

DESCRIPTION OF STUDENT LEARNING DIFFICULTIES IN THE ACID-BASE MATERIAL

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Abstract: Acid-base material is material that class XI IPA students study in the even semester. In this material, 81.38% of class XI IPA students at SMAN 16 Padang have yet to achieve the minimum criteria set. It indicates that students have learning difficulties. Learning difficulties are failures to attain learning goals characterized by low learning outcomes. This study aims to determine the percentage of students who experience learning difficulties for each indicator on acid-base material and determine the factors that cause learning difficulties experienced by students in terms of learning methods. Its research is a type of descriptive research. The sample for this research was students in class XI IPA 2 at SMAN 16 Padang in the 2022/2023 academic year, which consisted of 34 people. The research instrument was a diagnostic test with two-tier multiple-choice questionnaires and interviews. The data analysis used is descriptive, namely analyzing and then providing an understanding of the data in the form of numbers so that an overview can be given in an orderly, concise, and clear manner. The results of this study stated that students of SMAN 16 Padang had learning difficulties in acid-base material, with a percentage of 66.65% in the high category. The highest difficulty level is found in the first indicator (Analyzing the properties of the solution based on the acid-base theory according to Arrhenius, Bronsted-Lowry, and Lewis) of 72.88%. Ineffective learning methods cause learning difficulties experienced by students. Effective ways of learning are making study schedules and carrying them out, reading and taking notes, repeating subject matter, concentrating, and doing assignments.

Keywords: *Learning Difficulties, Acid-base, Diagnostic Test, Two-Tier, Questionnaires*

INTRODUCTION

Learning is an effort made so as to form a new behavior that is better than before. However, in reality, many students have yet to be able to change their behavior as expected or fail to complete the learning objectives. It indicates that students experience learning difficulties in achieving learning objectives [1]. There are obstacles experienced by students in learning, including students experiencing learning difficulties [2]. Learning difficulties are the inability of students to do the tasks given by the teacher [3]. Obstacles in learning, also known as learning difficulties experienced by students, can be seen in the grades obtained by these students [4].

The existence of obstacles in obtaining learning outcomes shows that students have learning difficulties [5]. Learning difficulties are failures when achieving learning goals. They are characterized by low learning achievement (the value obtained is less than the standard minimum completeness criteria set) and failing when achieving learning goals.

Internal factors and external factors cause learning difficulties. In this study, the learning difficulty factor will be examined from the student's external factors, namely the student's way of learning. The way of learning is the way or path that must be taken to achieve specific goals in learning [6], including activities in following lessons and facing tests/exams [7]. If students have found a good and effective way of learning for themselves, then learning activities will be easily carried out by these

students so that students can achieve high learning outcomes [8]. It is supported by the results of a study that states that the way of learning significantly influences student achievement. Thus the more effective way of learning will increase the learning achievement obtained by students [9].

Most students still think that chemistry is a difficult subject. It is because chemistry consists of abstract concepts, requires mastery of mathematical operations, and requires a strong memory [10]. Therefore, students are required to have the ability to understand concepts and apply understanding of mathematical operations. Understanding the concept is a crucial aspect of learning because students can develop their abilities in each subject matter by understanding the concept. Students' understanding of concepts affects their ability to solve problems. Acid-base material is one of the materials in chemistry lessons that students consider difficult [11]. In solving problems about acids and bases, an understanding of mathematical operations is also needed.

According to the results of distributing the questionnaire and the daily test scores of students at SMAN 10 Padang, SMAN 5 Padang, and SMAN 16 Padang, acid-base material is relatively difficult for students to understand. SMAN 16 Padang has the highest percentage of learning difficulties of the three schools. It can be seen from the daily assessment of acid-base material in the 2021/2022 school year, which has an average score below the minimum standard set of 78. 81.38% of class XI

MIPA students at SMAN 16 Padang have yet to reach the minimum completeness criteria standard set, 78 on the daily acid-base assessment. It indicates that students experience learning difficulties in acid-base material so learning outcomes could be better/below the minimum standards. However, the indicators the students struggle with still need to be made clear.

One effort to find out the difficulties of students to what extent the material being taught can be understood is by giving a diagnostic test. A diagnostic test is one of the tests used to determine students' weaknesses so that, based on these weaknesses, appropriate treatment can be carried out [12]. Students learning difficulties will be easier to identify using this test because it is effective and efficient [13]. Meanwhile, to find out the factors that cause students' learning difficulties in terms of learning methods, namely using questionnaires and interviews.

RESEARCH METHOD

This research was conducted in the odd semester of the 2022/2023 school year at SMAN 16 Padang. The sample in this study were students of class XI MIPA 2 SMAN 16 Padang, totaling 34 students who were selected using a purposive sampling technique.

