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# The Effectiveness of Problem Based Learning on Acid-Base Materials to Improve Scientific Attitude and Creativity of SMA N 1 Comal Students

**Agus Dirmanto**[✉1], **Edy Cahyono**[2], **Triastuti Sulistyaningsih**[2]

[1] SMA Negeri 1 Comal, Indonesia
[2] Pascasarjana, Universitas Negeri Semarang, Indonesia

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**Abstract**

The learning model is fundamental to increase the effectiveness of the teaching and learning process in the classroom. Learning models that make students more active in the chemistry teaching and learning process in class XI SMA N 1 Comal are rarely used. As a result, students become passive and scientific attitudes and student creativity have not developed. This study aims to determine: the process of implementing problem-based learning (PBL), the effectiveness of PBL on acid-base material in high school, increasing the scientific attitude and creativity of class XI SMA students. The research design used was a pretest-postest control group with a quasi-experimental design. This study's population was all students of class XI SMA N 1 Comal in the academic year 2020/2021. The sample was taken using simple random sampling technique and selected class XI MIPA 5 as the control class and XI MIPA 6 as the experimental class. Data collection techniques used documentation in the form of pretest and posttest scores, scientific attitude observation sheets and questionnaires to measure student creativity. The data analysis technique used is the t-test. The results showed that the average posttest score of students in the experimental class were higher than the average posttest score of students in the control class. The percentage of students with a high scientific attitude in the experimental class is also more remarkable than the control class. The creativity category with a very creative category in the experimental class shows a more significant percentage than the control class. From the analysis results, it can be concluded that first, the application of PBL starts from problem orientation, group organizing, conducting experiments, presenting work results, and evaluating. The second is the problem-based learning model provides excellent results and is quite effective compared to conventional methods. Third, PBL models can improve student's scientific attitudes and creativity compared to conventional methods.

✉ correspondence :
SMA Negeri 1 Comal, Indonesia
Jalan Raya Ahmad Yani No.77, Balutan, Purwoharjo, Kecamatan Comal, Kabupaten Pemalang, Jawa Tengah, Indonesia 52363
E-mail: adgoltia38@gmail.com

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## INTRODUCTION

The choice of learning model in the classroom has an effect on success in learning. If the learning model used involves the active role of students in the learning process, it is hoped that it will be able to improve students' scientific attitudes and creativity. One learning model that can be applied in the science learning process is the problem-based learning (PBL) model. PBL is a learning model with a student learning approach to authentic problems so that students can compile their own knowledge, develop higher skills; Inquiry and the independence of students (Arends, 2013).

The learning model is very important in order to improve the effectiveness of the teaching and learning process between teachers and students in the classroom. Wenning (2005) conducted research on learning. Wenning in his journal also explained that the obstacles faced in the learning process were the teacher's lack of understanding of the learning model so that scientific inquiry-based learning methods were rarely applied in science learning.

Another problem that has been found is that learning chemistry, which has been carried out so far, only provides opportunities for students with high academic abilities to obtain satisfactory achievements while students with low academic abilities are lagging behind in their achievements. Therefore, this has an impact on the relationship between children with high academic abilities and children with low academic abilities.

In conventional learning, students tend to compete with each other for certain ranks and other awards. Students with low academic abilities inevitably have to be in losing positions more often. So it needs efforts to improve scientific attitudes and creativity with low academic abilities.

Real solution to improve the achievement of children with low academic abilities is cooperative learning because cooperative learning produces better learning outcomes (Ahmad & Mahmood, 2010). The problem-based learning model is the right alternative because it is oriented towards group collaboration in solving problems and making project work easier for students to understand. Damiri (2012) defines problem-based learning or PBL as having a focus on the core concepts and principles of a lesson that involves students in problem solving, investigation and collaboration in producing a product. Problem-based learning is a learning model centered on student creativity, collaborative learning and inquiry- based learning that aims to improve student attitudes and motivation (Johnson, 2013).

Based on the problems that have been described, it is hoped that the application of a problem-based learning model in which there is a study group will encourage students to exchange ideas about the knowledge and concepts of acid-base they are learning so that through this process it is expected to increase the scientific attitude and creativity of students with low academic abilities.

## METHODS

This research is a quasi-experimental research (Control Group Pretest-Postest). This research design was used to analyze the difference in achievement between the experimental class and the control class. The population in this study were all class XI students at SMA Negeri 1 Comal in the academic year 2020/2021 which consisted of nine classes. The sample in this study consisted of two classes, namely class XI MIPA 5 as the control class and class XI MIPA 6 as the experimental class. The technique used in sampling is simple random sampling technique, namely taking members of the sample from the population at random without paying attention to the strata in the population. Simple random sampling is done by way of a lottery.

The techniques used in data collection are documentation, tests, and observations. The documentation method is used to determine the level of student creativity based on a questionnaire. The next data collection technique is the multiple-choice form test which is used to obtain students' initial data. The test instrument in this study must also be tested first to determine its feasibility in terms of validity and reliability. In addition to tests, data collection was also carried out by observation. Observation activities were carried out in order to evaluate the improvement of students' scientific attitudes.

