Jurnal Ilmiah Kanderang Tingang
Vol.15 No.2 Juli-Desember 2024
FKIP Universitas Palangka Raya
ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

Application Of The Problem Based Learning Model On Salt Hydrolysis Materials To Improve Science Process Skills And Metacognition Awareness Of Class XI MIPA Students At SMA

Ismail (1), Daud K. Walanda(2), Ratman(2)
[1]Sekolah Tinggi Keguruan dan Ilmu Pendidikan Abdul Mujib Laewang Dampal Selatan, Indonesia
[2]Universitas Tadulako, Indonesia
Email: ismailprayoga16@gmail.com

Received: 22-12-2024; Accepted: 30-12-2024; Published: 31-12-2024

ABSTRACT

This study aims to determine the effect of the problem-based learning model on science process skills and metacognitive awareness of class XI MIPA students at SMA Negeri 1 Dampal Selatan. This type of research is quasi-experimental by using the Pretest-Posttest control group design. The study population was (N = 129) students of class XI MIPA SMA Negeri 1 Dampal Selatan. The sampling technique is simple random sampling. Class XI MIPA 1 (n = 32) students as the experimental class and class XI MIPA 4 (n = 32) students as the control class. The research data was collected by using an essay test to measure science process skills and questionnaires to measure the metacognitive awareness of students on the salt hydrolysis materials. Data were analyzed descriptively with the statistic application. The science process skills of students with the problem-based learning implementation model had (M = 71.84, SD = 7.956) with an effect size value of 8.92 while the discovery learning model had (M = 72.34, SD = 7.872) with an effect size value of 8.33. Metacognition awareness of students with problem-based learning implementation model has (M = 77.03, SD = 3,961) with an effect size value of 5.56 while the discovery learning model has (M = 77.62, SD = 2.738) with an effect size value of 6.46. Research result show that: (1) the problem-based learning model affects the science process skills of students on the salt hydrolysis materials; (2) the problem-based learning model affects the metacognitive awareness of students on the salt hydrolysis materials; (3) there is a positive relationship between science process skills and metacognitive awareness of students on the salt hydrolysis materials.

Key words: Problem-based learning, science process skills, metacognition awareness

INTRODUCTION

Education at various levels adapts to the development of the era of globalization. Therefore, various efforts have been made to improve formal education. Metacognition in learning and is an important determinant in the academic success of students. Students with good metacognition show better academic performance than students with poor metacognition (Danial, 2010). Through the development of metacognitive awareness, students are expected to be accustomed to planning, monitoring, controlling and evaluating what they have done (Jayapraba, 2013). This is in line with the research conducted by Sophianingtyas & Sugiarto (2013) which states that metacognition plays an important role in making learning and thinking more effective and efficient.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

In addition to metacognition awareness, students' science process skills really need to be applied in the 2013 Curriculum through a learning model based on a scientific approach (Katuuk, 2014). The scientific approach is an approach in which in learning, students carry out scientific thinking and work processes so that learning objectives on aspects of attitudes, skills and knowledge can be achieved (Umar, 2016). The 2013 curriculum can be applied to all subjects, especially in the field of science, including chemistry (Permendikbud, 2018).

Chemistry subjects are one of the subjects that can be obtained from the investigation process which includes ways of thinking, reasoning, formulating problems, conducting experiments and observations, analyzing data and concluding to produce scientific products (Hidayatin & Mitarlis, 2018). One of the objectives of learning chemistry in schools is so that students have the ability to gain experience in applying the scientific method through experiments or experiments. Therefore, chemistry learning in schools should involve students to be active in practical activities. It aims to hone students' skills in working scientifically, especially in science process skills (Permendikbud, 2018).

According to Ergül et al (2011) science process skills are the skills possessed by scientists to acquire and develop scientific products. Science process skills involve cognitive, intellectual, manual and social skills. These skills include observing skills (observation), inference, grouping (classification), interpreting (interpretation), predicting (prediction), and communicating. During the learning process, students' science process skills can be developed and trained (Karsli et al., 2010). Science process skills that have been achieved by students can be measured through learning evaluations in the form of appropriate assessments or assessments.

Based on the results of interviews with several chemistry teachers in Tolitoli district, it is known that so far learning has been carried out using lecture, practice and practice methods. However, learning with the practical method is only done as a demonstration or never done. Students are not directly involved, so that the skills of students in implementing the scientific process have not been maximized. The results of observations at SMA Negeri 1 Dampal Selatan showed that the science process skills that emerged in learning activities were observation and communication. These skills are still relatively low because they are still limited in observing the teacher's explanations and communicating to provide opinions on the topics presented by the teacher. The low science process skills can be caused by the selection of learning models that are not related to science process skills.

