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Thinking Ability and Student Learning Outcomes in the Material of Electrolyte and Non Electrolyte Solutions at Madrasah Aliyah Negeri

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Abstract

This research was conducted to describe the application of problem-based learning models to critical thinking skills and student learning outcomes after the material on electrolyte and non-electrolyte solutions in Class X IPA MAN 1 Palu City. This type of quasi-experimental research or quasi-experimental, with a quantitative descriptive research design using the One group pretest-posttest design. The sampling technique used is total sampling or saturated samples. Analysis of the results of students' critical thinking skills as measured by 3 (three) indicators, namely interpretation, analysis, and evaluation. The value of each indicator in experimental class 1 was interpretation 83.33%, analysis 75.54%, and evaluation 79.35%, while in experimental class II interpretation 83.33%, analysis 83.33%, and evaluation 83, 33%. Based on the data analysis with N-gain, it was obtained that the experimental class 1 was 0.59 and the experimental class 2 was 0.60, which means that all are in the medium category. This shows that the application of problem-based learning is very effective in improving critical thinking skills and student learning outcomes. in class X electrolyte and non-electrolyte solutions MAN 1 Palu City

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Introduction

The activeness of students in the learning process is strongly supported by the use of devices that are effective in improving learning outcomes and in the learning process in order to spur student brain performance. The components that influence the education system, especially the learning process, are learning models, methods, approaches, strategies, and techniques. One of the factors causing the less attractive learning process is the teacher does not design the learning model or method and the teacher's lack of knowledge about the use of learning models and media that are attractive to students in the learning process.

Along with the change in the learning paradigm, there is also a change in the orientation of learning from being teacher-centered to being student-centered and from being textual to contextual. Therefore, the learning paradigm should shift from conventional learning which emphasizes low-level thinking skills to higher-order thinking skills, especially critical thinking skills students' critical thinking skills which are one of the internal factors and can also affect the success of the learning process. Critical thinking skills play a role in encouraging a person to evaluate/assess and consider conclusions to make a decision. Students' critical thinking skills are expected to have the ability to make rational decisions about what to do and what they believe. Johnson (2002) explains that critical thinking is a skill that can be developed by everyone.

Technically, the ability to think in Bloom's taxonomy language is defined as intellectual ability, namely the ability to remember, understand, apply, analyze, evaluate, and create. In other languages, this thinking ability can be said a critical thinking ability (Komalasari, 2013). Critical thinking skills allow a person to study problems faced systematically, face various challenges, in an organized manner, formulate innovative questions, and design original solutions (Hassoubah, 2004). Thinking critically can also develop a person in making decisions or giving an assessment of something so that it can solve a problem. Critical thinking skills are a process that allows students to acquire new knowledge through a process of problem-solving and collaboration (Sujiono & Arif, 2014).

Based on this statement, it is known that a person's critical thinking ability can be improved through continuous practice. Systematically, chemistry lessons train students to think critically, by finding solutions to problems that occur. Therefore, it is necessary to apply innovative learning models that can improve students' critical thinking skills. The learning model is a form of learning that is described from beginning to end which is specifically presented by the teacher.

Another thing is that the learning model is a package or frame of the application of learning approaches, methods, and techniques. One model that can be used to empower critical thinking skills is through a problem-based learning model.

Problem-based learning presents problems at the beginning of learning so students are required to think more about solving a problem so that conclusions can be drawn from the learning outcomes. Problem-based learning (PBL) emphasizes the integration between theory and practice as well as material aspects of a number of relevant disciplines, emphasizes the growth of learners' competence in problem-solving through active and cooperative learning in small groups or through independent or self-directed learning in order to find solutions to various real cases and problems. The PBL model is a constructivist learning model in which students seek and build their own information from what they learn so that the learning process is not just an activity to transfer knowledge from teacher to student but an activity that arouses student activity (Ayuningrum & Susilowati, 2015).

These critical thinking skills are developed at every stage of problem-based learning so that students are encouraged to learn and teachers are only mediators and facilitators so as to improve the quality of learning. According to Weiss (2017) Problem-oriented teaching methods support learners in finding their own solutions to substantial and relevant problems or in other words problem-oriented teaching methods support students in finding their own solutions to substantial and relevant problems. PBL has five steps, namely: (1) orientation of students to problems, (2) organizing students to learn, (3) guiding group investigations, (4) developing and presenting work results, and (5) Analyzing and evaluating the solving process problems (Sumarmi, 2012).

