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The Influence of Project Based Learning Model on Students' Problem-Solving Competence in Learning of Acid-Base

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Article Info	Abstract
	The study aims to determine the influence of Project Based Learning Model on students' problem-solving competency. The method used was experimental method with Pretest-Posttest Control Group Design. This study was conducted at the State Junior High School 2 Brebes with the students of grade VII in the academic year 2021/2022 as the research population. The sampling technique used in this study was Simple Random Sampling. The results showed that the average N-Gain Score for the experimental class was 0.76, it was higher than the control class with the score of 0.60. The results of the T-Test indicated that the data resulted in this study met the criteria with the value of tcount = 18,812 > ttable = 1,97897 meaning that H0 is rejected. It can be concluded that the Project Based Learning Model has an influence on the students' problem-solving competence in learning of acid-base.

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INTRODUCTION

One of the students' competencies expected to be achieved in educational process is problem-solving ability. The curriculum of 2013 contains the importance of problem-solving skills as found in the basic competence of Natural Science learning which states that "Students are expected to understand Natural Science concepts and principles and their interrelationships and are applied in solving problems in life." ((Kemendikbud, 2016).

Natural Science learning not only understands concepts but also emphasizes the students' mindset so that they are able to master and to solve problems critically, logically, carefully and thoroughly (Darwanti, 2013). Problem solving competence needs to be trained to the students as their provision in dealing with their real problems in everyday life.

In fact, there are still many students who have difficulty in solving and determining the problems related to Natural Science learning materials. It is because they only memorize the concepts and do not use them in a real life. It makes the students less able to determine and formulate their problems (Trianto, 2009).

The low problem-solving competence of the students is proved by the low scores obtained by the Indonesian students in taking the TIMSS (Trends International Mathematics and Science) test. Based on the results of TIMSS in 2011, Indonesian students got a score of 406 which is the 5th lowest score, while in 2015, Indonesian students got a score of 397 which is the 4th lowest score out of 64 countries. The score puts Indonesia in the Low Science Benchmark predicate (Martin et al., 2015).

Problem-solving competence is an important part of Natural Science learning because the activity to solve a problem require students to find their own learning concepts so that the learning process becomes more meaningful. Based on (Mariawan, 2013)), problem-solving competence is an important aspect in Natural Science learning, because it can be used by the students in applying scientific knowledge and abilities acquired during the learning process.

Problem solving ability is one of the important abilities that students must have because everyone is always faced with various problems in everyday life that must be solved and requires creativity in order to be able to find solutions to the problems they face

(Permatasari, 2014). Problem solving skills train students to find various concepts in a holistic, meaningful, authentic and applicable manner (Hariawan, 2013). Gok (2010) stated that problem solving skills are very fundamental in science learning.

The low problem-solving ability of students in Natural Science learning is caused by many factors. The factors that affect the low problem-solving competence and creative thinking of students include internal factors and external factors. The internal factors that influence students' problem-solving competence and creative thinking include attitudes, talents, interests, and self-motivation of students who are still lacking, while the external factors include the role of educators (teachers). The teacher's role that can affect students' problem-solving competence and creative thinking is the teacher's inaccuracy in choosing the learning model used during the classroom learning process.

One of the solutions for this problem is to apply a learning model that is able to make the students get involved and contribute actively to the learning process so that their problem-solving competence in Natural Science are further improved and the learning process is more meaningful. One of the innovative models that can improve the students' problem-solving competence is the Project Based Learning (PjBL) model.

Project Based Learning (PjBL) is a student-centered learning model with the project duration is relatively long and it focuses on the problem to be solved and provides a more meaningful and real learning experience for students (Rohana & Wahyudin, 2017). PjBL requires students to think critically, creatively, analytically and to use higher thinking skills, collaboration, communication, problem solving and independent learning ((Astuti, 2015); (Sumarni & Wardani, 2016). The advantages of this learning model are: (a) To foster students' active participation during a learning process, (b) to develop students' mastery and creativity in solving problems, (c) to increase students' willingness to carry out creative action plans that have been made in groups, (d) train students to work in group together (Astuti, 2015).

