Applying Learning Model of Problem Based Learning (PBL) to Improve Category of Student Learning Result on the Subject of Solubility and Solubility Product Constant in Class XI Science of SMAN 1 Kampar

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Abstract: The research aims to improve category of student learning result on solubility and Solubility Product Constant subject in class XI science, SMAN 1 Kampar. This research is an experiments research with pretest-posttest design. Sample of the research is student of class XI science 2 as experimental class and class XI science 3 as control class. The experimental class applies Problem Based Learning (PBL) while the control class using discussion method. Data are analyzed using t-test. Result from the data analysis shows t count > t table (2.14 > 1.67). It means that PBL learning model can increase study result of student on solubility and Solubility Product Constant subject in class XI science of SMAN 1 Kampar with high category.

Keywords: Study results; problem based learning; solubility and result time solubility.

1. Introduction

Education is one of the most fundamental factor in the cycle of human life from birth until death. The issue of education is always very interesting to be discussed and addressed at every age. Not only because of issues more specific education or educational, is always the task of teachers, parents or all of the parties that are directly related to education, but the education issue has become problematic people from generation to generation.

National education aims to improve the life of the nation and developing the whole person. Education is expected to improve the ability, quality of life and can produce an educated man. According [2] education is an effort to prepare the younger generation not only obtain data, information and knowledge, but more important is to construct comprehension(understanding), fosters insight, and developing wisdom. In addition, education is a process of producing culture and value systems into a better direction, among others, in the formation of personality, skills and intellectual development of students [8]. The main problem is still prevalent learning is the low level of student learning outcomes. Based on a review of data, it is known that Senior high school student learning outcomes / equivalent is still low in terms of achieving value minimum completeness criteria is 75, especially for science subjects.

Chemistry is one branch of science lessons that are still widely considered difficult. Chemical subjects is a product of natural science in the form of facts, theories, principles, and laws of scientific work processes. So, in chemistry learning implementation should include three main aspects, namely: products, processes, and scientific attitude. Students often have difficulty understanding the chemical
material because it is abstract. Difficulties can bring adverse implications for students’ understanding of various concepts of chemistry, because basically the facts are abstract is the explanation for the facts and concrete concepts. One indicator of the weakness of the learning activities related to the implementation of the study, namely the lack of a learning process that takes place. During this learning process lasts less encouraging student activities to engage and actively develop knowledge for action is still often dominated by teachers.

According [9], the situation and the passive learning process will not be able to develop the skills of students to think constructivist build ideas and concepts, resulting in a lack of activity and creativity of students. The condition can cause the students are passive because they tend to just memorize, consequently students theoretically only clever but weak in the application. Therefore, students need to get used to construct knowledge through direct experience and not just a real reason. The learning process is based on the theories of constructivism learning can build on the ideas and the students’ understanding and giving meaning to information and events experienced as students trained to think creatively in the face of problems. [9] argued, the development of ideas or knowledge can be done with the real problems, direct, and relevant to the needs of students’ knowledge, so in learning teachers are required to be able to package learning activities with a model that can provide opportunities for students to explore simple so that they not only receiving and memorizing.

Based on data from discussions with students and chemistry teachers SMAN 1 Kampar on 22 April 2015, is known to occur and faced problems in learning activities in the material solubility and solubility product. Some of these problems include: 1) Presentation of the material is still often done by a teacher and discussion that makes the teacher as the center of learning (teacher centered), 2) involvement of students is still low in learning activities, where students used to just take notes and listen to the teacher, 3) the lack of utilization of laboratory and infrastructure else was there, 4) Lack of reference and learning resources for students, 5) lack of student motivation in learning activities because the activities that take place seem monotonous and boring, 6) concepts that are embedded weaker students, as they tend to just memorize without understanding the concept. Based on these problems, it is necessary to act in the exploration stage to improve the quality of student learning processes and products in order to become better. One way to improve the quality of the learning process and results is by the application of a learning model that corresponds to the characteristics of the material and the condition of the student.

Solubility and solubility product being studied is a matter of integrating concepts and mathematical calculations, so that the necessary way of thinking and analysis to building and associate the concept of the law is given. Therefore, to assist the activity of thinking and working of the students need a model of scientific learning. Scientific learning model has several models that are tailored to the level of difficulty and the material characteristics and conditions of the students, so that scientific learning can be applied to the learning model based on constructivism. Constructivism learning model that can build scientific thinking processes of students include: Inquiry, Project Based Learning (PBL), Discovery Learning (DL), and Problem Based Learning (PBL). Through constructivism learning activities, students explore and develop their own information from something to learn, so the learning process is not just the activities transferring knowledge from teacher to student, but it is an activity that generates activity and allows students to construct their own knowledge.

