Exploring the implementation of problem-based learning on acid base neutralization reaction in high school

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Abstract. Chemistry learning that only emphasizes the conceptual understanding and calculations is no longer appropriate to the needs of human resources today. Problem-based Learning as one of the innovative learning models designed to help students’ conceptual understanding of chemistry and develop their problem solving skills. This study aims to obtain information’s about the implementation of Problem-based Learning on acid base neutralization reaction subject. This descriptive research involved 20 high school chemistry teachers as participants. Data were collected using interview guidelines which were further processed in accordance with the research question. Result shows that Problem-based Learning has not been widely implemented to acid base neutralization reaction subject due to constraints such as limited time and learning resources. The results of this study indicate the necessary of Problem-based Learning implementation on acid base neutralization reaction subject.

1. Introduction
Chemistry learning nowadays more emphasis on memorization and seeks a true answer to the given question, creative thinking processes are rarely trained, so the development of students’ creativity is important to achieve a learning goal, which is to improve the conceptual understanding [1]. Creativity of students will improve students’ conceptual understanding, but nowadays it has not achieved maximum results. Along with the progress of time, teaching and learning process are still less effective because there is no good cooperation between teachers and students where teachers still prioritize the material content and less optimizing students learning activities, consequently learning is only focused on concept memorization [2]. Implementation of learning requires a model in improving the conceptual understanding and creativity. One of the learning model is Problem-based Learning which has been widely used in conceptual understanding and students’ creativity.

Problem-based Learning is a learning model for developing creative thinking and creative problem solving skills [3]. Problems are a source of creativity where problems can vary, such as unclear observations or phenomena, inequalities in knowledge and information, decision-making circumstances, or new design and innovation needs [3]. In the implementation of Problem-based Learning a question allows for a deeper exploration of students’ thinking, experience and knowledge [4].

The positive impact of the implementation of Problem-based Learning is showed in the successful conceptual understanding for the gas topic between the experimental class and the control class [5]. Positive and significant influence on students in problem solving skills with Problem-based Labs [6]. Influence of positive attitude, problem solving skills, and students’ interest in learning environment with
Problem-based Learning [7]. The value of behavior increases with the use of tutor-less PBL [8]. Problem-based Learning as an active learning model has a positive effect on higher performance, overcome alternative conceptions, and development of some social skills [9]. Effective Problem-based Learning to develop critical thinking skills to enhance creativity [10]. The implementation of Problem-based Learning for training is required and practiced by students in discussions and learning creativity theories [11]. Classes taught by Problem-based Learning allow more space for development, conceptual understanding, and the process of chemistry lab practice [12]. Decision making skills, critical and creative thinking, analyzing data, and interpreting questions increase by implementing Problem-based Learning to chemistry potential cell materials [13]. Problem-based Learning improve critical thinking skills, problem solving skills, in the process physical chemistry practice [14]. Problem-based Learning can improve creative thinking and creativity in chemistry learning [15].

One of the chemistry subject that has benefits in everyday life is the acid base neutralization reaction subject. Students have difficulty in understanding the concept of neutralization reactions, where students assume a neutralization reaction will always produce a neutral compound [16]. Most chemistry textbooks explain the concept of neutralization reaction through the formation of salt [17]. Students still have a misconception on the acid base neutralization reaction in which the students assume that all of the neutralized reaction salts are neutral [18].

Based on these thoughts, then conducted a research to determine the Problem-based Learning implementation has been done by high school teachers on acid base neutralization reaction subject that have many applications in everyday life.

2. Method

This study is a descriptive research that aimed to describe a state or phenomenon as it is [19]. Participants are 20 high school chemistry teachers from various cities in Sumatra and Java. Research is teachers interview which has been done at the end of January to early March with interview guidance instrument that aims to know the opinion of teachers about Problem-based Learning and their opinions on Problem-based Learning that prioritizes problems in everyday life as the beginning of the learning process to the development of problem solving skills and conceptual understanding.

Technique of data analysis is the interview results which analyzed qualitatively of teachers’ knowledge to Problem-based Learning, difficulties in implementing Problem-based Learning especially on subject which put forward the application in everyday life like acid base neutralization reaction.