One of the goals of learning chemistry in schools is as a vehicle to develop thinking skills that are useful for solving problems in everyday life (Subagia, 2014). Students who think critically are students who are able to identify, evaluate, and construct arguments and are able to solve problems appropriately (Splitter 1991). Understanding each material concept becomes the foundation for students to hone critical thinking skills (Lembang, 2019). One of the important skills to be developed by students is high-order thinking skills (Pusparini et al., 2018).

Chemistry is one of the most difficult subjects for middle school and university students (Rusmansyah, 2007). The results of Hutabarat's (2005) showed that 49.1% of students disliked chemistry lessons, 66.8% of students agreed that chemistry subjects were boring subjects, 51.3% of students did not pay attention seriously when the teacher delivered chemistry subject matter,82.8% of students agree that chemistry is a difficult subject to understand.

Chemistry lessons are expected to provide innovation so that students are able to solve problems through practicum activities and relate them to everyday life. One of the materials that are closely related to everyday life is an electrolyte and non-electrolyte solution material because these materials have characteristics that require proof to obtain facts and the process of solving the problem. Proving the facts regarding electrolyte and non-electrolyte solution materials can be done through an experiment which is expected that students will be able to master the basic competencies in analyzing the properties of electrolyte and non-electrolyte solutions based on their electrical conductivity.

This PBL learning model was chosen because it is a learning model that can train students to think critically and solve problems independently, which are adjusted to the facts in the environment around students. In order for a meaningful construction of knowledge to occur, the teacher must train students to think critically in analyzing and solving a problem. The current condition requires a new paradigm of learning chemistry by changing the way students think about chemistry, especially in hydraulic and non-hydraulic materials by conveying that chemistry is an important subject to learn. Another thing can be done by linking chemistry lessons with chemical phenomena that exist in everyday life by teaching critical thinking. The purpose of this study was to describe the effectiveness of the Problem-based Learning model on critical thinking skills and student learning outcomes on electrolyte and non-electrolyte solution material for class X MAN 1 kota Palu.

Materials and Method

This type of research used is a Quasi experiment, with a quantitative descriptive research design using One group pretest-posttest design. This research was conducted in MAN 1 kota Palu. The sample was taken using a total sampling technique or saturated sample, namely class X IPA 1 which consisted of 23 students, and class X IPA 2, which amounted to 44 students and the two classes were as experimental classes.

This study involves two variables, namely the independent variable is the Problem Based Learning model and the dependent variable is the ability to think critically and student learning outcomes. The type of data used in this research is quantitative data, namely critical thinking skills and student learning outcomes. Sources of data in this study are primary data and secondary data. The technique of collecting and collecting data is through giving tests for learning outcomes in the form of multiple choice (multiple choice), while critical thinking skills are given by giving essay tests. The data analysis technique is in the form of statistical and descriptive analysis (Sudjana, 2015).

Results and Discussion

The results of the pretest and posttest data analysis for the two experimental classes 1 are depicted in the following diagram

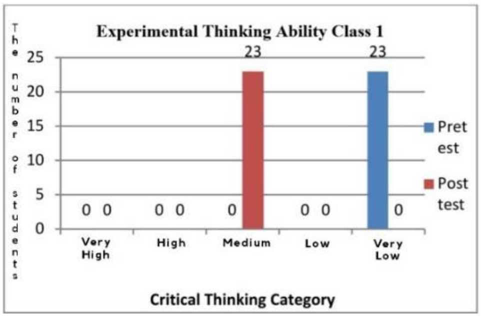

Figure 1. Diagram of the students critical thinking ability in experiment class 1

The results of the analysis of critical thinking ability for experimental class 2 can be illustrated in the form of diagram 2 below.