Research that has been conducted by Abidin (2014) stated that the PjBL model is a model which emphasizes the activities of students in solving problems and applying their knowledge in working

on a project. Based on the problems description above, it can be seen the PjBL model is very necessary to be applied to learning activities in improving the students' problem-solving competence. Therefore, the writers are interested in conducting research entitled "The Influence of *Project Based Learning* Model on Students' Problem-Solving Competence in Learning of Acid-Base".

METHODS

The method used in this study is experimental. There are two variables, they are independent variable and dependent variable with control class and experimental class. The independent variable in this study is the application of the *Project Based Learning* model and the dependent variable is the problem-solving competence. The Project Based Learning Model has six components, they include (1) determining the basic questions, (2) designing the project, (3) compiling a schedule, (4) monitoring project progress, (5) presenting results, and (6) evaluating (Foundation, 2005).

Before collecting the data, the research instrument was tested in advance with the instrument test stages including test validity, reliability, level of difficulty, and discriminatory power of Likert scale. The instrument tested was a multiple-choice reasoned test. The instrument trials were analyzed using the SPSS 22.0 for windows program. This study was conducted at State Junior High School 2 Brebes in the academic year 2021/2022. The population in this study were the students of grade VII semester 1. This research was conducted in two classes, class VII A as the experimental class and class VII E as the control class. The sample selected by using the simple random sampling technique. The test of problem-solving competence was developed based on indicators of the problem-solving competence itself, including (1) understanding the problem by knowing what was asked of the question/problem, (2)

developing a problem-solving plan including being able to make experiments and simulations, compiling rules or possible sequences of problem solving, (3) implementing a problem-solving plan by implementing strategies during the process, (4) finding/re-examining the results obtained by re-examining the process and solutions made to ensure the method used is good and correct.

RESULTS AND DISCUSSION

The data resulted in this study was in the form of quantitative data by using the students' problem-solving competence test on acid-base material. The increase in students' competence could be found from the results of pretest and posttest scores. The following are the score recapitulation results of the problem-solving competence test in the experimental class and control class. The description of the data is shown in Table 1.

Table 1. The Result of Problem-Solving Competence Test

Class	Pre-test	Post-test	N-Gain	Criteria
Experimental	75.67	81.31	0.76	High
Control	60.31	64.85	0.60	Medium

Based on Table 1, the results of the score recapitulation of students' problem-solving competence test show an increase. It can be seen the control class and the experimental class show different values. The average pre-test score in the experimental class is 75.67 while the average score in the control class is 60.31. However, after the treatment was given during the learning process for each class, there is an increase in students' problem-solving competence. The post-test score of the experimental class is 81.31 and the control class is 64.85. The average score of the pre-test and post-test taken from each class can be seen in Figure 1.
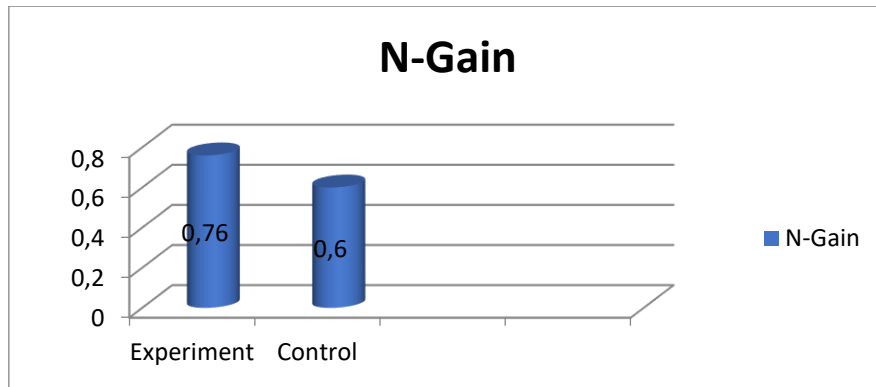
Figure 1. The Average N-gain Score of the Experiment Class and Control Class

Table 1 shows not only the average score of the pretest and posttest but also the average N-gain score in the experimental class and control class. The experimental class shows an average N-gain score of 0.76 while the control class shows an average N-gain score of 0.60. Based on the category (Hake, 1999) the increase in problem-solving competence of the experimental class is included in the high criterion while the control class is included in the medium criterion, meaning that the students' problem-solving competence in the experimental class is better than the control class.