One scientific study model based on constructivist theory which can be applied in learning activities solubility and solubility product is the Problem Based Learning (PBL). Implementation of PBL models consists of five main steps: orientation of students on the issue, organizing students to study, individual and group investigation, development and presentation of results, as well as analysis and evaluation activities.

According to [3] the model PBL begins with the presentation of the problem, and then the students seek and analyze the issue through direct experimentation or scientific study. Through these activities and the activities of scientific thought process students become more logical, organized, and detailed that they facilitate the understanding of the concept.

Model PBL chosen because it has several advantages, among others: 1) solving a given problem can be challenging and provoke critical thinking skills of students as well as to give satisfaction to find a new knowledge, 2) learning model PBL is considered to be more fun and more preferably
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students, 3) PBL model can enhance the activity of students in the learning process, and 4) PBL model can give students the opportunity to apply the knowledge they have in the real world.

2. Related Works

Excess model of PBL in this study was also supported by some researches results: 1) Suardana (2006) argues that the quality of students' skills in finding concepts and problem solving can be improved through learning PBL [11]. 2) Model of PBL can build and improve the level of cooperation and communication between students [5], 3) Sahala (2010) found on learning activities with a pattern of problem based learning (PBL), students are taught to find and construct their own knowledge so that learning will become more meaningful [9]. 4) Mergendoller (2006) found the model PBL can improve student activities, where students who have an average low skills and knowledge will study harder and active [6].

PBL can be applied to the material solubility and solubility product to provide a learning experience that is more meaningful to students with the implementation phase of systematic and jumping, so that the activity and student learning outcomes can be achieved with good. PBL model's success is supported by the activity of students in developing the concept, while teachers are also required to have expertise in guiding and facilitating the learning activities of students well.

In connection with the above reasoning, it is to investigate improving student learning outcomes in class XI Science in the subject matter solubility and solubility product with the application of PBL learning model incorporates LKS SMAN 1 Kampar the academic year 2014/2015.

3. Material & Methodology

3.1. Data

Technique of collecting data in research is test technique. The data collected were: (1) The homogeneity test result (prerequisite material), (2) Pretest: performed in both classes before learning of solubility and solubility product constant, and (3) Posttest: given to both classes after learning of solubility and solubility product constant. While the data analysis technique used in the study is t-test.

3.2. Method

The research design is Pretest-Posttest Design Randomized Control Group can be seen in Table 1 [7].

<table>
<thead>
<tr>
<th>Table 1. Experimental Design Used in The Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Experimental</td>
</tr>
<tr>
<td>Control</td>
</tr>
</tbody>
</table>

Where:

T₀ : Initial data (data before treatment), taken from pre-test value
X : Treatment of learning is strategy type True False Chain on solubility and solubility product constant subject
T₁ : The final data (data after treatment), is obtained from the post-test value.

T-test statistics can be performed based on the criteria of normally distributed data. Therefore, before the data processing, first tested the normality using Lilliefors test. If $L_{max} \text{count} < L_{table}$, then the data is normally distributed. $L_{table}$ is obtained from the formula as follows [1]:

$$L = \frac{0.886}{\sqrt{n}} \quad (1)$$

After the data is normally distributed, then the homogeneity test is done by testing the variance of both samples (homogeneous or not) firstly, by using the formula:
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\[ F = \frac{\text{Varians Terbesar}}{\text{Varians Terkecil}} \]  

Both samples are said to have the same or homogeneous variance if \( F_{\text{count}} < F_{\text{table}} \), where \( F_{\text{table}} \) is obtained from the distribution of F with probability \( \alpha \), where \( (\alpha = 0.05) \) and \( dk = (n_1 - 1, n_2 - 2) \). Hypothesis test is done by using the right-t test with the formula as follows:

\[ t = \frac{x_1 - x_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \]  

The combined standard deviation can be calculated using the following formula:

\[ s_g^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2} \]  

The hypothesis is accepted if \( t_{\text{count}} > t_{\text{table}} \) with probability criterion 1 - \( \alpha \) (\( \alpha = 0.05 \) and \( dk = n_1 + n_2 - 2 \)), for the other price \( t \), the hypothesis is rejected. To determine the category of increase result of student learning on the subject of solubility and solubility product constant through implementation of Problem Based Learning model to do Normally Gain Test (N-Gain) of determination by formula:

\[ \text{N-Gain} = \frac{\text{skor posttest} - \text{skor pretest}}{\text{skor maksimum} - \text{skor pretest}} \]  

Where, the category of increase result of student learning can be seen on the Table 2.