The choice of learning model is left to the teacher, adjusted to the characteristics of the material. Salt hydrolysis is a part of chemistry that studies the reaction of anions or cations of a salt or both with water, so that it can affect the pH of a solution (Chang, 2004). According to Desriyanti & Lazulva (2016) salt hydrolysis material is a material that has an applicative concept in everyday life. This material is an amalgamation of mathematical concepts and calculations, so a high way of thinking and analysis is needed to link these concepts and calculations.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

One of the learning models that can be applied in the implementation of the curriculum 2013 is the problem-based learning model. Learning with a problem-based learning model is an effective learning method to help students process information and construct their own knowledge about the social world and its surroundings (Permendikbud, 2018). The problem-based learning model is a learning model that stimulates students to think about solving contextual problems (Mariani et al., 2014). This learning model trains students to solve problems with the knowledge they have. Problem Based Learning is a learning model that uses problems as the first step in collecting and integrating the new knowledge. Problem-based learning is learning a model that presents a contextual problem that stimulate students to learn. In the class that applying problem-based learning, students work in teams to solve real-world problems (Sanjaya et al., 2022).

Based on the results of research Tamsyani (2016) states that there is an interaction between learning models and metacognitive awareness in influencing learning outcomes, students' prior knowledge affects their metacognition, where students who have high prior knowledge have higher metacognition than students who have low prior knowledge. This is in line with research by Rahmawaty, et al (2020) who said that metacognition is closely related to problem solving causes, one's awareness in use and control their thought processes can decide how to solve it a problem. The thought process in the problem solving is an important thing that is necessary received the attention of educators especially for help students to get develop problem solving skills. Furthermore, research conducted by Hardyanti et al., (2017) found that the problem-based learning model was effective in improving students' science process skills. Therefore, the purpose of writing this manuscript is to describe the effectiveness of the application problem-based learning model of salt hydrolysis material on science process skills and metacognitive awareness of class XI MIPA students at SMA Negeri 1 Dampal Selatan.

RESEARCH METHOD

The research method used in this study is a quasi-experimental design with a pretest-posttest control group design. This type of research is a quantitative approach using quasi-experimental and correlation methods.

The research subjects were carried out in class XI MIPA 1 and XI MIPA 4 at SMA Negeri 1 Dampal Selatan in the academic year 2021/2022. Class XI MIPA 1 consists of 32 students, consisting of 11 boys and 21 girls, the average age is 16-18 years. Meanwhile, class XI MIPA 4 consists of 32 people, consisting of 11 boys and 21 girls, the average age is 16-19 years.

The design used in this study is the Pretest-Posttest control group design. In this design, chemistry learning is carried out, there are two groups chosen randomly, both groups are given a pretest to determine the students' initial knowledge, then given treatment and finally given a posttest as the final evaluation of learning (Sugiyono, 2016). The pretest-posttest control group design for the implementation

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

of the research can be seen in Table 1.

Table 1. Pretest-posttest control group design

Class	*Pretest*	Treatment	*Posttest*
Experiment	T	X	T
Control	T	Y	T

Source: Sugiyono (2016)

Population in this study are students of class XI MIPA SMA Negeri Dampal Selatan as 129 students. Sample is a representative or part of the number of groups with characteristics possessed by the population. The sampling technique used by the researcher is the simple random sampling technique, where the determination of the sample is done randomly with the consideration that the class has almost the same characteristics (Arikunto, 2013). The samples of this study were students in class XI MIPA 1 as an experimental class with 32 students and class XI MIPA 4 as a control class with 32 students.

The source of data in this study is primary data collected by researchers directly obtained through pretest and posttest filled in by students, then scores on each test result for science process skills and scores each statement in the MAI questionnaire for metacognition awareness. This research was conducted in three stages, namely the preparation stage, the implementation stage, and the final stage.

After the data was obtained, descriptive analysis and statistical analysis were carried out using the T test, effect size test and correlation test. Statistical tests were carried out at a significance level of 5%. To determine the level of students' metacognition awareness using the value of each metacognitive awareness indicator in the MAI questionnaire, it is interpreted based on the assessor's guidelines according to Arikunto (2013).

To determine the strength of the effect size of the application of the learning model in improving science process skills and metacognitive awareness of students by calculating the effect size value and interpreted based on the criteria guidelines according to Cohen (2013).

To determine the relationship between science process skills and students' metacognitive awareness with a correlation test and interpreted based on the relationship level guidelines according to Sugiyono (2016).

