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The Effectiveness of KAPRA Learning Model on Buffer Solution to Improve Students' Critical Thinking Skills

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Abstract

This study analyzes the effectiveness of the KAPRA learning model (associate, experience, think, negotiate, and apply) students' critical thinking skills on buffer solutions. The subjects of this research are students of class XI MIPA 3 as the experimental and class XI MIPA 4 as the control class at SMAN 10 Pekanbaru. The method uses experimental research with a randomized control group pretest-posttest research design. The data obtained were analyzed using normality test, homogeneity test, hypothesis testing and N-Gain test. The results showed that the KAPRA learning model effectively increased students' critical thinking skills. Based on the hypothesis test, $t_{count} > t_{table}$ (5.89 > 1.66) with the N-Gain value in the moderate category of 0.52.

Keywords: buffer solution, critical thinking skills, KAPRA learning model

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1. Introduction

Intense competition in the development of science and technology requires individuals to have good abilities in critical thinking skills and mastery of science concepts. One way to obtain that is obtained from quality education. According to (Seftian et al. 2017), a developed nation can be seen from the quality of its people in education field.

21st century education emphasize critical thinking and problem-solving, creativity and innovation, communication, and collaboration. The challenges of 21st century education require individuals to prepare themselves to think critically, creatively, problem solver, and investigator (Tarawu et al., 2020). These abilities can be trained in the learning process (Hidayah et al., 2017). Learning that requires students to have these four abilities can be applied in all subjects, such as chemistry.

Studying chemistry requires understanding, analyzing and linking it to everyday life, such as buffer solution. Buffer solution is an abstract and hierarchial material because it's material requires an initial understanding of equilibrium, acid-base and stoichiometry concepts (Ulva et al., 2016). Moreover, it's also required a representation that can visualize (Alghiri et al., 2018) and requires students to have good mastery of mathematical concepts and abilities (Stephanie at al., 2019). Buffer solutions are taught in class XI in even semesters related to everyday life and calculations that require understanding and analysis. Therefore, the learning model applied must be following the material and personality of students (Wardani et al., 2019).

According to Trianto (2014), learning models are important in planning a guide in the learning process. These guidelines will later become a reference in learning.

The learning model contains approches, and learning syntax that must be carried out to achieve learning objectives.

According to the interview conducted with chemistry teachers at SMAN 10 Pekanbaru, information was obtained that the methods used in learning were discussion, question and answer, and practicum methods. While the learning model applied is only the Number Head Together (NHT). From the learning process carried out, it turned out that many students ignored teachers' explanation, were less critical of the material presented. For example, only two or three students could answer the teachers' question when working on Student Worksheet; only smarts student did it while the other students played. Moreover, only three or four students dared to express their opinions about material being taught, so that many students had not been able to work on the questions given by the teacher were 54% with the Minimum Completeness Criteria of 80.

Improving critical thinking skills requires exercises that can be obtained in the learning process (Rahmawati et al., 2019). For example, if students can analyze a phenomenon and simplify it into a conclusion, it means that they have critical thinking skills (Erna et al., 2012; Husnidar et al., 2014; Nusarastriya et al., 2013; Amalia et al., 2014).

Gleason (2018) stated that in facing the 4.0 revolution era, ten main abilities must be possessed; critical thinking skills are also important abilities for the student in 21st century learning and help students understand lessons (Halpern et al., 2013). This aligns with Facione's research (2013), which shows that the critical thinking skills test scores of 1100 students are significantly correlated with student learning outcomes.

According to Fabian (2015), a teacher is the main source in stimulating the critical thinking process as expected. Rahmawati et al. (2019) stated that a good teacher is a teacher who can stimulate students' critical thinking in the classroom. Critical thinking itself requires the teachers' role as facilitators in improving critical thinking skills in the classroom. Critical thinking itself related to asking reasons and being open to the problems given (Jufrina et al., 2016).