<table>
<thead>
<tr>
<th>N-Gain Average</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.70 &lt; N-Gain</td>
<td>High</td>
</tr>
<tr>
<td>0.30 ≤ N-Gain &lt; 0.70</td>
<td>Midle</td>
</tr>
<tr>
<td>N-Gain &lt; 0.30</td>
<td>Low</td>
</tr>
</tbody>
</table>

4. Results and Discussion

4.1. Result

The results of data processing analysis in this study include the results of data processing analysis of homogeneity test, the results of hypothesis test data analysis and the coefficient of influence described as follows:

a. Homogeneity Test

Data used to test homogeneity in this research is data obtained from the value test prerequisites material of solubility and solubility product constant that subjects is chemical calculation, chemical equilibrium, and acid base. Before the homogeneity test, normality test data to see normal distributed data or not. The results of normality test data analysis of test items prerequisite samples 1 and 2 can be seen in Table 3.

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>( \bar{X} )</th>
<th>Sd</th>
<th>( L_{\text{max count}} )</th>
<th>( L_{\text{table}} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample 1</td>
<td>32</td>
<td>73.90</td>
<td>13.83</td>
<td>0.14</td>
<td>0.15</td>
</tr>
<tr>
<td>Sample 2</td>
<td>32</td>
<td>72.96</td>
<td>14.01</td>
<td>0.12</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Where:

n = total of students
\( \bar{X} \) = value average of the prerequisite material test results

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\[ S_d = \text{standard deviation} \]
\[ L = \text{statistical symbol to test the normality (Liliefors test).} \]

After the normality test, the data homogeneity test is performed. The data were first tested for variance and then tested the similarity of two parties to know the homogeneity of the two classes. The variance test is performed as a requirement of the homogeneity test because the tested data must have the same variance. The result of data processing analysis for homogeneity test can be seen in Table 4.

<table>
<thead>
<tr>
<th>Table 4. Homogeneity Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>------------</td>
</tr>
<tr>
<td>Sample 1</td>
</tr>
<tr>
<td>Sample 2</td>
</tr>
</tbody>
</table>

When:
\[ n = \text{total of students} \]
\[ \sum X = \text{total value of the prerequisite material test results} \]
\[ \bar{X} = \text{value average of the prerequisite material test results} \]
\[ F = \text{statistical symbol for the variance test} \]
\[ t = \text{statistical symbol for homogeneity test} \]

b. Hypothesis Test

Data used to test the hypothesis in the research is the difference between posttest and pretest value in both groups that is experimental class and control class which shows the magnitude of student achievement improvement before and after learning solubility and solubility product constant with and without using active learning strategy type True False Chain. Posttest and pretest data were first tested for data normality. The result of normality test of pretest data of experimental class and control class can be seen in Table 5.

<table>
<thead>
<tr>
<th>Table 5. Test Result of Normality of Pretest Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>Experimental</td>
</tr>
<tr>
<td>Control</td>
</tr>
</tbody>
</table>

Where:
\[ n = \text{total of students} \]
\[ \bar{X} = \text{value average of pretest sample} \]
\[ S_d = \text{standard deviation of pretest} \]
\[ L = \text{statistical symbol to test the normality (Liliefors test).} \]

While the result of normality test of posttest data of experimental class and control class can be seen in Table 6.

<table>
<thead>
<tr>
<th>Table 6. Test Result of Normality of Posttest Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>---------------------------</td>
</tr>
<tr>
<td>Experimental</td>
</tr>
<tr>
<td>Control</td>
</tr>
</tbody>
</table>

Where:
\[ n = \text{total of students} \]
\[ \bar{X} = \text{value average of posttest sample} \]
\[ S_d = \text{standard deviation of posttest} \]
\[ L = \text{statistical symbol to test the normality (Liliefors test).} \]
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Normally distributed pretest and posttest data can be used subsequently for hypothesis test. The results of hypothesis test analysis can be seen in Table 7.

