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Application of Creative Problem Solving Learning Model to Problem Solving Ability in Chemistry Material

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Abstract

This study aims to determine the effect of applying creative problem solving (CPS) learning models on students problem solving abilities in chemistry on acid-base material. This study uses a quasi experimental research design with a pretest-posttest control group design. The population of this study was class XI MA As adiyah Tolai Parigi Moutong Regency as many as 2 classes consisting of 44 students. The sampling technique in this study was saturated sampling, so class XI A was the control class and XI B was the experimental class, each of which consisted of 22 students. Data collection using a problem solving ability test instrument. The results showed that the level of problem solving ability in the control class using conventional learning models obtained an average value of 70 while the experimental class using creative problem solving learning models obtained an average value of 82. Analysis of each indicator of problem solving ability showed that students had able to understand the problem, plan problem solving, and carry out the solution plan well. However, students have not been able to re examine the results of problem solving properly. The analysis of hypothesis testing using t test shows that the value of sig-(2-tailed) obtained is 0,004 less than 0,05 so that it shows the effect of applying creative problem solving (CPS) learning models on students problem solving abilities in acid-base material.

Keywords: Problem solving ability · Creative problem solving (CPS) learning model · acid-base material

INTRODUCTION

In the 21st century, the learning process aims to make students master critical thinking skills and problem-solving skills and shape students to be creative, innovative, communicative, and collaborative (Hobri et al., 2020). Higher order thinking is an important component of 21st century skills. One of them is problem solving ability whose cognitive domain includes analyzing (C4), evaluating (C5), and creating (C6). Problem solving abilities can be developed in learning by honing students to think critically, creatively, logically, and systematically in solving problems so as to increase students' skills in dealing with life developments (Hobri et al., 2018).

One of the thinking skills needed to be empowered in education to succeed is problem solving ability (Affandy et al., 2019). Problem solving is the interaction between stimulus and response. The environment provides input to students in the form of problems, while the brain's nervous system functions to interpret effectively so that the problems encountered can be investigated, assessed, analyzed, and searched for solutions properly (Nuruddaoroini et al., 2022). Scientists call problem solving as a high-level thinking process that consists of intellectual abilities that involve cognitive processes in their activities. To solve a problem, a problem solver can use the strategies or steps formulated by Polya (1973), namely understanding the problem, plan problem solving, carry out the solution plan, and re-exemine (Simamora et al., 2018).

The fact is that in chemistry learning activities, students often only memorize the material presented by the teacher because during the learning process it is only centered on the teacher so that students are also limited to memorizing and knowing ultimately makes students not accustomed to solving problems (Surur et al., 2020). In fact, the learning process should allow students to be fully

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involved with the object of learning so that students are able to build knowledge independently (Simanjuntak et al., 2021). This problem should be a concern , teachers should plan innovative and solution strategies. so that this problem does not have an impact on the development of students' problem solving abilities (Fauziah et al., 2020).

Whereas chemistry learning activities must be well designed to ensure students are at the forefront of learning activities or are student-centered , teachers are more creative in creating conducive classrooms. (Schettino, 2016). Learning with student orientation as the main subject will produce meaningful learning (Chiang & Lee, 2016). The application of appropriate and good learning strategies and models will encourage the development of problem solving skills so that they are beneficial for students in cognitive, psychomotor, and affective aspects. (Chang et al., 2017).

The application of the creative problem solving (CPS) learning model is one solution to the application of problem-based learning. Creative problem solving (CPS) is a learning model that can support and develop students' abilities, both learning activities and student motivation. Student learning activities are well patterned through this model so that they are more motivated to learn. (Samson, 2015). The application of the CPS model learning model can develop students to think at higher levels, one of which is to hone students in solving the problems they face (Chen & Chen, 2019). The CPS learning model refers to teaching and problem solving skills followed by strengthening skills while the steps of the CPS learning model are problem clarification, opinion expression, evaluation and selection, then implementation (Sari et al., 2018).