According to (Vong et al., 2017; Gojkov et al., 2015; Aliakbari et al., 2013; Zivkovic, 2016), the thing truly involved in strengthening students' critical thinking is done through teaching as a door in getting critical thinking. Therefore, teacher should choose a suitable learning model for students and materials to make students think critically (Rahmawati et al., 2019). Several learning models can be used to improve students' critical thinking skills in chemistry learning, which are, discovery learning model (Nugrahaeni et al., 2017; Lailasari et al., 2018; Kusumaningtyas et al., 2020), preparing dong concluding learning model (Zulkarnain et al., 2019), problem based-learning model (Marhamah et al., 2020), and KAPRA learning model.

The KAPRA learning model is a learning model consisting of linking (link), experiencing (experience), reflecting (think), negotiating to mean (discuss), and strengthening (apply). This model is a model that emphasizes the active role of students (hands-on and minds-on) by using a constructivist approach, inquiry approach and contextual approach (Susanti et al., 2012; Nisa et al., 2015; Apriyani et al., 2015; Nisa et al., 2018).

The KAPRA learning model follows the 2013 curriculum, which is student-centered, so that learning becomes meaningful. The learning process in the KAPRA model requires students to find their learning concepts. So that the KAPRA learning model can suppress student activities, where students only focus on learning. So that, students will find their learning concept and will last a long time in memory and lead to meaningful learning.

Some research results that show the success of the KAPRA learning model include those conducted by (Juan et al., 2012), who conclude that after taught using the KAPRA model on the main subject of acid-base. The students were declared complete with a

percentage of 88.55%, and (Nisa et al, 2015) research in class XI SMA performed well with an average of 88.45%.

Given the importance of the application of KAPRA learning model on improving students' critical thinking, research on it is carried out on students' critical thinking skills in the buffer solution material. As a result, students' critical thinking skills after being taught using the KAPRA model is expected to increase, and the category of improvement can be known.

2. Research Method

The research that has been conducted is experimental research with randomized group pretest posttest design. In this research, two classes were used, namely the experimental class, which applied the KAPRA learning model and the control class, which applied the scientific approach. This is conducted so that learning is more systematic and directed. This research was conducted at SMAN 10 Pekanbaru in the 2019/2020 academic year from February 2020 to March 2020. The population in the research was all students of class XI MIPA SMAN 10 Pekanbaru, which consisted of 4 classes. Therefore, the class used as a sample in this study is a class that homogeneous in academic ability.

The instruments in this study were the syllabus, lesson plans, relevant chemistry textbooks, student worksheets, and evaluation questions and pretest posttest questions. The data analysis technique used is normality test for all data obtained, the homogeneity test for class pairs, and research hypotheses testing and categories using the N-Gain test. The normality test was carried out on the previous test value, which is on hydrolysis as a benchmark for pairing class pairs with the same ability using the Lilliefors test. Homogeneity test is carried out to determine whether the classes used as samples are homogenous or not. Two steps must be done, namely the variance similarity test and the average similarity test. Both samples are homogeneous if t_{count} lies between $-t_{table}$ and t_{table} ($-t_{table} < t_{count} < t_{table}$). The hypothesis of this research is whether the KAPRA learning model effectively increases students' critical thinking skills. The hypothesis is accepted if $t_{count} > t_{table}$. At the same time, the N-Gain test is carried out to see the increase in students' critical thinking skills and determine the category of increasing students' critical thinking skills on each indicator.

3. Result and Discussion

This research has been conducted in class XI MIPA of SMAN 10 Pekanbaru. This research was conducted with an experimental method Randomized Control Group Pretest Posttest with two group samples obtained from homogeneity test. The study consisted of four classes, therefore, for the purposes of homogeneity test, the data from the four classes were divided into six pairs of data (as started in Table 1.). These six pairs of classes were tested based on the variance similarity test and then the average similarity test. As a result, three pairs of classes were declared inhomogeneous, which are pairs of samples one and two, one and three, one and four. Because sample one or class XI MIPA 1 had higher cognitive abilities than the other three classes paired with other classes, the data was inhomogeneous. It has happened because the three classes were not homogeneous, so the class could not be used as a sample in the study. The results of the homogeneity test can be seen in Table 1.

