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Implementation of Learning with a Pre-Lecture Quiz to Train Students' Creative Thinking Skills

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This study aims to describe the implementation of learning strategies by using the Pre-Lecture Quiz, activities and creative thinking skills of students in the Acid-Base Titration material. The research method used is quasi-experimental with a non-equivalent *pretest-posttest* control group design. The sample selection was done by cluster random sampling, obtained in class XI IPA 3 as the experimental class and XI IPA 6 as the control class. The results obtained an average percentage of learning feasibility with a pre-lecture quiz of 93% had the criteria of "very high", the average percentage of student learning activities was 85% with criteria "very high" and the average percentage of students' creative thinking activities was 81 % with the criteria of "very high". The conclusion of this study shows that the learning through a pre – lecture quiz is significant for students' to gain creative thinking skills with the material of acid-base titration.

Key words: *Pre-Lecture Quiz, Students' creative thinking skills, Acid-base titration.*

Introduction

Technology in the 21st century is developing rapidly in business and industrial sectors (Wrahatnolo & Munoto, 2018). In this century, education becomes important to ensure students gain skills, innovation abilities, creativity, teamwork, and learn how to use life skills (Wrahatnolo & Munoto, 2018). The ability to think is the ability to reason, both inductively, deductively, accusatively, as well as cause and effect (Subagia, 2013). These three elements of reasoning are developed through the learning process, both of which take place in school through formal education, as well as that which takes place outside of school through formal and informal education (Subagia, 2013). The process of developing the potential of students' is directed so that students become human beings who believe and fear God Almighty, human beings who have a noble character, healthy humans, knowledgeable people, capable humans, and creative people.

In general, the problem faced by education is the weakness of the learning process, including the lack of student learning readiness (Rudibyani & Perdana, 2019). In the learning process, students are not ready to accept learning materials so that teachers have difficulty in developing concepts. Students do not have enough learning readiness so information obtained in the learning process is difficult to understand. As a result, a lot of information is not absorbed by students or there are many misconceptions in the learning process (Hamalik, 2010).

One of the materials in chemistry learning that must be mastered by students of class XI every Semester is Basic Competence (KD) 3.10. This explains the concepts of acids and bases, and their strength and equilibrium ionization in solution, and KD 4.10 which analyses the pH (*Power of Hydrogen*) change path of several indicators extracted from natural materials through experiments. In this research, the acid-base material that will be studied is acid-base titration. Acid-base titration material is one whose application is very close to daily life. Therefore, in learning acid-base titration, learning is needed that can increase the interaction of students with objects.

Based on the results of observations and interviews with chemistry teachers at one of the state high schools in Bandar Lampung, the information obtained was that students 'creative thinking skills were low. This was because the teacher had not given a quiz at the beginning of learning. Therefore, teachers had difficulty in developing students' chemical concepts because students lacked active, enthusiastic, tenacious, and creativity to participate in learning, especially the problems found in the acid-base titration material.

Efforts that can be made to solve this problem is to adopt variations in learning. This can be in the form of quizzes at the beginning of learning or a Pre-Lecture Quiz (Daniel, 2011). This quiz is given at each meeting so that students are expected to be more prepared, active, and creative in participating in chemistry learning. This means that teaching and learning activities can be more effective and efficient, so that student learning achievement increases. The Pre-Lecture Quiz (PLQ) is to give students a quiz students before the start of the learning process, with the aim of increasing students' readiness in participating in learning. In the results of the study, Lestari (2016) concluded that the application of PLQ can have a positive influence on student learning motivation in the experimental class with a significant level of 5%. Idayu (2017) concluded that the application of PLQ was influential in an effort to improve students' chemistry motivation and learning achievement. Trisna (2017) concludes that the method of giving a quiz at the beginning of learning, is effective in increasing readiness and student learning outcomes.

Problem based learning can be applied in variations of PLQ learning. It is a model of learning that requires students to play an active role, look for their own sources and trains students' creative thinking skills. Therefore, students are not only able to solve problems, but will also gain new knowledge (Wena, 2011).

Previous research conducted by Wulandari (2011) concluded that the application of the PLQ model was proven to increase students' creative thinking skills on buffer material. Rani (2018) concludes that the PLQ model is effective and has a large measure of influence in achieving students' skills on genuine thinking or point of view related to acid-base material.

