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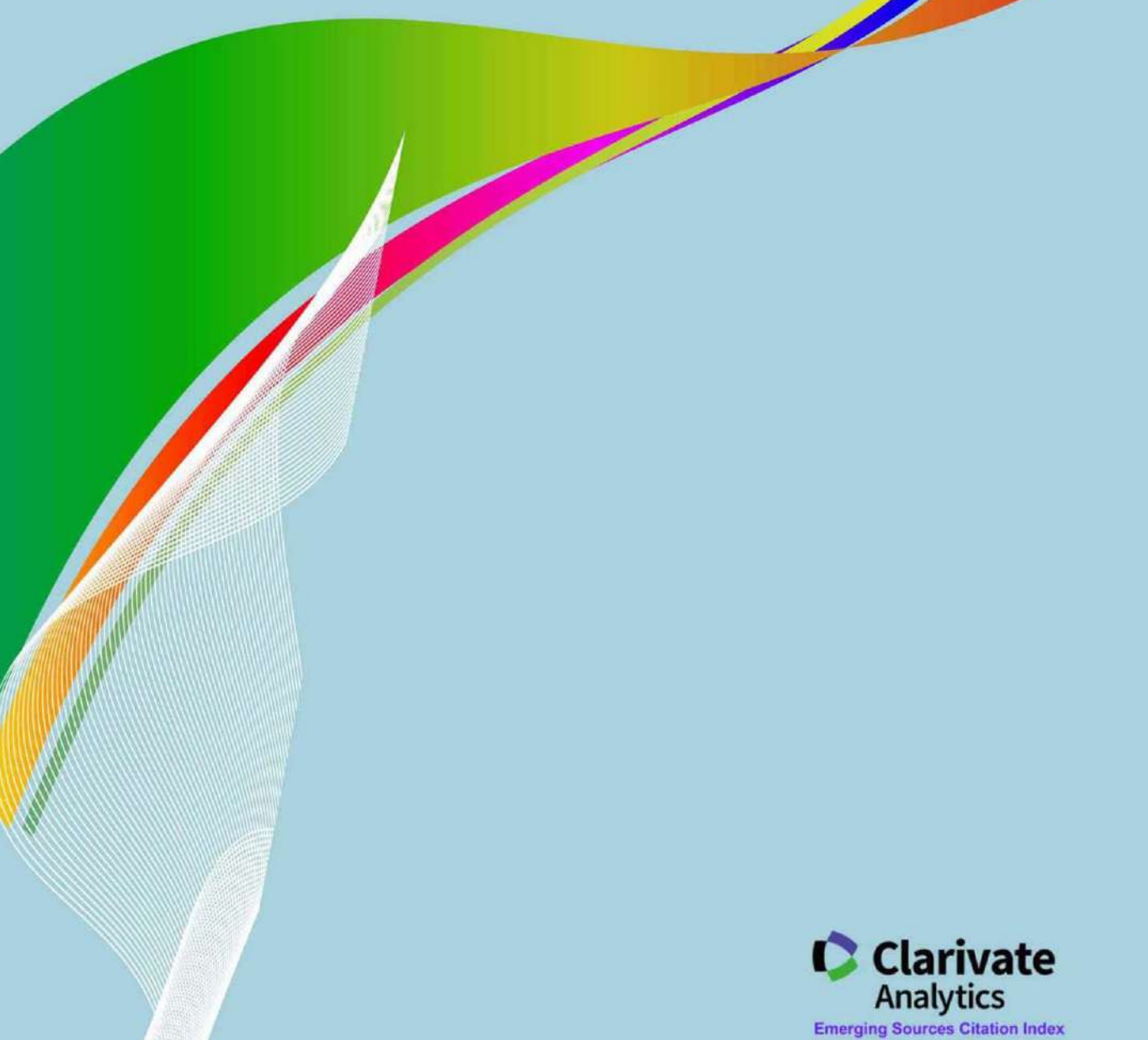
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The Effect of Problem-Based Learning on the Critical Thinking Skill of the Students

Susana Osiana Vegas¹ & Djukri²

^{1,2}Biology Education, Postgraduate Program, Yogyakarta State University, Indonesia