The type of research used is descriptive research. Descriptive research is a form of research that aims to describe or describe existing phenomena [14].

The instruments used in this study were diagnostic test sheets (two-tier multiple choice), questionnaires, and interview sheets. Previous researchers made the instruments in this study. Students are considered to understand a concept if the answers and the reasons are correct [15]. In the diagnostic test questions, there are two levels of questions, where at the first level are the answers to the questions, and at the second level are the choices of reasons for the answers the first level [13].

Students who experience misconceptions are students who have the right answer but give the wrong reasons or have a wrong answer but have the right reason. Students who need help understanding the concept are students who have wrong answers and wrong reasons [16].

The diagnostic test given to students is in the form of two-tier multiple choice questions consisting of 20 questions representing four learning indicators (analyzing the properties of solutions based on the acid-base theory according to Arrhenius, Bronsted Lowry, and Lewis, analyzing the properties of acid-base solutions by using litmus paper and indicators, calculating the pH or pOH of a known concentration of an acid or base solution, and relating the degree of acidity (pH) to the degree of ionization (α), and the acid equilibrium constant (Ka) or the base equilibrium constant (Kb)).

Students learning difficulties on each indicator can be grouped based on the results of the diagnostic tests obtained.

Then, the questionnaire sheet used contained 21 statements from 5 indicators of external factors, namely in terms of how students learn, which is used to determine the factors that cause learning difficulties experienced by students. Interviews are used as supporting data for the questionnaire answers (data not obtained from the questionnaire results will be supplemented by the interview results).

Based on the data from the diagnostic test results, the percentage of students who have learning difficulties per learning indicator can be seen, namely using the percentage calculation formula (%) to find out the number (%) of students who have learning difficulties in each indicator as follows.

$$\%K = \frac{\text{Students Answered Incorrectly}}{\text{All The Students}} \times 100\%$$

Information:

%K = Percentage of students with learning difficulties for each indicator question [17].

The interpretation of students' learning difficulties is based on the criteria put forward by Arikunto, as shown in Table 1 below.

Table 1. Criteria Of Student's Learning Difficulties

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

[18]

Grouping the results of students' answers from the level of understanding based on diagnostic test questions can be seen in Table 2.

Table 2. Categories of student answer groupings

Answer Type	Explanation	Category
T-T (True-True)	Answer both levels of questions correctly	Understand
T-F (True-False)	Answer correctly on the first level and answer incorrectly on the second level.	Misconception
F-T (False-True)	Answer wrong on the first level and answer	Misconception

	correctly on the second level	
F-F (False-False)	Answered incorrectly at both levels of the question	Do not Understand

[19]

Questionnaire statement answer scores are categorized based on the table below.

Table 3. Scores for Questionnaire Item Criteria

Criteria	Score (+)	Criteria	Score (-)
Always	5	Always	1
Often	4	Often	2
Sometimes	3	Sometimes	3
Seldom	2	Seldom	4
Never	1	Never	5

[20]

RESULT AND DISCUSSION

Based on the provision of diagnostic tests, the most difficult indicator is the first indicator, as much as 72.88% in the high category. The data for the student diagnostic test answer categories are shown in Figure 1.

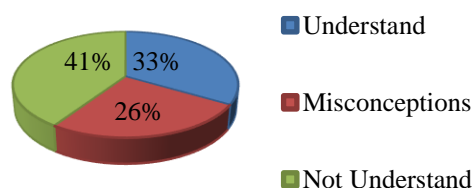


Figure 1. Students Answer Categories

Based on Figure 1. It can be seen that the number of students who understand concepts, misconceptions, and do not understand concepts is 33.47%, 26.02%, and 40.64%, as shown in Figure 1. Students are said to have learning difficulties if they don't understand the concepts and misconceptions, and the percentage of students' learning difficulties is 66.65%.

The indicator with the highest percentage of learning difficulties is the 1st indicator, namely analyzing the nature of the solution based on the acid-base theory according to Arrhenius, Bronsted-Lowry, and Lewis at 72.88% with a high learning difficulty category. The learning difficulties experienced by students in this learning indicator are because students are still experiencing inverse concepts between Arrhenius acid-base theory, Bronsted-Lowry acid-base theory, and Lewis acid-base theory. Students also need help in distinguishing acidic and basic compounds from each of these theories.

The second indicator has a percentage of 55.88%, which is relatively high. Students know how to determine acidic or basic properties based on

red and blue litmus paper. However, students experienced difficulties in determining the route of the unknown pH of the solution based on the color of the indicator provided in the table in the problem. In addition, students also needed help in answering questions related to natural indicators. Some students think the natural indicators do not affect the color change in acidic or basic solutions. Plant species that can be used as natural indicators are plants with dyes where the color will differ in acidic and alkaline environments.