Creative thinking involves creating something new or original (Hürsen, Kaplan, & Özdal, 2014). Creative thinking is important for chemistry learning, because chemistry learning requires understanding of concepts to solve chemical problems, as well as providing logical, systematic, critical, and careful reasoning skills. Chemistry learning also provides objective and open thinking that is needed in daily life (Sinaga, 2017). In creative thinking, learning occurs as a process of how knowledge is created through changing forms of experience (Fahrurrozi, Dewi & Rachmadtullah, 2019). Modified design thinking learning can help students with disabilities to think creatively and critically (Dewantoro, Muslihati & Pradipta, 2019). Creative thinking generates new solutions to old problems and is a unique process for each individual (Pramono, Nurhasan, Kusnanik & Winarno, 2019). The ability to think creatively consists of two concepts, namely thinking and creative ability. Thinking is a mental activity experienced by someone when they are faced with a problem or situation that must be solved. So far, no research has been conducted on learning with PLQ to train students' creative thinking skills on acid-base titration material. Learning with PLQ can be carried out efficiently, if the students' creative thinking skills on the acid-base titration material increase.

Research Methods

Methods

This study uses a quasi-experimental method with a *pretest-posttest control group design* (Fraenkel, Wallen, & Hyun, 2012; Sugiyono, 2013). The students of XI grade of science program in Senior High School of 9 Bandar Lampung became the population in this study. Sampling was done by cluster random sampling technique, obtained class XI IPA 6 as an experimental class (carried out problem-based learning using PLQ variations) and class XI IPA 3 as a control class (carried out problem-based learning without using PLQ variations).

Research Instruments

A pre-lecture quiz and pretest and posttest students' creative thinking skills on acid-base titration material were taken as the instruments applied in this study. In addition, there is a student activity sheet during learning.

Data Analysis Technique

Data analysis conducted in this study included tests of reliability and validity instrument, influence and its effectiveness. Data analysis was obtained through calculation by using Microsoft Office Excel and SPSS 22.0 software. Questions' validity is determined based on the calculated value and r_{table}. To interpret the correlation coefficient, the following criteria are used (Arikunto, 2013) :

Table 1: Test Instrument Validity Criteria

Alpha Value	Interpretation
0.81-1.00	Very high
0.61-0.80	High
0.41-0.60	Enough
0.21-0.40	Low
0.00-0.20	Very low

Cronbach's Alpha is applied to find the reliability of the test questions. The reliability degree of its criteria (r_{11}) (Arikunto, 2013) is presented in Table 2.

Table 2: Degree of criteria reliability

Cronbach's Alpha	Interpretation
$0.80 < r_{11} \leq 1.00$	High
$0.60 < r_{11} \leq 0.80$	Enough
$0.40 < r_{11} \leq 0.60$	A little low
$0.20 < r_{11} \leq 0.40$	Low
$0.00 < r_{11} \leq 0.20$	Very low

The effectiveness of PLQ is shown in the improvement of students' creative thinking skills on their achievement obtained from PLQ grades, pretest and posttest. Data of pretest and posttest values obtained were then analysed to obtain n-gain with the following formula:

$$n - Gain = \frac{Posttest - pretest}{X_{\max} - pretest}$$

The effectiveness of PLQ by the material of acid-base titration material is also supported by student activity data during learning, using PLQ variations assessed by two observers, namely teacher partners and research partners. The analysis uses the formula according to Sudjana (2005) as follows:

$$\% \text{Ji} = \left(\frac{\sum Ji}{N} \right) x100\%$$

With %*Ji* as the ideal percentage score for each aspect in observation on the i-th meeting, ∑Ji as the total score of each observation aspect given by the observer at the i-th meeting, and the maximum score becomes the N (ideal score). The resulting data is explained and described in accordance with the criteria for student activity (Widoyoko, 2009) in Table 3.

Table 3: Student Activity Criteria

Percentage	Criteria
80 ≤ X< 100	Very good
60 ≤ X< 80	Well
40 ≤ X< 80	Pretty good
20 ≤ X< 40	Not good
0 ≤ X< 20	Very less

Hypothesis testing in this study was conducted by t-test or testing the difference in two averages. This was preceeded by a homogeneity and normality and test, before conducting the t-test through the *SPSS statistical application 22 for windows system.*

To be accepted, the *independent sample t-test* must meet the criteria by H_0 if sig. (2-*tailed*)> 0.05, where students' creative thinking skills *n-Gain* average on acid-base titration material in the experimental class is coming to equal or lower average on *n-Gain* from students' creative thinking skills, related to acid-titration material bases in the control class, and vice versa.