Table 1. The Variance Similarity Test Results (Homogeneity)

Sample	*N*	∑ X	∑ X^2	F_{table}	F_{count}	Notes
1	35	2130	134464	1.80	1.42	Both Variance are the same
2	36	1592	80494			
1	35	2130	134464	1.80	1.05	Both Variance are the same
3	35	1601	83577			
1	35	2130	134464	1.80	1.61	Both Variance are the same
4	35	1675	92801			
2	36	1592	80494	1.80	1.02	Both Variance are the same
3	35	1601	83577			
2	36	1592	80494	1.80	1.13	Both Variance are the same
4	35	1675	92801			
3	35	1601	83577	1.80	1.10	Both Variance are the same
4	35	1675	92801			

Furthermore, from the three pairs of classes declared homogeneous, one pair of classes was selected, used as the experimental and control classes. Based on a suggestion from the chemistry teacher at SMAN 10 Pekanbaru, two classes were obtained, namely class XI MIPA 3 as the experimental class and XI MIPA 4 as the control class. The two classes that became the research sample were given different treatments; in the experimental class, the learning process was conducted with the KAPRA learning model while in the control class with a scientific approach.

Before the treatment was given, first, the two classes (experimental and control) were given a pretest in the form of critical thinking questions to see how students' critical thinking skills to the buffer solution material. Second, before the pretest was given, students were asked to read the buffer solution material at home. Finally, after all treatments were completed, at the end of the second meeting, the classes were given a posttest in the form of critical thinking questions to see the effect of treatment on students' critical thinking skills.

The results of this research are the results of students' critical thinking skills before and after the learning process, namely pretest and posttest data. The data obtained is processed to determine the improvement of students' critical thinking skills. Based on the results of the analysis of the normality test data in Tables 2 and 3, it can be seen that the pretest and posttest scores of students in the experimental and control classes are normally distributed.

Table 2. Pretest Data Normality Test Results

Class	*N*	$\bar{X}$	S	L_{max}	L_{table}	Notes
Experiment (XI MIPA 3)	35	20.11	6.55	0.1325	0.1497	Normal distribution
Control (XI MIPA 4)	35	19.74	7.32	0.1367	0.1497	Normal distribution

Table 3. Postest Data Normality Test Results

Class	*N*	$\bar{X}$	S	L_{max}	L_{table}	Notes
Experimental (XI MIPA 3)	35	75.51	8.55	0.1300	0.1497	Normal distribution
Control (XI MIPA 4)	35	59.20	12.59	0.0997	0.1497	Normal distribution

The experimental and control classes' pretest and posttest data were normally distributed because $L_{max} < L_{table}$. After it was stated that the data had normal distribution, a hypothesis test was conducted to determine the effectiveness of the KAPRA learning model on improving students' critical thinking skills.

The hypothesis is accepted if $t_{count} \geq t_{table}$ with $dk = n_1 + n_2 - 2$, probability criteria $1- \alpha$. Testing this hypothesis using the right-hand t-test aims to see the effectiveness of increasing students' critical thinking skills. The results of this research hypothesis test can be seen in Table 4.

Table 4. Research Hypothesis Test Results

Class	N	$\sum X$	$\sum X^2$	$\bar{X}$	S_{comb}	t_{table}	T_{count}	Notes
Experimental	35	1911	107393	54.60	10.75	1.66	5.89	Hipothesis accepted
Control	35	1381	59309	39.45				

Based on the hypothesis test data processing listed in Table 3, the value of $t_{count} = 5.89$ with a probability of $1- \alpha$ ($\alpha = 0.05$) and $dk = 68$. These results are obtained from table ($t_{0.95}(68)$) of the t distribution is 1.66. Seen t_{count} 5.89 > t_{table} 1.66. The results of this hypothesis test state that the application of the KAPRA learning model (link, experience, think, discuss, apply) effectively improve students' critical thinking skills on buffer solution material at SMAN 10 Pekanbaru. Then, the N-Gain test data analysis used to determine the improvement of students' critical thinking skills for each indicator can be seen in Table 5. The indicators of critical thinking skills learned according to Binkley are: (1) analyzing and identifying information, (2) expressing arguments and clarifying information, (3) evaluating information, (4) interpreting the meaning of information into other forms, (5) synthesizing by linking information to explain an opinion, (6) making conclusions from information.