RESULTS and DISCUSSION

The classical science process skills of students in the experimental class and control class can be seen from the pretest scores given at the beginning of the lesson and the posttest scores obtained after the end of the lesson. The data on the science

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

process skills of the experimental class and control class students can be seen in Table 2

Table 2. The value of the results of the pretest and posttest of classical science process skills

Experiment Class			Control Class		
Description	**Pre-Test**	**Post Test**	**Description**	**Pre-Test**	**Post Test**
Sample	32	32	Sample	32	32
Lowest Score	16	58	Lowest Score	17	56
Highest Score	25	96	Highest Score	30	90
Average Score	20,13	71,84	Average Score	22,88	72,34
Ideal Score	100	100	Ideal Score	100	100
Standard Deviation	1,996	7,956	Standard Deviation	2,915	7,872

Based on Table 2, the results of the pretest and posttest of students in the experimental class increased from an average pretest score of 20.13 to an average posttest of 71.84. This is due to implementing the problem-based learning model according to the stages, the delivery of the salt hydrolysis concept material by the teacher is also clear by using LKPD and teaching materials in the form of modules designed according to the model. For example, at meeting 1 discussed the neutralization reaction material and the nature of the salt solution, in learning through apperception activities the teacher asked the concept of an acid-based solution as a prerequisite material. In addition, through the LKPD presented in the activity in the form of orientation to problems related to the nature of the salt produced from the neutralization reaction, students are trained to formulate problems, seek information related to problems that arise, identify problems, collect data, present results, conclude and evaluate results end. For example, conclusions about the neutralization reaction and the acidic or basic nature of a salt solution through a review of indicators to be achieved at the meeting. The teacher conducts contextual learning that is connecting with everyday life. For example in water purification by PDAM using aluminum phosphate salt which is completely hydrolyzed in water, the use of fertilizers made in the form of salt which is used to lower the soil pH to match the pH needed by plants, the use of soap. The application of the problem-based learning model can improve the ability of students to seek information, knowledge and solutions to problems provided by the teacher, so that by using the problem-based learning model students have prior knowledge through reading and remembering and understanding the material provided is much better. time compared to students who only get information.

Science process skills also increased in the control class, it can be seen based on the data in Table 4, the results of the pretest and posttest given in the early and late stages of learning by applying the discovery learning model. The results of the pretest and posttest of students in the control class increased from an average pretest score of 22.88 to an average posttest of 72.34. This is because the application of the

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

discovery learning model can improve the ability of students to seek information, knowledge and solutions to problems given by the teacher, so that by using the discovery learning model students have prior knowledge through reading and remembering and understanding the salt hydrolysis material given far longer than students who only get information. The difference in science process skills between the experimental class and the control class after the learning took place was not too significant because the learning process that took place in the two classes both used an interactive learning model. The problem-based learning model applied in the experimental class and the discovery learning model in the control class can help students solve a problem that must be solved in groups, both to find answers based on their previous knowledge, understanding, and abilities by using the following steps arrive at an answer.

Based on the results of the normality test of the pretest and posttest data showing that the data is normally distributed, and the similarity test of the two variances pretest and posttest shows that the data is homogeneous, then the data is analyzed using parametric statistical testing, namely statistical analysis of the t-test. The conclusion from the results of hypothesis testing in the experimental class and control class is that there is a significant difference between the results of students' science process skills in the pretest and posttest data. However, the difference in the results of the KPS between the experimental class and the control class was not much different. This not much difference is because learning in the control class with the discovery learning model is basically also able to improve students' science process skills on salt hydrolysis material. Furthermore, the effect size test was carried out to determine the strength and weakness of the increase in learning outcomes that described the size of the contribution of the application of the classical learning model in improving students' science process skills on salt hydrolysis material. The data used in this effect size test are pretest and posttest of science process skills, the results of the analysis of this test are presented in Table 3.

Table 3. Effect size of students' classical science process skills

Parameter	**Class**	
	Experiment	**Control**
M Pretest	20,13	22,88
M Posttest	71,84	72,34
Std. Deviation Pretest	1,996	2,915
Std. Deviation Posttest	7,956	7,872
Effect Size (d)	8,92	8,33
Criteria	**Very large**	**Very large**

The results of classical data analysis, it can be interpreted that classically the effect of applying the problem-based learning model to improve students' science process skills on salt hydrolysis material is very large. The same thing also happened in the control class that applied the discovery learning model which had a very big influence in improving the students' science process skills on the salt

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

hydrolysis material. Classically, the effect size value in the experimental class is greater than the control class. This indicates that the problem-based learning model is more effective in honing the science process skills of students on salt hydrolysis material when compared to the discovery learning model. This finding is in line with Lutfa et al (2014) that the application of the problem-based learning model can grow science process skills. Furthermore, Susi & Yenti (2020) concluded that the problem-based learning model is more effective for students' science process skills.