To find out how much effect (*effect size*) *pre-lecture quiz* in lifting up students' acid-base titration material creative thinking skills, apply the test of *effect size* test mentioned by Jahjouh (2014) with the formula:

$$\mu^2 = \frac{t^2}{t^2 + df}$$

Where μ is as the size of effect, *t* is t calculated from the t-test, and *df* is the *degree of freedom.* The data obtained is interpreted according to the size effect criteria Dincer (2015) described in Table 4.

Table 4: Effect Size Criteria

Effect Size	Criteria
$\mu \leq 0{,}15$	Neglected effect
$0{,}15 < \mu \leq 0{,}40$	Small effect
$0{,}40 < \mu \leq 0{,}75$	Medium
$0{,}75 < \mu \leq 1{,}10$	Big effect
$\mu > 1{,}10$	Very big effect

Results and Discussions

Reliability and Validity

Based on the data of the reliability and validity of the test instruments, amounting to 10 item per test. Items were tested on 20 students outside the sample, but still in one population. Validity means the extent to which the accuracy, and accuracy of a measuring instrument in carrying out its measurement function (Aminah, 2017). Whereas reliability is the consistency of measurement (Aminah, 2017). The results of the validity test raises questions about the pretest posttest creative thinking skills of students on the acid base titration material are listed in Table 5 below:

Table 5: Validity Coefficient Values

Item	r_{count}	r_{table}	Criteria
1a	0.832	0.444	Valid
1b	0.750	0.444	Valid
2a	0.835	0.444	Valid
2b	0.606	0.444	Valid
3	0.918	0.444	Valid
4	0.871	0.444	Valid
5	0.786	0.444	Valid
6a	0.818	0.444	Valid
6b	0.540	0.444	Valid
6c	0.779	0.444	Valid

Table 6 shows that the value of $r_{count} > r_{table}$ which means the test questions of creative thinking skills on the material of valid acid-base titration from the students, so that it can be used as an instrument for measuring students' creative thinking skills. The reliability test results of the students 'creative thinking skills test were 0.778 with the criteria of "high" so that they could be used as instruments to measure the skills of students' creative thinking.

Effectiveness of Pre-Lecture Quiz

The pre-lecture quiz is given to students at each meeting, at the beginning of learning. Before the learning process the researcher explained to students that they would learn by using PLQ variations, namely in the form of giving a quiz at the beginning of the learning, which aims to increase student learning readiness. Students were divided into 5-6 groups and each group was given a problem-based worksheet. At the end of the meeting, the researcher always reminds the students that the quiz will be held at the beginning of the next meeting, and gives direction regarding what material needs to be learned. The average pre-lecture quiz scores of students from the first meeting to the fourth meeting are shown in Figure 1.