3. Result and discussion

3.1. Implementation of problem-based learning in chemistry

Figure 1 shows the percentage of teachers who have implemented the Problem-based Learning model during chemistry lesson. Teachers answered whether they ever implemented, never, or sometimes implemented the Problem-based Learning model in the class.

![Figure 1. Implementation of problem-based learning in chemistry.](image-url)
The results showed that 60% of teachers have implemented this learning model, but the teachers still have difficulties in managing the learning scenario that takes place, for example, the teacher does not guide the students to formulate the problem at the beginning of the learning, but the students prefer to understand the concept of the material first and the concept of calculation that takes more time. As a result of applying too many concepts, students quickly forget the real concept of the material. The other 40% of teachers have never implemented Problem-based Learning model, this is because they have not know much about what is Problem-based Learning and how to implement it, and some of them also said that there is lack of learning resources and time limitations.

3.2. Teachers’ knowledge of problem-based learning

Table 1 shows the results of teachers interview about their knowledge of the Problem-based Learning. Teachers answered what they know based on their experienced about implementing Problem-based Learning.

| Teachers | Responses to the knowledge of Problem-based Learning |
|----------|------------------------------------------------------|
| 1        | Problem-based learning that exists in real life so that the learning process will be more meaningful |
| 2        | Brings up issues to attract students |
| 3        | Learning which based on the problem |
| 4        | Problem-based Learning can build students’ scientific thinking processes because they encourage students to learn actively |
| 5        | Learning which based on the problem |
| 6        | Learning which based on the problem |
| 7        | Problem-based Learning invites students to think critically and skillfully solving the problems. |
| 8        | There are problems encountered then resolved by the students |
| 9        | Lessons are characterized by problems that students must solve |
| 10       | A learning model that focuses on a real life problem to learn about how to think critically and how students solve problems |
| 11       | Learning which based on the problem |
| 12       | Student-centered learning model. Students are given a problem (such as a question or the other) and the students solving the problem can discuss with the teacher as a facilitator |
| 13       | Learning which based on the problem |
| 14       | Learning which based on the problem |
| 15       | The learning model is in line with the 2013 curriculum, and the learning model presents the problem first |
| 16       | Do not know |
| 17       | Problem-based model, where students are expected to solve a given problem |
| 18       | Problem-based. Learning begins with problem-related contexts of everyday life and students are encouraged to think high-level |
| 19       | Learning model based on the problem first |
| 20       | Learning which based on the problem |

Most chemistry teachers are less aware of the Problem-based Learning model, even knowing only that Problem-based Learning is just a “problem-based learning” without knowing the meaning of the problem-based. Teachers assume that the problem is a problem that arises when the concept of chemistry has been studied, and how students have the ability to solve the problem. Some of the teachers also said that problem is such a given question that students must solve.
Though the problem referred to in Problem-based Learning should be done at the beginning of learning as a phenomenon that will be analyzed by students to obtain and understand the chemistry concepts. Problem-based Learning prioritizes problems at the beginning of learning [3]. Problem could come from the students based on some phenomenon they read in the first place because when they make their own problem with some research questions they will develop their creative thinking skills.

Learning with Problem-based Learning model begins with problem formulation in everyday life, from that problem students are guided to analyzed the problem and think creatively in finding the chemistry concept related to the problem, and solve it with group discussion activity. From the group discussion, students will work together finding their own ideas and develop their communication skills in oral presentation. The oral presentation also contributes to students' enhancement in their communication skills [20]. Problem-based Learning requires that students solve problems collaboratively, the use of this approach has the potential of greatly influencing the classroom [7]. In Problem-based Learning the expected results are not only the students are able to understand the concept but the students will also better understand the application of the chemistry subject in their life.