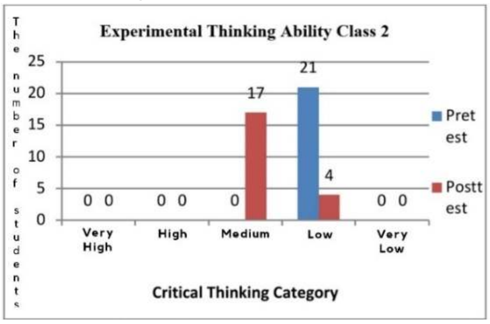

Figure 2. Diagram of the students' critical thinking ability in experiment class 2

The data diagram is based on indicators of critical thinking in the pretest and posttest for the two experimental classes 1, using the average value of the percentage indicators of students' critical thinking abilities, namely interpretation, analysis and evaluation, which can be described in diagram 3.

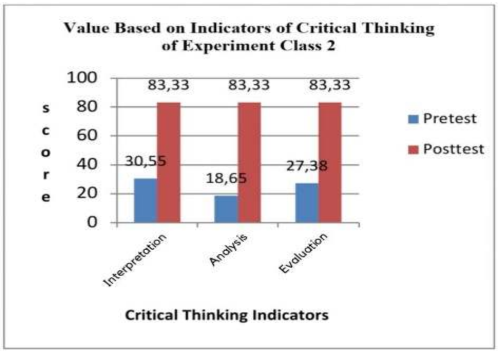

Figure 3. Indicator value diagram for critical thinking experiment class 1.

The student scores based on indicators of interpretation, analysis, and evaluation of Experiment Class 2 can be described in Figure 4.

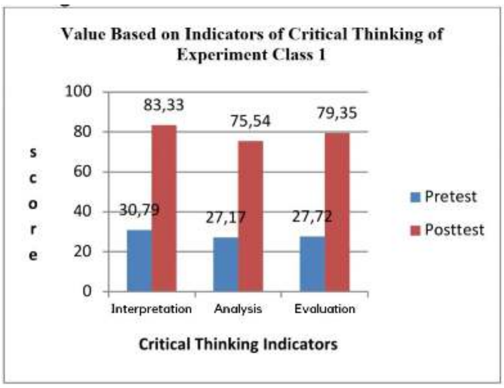

Figure 4. Indicator value diagram for critical thinking experiment class 2.

The data analysis of the learning outcomes test in the treatment group obtained a significant probability value of 0.000 and a t-count value of 9.045. The results of the t-test analysis of learning outcomes data show that the significant probability value is 0.000 <α (0.05), and tcount (9.045)> t table (0.05: 2.43) (2.017). The mean of the pretest and the mean of the final test of learning outcomes in the treatment group were significantly different. The average data on student learning outcomes in the treatment group on the initial test was 66.1364, while the average for the final test was 80.7955. The relationship between the initial test scores and the final test on the two dependent variables, that the ability to think critically has no relationship, because the significance obtained is 0.841> α 0.05. Whereas for learning outcomes there is a relationship because the significance value obtained is 0.00 <α 0.05. The correlation value of paired data on learning outcomes was obtained at 0.531, indicating a strong enough relationship with a positive coefficient value which means that good treatment will improve learning outcomes.

Based on the results of the T test, the t value of critical thinking skills is 35.693 > t table ((0.05: 2); 43 (2.017). These results are then H0 ¬ rejected and H1 accepted, so in general the average value of the final test is higher. From the mean value of the initial test. Likewise, the results of the t test analysis of the learning outcomes data obtained tcount (9.045 > t table ((0.05: 2); 43) (2.017). These results indicate that H0 is rejected and H1 is accepted, then in general the average value of the final test is higher than the average value of the initial test. So it can be explained that the PBL model has real effectiveness on critical thinking skills and student learning outcomes on electrolyte and non-electrolyte solution material for class X IPA MAN 1 kota Palu.

1. The effectiveness of the PBL model on students' critical thinking ability

Based on the results of the data analysis, it is known that the level of critical thinking skills of students from the two experimental classes is very low. This is due to several factors including the lack of interaction between students and teachers. Raths & Louis (1986) stated that one of the factors that can influence the development of critical thinking skills is the interaction between teachers and students. A conducive learning atmosphere will increase students' enthusiasm in the learning process so that students can concentrate on solving the problems given. The involvement of students in the learning process will make the interaction between students and teachers better. Because teachers are no longer the only source of information.