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THE EFFECT OF *PROBLEM-BASED LEARNING* ON THE CRITICAL THINKING SKILL OF THE STUDENTS

Susana Osiana Vegas¹ & Djukri²

^{1,2}Biology Education, Postgraduate Program, Yogyakarta State University, Indonesia

¹Contributor Email: osien.vegas@gmail.com

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Abstract

This research aimed to determine the effect of the problem-based learning model on critical thinking skills in the excretion system subject. The research was quasi-experimental research by using a pretest-posttest control group design. The population of this research was all students of SMA Negeri 1 Prambanan. The research samples of this research were two classes, class XI MIPA 4 with 27 students as the control class and class XI MIPA 3 with 31 students as the experimental class implementing problem-based learning. Data were collected by using a test instrument in the form of multiple-choice questions. The data obtained were analyzed using the Independent sample T-test. The calculation results showed a significant value of $0,000 < 0,05$, it can be concluded that there was a difference in the critical thinking skills between the control and experimental class.

Keywords: *Problem Based Learning; Critical Thinking; Excretion System.*



A. Introduction

Learning is an effort to create valuable activities. The learning activities include delivering knowledge, organizing, and creating methods for the learning environment so that students can perform learning activities effectively and efficiently so that they can later achieve learning outcomes optimally. Learning biology is essentially a process of interaction between living things, that is between humans, plants, and animals, and interaction between individuals and their environment as a source of learning. From these interactions will emerge the involvement of students processes physically and mentally students which enable them to think and act. This is in line with the opinion of Piaget (in Nasution 2009) emphasizing that the learning process is an individual interaction with new phenomena or information being studied.

Biology lessons contain many concepts and closely related to the process of finding out until the process of discovering and solving problems to build a concept and then understand it. Therefore, the process will occur when the learning process involves the physical and mental processes of students to have the opportunity to find their problems encountered directly in the surrounding environment. It is very supportive of the learning process if there is a sensitivity of teachers and students to facts related to issues and problems that develop in the environment and the community. Learning biology emphasizes providing direct experience to explore and understand problems in the environment so that it can affect developing student's scientific thinking abilities and attitudes.

The results of observations at the schools where the study was examined showed that most students showed low critical thinking skills in learning biology, this was seen from students who tended to be passive, always waiting for instructions or waiting for the teacher to give assignments. When learning, the teachers sometimes ask or allow students to ask questions. However, most students tend to be quiet. They are lazy to think and ashamed to express their opinions. Students are not determined to focus on learning, they tend to only memorize and not



develop learning material. When students are given assignments by the teachers, it appears that most of them are not serious about doing the assignment, lack of desire to find out, but prefer to copy the answers of other students. Students are very weak in analyzing facts, sparking and organizing ideas, maintaining opinions, making comparisons, drawing conclusions, evaluating arguments in Biological problems. Many students whose grades are below KKM. Out of 31 students of class XI MIPA 3, 20 people do not reach KKM, this also happens in class XI MIPA 4, out of 27 students, 18 people whose grades do not reach KKM. So every time the teacher gives the test, there will always be a remedial test for them.

Biology learning that takes place in schools so far has not provided many opportunities for students to develop critical thinking skills. Most schools encourage students to give correct answers rather than encouraging them to come up with new ideas or rethink existing conclusions. Teachers often ask students to retell, define, describe, describe, and register rather than analyze, draw conclusions, connect, synthesize, criticize, create, evaluate, and rethink. As a result, students' thinking abilities are very low. Critical thinking is very necessary for Biology, this is because to study biology requires critical thinking effort to solve problems, decision making, as an approach, analyzing scientific assumptions and discoveries. So thinking critically is a must in these efforts. Besides, critical thinking can also be applied to the student to learn to solve problems systematically in the face of challenges, solve problems innovatively, and design fundamental solutions. This is in line with Nur's opinion (2011) which states "critical thinking is one's ability to analyze, criticize, and formulate conclusions based on several considerations".