While the questions for critical thinking skills in the buffer solution material amounted to ten essay questions, essay question are chosen to measure student's critical thinking skills according to the indicators and follow the learning indicators required by the 2013 revised 2018 curriculum.

Table 5. N-Gain Test Results

No.	Critical Thinking Indicator	N-Gain of Experiment Class	N-Gain of Control Class
1	Analyze and identify information	0.16 (low)	0.11 (low)
2	Express arguments and clarify information	0.70 (high)	0.05 (low)
3	Evaluate information	0.82 (high)	0.59 (moderate)
4	Interpreting the meaning of information into other forms	0.72 (high)	0.67 (moderate)
5	Synthesize by linking information to explain an opinion	0.58 (moderate)	0.54 (moderate)
6	Making conclusions from information	0.17 (low)	0.14 (low)
	Average	**0.52 (moderate)**	**0,35 (moderate)**

The results of the N-Gain test calculation show that the category of increasing students' critical thinking skills lies in the moderate category with an average gain of 0.52. For indicators of critical thinking, expressing arguments and clarifying information, the N-gain of the experimental class is higher than the control class of 0.70 > 0.05, where the increase occurs from the low category to the very high category with an increase of 92.88%. Indicators of expressing arguments and clarifying information increasing as seen from the learning process in the experimental class. Students were active in expressing their opinions. When a group was presenting, another group was active in asking questions and adding various answers. Not only in

indicator two, in indicators three and four, there was also an increase from the moderate category to the high category in the experimental class. This improvement was seen in the process of working on the questions given to both classes. However, the control class had difficulty doing so because they were not used to working on questions as in the experimental class, which was accustomed to working on questions on the think sheet. Therefore, the experimental class understands the concept of learning better and can better work on questions in the form of critical questions. The shows that after the KAPRA learning model is applied, there is a significant increase in critical thinking skills in the indicators of expressing arguments and clarifying information. The increase in students' critical thinking indicators can occur because the KAPRA learning model suppresses student activities to find their learning concepts so that the learning atmosphere becomes more meaningful.

In addition to using the N-Gain test, the evaluation value can also be used as a benchmark in seeing students' critical thinking skills. For example, suppose the evaluation value of the experimental class students is higher than the evaluation value of the control class. In that case, it can be concluded that the experimental class students' critical thinking ability is higher, as shown in Figure 1.