The application of the problem-based learning model can improve students' understanding of chemistry, especially salt hydrolysis. In addition, by constructing their own understanding, it is hoped that they can improve the students' science process skills. The aspects used as a reference for science process skills in this study are 1) observing, 2) classifying, 3) predicting, 4) measuring, 5) concluding, and 6) communicating (Aydin, 2013).

The scores of the pretest and posttest results for the indicators of the science process skills of students in the experimental class can be seen in Figure 1.

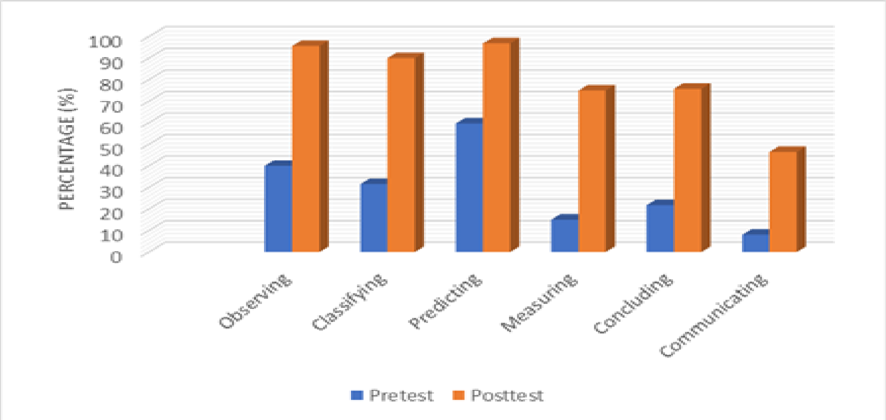

Figure 1. Experimental class science Process skills indicators

Based on Figure 1, it can be seen that the results of the pretest and posttest have increased in all indicators of science process skills. The KPS indicator whose percentage value is close to the ideal score after the learning activity takes place with the application of the PBL model on salt hydrolysis material is the indicator of observing, predicting and classifying. This shows that there is an effect of the problem-based learning model on the science process skills of students in the experimental class, based on the effect size value data, it can be seen that the influence of the PBL model on the KPS indicator is very large. This confirms that there is a positive effect of the problem-based learning model applied to the experimental class in improving students' science process skills on salt hydrolysis material. This statement is in accordance with the opinion of Arends (2012) that the problem-based learning model is the best innovation in education, which helps to improve the development of lifelong learning skills in an open, reflective, critical and active learning mindset. The results of this study are in line with the results of

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

research by Janah & Widodo (2018) which states that the application of the problem-based learning model affects the science process skills of students. Therefore, the application of the problem-based learning model contributes to science process skills. Learning with the problem-based learning model facilitates the success of problem solving, communication, group work and interpersonal skills better than other approaches.

The scores of the pretest and posttest results for the indicators of the science process skills of students in the control class can be seen in Figure 2.

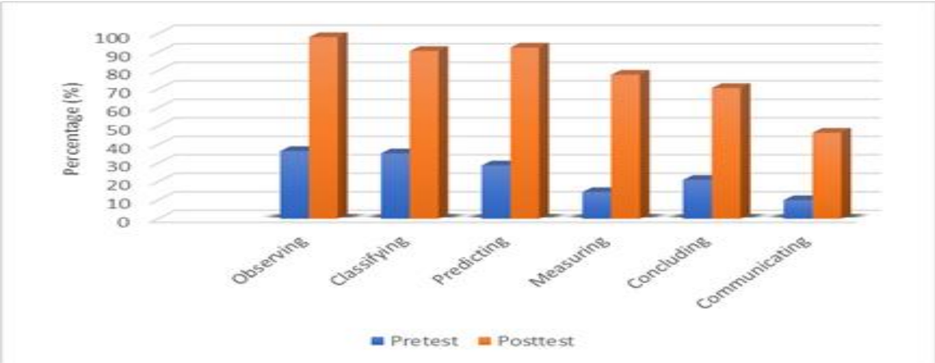

Figure 2. Indicators of science process skills in control class

Based on Figure 2, it can be seen that the results of the pretest and posttest showed an increase in all indicators of science process skills. This shows that there is an influence of the discovery learning model on the science process skills of students in the control class based on the effect size data. This can be due to the discovery learning model through stages that invite students to solve problems and consider relevant information so that they are able to draw and draw conclusions with reasonable considerations. However, based on the effect size value obtained through calculations on each KPS indicator, it can be said that the application of the problem-based learning model has a greater average effect when compared to the application of the discovery learning model in improving students' science process skills, namely on the indicator observe, predict, measure and conclude.

