average percentage of each category of answers per student indicator, as shown in Table 3. It can also be seen in the percentage of student answer categories as a pie in Figure 1 below.
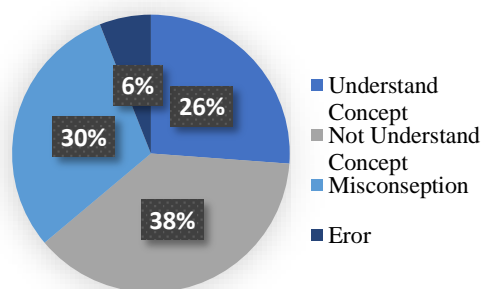

Figure 1. Percentage of Student Answer Categories Based on Pie

The percentage of students who do not understand the concept and experience errors and misconceptions is higher (74%) than those who understand the concept (26%). It can be said that the students of class X 7 SMA N 15 Padang have learning difficulties.

Result of Analysis of Causes of Students' Learning Difficulties

Based on the data in Figure 1. it can be seen that 74% of students have difficulty learning chemistry

in the basic law of chemistry. The questionnaire was given to find out the causes of student learning difficulties which consisted of 28 question items representing nine aspects of the causes of student learning difficulties. The results of the analysis of the questionnaire distribution can be seen in the Table below.

Table 5. Results of Questionnaire Sheet Analysis Causes of Student Difficulties

Factors	Aspects	Percentage
Internal	Interest	61.80%
	Talent	55.60%
	Motivation	66.70%
	Study Habits	56.90%
External	Teacher Teaching Methods	66.30%
	Study Time	50.00%
	Facilities School	67.80%
	Family Environment	70.30%
	Social Environment	64.60%
Average		62.20%

Based on the data in Table 5. It can be seen that the factors causing students' learning difficulties in the basic law of chemistry are caused by the lack of support for the student's family environment 70.30%. The aspect that causes the least amount of learning difficulties by class X 7 SMA N 15 Padang is the 6th aspect, namely the student's learning time in school, which is 50%, with the criteria agreeing that school time is too short.

Based on the results of the study, it can be identified learning difficulties experienced by students of SMA N 15 Padang in the basic law of chemistry. The diagnostic test results determine each learning indicator's level of student difficulties. The questionnaire data can also identify the factors causing student learning difficulties.

Students' Learning Difficulty Level Each Learning Indicator

This study tested basic chemical law material consisting of 7 learning indicators. Table 4 shows that the students of class X 7 SMA N 15 Padang have learning difficulties, with a high category of 71.1%. Learning difficulties in the very high category were found in the 4th and 5th indicators, namely 83.3% and 80.6%, respectively. In addition, the order of students with learning difficulties is in the high category. The 3rd indicator is 79.2%, the 2nd indicator is 78.5%, and the 7th indicator is 68.1%. Meanwhile, for students with the lowest learning difficulties with a reasonably high category, the 6th indicator is 52.8%, and the 1st indicator is 55.6%.

The 1st indicator is applying the concept of the law of conservation of mass (Lavoisier) to complete chemical calculations.

This indicator is included in the category of questions with a reasonably high difficulty level, 55.6%. Learning difficulties experienced by students are that students still have a problem applying the concept of the law of conservation of mass because many students think that there is a reaction that causes an increase in the mass of a substance. Students assume that a precipitate's formation affects the tube's mass and contents. In addition, students who answered incorrectly because of inaccuracies and misunderstandings about the gases involved in the calculation reactions did not add up the total mass of gases involved in the calculations or misunderstood the meaning of the problem.

Students make mistakes in answering questions by assuming that the mass of reactants in a reaction is smaller than the total mass of the products that form precipitates in the response. Students believed that the mass differs depending on the substance type [22].

The 2nd indicator applies the concept of the law of constant comparison (Proust) to complete chemical calculations.

The second indicator is included in the category of questions with a high difficulty level of 78.5%. The difficulties experienced by students in this indicator are that students are still wrong in determining the ratio of the masses of the elements used. Students incorrectly apply the concept of the law of constant comparison from the given experimental data. In addition, many students experience misconceptions because they think determining an element's ratio in a compound is twice the mass of other substances.

In addition, some students made errors in calculations because students ignored the relationship between concepts, namely the concept of the chemical reaction. Following the law of conservation of mass, students had difficulty determining the ratio of the masses of the elements that make up the compounds used in the reaction, as well as problems in doing calculations in making comparisons. After all, students do not understand the concept of the law of fixed comparisons. Most students assume the mass ratio is the same as the coefficient ratio.

Students who were still wrong in answering the questions were due to errors in translating the questions. Some students often forget to write down information from the questions when answering questions (what is known and what is asked [23].

The 3rd indicator is applying the concept of the law of multiple comparisons (Dalton) to complete chemical calculations.

This indicator is included in the category of questions with a high difficulty level of 78.5%. The difficulty experienced by students in this indicator is that students are still wrong in determining the mass ratio of one of the elements that make up the compound because students do not equate the mass of other elements in Compounds I and II. It is not following the law of multiple proportions, which states that "when two elements form two or more types of compounds, for the same mass of one element, the masses of the second element in the compound are compared as whole and simple numbers."

Suppose the student has understood the concept of the law of multiple comparisons. In that case, he can answer the indicator question correctly. Still, the student answers that the compound is the same because the two compounds have the same mass, which is also due to an error in reading the questions in the problem.

Students had difficulty calculating the ratio of the same element from two different compounds comparison. Students cannot conclude the legal concept because they do not understand that comparative numbers are simple integers and show the number of gas coefficients in the reaction equation [24].

