Analysis of Student Chemistry Learning Difficulties on Buffer Solution at SMA Negeri 2 Banjar Buleleng Bali

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Abstract. This research aims to describe and explain students’ learning difficulties in chemistry, the distribution of students’ learning difficulties, and the causative factors of students’ learning difficulties to understand the topic of buffer solution at SMA Negeri 2 Banjar. The data sources for this research were 154 students from all class XI MIA and one chemistry teacher at SMA Negeri 2 Banjar Buleleng Bali. The research method used a quantitative and qualitative method. Quantitative methods are used to collect data on student learning difficulties by using tests and the factors that cause learning difficulties using a questionnaire, while qualitative methods are used to collect data on factors that cause learning difficulties using observation and interview guidelines. Data were analyzed descriptively by grouping students’ learning difficulties into five types includes not difficult, less difficult, quite difficult, difficult, and very difficult. The result of this research showed that students have a difficulty in learning chemistry to understand of buffer solution topic. (1) The students’ learning difficulties on buffer solution topic was ranged between less difficult until very difficult. (2) The distribution and level of student learning difficulties in indicators explaining the definition of buffer solution, analyzing the constituent components of buffer solution, determining buffer and non-buffer solution, calculating pH of acid and base buffer solution, calculating pH of a buffer solution by adding few amount of acid or base or dilution, and explaining the function of buffer solution in the body of living creatures, are difficult enough (44,97%), difficult (74,57%), less difficult (31,66%), difficult enough (43,51%), very difficult (81,82%), and difficult enough (36,36%), respectively. (3) Internal factor that caused learning difficulties is less understanding toward supporting concepts of buffer solution topics and buffer solution concept, the lack of student’s ability in mathematics, less learning interest and motivation toward chemistry. The external factor that caused learning difficulties is teacher’s teaching method, negative effect from friend at the same age, and less conducive learning conditions and times.

1. Introduction
Learning difficulty means an understanding of a problem or emotional difficulty that affects a student’s ability to learn [1]. Students who have learning difficulty will get less optimal results in their learning process. Learning difficulties in students are influenced by internal factors and external factors. Internal factors that cause of students’ learning difficulties are intelligence, interests, talents, motivation, and health. Meanwhile, external factors that cause of students’ learning difficulties are the influence of family, school, and social environment [2].

Learning difficulties in students also occur in chemistry subject. Chemistry is one of the most important branches of science, it enables learners to understand what happened around them [3].
Chemistry also a complex and abstract science, it makes students think that chemistry is a difficult subject. Some research identified that students have difficulty understanding fundamental and advanced concepts in chemistry [4]. Chemistry had been regarded as a difficult subject for students by many researchers, teachers, and science education because of the abstract nature of many chemical concepts, teaching styles applied in class, lack of teaching aids and the difficult language of chemistry [5].

The essence of chemistry is divided into three specific characteristics that relate to each other, namely macroscopic, sub microscopic, and symbolic aspects [6]. Students are expected to understand these three aspects so that they can be used to describe a phenomenon. However, the fact in the field shows that many students do not understand and cannot use the three representations to explain a phenomenon [7]. The inability of the students to understand the three aspects of representation in chemistry makes students difficult to understand the topic of chemistry subjects. Chemistry is an important science to learn, but in school most students considered that chemistry is a difficult and boring subject [8]. This is because most of concepts in chemistry are abstract and complex, so it requires a deep understanding to learn. The difficulties of studying chemistry can be interpreted as the difficulty of students in accepting or understanding the topics in chemistry subject.

Students have learning difficulty in complex chemistry topics using many calculating and mathematic formula to solve problem. One of the topics in chemistry subjects are complex and use a lot of mathematical calculation is the buffer solution topic. According to Yunitasari et al. [9], the complex concepts of buffer solution topic caused student difficulty to understand this topic. Most students have learning difficulties to understand the buffer solutions topic. Low student’s learning achievement also indicates that students have leaning difficulty in understanding the buffer solution topic.

Studies on learning difficulties were also conducted by Marsita et al. [10]. The results of this study found the difficulty of students to understand the buffer solution topic, namely in the concept of (1) the definition of buffer solution; (2) the calculation of pH and pOH in the buffer solution using the principle of equilibrium; (3) calculating the pH buffer solution when addition of a little acid or base, and (4) the function of buffer solution in the body of living creatures.

The research was aimed to describe and explain the level students’ learning difficulties, the distribution of students’ learning difficulties based on competency indicator, and the factors causing students’ learning difficulties to understand buffer solution topic.

2. Method

The study was quantitative and qualitative research. Type of this research is sequential explanatory. The research was conducted at SMA Negeri 2 Banjar in the even semester of the academic year 2018/2019. The subjects of this research were 154 eleventh grade students of mathematics and natural class of SMA Negeri 2 Banjar Buleleng Bali. Meanwhile, the objects in this study were the students’ learning difficulties, the distribution of students’ learning difficulties, and the factors causing students’ learning difficulties to understand buffer solution topic.