Figure 1. Average PLQ Value of Experimental Class Students

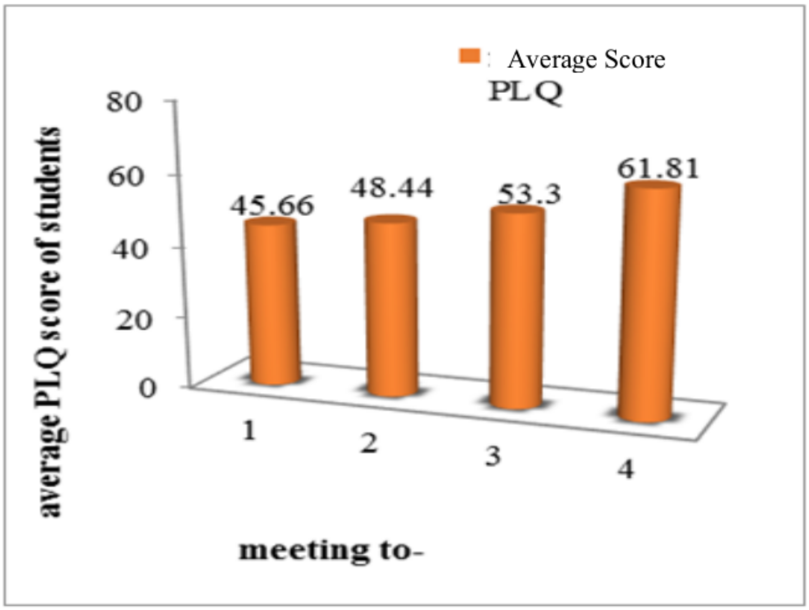


Figure 1 shows that the average PLQ score of students from the first meeting to the fourth meeting has increased. At the first meeting, the average PLQ value was 45.66. This is because giving quizzes at the beginning of the learning process on the first meeting is seen as an unusual starting activity, and it tends to make the students less interested in quizzes given. At the second meeting, the average PLQ score of students was 48.44. At the second meeting, the average PLQ score of students has increased by 2.78, this is because students are getting used to quizzes at the beginning of learning. At the third meeting, the average PLQ score was 53.30. At the third meeting, the average student PLQ score increased by 4.86.

At the third meeting, students have been trained with quizzes given at the beginning of learning, so they experience an increase in scores greater than the quiz scores at the second meeting. At the fourth meeting, the average PLQ score of students was 8.51. At the fourth meeting, there was a significant increase, amounting to 8.51. This is consistent with the opinion of Idayu (2017) that quizzes given continuously can improve learning achievement, because students will try to be active and study harder to get good grades.

Observations on student activities during learning using PLQ variations were assessed by two observers, namely partner teachers and research partners. The observations showed that student activity during PLQ learning from the first meeting to the fourth meeting had increased, both in the control class and in the experimental class.

Based on the PLQ score data on the acid-base titration material, the number of students has increased, has not increased, and has not experienced an increase or decrease in PLQ scores from the first meeting to the fourth meeting shown in Figure 2.

Figure 2. The number of students whose PLQ scores went up, remained, and fell from the second to fourth meeting

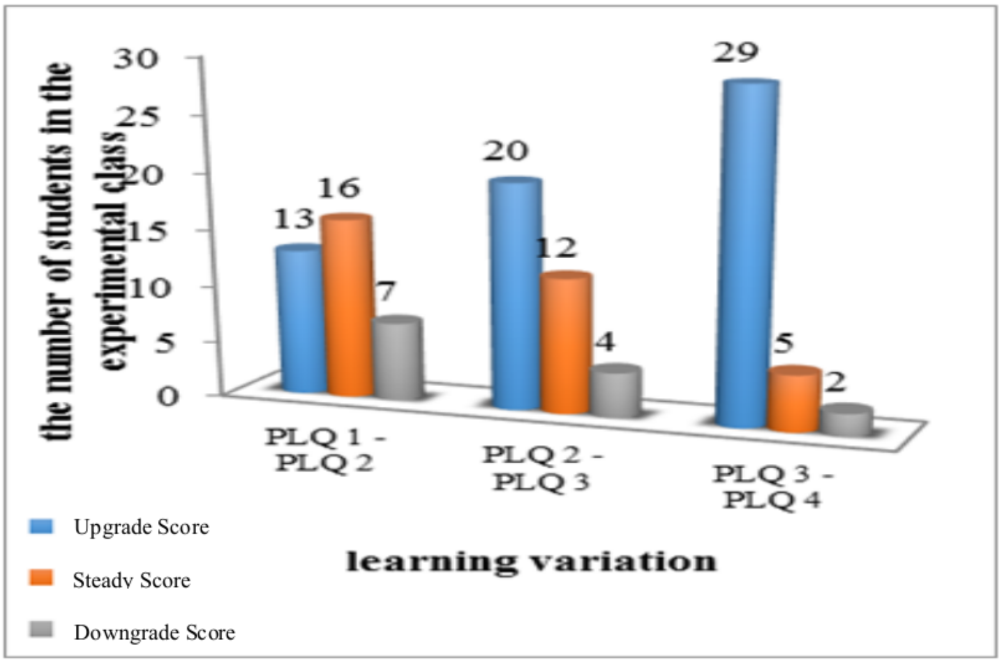


Figure 2 shows that the number of students who experienced an improvement in PLQ grades from the first meeting to the fourth meeting, was more than the number of students who experienced a decrease in grades and their grades were fixed. This is because when learning using PLQ variations students became more ready to receive learning, so that they were able to follow learning more clearly and in an organised way.