The skill of 'observing' can emerge in the problem orientation step. Students observe the pictures given, for example in this study students observe problems related to the nature of various salt solutions, ion balance in salt hydrolysis and how the hydrolysis equilibrium constant. At this stage students learn about how these problems occur and what causes them. In other words, students make observations as the first step in carrying out learning. Observation skills can be the fulcrum for the next development of science process skills.

The skill of 'classifying' can appear in the step of organizing students to research. Students search for information from various sources to find answers to problems that arise at the problem orientation stage. The skill of 'predicting' can be honed in the step of determining alternative solutions and the step of determining

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

the best solution to solve problem.

The skill of 'measuring' emerges at the independent and group investigation steps. Students determine the salt hydrolysis equilibrium constant to determine the pH value. The skill of 'inferring' can emerge at the stage of developing and presenting research results. After obtaining the results of the problems in the previous stage, students present the conclusions obtained. It aims to make students accustomed to doing analysis. The 'communication' skill can be trained at almost every step especially for the discussion aspect. Students discuss the matter of ionic equilibrium in a salt solution and determine pH.

Metacognition awareness of students in the experimental class and control class was obtained from a questionnaire filled out in the pretest and posttest of learning activities using a problem-based learning model that was converted in the form of numbers. The scores for the pretest and posttest results for the indicators can be seen in Figure 3.

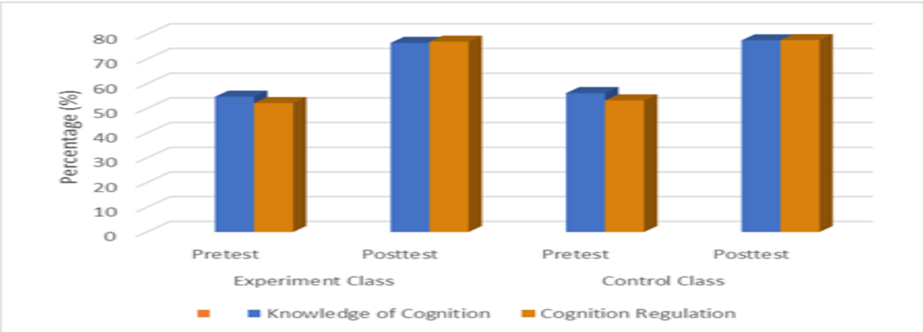

Figure 3. Metacognition awareness indicator

Based on the level of classical metacognition awareness in Figure 3, it can be seen that the metacognitive awareness of students in the experimental class and control class has increased after being given treatment in the form of providing problem-based learning models for the experimental class and discovery learning models for the control class. The results of this study are in line with the results of research by Sonyinga et al (2019) which states that the learning model has an effect on metacognitive awareness. The average metacognitive awareness on the metacognitive knowledge dimension of experimental class students at the pretest was 54.78 and on the cognitive regulation dimension was 52.18. After being given treatment by applying the problem-based learning model, the posttest showed that the average metacognitive awareness in the knowledge dimension was 76.55 and in the cognitive regulation dimension was 77.31. This is in line with hypothesis testing, the results show that there is an effect of the problem-based learning model on students' metacognition awareness, then on the classical effect size test, the result is 5.56. The effect of applying the problem-based learning model to increase the metacognitive awareness of experimental class students is very large. The same

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

thing also happened in the control class that applied the discovery learning model, where based on the results of hypothesis testing, it was found that there was an effect of the application of the discovery learning model on increasing the metacognitive awareness of the control class students, then on the classical effect size test the results were 6.46 which means that the influence of the discovery learning model is very large.

The description of the dimensions of the level of metacognition of each indicator of the experimental class can be seen in Figure 4.

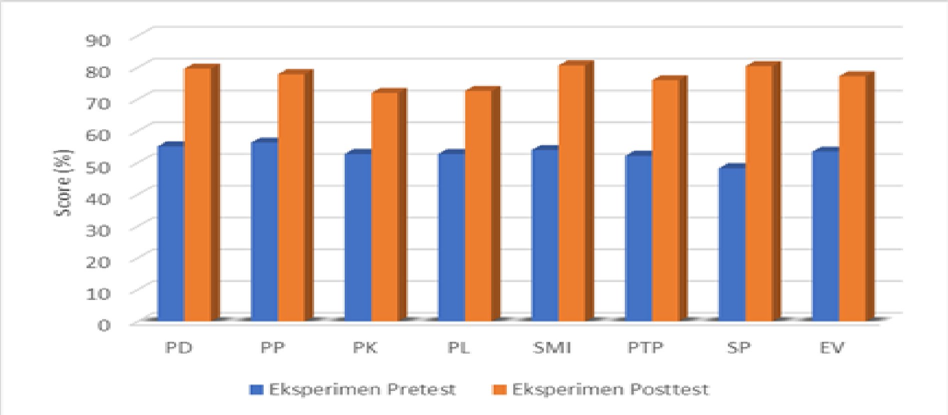

Figure 4. Dimensions of experimental class metacognition level of awareness

Information:

PD = Declarative Knowledge; PP = Procedural Knowledge; PK = Conditional Knowledge; OT = Planning; SMI = Information Management Strategy; PTP = Monitoring of Understanding; SP = Improvement Strategy; EV = Evaluation.

The level of awareness of metacognition on each indicator shows that the improvement strategy indicator ranks the highest with a posttest score of 80.47%. The improvement strategy is related to the ability of students to analyze the location of the error and change the strategy they use if the strategy is not able to help them in the learning process (Pujiank et al, 2016). Furthermore, the indicator that has the lowest level of metacognitive awareness is conditional knowledge with a score of 72.03%. Some students have not been able to demonstrate an understanding of the use of good learning strategies. According to Pujiank et al (2016) stated that students who are classified as good thinkers are students who use strategies regularly to solve problems and know when and where to use these strategies.

The level of metacognitive awareness of control class students on each indicator of metacognition awareness can be seen in Figure 5.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

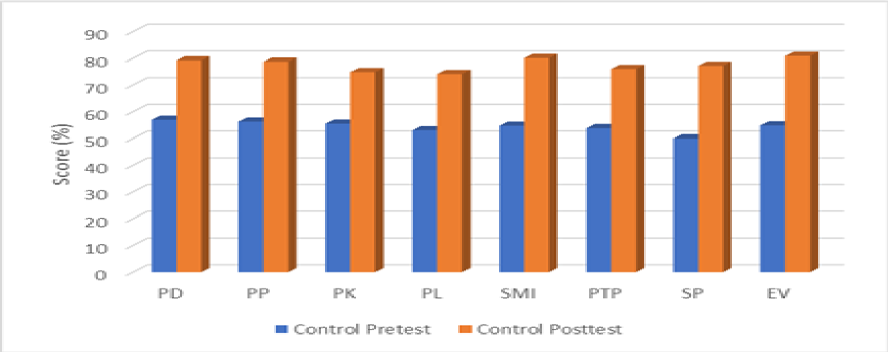

Figure 5. Dimensions of control class metacognition level of awareness

Based on Figure 5, it shows that the evaluation indicator ranks the highest with a score of 80.86%. On average, students in the control class after applying the learning model already have the ability to evaluate which is the ability to analyze the performance or effectiveness of the strategies used in learning activities (Pujiank et al, 2016). Furthermore, the planning indicator ranks the lowest with a score of 74.11%. Some students have not been able to formulate specific goals to be achieved before starting a task. This shows that self-control before starting a lesson still needs to be improved. Planning skills provide students' skills or abilities in predicting and managing their desires and expectations in their own learning process which will have an impact in the long term (Pujiank et al, 2016).

Based on the learning outcomes data, it was found that students who had high metacognitive awareness were greater than students who had low metacognitive awareness. This happens because students with high metacognitive awareness are able to design what they want to learn and assess what has been learned. In addition, students with high metacognitive awareness are able to control, monitor and control themselves in their learning.

Students trained to practice their cognitive regulation, students are able to organize or organize each activities they will do so that the expected goals can be achieved achieved. In addition, regulations regarding student cognition will increase motivation and active participation of students in learning process (Firmansah, 2022). The advantage of this problem-based learning model is the activeness of students. Through this learning model, students are guided and involved to actively think, be creative, find directly the understanding or concept they want to know through a given problem and can find out various abstract concepts through simple experimental or practical methods. In accordance with the statement (Mulyani et al., 2020) argues that problem-based learning helps students to develop thinking skills, how students solve problems and their intellectual skills. So, problem-based learning provides opportunities to build life skills (life skills), think metacognitive (reflection with thoughts and actions), communicate and various related skills. According to (Janah & Widodo, 2018) one of the efforts to improve learner-centered learning and be able to arouse curiosity from students is through a problem-based learning model.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

The relationship between science process skills and metacognitive awareness can be seen from the results of research by conducting a correlation test. Based on the results of inferential analysis in general for hypothesis testing that has been carried out in the experimental class shows a sig value of 0.000 <0.05. This means that there is a significant relationship between science process skills and metacognitive awareness. While in the control class, based on the results of the hypothesis test that has been carried out, it shows a sig value of 0.003 <0.05. This means that there is a significant relationship between science process skills and metacognitive awareness.