Pott (1994) states that there are three specific strategies for learning critical thinking skills, namely building categories, determining problems, and creating a supportive environment (physical and intellectual). Memory-based learning makes students rarely ask questions, critical thinking skills so that they become less motivated. students who have critical thinking skills can better optimize their learning outcomes and be



able to design and direct their lives in a future full of challenges and competition. This is supported by the opinion of Liliasari (2009) that demands in an era of globalization are increasingly advanced and complex, so the process of science education must prepare qualified students who have higher literacy, values, attitudes, and scientific thinking skills, so that there will be resources human power that able to think critically, creatively, make decisions, and solve problems.

Critical thinking is a systematic mental activity carried out by tolerant, open-minded people to broaden their understanding (Johnson, 2009). According to Facione (2011) critical thinking skills include interpretation, analysis, conclusions, evaluations, explanations, and self-regulation, formulate and select relevant hypotheses, and make valid conclusions and determine the validity of conclusions (Sofan & Ahmadi, 2010). According to Facione (2011), critical thinking skills include interpretation, analysis, conclusions, evaluation, explanation, and self-regulation. In learning biology students should be more active in the learning process. Learning that involves students can practice the ability of students to find out, understand, analyze, and find solutions to problems encountered so that it can ultimately improve students' critical thinking skills. The selection of the right learning strategy is very influential in mastery learning and increasing students' critical thinking skills.

Biological materials are not only composed of simple things that are memorized but also composed of complex materials that have analysis, application, evaluation, and creation. Students must play an active role in the learning process so they can find and understand biological concepts. Therefore, teachers need to provide opportunities for students to be more actively involved in the learning process through the selection of appropriate learning strategies. This is in line with the opinion of Sipayung and Simanjuntak (2017) stating that teachers have an important role in efforts to improve the quality of education. A teacher is required to be able to develop optimal learning programs so that an effective and efficient learning process is realized. Sianturi (2018) in her research said, creating a

conducive and pleasant learning atmosphere needed attractive learning packaging. With the innovation of learning models that are expected to create an active learning atmosphere, facilitate material mastery, students are more creative in the learning process, critical in dealing with problems, have social skills and get the result in optimal learning.

Problem Based Learning (PBL) is a learning model that allows students to develop critical thinking skills because, in PBL, students are faced with problems as the stimulus that is focused and must be completed in activities learning. As quoted from Samford University that "problem-based learning is a learning strategy that encourages students to develop critical thinking and problem-solving skills that they can carry with them throughout their lives," which can be concluded that the problem-based learning (PBL) models can help students develop critical thinking and problem-solving skills.

The PBL model as a solution to improve critical thinking skills is also expressed by Duch, Groh, and Allen (in Savery, 2006) that: The methods used in PBL and special skills are developed, including the ability to think critically, analyze and solve complex, real-world problems, to find, evaluate, and use the right resources of learning; to cooperate, to demonstrate effective communication skills, and use the knowledge and intellectual content skills to become continual learners. PBL-learning models begin with the provision of problems related to the real world, then students are asked to be active in formulating problems and identifying knowledge, learning and associating material with problems, and ultimately, making solutions to the problems provided (Amir, 2011). The learning process with the PBL model makes students more actively involved in the learning process, so they can automatically develop their critical thinking skills.

Previous research has shown a positive correlation between PBL models and students' critical thinking skills. Tiwari (1998), in his thesis, showed that PBL was effective in developing critical thinking skills. Sugiyarti (2005) shows that the use of PBL can improve critical thinking skills by 10.05 points and the average learning outcomes by 8.22 points.



While Fachrurazi (2011) in his research shows that students who use the PBL model have higher critical thinking skills than students in conventional classes. One of the main characteristics of PBL is the formation of small groups in the learning process. PBL applies learning through the concept of 'learning by doing', which creates an opportunity for students to learn by experiencing the problem-solving process.