The scores that can be obtained for each indicator of critical thinking on the pretest (figure 3) for experimental class 1 and (picture 4) for experimental class 2. These results indicate that all students have very low critical thinking skills. This is due to the lack of student’s ability to understand, identify and draw conclusions from the problems in the questions given. But this does not mean that all students absolutely do not have the ability to think critically because critical thinking skills can be instilled in education in everyday life by making a positive contribution to students in fostering confidence, willingness, and good judgment in using cognitive abilities (Nur, 2013).

Based on the data obtained, one of the main factors causing an increase in critical thinking skills in the experimental class 1 and the experimental class 2, as evidenced by the increase in posttest results compared to pretest results. This happens because learning with the PBL model has advantages, including providing opportunities for students to participate actively in building the knowledge they will acquire. The learning process is student-centered, fun, active creatively, and allows information between students, between students and teachers, and between students and the environment. Studies in electrolyte and non-electrolyte solution materials cannot only be explained, but it is important to use the practicum method by working to observe an event macroscopically. Suniati et al. (2013) stated that to overcome these limitations, currently there are many ways of giving problems and solving problems using visual media based on computer simulations.

Based on the results of data analysis with the application of the PBL model in learning activities, students were able to reach the high category in critical thinking on very good interpretation indicators while the indicators of analysis and evaluation were quite good. The results of this study are in line with the results of several researchers regarding the application of the PBL model, namely, Pusparini et al. (2018) in their research on the effect of the problem-based learning (PBL) learning model on students' critical thinking abilities on colloid system material. The results showed that there was an effect of the Problem-Based Learning (PBL) learning model on students' critical thinking skills in the colloid system material. Yulyana et al. (2016) applied problem-based learning models to electrolyte and non-electrolyte solution materials to train students' critical thinking skills in class X SMA. The results of this study are the implementation of problem-based learning models to train students' critical thinking skills with very good criteria, the activities that appear show that students have practiced critical thinking skills. This is in line with Hake & Richard (2002) which states that the category of student's critical thinking ability is declared good if the student's critical thinking ability level is at least moderate and high.

The increase in high-level thinking skills is very influential with the existence of student activities to formulate answers in solving problems/questions given in the learning process, so as to enable students to think critically and creatively. Lila (2007) explains that in learning students need to be accustomed to solving problems, finding something useful for themselves, and struggling with their ideas. Furthermore, Arends (2008) states, in this situation students take risks that can generate interest in learning.

Increased critical thinking skills and student learning outcomes also occur because during the learning process, students are motivated to study material and knowledge in-depth by themselves through reading activities, formulating answers in solving problems, discussing, peer tutoring, and summarizing individual subject matter on electrolyte material and non-electrolytes. Walker (2005) argues that PBL is an individual or group effort to find answers based on the understanding that students have previously had, in order to meet the demands of an unusual situation. The PBL model is very important because in learning, students quickly forget if it is only explained verbally, but they remember when given examples and understand if given the opportunity to try to solve problems (Dwijananti & Yulianti, 2010). Furthermore, Slavin (2006) suggests that students will find it easier to construct knowledge, understanding, and problem solving if they collaborate in learning.

These results have proven that the PBL model can have a positive impact on students' ability to solve problems and build their own knowledge, and show that the PBL model has a better effect on critical thinking skills and student learning outcomes from learning without PBL. This condition is in accordance with the results of previous studies in various fields of mathematics and natural sciences (MIPA), such as research conducted by Kowiyah (2012); Ardiyanti (2016); Ayuningrum & Susilowati (2015); Yulianingtias (2016); Hayuna & Budijanto (2018); Yulyana et al. (2016); Wulan et al. (2018), and Agustin et al. (2016), the results of this study have proven that the PBL model can have a positive impact on student's critical thinking skills.

Based on the research results, the proposed hypothesis is accepted, this shows that the results obtained strengthen the opinions of experts as well as indicate an increase in critical thinking skills and student learning outcomes. This increase was not without obstacles, but several obstacles, including requiring more time for students to complete the assigned assignments, took up more time for the teacher, especially for correcting student assignments. Completion of one subject requires more frequency of meetings in learning and is constrained by the COVID-19 pandemic situation.