In this research the instruments were used multiple choice test, questionnaire, observation guidelines, and interview guidelines. In the multiple choice tests the questions used were 13 questions that already valid with range of $r_{bis}$ values are 0.34 – 0.80. Multiple choice questions have high reliability with a value of 0.800. The difficulty level of each question is, 1 question is classified as easy question, 9 questions are classified as quite difficult question, and 3 questions are classified as difficult question. The different levels in each question is, 2 questions that are classified as weak, 5 questions are classified as sufficient, 4 questions are classified as good, and 2 questions are classified as very good questions.

Data collection to determine the factors that cause students learning difficulties were obtained by the method of observation, questionnaires, and interviews. Interviewed student were determined by using a purposive proportional sampling technique. Data from the results of observations, tests, questionnaires, and interviews were analyzed descriptively.
3. Result and Discussion

The results of this study consist of three components, namely: students’ learning difficulties in chemistry, the distribution of students’ learning difficulties on buffer solution topic, and the causative factors of students’ learning difficulties to understand the buffer solution topic.

Student’s result tests were used to determine the level of learning difficulties, types of learning difficulties, and the distribution of learning difficulties on buffer solution topics. The criteria used to determine the level of learning difficulties in students adapted from criteria according to Arikunto [11]. Student learning difficulty levels for the buffer solution topic shown in Table 1.

**Table 1. The level and percentage of students’ learning difficulty in buffer solution topic**

| Range of score | The percentage of learning difficulty levels | The criteria of learning difficulties | The number of students | Percentage |
|----------------|--------------------------------------------|--------------------------------------|------------------------|------------|
| 81 – 100       | 0 – 20%                                    | Not difficult                        | 14 people              | 7%         |
| 61 – 80        | 21 – 40%                                   | Less difficult                       | 28 people              | 18%        |
| 41 – 60        | 41 – 60%                                   | Quite difficult                      | 36 people              | 24%        |
| 21 – 40        | 61 – 80%                                   | Difficult                            | 65 people              | 42%        |
| 0 – 20         | 81 – 100%                                  | Very difficult                       | 11 people              | 9%         |
| **Total**      |                                            |                                      | **154 people**         | **100%**   |

The results of the students’ test scores on the buffer solution topic were converted into a percentage of learning difficulties categories, which were used to determine the level of learning difficulties. After the data were converted, there were 140 students from 154 students or 93% of students have learning difficulties.

Types of student’s learning difficulties to understand buffer solution topic can be observed from the results of student test answer and interviews. Types of students’ learning difficulties to understand the buffer solution topic were grouped based on indicators in the buffer solution topic. Description of the student’s learning difficulties type is shown in Table 2.

**Table 2. Description of the students’ types learning difficulties**

| Indicator | Types of learning difficulties |
|-----------|--------------------------------|
| 1         | a. Students lack understanding about the nature of buffer solutions  
             b. Students do not understand the constituent components of a buffer solution |
| 2         | a. Students lack the understanding to determine which included a strong acid or weak acid solution, a strong base or weak base solution, and salt solution |
| 3         | a. Students lack understanding about the nature of buffer solutions  
             a. The ability of students is still lacking in writing the equation of a chemical reaction  
             b. Students are less able to determine the formula used to calculate the pH of a buffer solution  
             c. The ability of students who are still lacking in chemical calculations (stoichiometry)  
             d. Accuracy of students when answering the questions is still lacking |
| 4         | a. Students are less able to determine the formula used to calculate the pH of a buffer solution  
             b. Students are still confused in writing and determining the results of chemical reaction  
             c. Understanding of students about the concept of acid-base is still lacking  
             d. Students do not understand how the buffer solution works so that it can maintain the pH of a solution |
| 5         | a. Students are less able to determine the formula used to calculate the pH of a buffer solution  
             b. Students are still confused in writing and determining the results of chemical reaction  
             c. Understanding of students about the concept of acid-base is still lacking  
             d. Students do not understand how the buffer solution works so that it can maintain the pH of a solution |
The most common type of learning difficulties experienced by students was the lack of understanding of the basic concepts that support the buffer solution topic and the concept of buffer solution topic. If students do not understand the basic concept, students will have difficulty to understand the more complex concepts [5]. To understand a concept, students must able to associate the newly acquired knowledge with the knowledge they already had before.