Furthermore, the results of hypothesis testing the relationship between science process skills and students' metacognition awareness in the experimental class it shows the Pearson correlation value of 0.772. Based on the correlation test criteria, these results indicate that the relationship between science process skills and students' metacognitive awareness in the experimental class that applies the problem-based learning model is a strong correlation. This means that there is a positive relationship between metacognitive awareness and students' science process skills, this positive relationship indicates that if students' metacognitive awareness is high, then their science process skills will also be high. While in the control class that applies the discovery learning model based on the results of the analysis, the Pearson correlation value is 0.505. Based on the correlation test criteria, these results indicate that the relationship between science process skills and students' metacognitive awareness in the control class is quite strong. So it can be said that the correlation between science process skills and students' metacognitive awareness in the experimental class is higher than the control class. The results of this study are in agreement with the results of previous research, namely Murniaty (2014) which states that there is an interaction between learning models and metacognitive awareness in influencing students' critical thinking skills.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that: (1) the application of the problem-based learning learning model has a positive effect on students' scientific process skills on salt hydrolysis material, (2) the application of the problem-based learning model has a positive effect on students' metacognition awareness. on salt hydrolysis material, (3) there is a positive relationship between science process skills and students' metacognition awareness on salt hydrolysis material.

REFERENCES

Arikunto. S. (2013). Dasar-dasar evaluasi pendidikan. Yogyakarta: Bumi Aksara.

Aydin, A. (2013). Representation of science process skills in the chemistry curricula for grades 10, 11 and 12 / Turkey. International Journal of Education and Practice. 1(5), 51–63.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

DOI:10.18488/journal.61/2013.1.5/61.5.51.63.

Chang, R (2004). Kimia dasar: Konsep-konsep inti jilid 1. Jakarta: Erlangga.

Cohen, J. (2013). Statistical power analysis for the behavioral sciences. Statistical Power Analysis for the Behavioral Sciences. Routledge. https://doi.org/10.4324/9780203771587.

Danial, Muhammad. (2010). Kesadaran metakognisi, keterampilan metakognisi, dan penguasaan konsep kimia dasar. Jurnal Ilmu Pendidikan Universitas Negeri Malang, 17(3), 225-229. doi:10.17977/jip.v17i3.2722.

Desriyanti, R. D., & Lazulva, L. (2016). Penerapan problem based learning pada pembelajaran konsep hidrolisis garam untuk meningkatkan hasil belajar siswa. JTK (Jurnal TadrisKimiya),1(2),70–78. https://doi.org/10.15575/jta.v1i2.1247.

Ergül, R., Şımşeklı, Y., Çaliş, S., Özdılek, Z., Göçmençelebı, S., & Şanli, M. (2011). The effects of inquiry-based science teaching on elementary school students' science process skills and science attitudes. Bulgarian Journal of Science and Education Policy (BJSEP), 5(1), 48–69.

Firmansah, F., Aminah, A., & Said, I. (2022). The effect of discovery learning implementation models on buffer solution materials toward critical thinking ability and metacognition awareness of Class XI IPA Students at SMA Negeri 3 Palu. Jurnal Riset Pendidikan MIPA, 5(2),76-85. https://doi.org/10.22487/j25490192.2021.v5.i2.pp76-85.

Hardyanti, C. P., Wardani, S & Nurhayati, S. (2017). Keefektifan model problem based learning untuk meningkatkan keterampilan proses sains siswa. Jurnal Inovasi Pendidikan Kimia, 11(1), 1862-1671.

Hidayatin, S., & Mitarlis. (2018). Pengembangan lembar kegiatan peserta didik (LKPD) pada materi koloid untuk melatihkan keterampilan literasi sains. UNESA Journal of Chemical Educationf Chemical Education, 7(1), 76–80.

Irnaningsih, I., Jamhari, M., & Bialangi, M. (2022). The effect of problem-based learning models on students' critical thinking ability and problem solving of science concept at SMP Negeri 7 Palu. Jurnal Riset Pendidikan MIPA, 6(1),46-54. https://doi.org/10.22487/j25490192.2022.v6.i1.pp46-54

Janah, M. C., & Widodo, A. T. (2018). Pengaruh model problem based learning terhadap hasil belajar dan keterampilan proses Sains. Jurnal Inovasi Pendidikan Kimia, 12(1), 2097–2107.

Jayapraba. (2013). Metacognitive instruction and cooperative learning-strategies for promoting insightful learning in science. International Journal on New Trends in Education and Their Implications, 4(1), 165–172.