Table 7. Hypothesis Test Results

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>ΣX</th>
<th>( \bar{x} )</th>
<th>( s_{combined} )</th>
<th>( t_{table} )</th>
<th>( T_{count} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eksperimental</td>
<td>32</td>
<td>1448</td>
<td>45.25</td>
<td>10.29</td>
<td>1.67</td>
<td>2.14</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>1272</td>
<td>39.75</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Where:

- \( n \) = total of students
- \( \Sigma X \) = number of posttest and pretest difference values
- \( \bar{x} \) = the average value of posttest and pretest differences
- \( s_{gab} \) = the combined standard deviation.

Table 8. Category Increase result study of student Learning

<table>
<thead>
<tr>
<th>Class</th>
<th>n</th>
<th>(Xo)</th>
<th>(Xi)</th>
<th>N-Gain</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>32</td>
<td>41.25</td>
<td>86.50</td>
<td>0.77</td>
<td>High</td>
</tr>
<tr>
<td>Control</td>
<td>32</td>
<td>41.00</td>
<td>80.75</td>
<td>0.67</td>
<td>Middle</td>
</tr>
</tbody>
</table>

Where:

- \( n \) = total of student
- \( X_o \) = Pretest Average Score
- \( X_i \) = Posttest Average Score

Based the homogeneity test on the Table 2 shows that normality test value of prerequisite materials in sample 1, \( L_{max \ count} \) was smaller than \( L_{table} \), 0.14 < 0.15 same as in sample 2, \( L_{max \ count} \) was smaller than \( L_{table} \), 0.12 < 0.15 means that the test value data of the prerequisite materials of both sample classes is normally distributed. Than the Table 3 shows that the value of \( F_{count} = 1.03 \) and \( F_{table} = 1.82 \) at \( \alpha = 0.05 \) with \( dk(11,31) \) from distribution list F which means \( F_{count} \) was smaller than \( F_{table} \), 1.03 < 1.82 means that both groups of samples have the same variance (homogeneous).

Based the Hypothesis test on the Table 4 shows that the value of pretest normality in experimental class, \( L_{max} \) was smaller than \( L_{table} \), 0.13 < 0.15, same as in control class, \( L_{max \ value} \) was smaller than \( L_{table} \) is 0.12 < 0.15 means that the pretest data of both classes is normally distributed. Than the Table 5 shows that the value of posttest normality in the experimental class, \( L_{max} \) was smaller than \( L_{table} \), 0.12 < 0.15, the same as in the control class, the value of \( L_{max \ count} \) was smaller than \( L_{table} \), 0.09 < 0.15 means that posttest data of both classes are normally distributed.

Hypothesis test is done by using t-test one side (1- \( \alpha \)) with \( \alpha = 0.05 \) and known \( dk = n_1 + n_2 - 2 = 62 \) to know whether hypothesis in this research accepted or not. From the Table 6 can be seen that the value of \( t_{count} \) was greater than \( t_{table} \), 2.14 > 1.67, therefore hypothesis : "Applying Learning Model of Problem Based Learning (PBL) to Increase Result of Student Learning on the Subjects Solubility and Solubility Product Constant in Class XI Science SMAN 1 Kampar" is acceptable.

The data used to test the hypothesis in this study is the difference between the posttest and pretest. Difference in value indicates the magnitude of the increase in student learning outcomes before and after studying the material solubility and solubility product and treated.

Based on Table 8, it can be seen that the category of increase result of students learning is obtained from the Normally Gain (N-Gain). After doing analysis of data obtained N-Gain from experiment class is 0.77 that mean the category increase result of student learning is High while N-Gain from control class is 0.67 that mean the category increase result of student learning is Middle.

4.2. Discussion

Increased result of student learning experimental class on the subject of the solubility and solubility product constant by the model of problem based learning is due to the influence of creative students in the learning process, Student activity seen when students collaborate and help each other in a group discussion to solve the existing problems on the paper statement questions.
Stage orientation by drafting and validating learning and research instruments used in this study. Learning instruments include syllabi, lesson plans and worksheets based PBL. Syllabus used was 2013 chemistry curriculum syllabus specialization in Science on the subject matter of the fundamental laws of chemistry and the preparation of the RPP guidelines. RPP compiled with 4 meetings planned in time 2x45 minutes. RPP includes 4 sessions of learning. PBL learning conducted by practicum and discussion. Instruments assessment of learning outcomes (attitudes, skills and knowledge) and student activities.

The subject matter of the chemicals used in this study the solubility and solubility product. In the study it is necessary way of thinking and analysis to building and associate legal concepts and the other one through scientific activities that the whole concept is able to firmly planted in the minds of students, the theory is consistent with the theory of constructivism, so as to achieve these objectives applied the model PBL at the implementation stage.