Table 3. The percentage of distribution students’ learning difficulties in each question and indicators of buffer solution topics

| Indicator | Question Number | Student Learning Difficulties (%) | The Criteria of Learning Difficulties for Each Question | The Average of Learning Difficulties in Students (%) | The Criteria of Learning Difficulties for Each Indicator |
|-----------|-----------------|-----------------------------------|-------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------|
| 1         | 1               | 39.61                             | Less difficult                                        | 44.97                                               | Quite difficult                                       |
|           | 2               | 50.32                             | Quite difficult                                       |                                                     |                                                       |
| 2         | 3               | 64.29                             | Difficult                                             | 74.57                                               | Difficult                                             |
|           | 4               | 75.65                             | Difficult                                             |                                                     |                                                       |
|           | 5               | 83.77                             | Very difficult                                        |                                                     |                                                       |
| 3         | 6               | 34.42                             | Less difficult                                        | 31.66                                               | Less difficult                                        |
|           | 7               | 28.90                             | Less difficult                                        |                                                     |                                                       |
| 4         | 8               | 37.99                             | Less difficult                                        | 43.51                                               | Quite difficult                                       |
|           | 9               | 29.87                             | Less difficult                                        |                                                     |                                                       |
|           | 10              | 62.66                             | Difficult                                             |                                                     |                                                       |
| 5         | 11              | 81.17                             | Very difficult                                        | 81.82                                               | Very difficult                                        |
|           | 12              | 82.47                             | Very difficult                                        |                                                     |                                                       |
| 6         | 13              | 36.36                             | Less difficult                                        | 36.36                                               | Less difficult                                        |

The distribution of students’ learning difficulties in 1st indicator was quite difficult with a percentage of 50.32%. Students have difficulties because students do not understand the constituent components of a buffer solution. The 2nd indicator was difficult with a percentage of 74.57%. Students have difficulty because students cannot determine which solution is classified as a strong acid or weak acid and a strong base or weak base. Besides that, students also do not understand the concept of chemical calculation (stoichiometry). The 3rd indicator was less difficult with a percentage of 31.66%. Students have difficulty because students do not understand the nature of the buffer solution. The 4th indicator is quite difficult with a percentage of 43.51%. Students have difficulty because students were still lacking in writing the equation of a chemical reaction less able to determine the formula used to calculate the pH of a buffer solution do not understand the concept of chemical calculation (stoichiometry), cannot determine which solution was classified as strong acid or weak acid and strong base or weak base, and accuracy of students when answering the questions was still lacking. The 5th indicator was very difficult with a percentage of 81.82%. Student learning difficulties on this indicator the same as the 4th indicator, but additional types of learning difficulties were found is students do not understand how the buffer solution works. The 6th indicator was less difficult with a percentage of 36.36%. Students have difficulty because do not understand how the buffer solution works.
Table 4. Internal and external factors that cause students’ learning difficulties

| Number | Factor Classification | Factors That Cause Learning Difficulties |
|--------|-----------------------|------------------------------------------|
| 1      | Internal Factors      | a. Less understanding toward supporting concepts of buffer solution topics |
|        |                       | b. Less understanding concepts of buffer solution topics |
|        |                       | c. The lack of student’s ability in mathematics |
|        |                       | d. Student’s interest to study chemistry is still low |
|        |                       | e. Student’s motivation for learning chemistry is still low |
| 2      | External Factors      | a. Teaching methods applied by teachers |
|        |                       | b. The negative effect of a friend at the same age |
|        |                       | c. Less conducive learning conditions and times |

The internal factors that most influences students’ learning difficulties were the less interest and motivation of students to learn chemistry because students do not understand the chemistry concepts, especially on the buffer solution topic. Interest and learning outcomes were intertwined. Interest in learning contributes greatly to the success of learners [12]. The low student interest in learning chemistry has an effect on learning outcomes. Students who have low interest do not feel interested in learning activities this causes students not to pay attention when the teacher explains, so students do not understand the learning topics explained by the teacher which causes students learning difficulties. High interest in learning will greatly affect the way learners to learn [13].

A high interest in learning will affect the process of successful teaching and learning activities. With the interest in learning, learners can be more focused on the lessons, and they will be more easily attached to the lessons and do not quickly get bored while studying [14].

Low student motivation to learn chemistry is also a cause of learning difficulties for students. Learning motivation has a very important role in the achievement of learning outcomes, students cannot learn well without motivation [15]. If students do not have the motivation to learn, students will be passive in learning activities.

Low chemistry learning motivation is also influenced by low student interest in learning. This is because students do not have the desire to study chemistry, so students are not motivated to learn. Interest and motivation to learn have a positive and significant relation, if students have a low learning interest then students’ learning motivation is also low [16].

4. Conclusion

Based on the results of the study and discussion can be concluded as follows 93% of students in SMA Negeri 2 Banjar have learning difficulty to understand the buffer solution topic. Most types of learning difficulties found in students are lack understanding of the supporting concepts and the concept of buffer solution topic.

The distribution and level of student learning difficulties in indicators explaining the definition of buffer solution, analyzing the constituent components of buffer solution, determining buffer and non-buffer solution, calculating pH of acid and base buffer solution, calculating pH of a buffer solution by adding few amount of acid and base, and explaining the function of buffer solution in the body of living creatures, are difficult enough (44.97%), difficult (74.57%), less difficult (31.66%), quite difficult (43.51%), very difficult (81.82%), and quite difficult (36.36%), respectively.

Internal factors that have the most influence of students’ learning difficulties are the low interest and motivation of students to learn chemistry. While the external factors that have the most influence on students’ learning difficulties are the teaching method applied by teacher, the time and conditions of learning are less conducive.

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