Based on the results of interviews with class XI chemistry teachers at MA As'adiyah Tolai, when viewed from class XI students have low ability to solve problems in chemistry on acid-base material. This is because it still applies the conventional teacher-centered learning model where students tend to listen to the explanation of the material given by the teacher which causes students to become passive in learning. The teacher also explains why they are still applying conventional learning models in learning because students are not accustomed to using student-centered learning models so that it makes students' abilities less honed in solving a problem.

Judging from the results of interviews, the learning system in schools needs to be upgraded. The learning process should be designed in the concept of problem solving and relate it to real life so that learning is not just memorizing concepts or adding vocabulary, but students are expected to be able to solve problems through the development of concepts that have been obtained (Gultepe et al., 2013). So that researchers are interested in taking a study entitled the application of creative problem solving (CPS) learning models to students' problem solving abilities in chemistry.

This study aims to determine the level of problem solving ability of MA As'adiyah Tolai students in chemistry through the creative problem solving (CPS) model and find out the effect of applying the creative problem solving (CPS) learning model on chemistry on students' problem solving abilities.

Muhammad et al., (2018), examined the use of creative problem solving learning models to improve students' mathematical problem solving abilities. The purpose of this study was to obtain empirical evidence of increasing students' mathematical problem solving abilities using the Creative Problem Solving learning model. Based on the results of the study, it was found that the increase in mathematical problem solving abilities of students who used creative problem solving learning models was better than students who used ordinary learning models. Muhali, (2021), examines the Effect of the Implementation of the Creative Problem Solving Model on the Improvement of Problem Solving Ability, Science Process Skills, and Metacognition Awareness of Learners. Based on the results of the study, it was found that the Creative Problem Solving model had an effect on increasing problem solving abilities, science process skills, and metacognition awareness of students in learning chemistry of Salt Hydrolysis material.

METHODS

This type of research is a quantitative research that uses a quasi-experimental research design with a pretest-posttest control group design in which the selection of group subjects is not done randomly (Arikunto, 2013). This research was conducted at MA As'adiyah Tolai, Torue village, Parigi Moutong district. The population of this study was class XI students consisting of class XI A and class XI B at

MA As'adiyah Tolai, amounting to 44 people. The sample of this study consisted of class XI A as the control class and class XI B as the experimental class, each of which amounted to 22 people. The sampling technique in this study is saturated (Arikunto, 2013). In this case, the sample is class XI A as the control class and class XI B as the experimental class.

The research instrument used in this study was a test of students' problem-solving abilities consisting of 5 essay questions. Before being used, the research instrument was validated by an expert validator, namely one of the lecturers of the chemistry education study program who has an expert in his field. Data analysis in this study is divided into two, namely descriptive analysis and analysis statistics inferential.

Descriptive analysis was used to calculate the percentage. Students' problem solving abilities were analyzed through students' answers to questions that could indicate students' problem solving abilities. The data obtained from the above instrument can be analyzed using the following steps (Peranginangin & Surya, 2017):

- Provide a raw score for each student's answer based on the assessment rubric.
- Calculate the total test score for each aspect of problem solving ability based on the indicators.
- Determine the percentage value of students' problem solving abilities for each aspect that appears to all students, with the following formula:

$$\mathrm{NP} = \frac{\mathrm{R}}{\mathrm{SM}} \tag{1}$$

  Information:
  NP = Percentage Value
  R = Raw score obtained by students
  SM = Ideal maximum score

- The score of students' problem-solving abilities is calculated based on the achievement of four aspects of problem-solving abilities which consist of understanding the problem, plan problem solving, Carry out the completion plan, and check re-exemine.