The 4th indicator applies the law of volume comparison (Gay-Lussac) to complete chemical calculations.

This indicator is the indicator with the highest level of problem difficulty, which is 83.3%, in the very high category. The learning difficulties experienced by students are caused because there are still students who do not understand the law of volume comparison. Even students assume that the volume of gas involved in the reaction is always the same. Based on the results of students' answers, students understand the concept of the law of volume comparison. Still, students choose the wrong reason to use the concept of the law of volume comparison from the questions given. Students do not understand how to balance a reaction. Students ignore whether the reaction equation is balanced or not. The affect volumes involved in the reaction, and not yet known how to compare the reaction coefficients of gases in the reaction equation.

Many students still do not know how to find the limiting reagent for a reaction. Students experience misconceptions that make it difficult for students to accept substances with smaller amounts that are not necessarily depleted at the beginning or act as limiting reagents. They do not know that the ratio of simple integer numbers that show the reaction coefficients of gases in the reaction equation can display the amount of the volume that reacts.

In addition, students also experience that students still have not used the law of volume comparison to determine the molecular formula of gas when the volume of gas in the reaction equation is known. The ratio of the reaction coefficients must be determined using the ratio of gas volumes according to the law of volume ratios. Still, students balance the number of atoms in the reactants and products directly without first determining the reaction coefficients.

The results of the research were conducted. In the law of volume comparison, students cannot conclude the legal concept of the law of volume comparison because they do not understand that comparison numbers in the form of simple integers also show the number of gas coefficients in the reaction equation [10].

The 5th indicator is, applying Avogadro's law concept to complete chemical calculations.

This indicator is included in the category of questions with a very high difficulty level, 80.6%. The learning difficulties experienced by students are that many students still assume that at the same temperature and pressure. The number of moles of substances involved in a reaction equals the ratio of their volumes. Students think that different gases have different numbers of molecules, even though they have other volumes same. Next, students assume that the volume of the gas that reacts is equal to the mass of the gas involved in the reaction.

Students consider that the coefficient comparison shows the ratio of the mass of the elements [24].

The 6th indicator is applying the concept of relative molecular mass to complete chemical calculations.

This indicator has the lowest difficulty level of 52.8%, with the category high enough. This indicator can be answered correctly by most students because students understand the concept of the law of relative molecular mass applied to the problem. Students will also be able to answer correctly because students in practice commonly encounter questions like this. Students will know that to determine the relative molecular mass. Students must add all the relative atomic masses that make up the molecule/compound. Students who answer incorrectly are caused by students doing wrong calculations or students who do not understand the concept of relative molecular mass itself.

Students know the meaning of relative molecular mass but do not understand its application. It is proven that when students calculate the relative molecular mass, they ignore the number of atoms, resulting in the perception of the relative molecular mass being the same as the relative atomic mass [25].

The 7th indicator is, applying the mole concept to complete chemical calculations.

This indicator is included in the category of questions with a high difficulty level, 68.1%. The difficulties experienced by students in this indicator are that students do not understand the concepts of moles, atomic mass, relative molecules, and types of particles, and students still cannot distinguish the types of substance particles consisting of atoms, molecules, and ions. The difficulties faced by students occur because students do not understand the standard of moles. That is, each mole of a substance contains 6.02×10^{23} particles. Students cannot use this definition when calculating the number of moles of a known number of particles of a substance. It can also be seen from the students' answers to the questions in this indicator. Students have difficulty converting the number of elements in grams into the number of moles. Many students can only count the number of moles but cannot relate moles to the number of particles of a compound.

Factors Causing Students' Learning Difficulties

Giving questionnaires to students aims to identify the factors causing students' learning difficulties in terms of internal and external factors. Internal factors are factors that come from within the students themselves. In this study, the internal factors investigated were the aspects of students' interests, talents, motivations, and study habits. External factors are factors that come from outside of students. In this study, external factors investigated were aspects of a teacher's teaching, learning time, school facilities, family environment, and students' social environment. Table 3 describes that the aspects that greatly influence the learning difficulties experienced by students in the basic law of chemistry are aspects of the student's family environment, with a percentage of 70.3% with the criteria agreed.

Family factors were this study's most significant cause of student learning difficulties. 70.3% of students agree that the family environment is the most influential factor in student learning success. The family is the main center of education, so the problems that occur in the family will undoubtedly affect the student's learning process. Conditions in the family that affect student learning include the way parents educate, the relationship between parents and children, examples/guidance from parents, home atmosphere, and family economic conditions [26]

Based on data analysis, it can be said that the study's results indicate that the family environment significantly affects student learning difficulties to a substantial degree. The family environment contributes 53.3% to student learning difficulties, while 46.7% is influenced by other factors [3].

CONCLUSION

Students learning difficulties in basic chemistry law materials in class X 7 SMAN 15 Padang are in the high category. The highest level of student learning difficulty is found in the 4th indicator, which applies the law of volume comparison (Gay-Lussac) to complete chemical calculations of 83.3% with a very high category. Meanwhile, the lowest level of student learning difficulties is found in the 6th indicator, which applies the concept of relative molecular mass to complete chemical calculations of 52.8%, with a reasonably high category.

The factors that cause students' learning difficulties in the basic law of chemistry are seen from internal and external factors, which consist of 9 aspects. The most influential aspect is the family environment, and the lowest is student learning time. The most influential internal factors are the aspects of students' motivation and interest in learning. In addition, aspects of other internal factors include students' talents and study habits.

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