This shows that PLQ is found to be effective in pushing the students' creative thinking skills on the material of acid-base titration. This is in accordance with the opinion of Slameto (2010) that the application of a Pre-Lecture Quiz (PLQ) can make students better prepared to study chemistry so that it produces better learning outcomes. In addition, in line with Idayu (2017) there is a progressive outcome in the value of students' PLQ on acid-base titration material.

Creative Thinking Skills

The effectiveness of PLQ on acid-base titration material, is measured based on achievement in improving students' creative thinking skills in the control class and the experimental class, can be seen based on statistical calculations.

The average value of students' pretest and posttest creative thinking skills on the acid-base titration material in the control class and the experimental class is presented in Figure 3.

Figure 3. Average Student Pretest and Posttest Scores

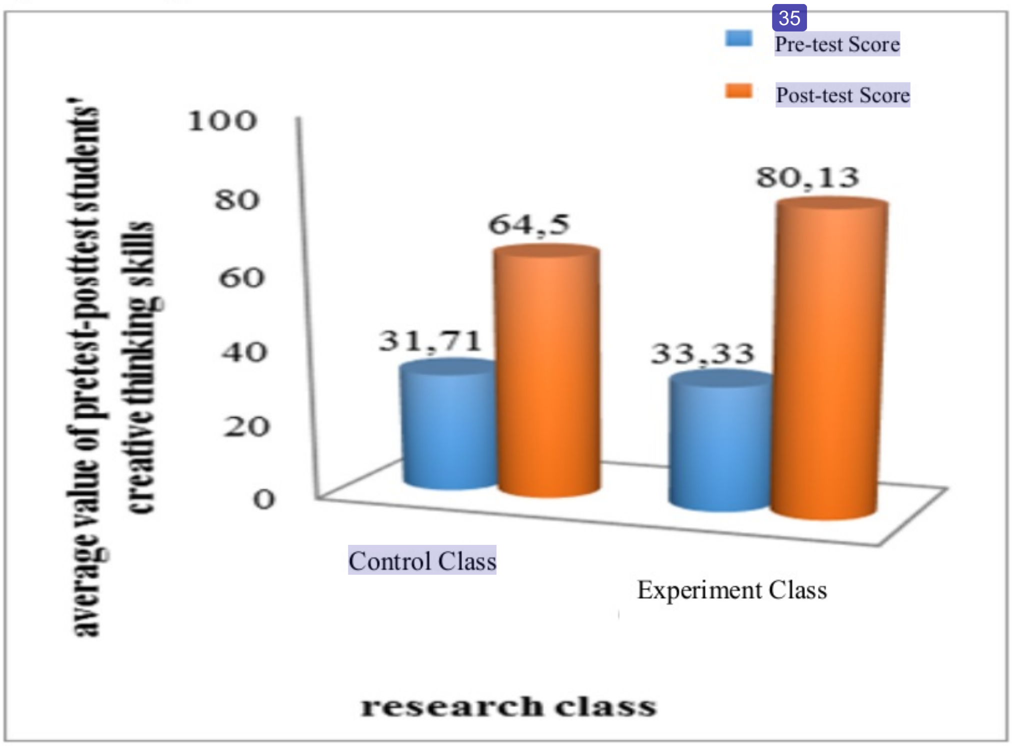
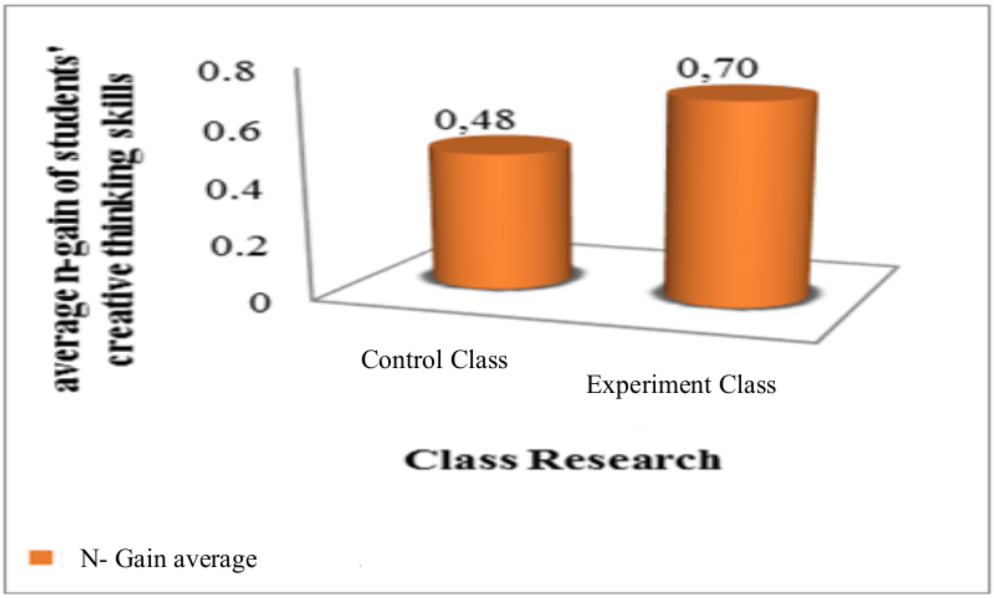