Table 1. Troubleshooting ability scoring guidelines

Rated aspect	Answers to questions (problems)	Score
Understanding the problem	No answer at all	0
	Write down what is known without mentioning what was asked or vice versa	1
	Write down what is known and asked but not quite right	2
	Write down what is known and what is asked but is not quite right	3
plan problem solving	Not planning a solution at all.	0
	Planning the solution by writing the formula incorrectly	1
	Plan the solution by writing the formula correctly	2
Carry out the completion plan	There is no solution at all.	0
	Carry out the plan by writing down the answers but the answers are wrong or a small part of the answers are correct	1
	Carry out the plan by writing half correct answers or mostly correct answers	2
	Implement the plan by writing down answers correctly and completely	3
Re-exemine	Don't write conclusions	0
	Writing conclusions and/or checking the process incorrectly	1

Rated aspect	Answers to questions (problems)	Score
	Writing conclusions and/or checking the process appropriately	2

- Give a score based on the students' answers given by looking at the achievement of four aspects of problem solving abilities.
- Add up the scores that each student gets from all the questions that are worked on.
- Convert the scores obtained into percentages and categorize students' problem solving abilities as shown in the table below.

Table 2. Category of problem solving ability

Criteria	Category
85% - 100%	Very high
75% - 84%	Tall
60% - 74%	Enough
40% - 59%	Low
0% - 39%	Very low

Inferential statistical analysis was used to see the effect of applying the chemical creative problem solving (CPS) learning model on students' problem solving abilities. This research was conducted by independent sample t-test through normality test, homogeneity test, and t-test. So for data processing using SPSS version 25.

RESULTS AND DISCUSSION

The results of this study include the results obtained during the teaching and learning process at MA As'adiyah Tolai in class XI A as a control class and class XI B as an experimental class with chemistry learning. Students' problem solving ability is measured based on the stages adapted from Polya, namely understanding the problem, planning problem a solution, Carry out the completion plan, and check again.

Table 3 . Number of students based on students' problem solving ability criteria

Category	Experiment		Control	
	Pretest	Posttest	Pretest	Posttest
Very high	0	6	0	3
Tall	0	11	0	7
Enough	0	3	0	8
Low	19	2	19	4
Very low	3	0	3	0

Based on table 3, it can be seen that before the treatment (pretest) shows that the level of problem solving ability of students in the control class and experimental class is still relatively low. However, after being given a final test (posttest) students' problem-solving abilities improved but the experimental class was better than the control class where the control class consisted of 3 students in the very high category, 7 students in the high category, 8 students in the medium category and 4 students in the low category. while the experimental class which found 22 students consisted of 6 students in the very high category, 11 students in the high category, and 3 students in the medium category, and 2 students in the low category. This shows that the experimental class that uses creative problem solving learning models is more influential than the control class that uses conventional learning models on students' chemical problem solving. This is in line with (Sagala & Simanjuntak, 2017) which states that student problem solving whose learning uses a student-centered learning model is better than teacher-centered learning. This is because students are actively involved in building their knowledge independently so that they can develop problem solving skills and improve student learning outcomes.

Table 4. Results of the pretest-posttest analysis *of* indicators problem solving ability of experimental class students

Indicator	Score	
	Pretest	**Posttest**
Understanding the Problem	73.03 (Enough)	87.27 (Very high)
Plan problem solving	53.64 (Low)	87.27 (Very high)
Carry out the completion plan	35.45 (Very low)	81.21 (Tall)
Re- exemine	22.73 (Very low)	68.18 (Enough)

The results of the analysis of the problem-solving ability indicator data on the pretest and posttest for the experimental class based on table 4 shows that the posttest value of the experimental class has increased in value from the pretest value . It can be seen from the value obtained on the indicator of understanding the problem, the value of the pretest was 73.03 to 87.27 in the posttest, the indicator of planning problem solving obtained the value of the pretest of 35.45 to 87.27 in the posttest, the indicator of carry out the completion plan the value of the pretest was 35.45 to 81.21 in the posttest, and the indicator re-exemine, the value of the pretest was 22.73 to 68.18 in the posttest.