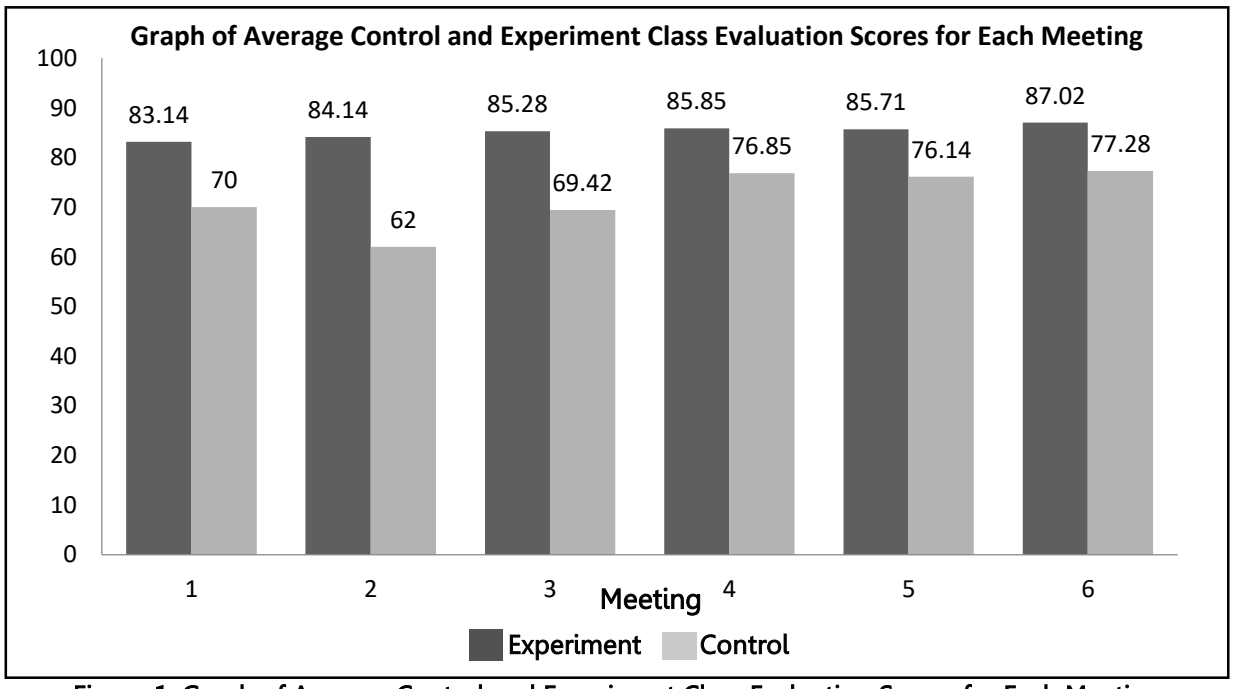

Figure 1. Graph of Average Control and Experiment Class Evaluation Scores for Each Meeting

In Figure 1, it can be seen that the average evaluation value of the experimental class increased more than the control class. It happens because students taught using the KAPRA learning model obtain their learning concepts to becomes more meaningful, and concepts last longer in students' memories. In addition, students taught with the KAPRA model are more accustomed to working on questions related to buffer solution learning with the additional thinking sheets. It is provided from the student worksheet and evaluation questions compared to classes that are not taught with the KAPRA model.

The KAPRA learning model is applied because it emphasizes the active role of students (hands-on and minds-on) in the learning process so that learning becomes more productive and able to foster the full

strengthening concepts to students. Learning with KAPRA model can also more meaningful because students are guided in following systematic and directed learning steps to finding their learning concepts. Knowledge becomes more durable in memory to influence students' critical thinking skills. The knowledge obtained by students through the discovery of their concepts becomes more meaningful than the knowledge provided by others so that the students' critical thinking skills also increase (Sanjaya, 2011; Sari et al., 2016).

In the learning process using KAPRA learning model, students have been divided into nine groups, each consisting of four people, making it easier for students to understand concepts formed with peers. The nine groups were arranged based on students' cognitive abilities and students' gender. Group arrangement aims to make study groups responsible for working on a Student Worksheet to find a concept of their learning so that learning objectives can be achieved with the help of cooperation and responsibility in study groups (Hamdani, 2012).

The syntax of the KAPRA learning model is: link, experience, think, discuss and apply. At the linking stage, the teacher relates to the previous material (apperception) and relates learning to everyday life (motivation). When teachers relates topics components and properties of buffer solution, student asked question about properties of learning, namely the material understanding of buffer solutions, components of buffer solutions and properties of buffer solutions, students are asked questions about the properties of several compounds, including NaOH, HCl, CH_3COOH, NH_4OH and HF solutions. Then students answer simultaneously about the properties of these compounds correctly. Next, the students were asked the question, "Who can mentioned three compounds and their properties other than the example you gave?" Several students raised their hands but the chance were only given to three students. The teacher motivates students by linking the learning to be taught with students' daily lives by telling the fact that the pH in the body ranges from 7.35 to 7.45. Then the teacher shows pictures of people who eat food with various tastes such as: bitter, sour, salty, spicy and sweet and then assumes that the person is the student himself named Vito. Then the teacher asked the question, "What will happen to the pH of Vito's blood?". The results of the linking stage make students more enthusiastic and motivated in learning so that students actively answer with various answers and reasons when the teacher asks questions (Kurniati et al., 2018).

In the Experience stage, the teacher gives a video about the buffer solution experiment and instructs students to pay close attention to the video. When students watch the video, the teacher instructs them to record important things in the video. During the video is finished, the students respond to the video with questions. Then to these questions, the teacher instructs students to read the relevant literature to answer the students' questions (Kurniati et al., 2018).