Karsli, F., Yaman, F., & Ayas, A. (2010). Prospective chemistry teachers' competency of evaluation of chemical experiments in terms of science process skills. Procedia - Social and Behavioral Sciences, 2(2), 778–781. https://doi.org/10.1016/j.sbspro.2010.03.101.

Katuuk, D. A. (2014). Management of curriculum implementation : a strategy.

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

Cakrawala Pendidikan,XXXIII(1),13–26. DOI:10.21831/cp.v1i1.1858.

Lutfa, A., Sugianto, & Sulhadi. (2014). Penerapan model pembelajaran problem-based learning untuk menumbuhkan keterampilan proses sains pada siswa sma. Unnes Physics Education Journal.3(2). https://doi.org/10.15294/upej.v3i2.3592.

Mulyani, S., Gani, A., Syukri, M., Tarmizi, T., Elisa, E., Nurhasanah, N., & Fajriani, F. (2020). Penerapan model problem-based learning pada materi alat-alat optik untuk meningkatkan kepercayaan diri dan kemampuan menyelesaikan masalah kontekstual. Jurnal Pendidikan Sains Indonesia, 8(1),105–113. https://doi.org/10.24815/jpsi.v8i1.15666.

Murniaty. (2014). Pengaruh model pembelajaran dan kesadaran metakognisi terhadap kemampuan berpikir kritis peserta didik kelas XI IPA SMA Negeri 1 Barru pada materi pokok hidrolisis garam. Unpublished Thesis. Pendidikan Kimia, Universitas Negeri Makassar.

Pujiank, S., Jamaluddin, J., & Hadiprayitno, G. (2016). Kemampuan metakognisi mahasiswa program studi pendidikan biologi FKIP Universitas Mataram. Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 1(10), 2016-2022.

Rahmawaty, R., Werdhiana, I. K, & Saehana, S. (2020). Study of the metacognition process using the rubric of physic metacognition inventory (PMI) and minnesota assessment of problem solving (MAPS) on physics students in problem solving. Jurnal Riset Pendidikan MIPA,4(2),108-118. https://doi.org/10.22487/j25490192.2020.v4.i2.pp108-118

Sanjaya, Adi., Pasaribu, M., & Ramadhan, A. (2022). The effect of the problem-based learning model with experimental methods and scientific attitudes on learning outcomes in Class IV Students of SD Negeri 4 Dampelas. Jurnal Riset Pendidikan MIPA, 6(1),36-45. https://doi.org/10.22487/j25490192.2022.v6.i1.pp36-45.

Silvia, S., Hamzah, B., & Mustapa, K. (2022). The effectiveness of the problem-based learning model on the critical thinking ability and student learning outcomes in electrolite and non-electrolite solution materials Class X At MAN 1 Palu. Jurnal Riset Pendidikan MIPA, 5(1),1-8. https://doi.org/10.22487/j25490192.2021.v5.i1.pp1-8.

Sonyinga, D., Danial, M., & Herawati, N. (2019). Pengaruh model pembelajaran dan kesadaran metakognisi terhadap hasil belajar peserta didik. Chemistry Education Review, 3(1), 31-41. DOI:10.26858/cer.v0i0.8487

Sophianingtyas, F., & Sugiarto, B. (2013). Identifikasi level metakognitif siswa dalam memecahkan masalah materi perhitungan kimia (identification of students' metacognitive level in solving stoichiometry problem). Jurnal mahasiswa.Unesa.Ac.Id, 2(1), 21–27.

Sugiyono. (2016). Metode penelitian pendidikan. Bandung: Alfabeta.

Suharta, Luthan, dan Putri, L. A. (2013). Application of cooperative problem-based learning model to develop creativity and foster democracy, and improve

ISSN 2087-166X (printed)
ISSN 2721-012X (online)
DOI: https://doi.org/10.37304/jikt.v15i2.367

student learning outcomes in chemistry in high school. Journal of Education and Practice, 4(25), 55- 60.

Susi, & Yenti, E. (2020). Efektivitas model problem-based learning terhadap keterampilan proses sains. JEDCHEM(Journal Education and Chemistry), 2(2), 48–56. DOI: https://doi.org/10.36378/jedchem.v2i2.693

Tamsyani, W. (2016). Pengaruh model pembelajaran dan kesadaran metakognitif terhadap hasil belajar peserta didik SMA dalam materi pokok asam basa. Jurnal of EST, 2(4), 10-26. DOI:10.26858/est.v2i1.1887

Umar, M. A. (2016). Penerapan pendekatan saintifik dengan metode pembelajaran berbasis proyek (project-based learning) pada mata pelajaran kimia. Jurnal Entropi, 11(2), 132–138.