Table 5. Results of the pretest-posttest analysis of indicators problem solving ability of control class students

Indicator	Score	
	Pretest	**Posttest**
Understanding the Problem	72.12 (Enough)	78.79 (Tall)
Plan problem solving	54.55 (Low)	80.91 (Tall)
Carry out the completion plan	34.55 (Very low)	69.09 (Enough)
Re- exemine	22.73 (Very low)	47.27 (Low)

The results of the data analysis of the problem-solving ability indicators in the pretest and posttest for the control class based on table 5 shows that the posttest value of the control class has increased from the pretest value . It can be seen from the value obtained on the indicator of understanding the problem, the score from the pretest is 72.12 to 78.79 in the posttest , the indicator of planning problem solving is obtained from the pretest score of 54.55 to 80.91 in the posttest, the indicator is carry out the completion plan the value of the pretest was 34.55 to 69.09 in the posttest, while the re-exemine indicator obtained the value of the pretest of 22.73 to 47.27 in the posttest.

Analysis of the value of each indicator of problem solving ability achieved in the experimental class and control class can be seen in table 4 and table 5. The first indicator is understanding the problem, at this stage students identify the parameters of the problem to get a picture of the problem (Priansa, D, 2017). At the time of the pretest, in the experimental class, the indicator value of understanding the problem was 73.03 with a sufficient category and the posttest obtained a value of 87.27 with a very high category. Meanwhile, the pretest in the control class obtained an indicator value of understanding the problem of 72.12 with a sufficient category and the posttest obtained a value of 78.79 with a high category. This shows that students in the experimental class and control class during the posttest on the indicators of understanding the problem have been able to digest the problems they are facing so that they can find out the information in the problem. In the indicator of understanding the problem, students are asked to hone their skills in finding relevant information in a problem so that students are able to analyze information in the problems they face. This corresponds to (Ijirana & Nadjamuddin, 2019)states that students who are able to solve problems in addition to having the ability to apply facts, laws and principles learned are also possible to be able to think critically. Students who are able to think critically also have the ability to analyze information obtained in everyday life.

Analysis of the second problem-solving ability indicator is planning problem solving, at this stage students determine problem-solving steps (Priansa, D, 2017). At the time of the pretest, in the experimental class, the indicator value for planning problem solving was 53.64 in the low category and the posttest score was 87.27 in the very high category. Meanwhile, the pretest in the control class obtained an indicator value of planning problem solving of 54.55 in the low category and the posttest score of 80.91 in the high category. This shows that students in the experimental class and control class during the posttest on the indicator planning problem solving are very good in formulating strategies or solutions for problem solving. In the indicator of planning problem solving, students are asked to develop a problem-solving plan so that they are directed in solving problems properly . This is in line with (Balcikanli, 2011)which states that Students who have the skills to strategize and allocate time or attention before starting problem solving will be able to describe problems so that problems can be solved properly.

Analysis of the third problem-solving ability indicator is carry out the completion plan, at this stage students solve problems based on the plans that have been prepared to solve the problem (Priansa, D, 2017). At the pretest, in the experimental class, the indicator value of implementing the problem-solving plan was 35.45 with a very low category and the posttest score was 81.21 in the high category. Meanwhile, the pretest in the control class obtained an indicator value of implementing the problem-solving plan of 34.55 with a very low category and the posttest score of 69.09 with a sufficient category. This shows that in the posttest the students in the experimental class were good at solving problems but in the control class it was still in the sufficient category because students were only fixated on the final result without seeing the process in solving the problem. In the indicator of planning problem solving, students are asked to solve problems in accordance with the analysis of information obtained from the problem and work according to the right solution so that they can solve the problem with the correct process. This is in line with (Zydni et al., 2013) which says that problem solving does not only pay attention to the final answers to calculations from students, but must pay attention to the completion process carried out by students so that the problem can be resolved. In the problem solving process, it is expected that students can solve the problem through a step by step so that it can be seen the flow of thinking and students' understanding of the concepts used.