3.3. Difficulties in problem-based learning
Table 2 shows the results of teachers interview on the difficulties experienced by students in the implementation of Problem-based Learning. Teachers stated what the difficulties experienced by their students when they implemented Problem-based Learning model in the class, or what difficulties will students face when they study with Problem-based Learning.

| Teachers | Responses to the students’ difficulties in Problem-based Learning |
|----------|---------------------------------------------------------------|
| 1        | Students are not get used to collect data from several sources to make problem solving hypotheses |
| 2        | Formulate the problem, and find a solution                   |
| 3        | Imagine something that cannot be seen                         |
| 4        | In case of problem solving. Because students should be more active and have many sources of reference |
| 5        | Problem analysis                                              |
| 6        | Problem analysis in chemistry concept                         |
| 7        | Less learning motivation, so that students are lazy to find relevant sources to solve the problem given. |
| 8        | Students have not understood the concept of the subject at first |
| 9        | Lack of teaching materials used in solving problems           |
| 10       | Students will be confused on the reaction and calculation     |
| 11       | Create equations of reactions along with the calculations     |
| 12       | Solving the problems related to the material if not guided directly by the teacher |
| 13       | Students’ reasoning should be up to the teacher’s explanation that should be able to provoke the students’ reasoning skills |
| 14       | Difficult to create the equations of chemical reactions       |
| 15       | Students are not familiar with the Problem-based Learning model so it is difficult to analyze the problems and not understand the concept |
| 16       | Do not know because never done that before                    |
| 17       | In resolving the given problem                                |
| 18       | Equations of chemical reactions writing and calculation analysis are in desperate need of teacher guidance |
| 19       | Finding the problem                                           |
| 20       | Less understanding of the problem to be formulated            |
In the implementation of Problem-based Learning model, teachers still feel the difficulties that have been experienced or will be experienced by students such as difficulties in solving problems, syntax or learning steps that take too much time, and lack of learning resources that can be utilized by students in seeking information because students may not learn only from one source. Students should collect as much data as possible from various sources so that the Problem-based Learning can run well. Students are not familiar with the Problem-based Learning model especially when formulating the problem, so it is difficult to analyze the problems that occur and not understand the concept. Problem-based Learning would be more effective if the instructors could provide clear guidelines and play the role of facilitator when required, especially at the beginning of the study [21].

The lack of interest of students for self-study is also one of the limitation that can make it difficult for teachers to control every students to try to find sources of information and link them to solve problems and manage effective discussions. Students think that the limited time, unfamiliarity with the approach and the presence of students who do not want to work cooperatively within the Problem-based Learning environment [22]. There is also a teacher who considers the difficulties that occur such as the difficulty of students reasoning skills to given problem, and teachers still think that the students’ difficulties are when they write equations of reactions along with the calculations.

3.4. Problem-based learning on acid base neutralization reaction

In the acid base neutralization reaction subject, the result states that the teachers only deliver the application of the concept in everyday life as an example after the students understand the concept of calculation and equation of acid base neutralization reaction. As said before, students learn more about the concept of calculation than the actual application of concepts which actually much more useful for students, especially to understand the concept of acid base neutralization reaction itself.

In studying acid base neutralization reactions, mostly teachers teach the application of concepts with gastric acid patients in which neutralizing stomach acid using alkaline medicinal drugs. Then the students discuss to find the solution of the problem. The teachers assumed that the implementation of Problem-based Learning model was appropriate to study acid base neutralization reaction, because acid base neutralization reaction was related in everyday life and when students involved to the group discussion and practice in chemistry lab the lesson became more interesting to them, but the teachers thought that the Problem-based Learning model is less suitable for acid base neutralization reaction because of the lack of time allocation that leads to learning that will not be completed according to the plan.

4. Conclusion

Based on the results of research that has been done can be concluded that the implementation of Problem-based Learning is still rarely done by the teachers. The teachers believe that the chemistry should be explained by the application of the concept, but the teachers have not yet implemented the appropriate model of learning, the teachers only teach students about the application of chemistry at the beginning as apperception and at the end of the lesson as an example after students understand the concept of subject and calculation first. Teachers have not understood the implementation of the Problem-based Learning model that prioritizes the problem at the beginning of the lesson. The difficulties experienced in the implementation of Problem-based Learning such as the lack of time allocation and inadequate learning resources, the difficulties of students to solve the problems given, and the lack of interest of students in self-study. Based on these conclusions it is better to give the teachers examples of the implementation of each steps in Problem-based Learning model with adequate learning resources and appropriate time allocation.

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