Figure 3 shows that the average creative thinking skills of students on acid-base titration material after learning, are higher than before learning, both in the control and experimental classes. This shows that the increase in students' creative thinking skills in the experimental class, is higher than the increase in students' creative thinking skills in the control class, on acid-base titration material.

The positive progress of students' skills in creative thinking on material of acid-base titration l in the experimental class and the control class is described by the average n-Gain value shown in Figure 4 below.

Figure 4. Average n-gain values



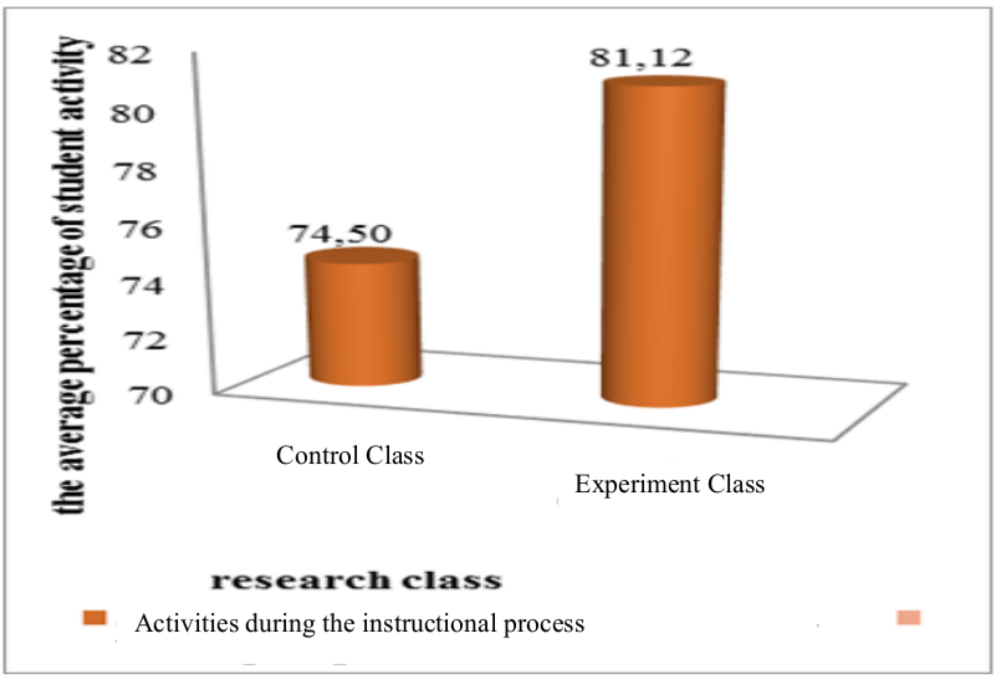
Based on Figure 4, it appears that the average n-gain of the experimental class is higher than the average of the n-gain of the control class. The average n-Gain of the experimental class is "high", whereas the average n-Gain of the control class is "medium". This means the increase in students' creative thinking skills in the experimental class is higher than the control class.

The students' increased creative thinking skills during learning in the experimental class by using PLQ variations on the PBM model, so that students became better prepared to participate in learning. Students also became more enthusiastic, active, and creative. This is in accordance with the opinion of Nuraeni (2010), which states that the variation of learning is said to be effective in increasing students 'thinking skills if statistically their students' thinking skills show differences. There is a significant change between initial understanding and understanding after learning, which is indicated by significant gain.