Analysis of the fourth problem-solving ability indicator is re-examine, at this stage students re-examine the problem-solving answers whether they have been carried out according to plan so that they can make conclusions (Priansa, D, 2017). At the time of the pretest, in the experimental class, the value of the indicator of looking back was 22.73 with a very low category and the posttest value of 68.18 was obtained in the sufficient category. Meanwhile, the pretest in the control class obtained a review indicator value of 22.73 with a very low category and the posttest obtained a value of 47.27 with a sufficient category. This shows that in the posttest the students in the experimental class are categorized enough in looking back but in the control class it is still in the low category. In the indicators of looking back, students need more time, because students must be able to prove the logic to connect the results obtained with the students' own understanding of the concept. This is in line with Ijirana (Ijirana & Nadjamuddin, 2019), if students are able to look back at the results of solving the problem, then these students are not only able to solve problems, they are also able to apply facts, laws, and principles learned and are able to think critically.

All from Polya stages, the stage of re-exemine has the lowest percentage value. This is because students are in a hurry to solve problems and are not used to making conclusions in solving problems or questions so that students feel enough with the acquisition of the final result without looking back at the answers. This is supported by research (Peranginangin & Surya, 2017)the value of students' problem solving abilities in this stage is the smallest compared to other polya stages. Most students do not pay attention to the instructions on the questions for the stage of looking back, students are satisfied with the acquisition of results, the end without giving conclusions.

Inferential statistical analysis was used to see the effect of applying creative problem solving (CPS) learning models on students' problem solving abilities in chemistry. As for data processing using SPSS version 25. The study used independent sample t-test.

Tabel 6. Normality Test

Class	Data	Significance	Information
XI A Control	*Pretest*	0,079	Normal Distribution
	Posttest	0,199	Normal Distribution
XI B Experiment	*Pretest*	0,131	Normal Distribution
	Posttest	0,161	Normal Distribution

Based on table 6 shows the pretest data in the experimental class obtained a significance value of 0,131 > 0,05 and in the control class obtained a significance value of 0,079 > 0,05. Meanwhile, the results of the posttest data normality test in the experimental class obtained a significance value of 0,161 > 0,05 and in the control class obtained a significance value of 0,199 > 0,05. Based on the data obtained, the significance value of the two data shows more than 0,05 so that it can be concluded that the decision making on the distribution of data in the two classes is normally distributed.

Tabel 7. Homogeneous

		Significance	Information
Posttest	Based on Mean	0,257	Homogeneous

Based on table 7 shows the posttest data obtained a significance value of 0,257> 0,05 . Based on the data obtained, the significance value of the data shows more than 0.05 so that it can be concluded that the decision making on the distribution of the data is homogeneous.

Based on the prerequisite tests that have been carried out, namely normality and homogeneity tests, the data shows that the data is normally distributed and homogeneous. This means that the data has met the prerequisites for conducting the t-test. The t-test in this study was independent sample t-test on the experimental and control class final test data (posttest)

Tabel 8. T-Test

	Levene's Test for Equality of Variances
	Sig. (2-tailed)
Equal variances assumed	0,004

Based on table 8, the t-test of the posttest data obtained the sig-(2-tailed) value of 0,004<0,05. So based on the criteria for making decisions on the hypothesis test, it was determined that Ho was rejected and Ha was accepted so that it showed the influence of the creative problem solving (CPS) learning model on students' problem solving abilities in chemistry on acid-base material.

CONCLUSION

Based on the results of research analysis data, it can be concluded that the control class students and the experimental class have different levels of ability where students in the experimental class on average have a high level of problem solving ability while students in the control class on average have a moderate level of problem solving ability.

The analysis of each indicator of problem solving ability shows that students have been able to understand the problem well, plan problem solving well, carry out the completion plan well. However, students have not been able to re-examine the results of problem solving properly on acid-base material. The results of the t-test data obtained that the posttest data had a sig-(2-tailed) value of 0,004<0,05. So based on the decision making criteria in the hypothesis test, it was determined that Ho was rejected and Ha was accepted so that it showed the influence of the creative problem solving (CPS) learning model on students' problem solving abilities in chemistry on acid-base material.

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