After processing the results of the pre-test and post-test from the experimental class and control class, statistical tests were carried out to prove whether there is an influence of the Project Based Learning model on the students' problem-solving competence on both classes. It was done in the form of Normality Test, Homogeneity Test and Hypothesis Test. The following are the results of those statistical calculation analysis.

Table 2. The Results of Normality Test

		Shapiro-Wilk			Description
	Class	Statistic	df	Sig.	
Students' Result	Trans_EksPreM	,943	32	,090	Normal Distribution
	Trans_EksPosM	,947	32	,121	
	Trans_KonPreM	,939	32	,072	Normal Distribution
	Trans_KonPosM	,950	32	,140	

Table 3. The Results of Homogeneity Test

Levene Statistic	df1	df2	Sig.	Description
,284	3	124	,837	Homogen

Table 4. The Results of Hypothesis Test

Hypothesis Test	t_{count}	t_{table}	Description
$t = \dfrac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{(n_1 - n_2)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$	18.812	1.97897	Significantly Different

The calculation results show t_{count} of 18,812 and t_{table} of 1,97897 with sig. 0.000. This means that $t_{count} > t_{table}$ then the hypothesis is accepted, thus Ha is accepted, and Ho is rejected. It can be found that there is a significant difference between the students' problem-solving competence in learning Acid-Base using the PjBL model.

Based on the results of the hypothesis test, it shows that the Natural Science problem-solving competence of the students taught by the PjBL model is better than the non-PjBL model.

The results of this study are in accordance with previous research conducted by (Fiana et al. 2019) proving that there is a positive influence of PjBL model on students' problem-solving abilities.

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As stated by Abidin (2013) that the project-based learning model is one of the very good learning models in developing the basic skills that students must possess, such as decision-making skills, creativity skills, and problem-solving skills.

The ability to solve problems is a very important skill. That is why (NCTM, 2000) stated problem solving is not only the goal of learning but also the primary means of doing so. Every human being in his life will always be faced with a problem that requires a skill and ability to solve it. The importance of teaching problem solving was stated by (Hudojo, 2003), teaching students to solve problems allows students to be more analytical in making decisions in everyday life. When students are trained to solve problems, they will be able to make decisions because they already have the skills how to collect relevant information, analyze information, and realize the research needs to be reviewed or not.

Problem-solving competence is a competence needed to solve problems in building knowledge concepts. The implementation of the *Project Based Learning* (PjBL) model in Natural Science learning is expected to increase students' problem-solving competence along with its exercises conducted through the investigation process. According to (Serin, 2019), the application of PjBL in the learning process gives students the opportunity to build knowledge in a real context, where the main idea in PjBL is to give students the opportunity to investigate problems in their real world that will allow them to gain new knowledge. PjBL provides opportunities for the students to explore their abilities in critical thinking, problem-solving, and independent work. Therefore, improving the students' problem-solving skills is very important to achieve learning objectives effectively.

Problem-solving skills will be effective for the students if they are able to analyze and to evaluate the problems given. In addition, they are also expected to be able to find solutions to their problems effectively and accurately through the problem-solving competence they have mastered (Istiyono et al., 2019).

The problem-solving competence will produce many positive things if it can be implemented optimally and seriously. Through problem-solving, it is hoped that someone can build their own understanding of the reality of nature and science by reconstructing their own "meaning" through their personal relevant understanding (constructivism view). Individuals are facilitated to apply their exiting knowledge through problem-solving, decision-making, and discovery design. They are required to think and to act creatively and critically. Theoretically, problem-solving is believed to be a vehicle for developing higher-order-thinking skills (Kusmawan, 2002).

CONCLUSION

Based on the results of the study that has been conducted, it can be concluded that there is an influence of the PjBL model on the problem-solving competence of class VII students at State Junior High School 2 Brebes in the academic year 2021/2022. The average score of the problem-solving competence of the students who apply the PjBL model during the learning process is 81.31. It is higher than the average score of the students who do not apply the PjBL model which is only 64.85.

SUGGESTION

PjBL model requires a relatively long time and requires the skills of teachers who are able to carry out these learning steps. As a result, a good preparation is needed before the teachers carry out a classroom learning to optimize their time in accordance with the PjBL learning syntax. In addition, the application of the PjBL model must be used intensively to sharpen the students' problem-solving competence.

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