The data analysis technique is divided into two, namely the early stage analysis and the final stage analysis. The preliminary stage

analysis (prerequisite test) was conducted to determine whether the two classes (control class and experimental class) departed from the same initial conditions (homogeneous) and the data were normally distributed. The data used is the pre-test value of acid-base material. The final stage of data analysis was carried out after the two samples were given different treatments and tested. From this final test, data will be used as a basis for testing the research hypothesis. Before testing the hypothesis, a prerequisite or preliminary test is carried out, namely the normality and homogeneity test of the final data (Benderrick, 2019). To test the hypothesis, the statistical analysis used is the t-test analysis and the F test.

## RESULTS AND DISCUSSION

Hypothesis testing is carried out on the control class and the experimental class. The data needed for this test is the learning outcome data for the two sample groups. The results of the t-test and F test calculations can be seen in table 1 and table 2.

**Tabel 1.** Rekapitulasi data uji-t

| Research Hypothesis | Research result | Interpretation Criteria | Conclusion |
|---|---|---|---|
| There is an effect of the PBL model on improving students' scientific attitudes and creativity | $t_{hit}$ = 5.02 | $t_{tab}$ = 1.69 With a significant degree 0.05/5% | There is a significant effect of the PBL model on improving students' scientific attitudes and creativity |

**Tabel 2.** Rekapitulasi data uji F

| Variety | db | JK | KR | $F_{tab}$ | $F_{hit}$ |
|---|---|---|---|---|---|
| Treatment | 1 | 4872587 | 4872587 | 4.57 | 26.25 |
| Error | 30 | 5567312 | 185577.1 | | |

### Application of Problem Based Learning Model in Acid-Base Material to Improve Student's Scientific Attitude and Creativity

Sears and Hersh (2001) stated that problem-based learning can involve students' ability in problem solving. Problem-based learning or PBL is a learning model based on constructivist understanding that accommodates student involvement in learning and authentic problem solving. The process of applying the problem-based learning model carried out by researchers in the fifth-grade subject of class XI MIPA SMA N 1 Comal begins with preliminary observations before the research is carried out.

The next step is to prepare learning tools such as syllabus and lesson plans. The steps for making the syllabus and lesson plans are in accordance with the 2013 curriculum format where the 2013 curriculum is integrated scientifically, then what the researchers do is that learning begins with student orientation to acid- base material, where students are taught material that has been determined.

The next stage is the researcher organizing students to learn by helping students in defining and organizing tasks related to the problem. The next stage of PBL is the teacher guiding individual and group investigations by means of the teacher encouraging students to collect appropriate information, carrying out experiments to get explanations and problem solving. After the experimental activities have been carried out, students must develop and present their work in a way that the teacher helps students plan and prepare appropriate work such as the report format provided.

The final stage of problem-based learning is analyzing and evaluating the problem-solving process by means of the teacher helping students to reflect or evaluate student investigations and the processes used. During the learning activities, the teacher makes observations on small groups to find out the development of scientific attitudes that students have.

### Effectiveness of Problem Based Learning on Acid-Base Materials

In this discussion, the researcher will discuss the effect of problem-based learning models on acid-base material. The findings obtained by researchers are relevant to the results of previous studies and several other studies show that the problem-based learning model provides excellent results and is quite effective compared to conventional methods. Ibrahim (2009) in his research results showed that students in the experimental group had better performance on conceptual problems while there was no difference in student performance on quantitative problems.

Zheng (2013) states that the application of PBL in learning can make it easier for students to solve problems that arise during the learning process. Similar research has been conducted by Qianli (2008) which states that the PBL model can encourage students to solve a problem so that they can produce logical conclusions. Furthermore, Kusnadi (2013) in learning chemistry with PBL using real and virtual laboratories in his research it can be concluded that there are differences in student cognitive achievement between learning with the PBL method using real and virtual laboratory media, and mathematical abilities provide differences in cognitive learning achievement.

Another research result, Deti Rostika (2013) states that problem-based learning has a significant effect on students' ability to find alternative solutions to solving math problems. This can be seen from the test used is the t test (T-Test Sample Independent) with the assumption that the data comes from a normally distributed population. From the test results, it was obtained the significance score of the ability to find alternative solutions in solving students' mathematics problems with the assumption that the two data came from a normally distributed population of 0.000. This significance value is less than 0.05, so based on the above decision- making criteria, Ho is rejected. Thus it can be concluded that the mean at the time of pre-test and post-test is different. This means that there are differences in the ability to find alternative solutions in solving problems during the pre-test and post-test.

In problem-based learning activities students are required to build knowledge in their minds through scientific activities, and the teacher is only a facilitator. The role of teachers in problem-based learning models is reflected in the delivery of material and monitoring of scientific activities on acid-base material. In this study, class XI MIPA 5 as a control class using conventional methods and class XI MIPA 6 as an experimental class with a problem-based learning model, so that a research design like this can answer the predetermined hypothesis.