Student Activities during Learning Using PLQ Variations

Observations on student activities during learning using PLQ variations were assessed by two observers namely partner teachers and research partners. The observations showed that the average student activity during learning in the control class was 74.50 with the "high" criteria, while the average that the student activities during the learning class in the experimental class were 81.12 with the "very high" criteria. This shows that the activities of students during learning using PLQ variations are significant to raise their skills in creative thinking, especially on the material of acid-base titration. Student activities are effective in improving students' creative thinking skills. The results of observing student activities during learning using PLQ variations are presented in Figure 5 below.

Figure 5. Student activities during learning using PLQ variations



Hypothesis Testing

The normality test is used to determine whether two groups of samples come from normal distribution populations or not (Arikunto, 2013). The normality test results on students' skills of creative thinking in the control class and experimental class that the value of sig. obtained in the students' normality test on the skills of creative thinking for the control and the experimental class is greater than 0.05, meaning that both samples come from normally distributed populations.

The homogeneity test is performed to determine whether the population variance is uniform or not, based on the sample data obtained (Arikunto, 2013). The homogeneity test results of students' skills on creative thinking in the control and experimental class have a significance greater value than 0.05, which means that both samples have homogeneous variance or come from a homogeneous population.

Difference Test of Two Averages (t-Test)

Based on the results of the normality test and homogeneity test, obtained n-Gain data of creative thinking skills of students in the control class and experiment are normally distributed and have homogeneous variance. This means that it can be continued with the t test using the Independent Samples t-Test. The significance value obtained in both classes is less than 0.05. In accordance with the test criteria, then accepted H_1, defined as the *n-Gain* average of students' skills on creative thinking for acid-base titration material in the experimental class is higher than the average of n-Gain's creative thinking of students on acid-base titration material in the control class.

Effect Size

Improving students' creative thinking skills is done using the effect size test. The results of the calculation of the effect size test show that the experimental class with variations of pre-lecture quiz on the PBM model, has a "large" influence in positively establishing students' skills on creative thinking related to the material of Arrhenius acid-base. Whereas in the control class, using the PBM model has a "medium" effect in improving students' creative thinking skills on Arrhenius's acid-base material. This is relevant to the opinion of Dincer (2015) who states if the effect size test results are in the range of $0.75 < \mu \leq 1.10$, then it is categorised as a "big effect".

These results also provide information that as much as 92% increase in students' creative thinking skills in the experimental class is influenced by variations in PLQ and PBM models, while 8% is influenced by other factors that are ignored. This is in accordance with the notion of effectiveness according to the Big Indonesian Dictionary (KBBI), that effectiveness is something that has an influence, an impressive thing or a result, it brings results, and is the success of a business or action.

Based on the results of the average *n-Gain*, the experimental class has a "high" criterion, the

PLQ value of students is increasing, the number of students experiencing an increase in grades is increasing and the students' activity average during learning has a "very high" criterion. This means that PLQ is effective in lifting up students' skill on creative thinking by the material of Arrhenius's acid-base. This is in accordance with Trisna (2017), that states the method of giving a quiz at the beginning of learning, is effective in increasing readiness and student learning outcomes.

Complex thinking processes include four groups, namely problem solving, making decisions, critical thinking and creative thinking. In this case the variation of a pre-lecture quiz has a great influence on improving students' creative thinking skills. Complex thinking processes are known as high-level thought processes. Some characteristics that arise in learning show that students look at a problem from various perspectives, and often take a trial and error approach in solving problems.

To improve the ability to think creatively, the first thing to do is to improve mentally and then develop technical abilities. Both are very important. If only technical problems are studied, and students are still not mentally creative, creativity will be difficult to emerge. Conversely, people who are mentally creative, but do not know the technique, will also be less optimal.

The first step is knowing how to overcome the obstacles of creative thinking. The main obstacle to creative thinking is not wanting to accept something new and strange. The purpose of creative thinking is to produce something new. If new concepts are not accepted, then great ideas will not appear.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that learning with a pre-lecture quiz is significantly effective to progress students' skills in creative thinking on acid-base theory material. It is indicated by an increase in the average PLQ score of students, the number of students experiencing an increase in grades, the average n-gain in the experimental class has "high" criteria and the average student activity during learning takes place has a "high" criterion. PLQ has a "big" influence on improving students' creative thinking skills on acid-base theory. Complex thinking processes include four groups, namely problem solving, making decisions, critical thinking and creative thinking. In this case the variation of pre-lecture quiz has a great influence on improving students' creative thinking skills. Complex thinking processes are known as high-level thought processes.

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