Implementation of PBL learning is applied in study groups. The group consists of 5-6 students. The group division is done randomly and heterogeneous with the aim that every student under the group or groups above have the same opportunity to develop knowledge. The division of this study group is based on Vygotsky's theory of learning that individual learning activities will have better results if implemented through joint activities (co-constructivism). This is consistent with the nature of PBL learning carried out in research by providing opportunities for students to work and share knowledge through activities and discussion groups.

Learning also implemented using PBL-based media in the form of worksheets to help the smooth running of activities. The PBL LKS has served the purpose of learning, instruction, how to work, observational data, issues and scientific data, sheets and discussion of individual tasks that must be solved together so that learning becomes more regular activity and to improve cooperation and student responsibility in finding the concept.

The first is to determine the subject of the solution is not saturated, precise saturated, and supersaturated, and the solubility and solubility product. Measures implemented to achieve the learning objectives are to perform verification and direct observation through student activity. In general, the activity of the students at the first meeting of students is quite good enough value there are 5 people. However, there are students who are reluctant to engage in learning activities, some students do other activities such as talking with friends, sleeping, playing, and even some students who do the work of other subjects. However, once implemented practicum, students' activity is getting better, the students were initially passive look vibrant and actively involved while studying.

The core competence that is expected is good. Some attitudes are still not optimal attained seen from the students who did not come to pray during the learning begins and ends, and out of the classroom without permission, do not speak polite when talking to the teacher, do not cooperate with other students, do not do the work and instructions and there are still some students who cheat job another friend. The realm of attitudes in the spiritual and social aspects at the first meeting is still much to be improved. The percentage of achievement domains such skills can be quite good although not optimal processes that occur.

The second meeting discussed the determining KSP a soluble electrolyte based on data solubility. In general, aspects of the learning process and results at the second meeting to be better than the first meeting. Activities at the second meeting of students achieved better than the first meeting. The achievement of student activity at this second meeting students who scored enough is 4. Activities that have not reached the optimum at the second meeting was on oral and mental activity. The realm of skills at this second meeting looks better than the first meeting, with the achievement of the preliminary stage until closing. It is allegedly because students are more prepared to perform the learning activities.

The third meeting discussed on Determining pH of KSP its price. PBL learning activities carried out by the discussion. Activities of students at the third meeting of the general good and has increased from the first and second meetings. Achievement of aspects of student activity at the third meeting, the better. Many students become more courage to express ideas and opinions, these students no longer feel embarrassed and afraid of dealing with clever students because teachers give the same treatment and does not discriminate between the answers given so that they are increasingly waking mental confidence. Attitudes and skills of students formed at this third meeting also looks better.
PBL implementation is entirely dependent on the activity, attitudes, and skills of students. Teachers in this case only serve as a mentor and facilitator, while learning is dominated by the activity of students in constructing knowledge through scientific processes such as observing, proposing, implementing, process data, performing experiments, reported results, and formulate a conclusion to the process fun and not monotonous so product knowledge gained students become stronger.

The learning process is referred to in this case is how students can be actively involved in the concept of learning and discovery. Therefore, in the application of PBL models supported Piaget developmental theory which states that the cognitive development of students depend on the activity in interacting with the environment and take advantage of real experience. This theory is consistent with the objectives of PBL in this study is to enable students with a real experience for the provision of data, scientific facts that support and give students practical activities to prove themselves the laws they learned that the process and product knowledge gained will be embedded strong in students.

Implementation of PBL learning in this study are not really running well, there are some disadvantages faced by, among others:

a. Less awakening interest of the students to be actively involved in learning,

b. practicum done little because of the limitations of the tools and materials lab,

c. allocation execution time is longer than the planning for students are still not organized in procedures of activities, as well as

d. students' lack of reference so that the development concepts are still many being led by the teacher.

Some of the efforts made to correct the shortcomings of the teacher is to provide guidance and motivation to students. Teachers are also constantly reminded that every activity that both individuals and groups will always rated, it encourages students to get used to actively and cooperate in performing a given task.

5. Conclusion

Based on the results of data analysis and discussion then it can be concluded:

1. The application of learning model of problem based learning can improve learning outcomes of students on the subject of chemical solubility and solubility results in class XI IPA of SMAN 1 Kampar.

2. Improving student learning outcomes on the subject of solubility and solubility results in class XI IPA of SMAN 1 Kampar through the application of learning models of problem-based learning at the high category with N-gain of 0.77.

References

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