The results of observations in the learning process, where the achievement of the effectiveness of a lesson in this paper is based on three things, namely the completeness of classical learning outcomes, the ability of the teacher (teacher) to manage learning and student activities which include student activities during the learning process. All of these indicators show positive results. The completeness aspect of student learning outcomes has been classically achieved, because at least 70% of experimental subjects obtained a minimum score of 65% on the final learning outcome test. The teacher's activity in managing to learn on average was in the good category for all meetings in experimental class 1, namely 87%, and in experimental class 2, namely 86.3%. Meanwhile, the aspect of student activity is in a good category (positive) for all meetings in experimental class 1, namely 83.7%, and in experimental class 2, namely 85%. These student activities are an indicator of the effectiveness of PBL learning. That to achieve maximum results in learning, one must be able to apply the principles of positive dependence, individual responsibility, face-to-face interaction, participation and communication between groups, and evaluation of group processes (Suyanti, 2010).

2. The effectiveness of the PBL model on student learning outcomes

The application of the PBL model is based on the learning syntax as outlined in the lesson plan (RPP) and the study of electrolyte and non-electrolyte solutions which include conceptual, factual, and procedural knowledge. Students find it difficult to learn this material. The material on the nature of electric currents was poorly understood by students. The difficulty of students studying electrolyte solutions is because the material being studied is microscopic so it cannot be imagined by students. This is what causes students' low interest in studying chemistry in electrolyte and non-electrolyte solution materials (Husni, 2015).

In an effort to increase student activity and learning outcomes, it is necessary to make learning innovations, one of which is to link the material with everyday life. The initial activity in the learning process is where the teacher shows a bottle of isotonic drink and then asks students to provide feedback about the use/benefits of the drink. Furthermore, the orientation of students by showing a video will generate questions from students, provide LKPD, to the evaluation process in solving problems that occur in the discussion both the results of the video and the results of the LKPD. Furthermore, the closing activity was carried out by re-evaluating. Before making a summary of the entire material, the teacher checks students' understanding and mastery of the material being studied by asking questions and asking students to answer them. If the student answers correctly, the teacher reinforces the student's answer and if the student's answer is not correct, the teacher will straighten it by providing an explanation in accordance with the question. At the end of the activity before closing the lesson, the teacher makes a summary based on the conclusions presented by the students.

After the PBL model learning process in all experimental classes, then the posttests was carried out. The postest average score obtained is 80.79 in good category. The PBL model directs students to have a desire to understand, and learn good learning needs so they want to use and find the best learning resources in order to solve the problems at hand. The PBL model is a way of presenting learning material by exposing students to problems that must be solved or resolved in order to achieve educational goals (Trianto, 2011). Mustapa (2014) stated that the role of learners in problem-based teaching is to present problems, ask questions, facilitate investigation and dialogue. The PBL model cannot be implemented if learners do not develop a learning environment that allows an open exchange of ideas. In essence, students are faced with authentic and meaningful problem situations that can challenge students to solve them.

Some of the research results showed that students experienced misconceptions in electrolyte and non-electrolyte solutions. One of the results of the study, revealed by Siswaningsih et al. (2015) that students experience a misconception by assuming all electrolytes are ionic compounds, electrolytes are substances that can conduct electric current, and consider an electrolyte solution to conduct electric current due to the content of free electrons in the solution. Other research results, revealed by Supartono et al. (2009) that students consider electrons to act as conductors of electricity. Thus it can be concluded that students do not understand the concepts contained in the chemical bonding material in semester one so that in the electrolyte and non-electrolyte solution material students experience continuous misconceptions (Suyanti, 2010). Electrolyte and non-electrolyte solutions are basic materials and are a prerequisite for studying acids and bases, and electrochemistry. If students' understanding of the electrolyte and non-electrolyte solution material is not intact, it will affect learning in the next material. If this is allowed, it will have an impact on further material and will experience increasingly complex misconceptions (Ramadhan et al., 2017).

This learning condition will change the role of the teacher from just conveying information to being a facilitator who facilitates students. Arends (2008) argues that this change in the role of teachers is one of the characteristics that show success in learning. According to Slavin (2006) the teacher is only a facilitator and helps students who have difficulty understanding the material of their assignments so that in the end students can find the concepts they have to learn. Furthermore, Mustapa (2009) argues that the models, strategies, or approaches used in learning to improve learning processes and outcomes including students' reasoning abilities need to consider several things, including learning control is not held by systems outside students including teachers, but learning control. held by the students themselves.

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