The third indicator is included in the high category, namely 69.61%. The difficulties experienced by students in this learning indicator are because students need to learn the pH range in acidic or alkaline conditions, the value of $[H^+]$ in acid solution, and the value of $[OH^-]$ in alkaline solution. It is also because students need help converting pH into concentration; in other words, students have difficulty determining the results of logarithmic equations. Students also experience difficulties in finding pH and pOH values because students need to learn the formula used in the calculations if the questions are known to be weak acids, strong acids, weak bases, or strong bases.

Meanwhile, the fourth indicator is also included in the high category of 68.24%. The difficulties experienced by students on this indicator were caused because students needed to learn that the value of K_a was used as a benchmark in determining the order of acid strength, so some students used pH or concentration as a benchmark in determining the order of acid strength. While solving calculation problems in this learning indicator, the difficulties experienced by students are not knowing the formula used in the calculations or making mistakes when doing the calculations. Many students have difficulty with this indicator because students need to learn the formula that must be used for each different problem.

The questionnaire research showed that the factors causing students' learning difficulties in acid-base material were caused by students rarely repeating subject matter and practice questions that had been studied. The results of the questionnaire distribution analysis can be seen in Table 4.

Repeating subject material is one indicator of a questionnaire that causes learning difficulties. Based on the results of the questionnaire analysis, the cause of students experiencing learning difficulties is that students seldom repeat or review a summary of the material they have learned, with a percentage of 47.50%. Students rarely repeat or re-learn the acid-base practice questions they have learned. Following the results of the interviews, students repeated the subject matter when exams or daily assessments were held. If material needs to be understood, students prefer to ask friends who understand acid-base material better than asking the

teacher to explain it again. Students feel afraid or lack confidence when they want to ask the teacher.

Table 4. Results of the Questionnaire on the Causes of Learning Difficulties

Indicators	Σ Score	Percentage	Average
Make Schedule and Implement-station	81	50.63%	48.13%
	73	45.63%	
Read and Take Note	77	48.13%	51.94%
	76	47.50%	
	77	48.13%	
	68	42.50%	
	75	46.88%	
	83	51.88%	
	84	52.50%	
Repeat Subject Materials Concentration	83	51.88%	56.04%
	132	82.50%	
	70	43.75%	
	75	46.88%	
	77	48.13%	
Carry out a task	81	50.63%	59.69%
	93	58.13%	
	95	59.38%	
	66	41.25%	
	80	50.00%	
	105	65.63%	
	131	81.88%	

When it is related to the learning difficulties experienced by students in the 1st, 3rd, and 4th learning indicators, because students rarely repeat subject matter at home after studying it at school, students experience learning difficulties in these three indicators by high category. Then, in the second learning indicator, students experience learning difficulties in the "high enough" category. It shows that repeating learning is very necessary, as in the 1st and 2nd indicators, to answer questions related to conceptual understanding, students must repeat the subject matter at home. Furthermore, to answer questions related to mathematical operations, as in indicators 3 and 4, students are required to repeat the subject material at home because in solving questions related to mathematical operations, students cannot rely solely on the explanation given by the teacher but must be repeated so that remember and understand.

Repeating material has a large influence on student learning outcomes. Repetition of material

that has yet to be mastered will keep the material embedded in one's brain. Repeating can be done directly after reading, but more important is to review the material studied [21].

Based on the analysis carried out on diagnostic test questions, questionnaires, and interviews, it was found that how students learn greatly influences student learning outcomes. This study's results align with research conducted by other researchers, which revealed a positive influence between learning methods and student learning outcomes [22]. A similar statement was also put forward, learning methods are closely related to learning outcomes [23].

If students apply good learning methods, the learning outcomes obtained by students will also be maximized. Based on the research results, how students learn still needs to be appropriately implemented. Many students fail or do not get good learning outcomes in their lessons because students need to know effective learning methods. How to learn has a significant influence on learning outcomes, so how to learn is very important to encourage and improve learning outcomes [21].

CONCLUSION.

Students of SMAN 16 Padang experienced learning difficulties in acid-base material, with a high category of 66.65%. The difficulty level of students in the first indicator is to analyze the nature of the solution based on the acid-base theory according to Arrhenius, Bronsted-Lowry, and Lewis at 72.88% in the high category; on the second indicator, namely analyzing the nature of the acid-base solution using litmus paper and an indicator of 55.88% in a reasonably high category; the third indicator, namely calculating the pH or pOH of an acid or base solution with a known concentration of 69.61% in the high category; The fourth indicator relates the degree of acidity (pH) to the degree of ionization (α), and the acid equilibrium constant (K_a) or base equilibrium constant (K_b) is 68.24% in a reasonably high category. Learning difficulties experienced by students are caused because students have not studied effectively, namely making schedules and implementing them, reading and making notes, repeating subject matter, concentrating on learning and doing assignments.

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