The next stage is the thinking stage: Students work on the thinking sheet individually in the experimental class at this stage. The thinking sheet is in the form of questions that lead students to find answers from learning at that days so the concept discovery process is more focused. At the same time, the control class was not given a think sheet and was only instructed to read literature related to learning materials. When students work on the thinking sheet, it is seen that each individual is trying to answer the thinking sheet according to what has been observed in the video shown in the previous stage and read through the relevant literature. At this stage, each student already has their learning concept so that when entering a group discussion, smart students do not dominate the worksheet (Husnidar et al., 2014).

This discussion stage is the student worksheet work stage. Students sit in heterogeneous groups of four people in one control classes are the same. But in the experimental class, each individual has been given questions on the thinking sheet so that when working on the student worksheet, the students look more enthusiastic in doing it. While in the control class, the students still look confused in the process (Jannah et al., 2016). In the application stage, the concept is strengthened to students by presenting the discussion results in front of their friends, and if there is a different answer, it will be refuted by other groups. In the experimental class, when the presentation is done by one group, the group with different answers also dares to give their opinions (Susanti et al., 2012). After the buffer solution material has been taught, posttest questions are then given to both answered by the control class in the moderate category only. So it can be seen that the indicators that were answered by the experimental class students correctly were in the indicators of expressing arguments and clarifying information from the low category to the high category. Then the difference between the pretest and posttest scores will be used to see the improvement of students' critical thinking skills by using hypothesis testing. Then the increase in critical thinking skills can be known by the N-Gain test. Students in the experimental class have moderate critical categories of thinking and are declared to be increasing.

Critical thinking skills improved significantly after learning using KAPRA learning model because students were directly involved in the learning process. The role in groups made students responsible for their respective tasks and collaborated in solving problems contained in the student worksheet so that students were active during the learning process and understood the material being studied. The achievement of student evaluation scores evidences this. When students are active in the learning process, the student can optimize the potential for the student to produce satisfactory critical thinking (Hartono, 2012; Jufrina et al., 2016; Rahmawati et al., 2019).

group at this stage, and there are nine groups in the experimental and control classes. The worksheets given to the experimental and classes. The number of questions, the form of the questions and the time for the posttest questions are the same as the pretest questions given at the beginning of the meeting. However, there was a significant difference in the answers between the experimental class and the control class. More questions were answered in the experimental class with a variety of answers that matched the answer key. Indicators that are answered correctly are more indicators of expressing arguments and clarifying information, evaluate information and interpreting the meaning of information in other forms. At the same time, the indicators evaluate information and interpret the meaning of the information into other forms

KAPRA learning model (link, experience, think, discuss, apply) greatly influences on students' critical thinking. This can be seen from the significant increase in critical thinking skills after students are applied to the KAPRA learning model. In addition, the increase in critical thinking skills can be seen from critical thinking between the results of the pretest and posttest carried out by students.

KAPRA learning model applied can build students' knowledge so that students' knowledge becomes wider, increasing students' critical thinking skills. The ability to master the material in the experimental class can be observed from the average student worksheet and the evaluation given at the end of each meeting. The average value of the evaluation of the experimental class is higher than the control class. Thus the mastery of the material in the experimental class is better than the control class (Rahmawati, 2014).

The obstacle faced in implementing the KAPRA learning model is that the teacher has tried to limit on the discussion process during the learning process. Still, when the discussion is in progress, students need a longer time to work on the discussion sheet. This is because students are not accustomed to using learning models and conducting group

discussions. So that it affects the evaluation time, which is faster than the set.

The solution to minimizing these obstacles is to inform students that as long as the material for ion equilibrium and pH of the buffer solution will continue to use the KAPRA learning model and always warn students if The discussion time is up; besides that, the teacher is also required to manage and guide the discussion so that each stage of the learning model KAPRA can run well.

4. Conclusion

Based on the hypothesis test $t_{count} > t_{table}$, which is 5.89>1.66, it can be concluded that the KAPRA learning model effectively improves sudents' critical thinking skills at SMAN 10 Pekanbaru with N-Gain in the moderate category of 0.52. Moreover, indicators of critical thinking skills with the highest increase in indicator number 2 express arguments and clarify the information by 92.88%.

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