The results of the analysis of both obtained the influence of the PBL model on the learning process of acid-base material chemistry. This is evidenced by the results of the pre-test and post- test of the experimental class and the control class with the post-test mean score of the experimental class higher than the average post- test result of the control class. The analysis results from table 4.13 and table 4.14 also obtained tcount = 5.02> ttable = 1.69 and Fcount = 26.25> Ftable = 4.57 at the 95% confidence level. This shows that Ha is accepted and Ho is rejected, which means that there is a significant effect of problem-based learning models on learning outcomes and increasing scientific attitudes and creativity of students of class XI MIPA.

This shows that the problem-based learning model has an influence on student learning outcomes and achievement and it can be concluded that it is quite effective and very good. In the learning process, the problem-based learning model teaches students to be more creative and improve their scientific attitude from the project that has been given. Moreover, the 2013 curriculum which is oriented towards developing a scientific attitude will certainly help in developing positive character character development for students. The development of a scientific attitude can be done by the teacher, namely by frequently making observations or practical activities about a concept.

**Problem Based Learning Model Towards Increasing Scientific Attitude and Student Creativity**

From the results of the analysis of the interpretation of the data from the control class and the experimental class, a significant comparison of the students' scientific attitude data was obtained. In class XI MIPA 5 as a control class, 46% of students have a high scientific attitude, while in class XI MIPA 6 there are 77% of students who have a high scientific attitude. Judging from the data collection, there is a difference of 77% - 46% = 31% between the control class and the experimental class that uses problem-based learning.

Based on the description above, it can be concluded that the problem-based learning model can improve the scientific attitude of class XI MIPA high school students on acid-base chemistry subjects. This finding is consistent with the results of research that has been done before, namely research conducted by Astika (2013) states that problem-based learning models can provide differences in scientific attitudes and critical thinking skills and there are differences in scientific attitudes between students learning using problem-based learning models and students. those who learn to use the expository learning model and there are differences in critical thinking skills between students who learn to use problem-based learning models and students who learn using expository learning models.

For the level of student creativity, from the results of the analysis of the interpretation of the data shown in table 4.5 as the control class and table 4.6 as the experimental class, it was obtained a significant data comparison of the student's creativity level. In class XI MIPA 5 as a control class there are as many as 40% of students who have a very creative level and as many as 60% of students are at a creative level while in class XI MIPA 6 there are 80% students who have a very creative level and as many as 20% are at a creative level. . Judging from the data collection, there is a difference at the very creative level of 80% - 40% = 40% between the control class and the experimental class using problem-based learning. Based on the description above, it can be concluded that the project-based learning model can increase the creativity of class XI MIPA high school students in acid-base chemistry subjects.

Relevant research results include those conducted by Ratna (2016) which shows that from cycle I to cycle II, there is a tendency to increase creativity and activity with PBL. This increase shows that creativity and activity can be formed with habits that are carried out and continuous training, with PBL they facilitate creative thinking (Wang, 2013). The role of the teacher in providing learning methods is very large for increasing creativity. In line with that, Ulger K. (2018) in his research also stated that PBL can support the development of creative thinking skills through investigation and criticism while maintaining uncertainty.

According to Tan (2005) PBL is an active learning with a student-centered approach, PBL begins with a problem as a basis for investigating the learning process. PBL is not only about problem solving, but is also based on constructivism where real problems are used in learning design related to the environment (Tan, 2004b). The development of problem-solving intelligence and competence for creative problem solving is an important goal of PBL (Tan, 2004a).

Based on this, Tan's PBL not only emphasizes the cognitive aspects but also emphasizes creativity. PBL is designed to help students develop thinking and problem solving skills, learn adult roles and become independent students. This approach provides an attractive alternative for teachers who wish to move beyond more teacher-centered approaches to challenging students with the active learning aspects of PBL.

Problem-based learning is closely related to the experimental method for students. By using experiments, students will be more creative and active in finding the problems at hand. Students who are active and creative will always try to improve various logic of thinking and doing. To support the logic of thinking and doing, creativity and activity arise. Problem- based learning can be applied through experiments. Sladek (2011) states that the development of experiments can also be used as a method to increase student creativity.

## CONCLUSIONS

Based on the results of research on the effectiveness of problem-based learning models to improve students' scientific attitudes and creativity in acid-base material in class XI SMA NI Comal, it can be concluded as follows: and raises problems, the teacher helps students to define and organize learning tasks related to the problem, the teacher encourages students to collect appropriate information, carries out experiments to get explanations and problem solving, the teacher helps students plan and prepare appropriate work such as reports, teachers help students to reflect or evaluate their investigations and the processes they use. The problem-based learning model gives excellent results and is quite effective compared to conventional methods which is shown by testing the hypothesis and acceptance of the alternative hypothesis and rejecting the null hypothesis. The problem-based learning model can improve students' scientific attitudes and creativity based on the results of data analysis of the experimental class research compared to the control class.

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