The teachers at PBL acts as a facilitator and is responsible for monitoring students development, stimulating their meta-cognition, setting the tone, and playing a major role in setting norm groups conducive to learning. In PBL's initial work, the role of the facilitator was mainly to ask meta-cognitive questions such as "Why?" "How do we know that?" and "Is there anything else?" The facilitator is not advised to provide information or to directly evaluate students the contributions. However, the facilitator needs to model reasoning with questions such as "Do you know what that means?" and "What are the implications of that?" By modeling this meta-cognitive approach, PBL operates in several major steps, such as the "Seven-jump" model (model Maastricht PBL model). The steps can be summarized into three main stages namely; the initial stage, the PBL stage, and the final stage (Masek & Yamin 2010). In the first stage, the first activity involves forming groups, whether administratively or randomly assigning students into small groups during the first meeting session.

The group is then presented with a PBL problem and they begin to analyze and understand the problem. Among the special activities in this stage include; formulating learning objectives, identifying knowledge gaps, generating hypotheses, defining learning problems and concepts that must be learned and this is mostly done by defining "what they know", "what they don't know" and then "what they need to know ". In this case, the PBL stage begins with students conducting an independent self-study. Students are expected to master the knowledge relevant to the problem to be solved. Then, the students conduct group brainstorming and discussion sessions. They exchange and share information with all learning problems and hypotheses, and must reach an acceptable

definition agreed upon by all members (Wee 2004). Meanwhile, the facilitator monitors the group's progress through direct observation and formative assessment.

Direct observation involves coaching roles such as probing and questions, to trigger students' meta-cognition. The facilitator then gives feedback immediately after the formative assessment and always encourages students to compete with the self-assessment. In the final stage, students prepare for project presentations and assessments during the final meeting session. Students partially present their proposals for solutions. The facilitators evaluate students' work based on either group or individual presentations (Kolmos & Holgaard 2007).

Based on the background above, to create learning that provides direct experience to students and hone students' ability to solve problems, and help students to improve their critical thinking skills, the concrete efforts undertaken are conducting research with the title: "The Effect Of *Problem Based Learning* On The Critical Thinking Skill Of The Students On Excretion Material".

B. Method

1. Research design

The design of this study is quasi-experimental. A quasi-experimental design has a control group, but it cannot fully control the external variables that influence the implementation of the experiment (Sugiyono, 2017). This Quasi-experimental study was used to determine differences in the ability of classes that were treated and classes that were not treated. This study is to find out how the PBL learning model influences students' problem-solving abilities and critical thinking skills. The design used was a pretest-posttest control group design with Cluster random sampling. In this study, samples were randomly selected using a lottery. This study uses two classes, where one class as an experimental group and one class as a control group. The research design plans used are presented in the following table:



Table 1. Research Design

Class	<i>pretest</i>	<i>treatment</i>	<i>posttest</i>
KK	O1	X	O2
KE	O1	-	O2

Note: KK: Control Group O1: Giving pretest

KE: Experimental Group

O2: Giving posttest

X: Treatment using PBL

2. Place and time of the Research

The research was conducted at SMA Negeri 1 Prambanan in the 2018/2019 academic year in February 2019. The research was carried out in the experimental and control group each with 4 meetings.

3. Population and Sample of the Research

The population in this study were all students of class XI MIPA Prambanan 1 high school. The sample in this study was a class XI MIPA student consisting of two classes then drawn to determine the control class and experimental class. The control class is obtained by the MIPA 4 class consisting of 27 students and the experimental class which is MIPA 3 class consisting of 31.

4. Data Collection and Analysis Techniques

Data were collected through tests and non-test. The test is used to measure the critical thinking skills of students while the non-test measures the activity of students through the student activity observation sheet. The written test was conducted before the lesson (pretest) and after learners following study material Biology at the excretory system (post-test). The techniques used to collect the data as follows: (1) develop research instrument that includes: syllabus, lesson plans, worksheets, about the pretest and posttest, (2) provide pre-test to the 2 treatment groups, (3) analyzing the results of the pretest, (4) take any action to implement PBL study the experimental class and the control class lectures models, (5) provide post-test, (6) an analysis of the data. The steps of the implementation of PBL can be seen in the table below:



Step PBL	Teacher behavior
phase 1 Give orientation about the problem to students	The teacher discusses learning objectives, describe various important logistical needs, and motivate students to get involved in addressing the problem
phase 2 Organize students to examine	Teachers help students to define and organize learning tasks related to the problem
phase 3 Assisting with the investigation independently and in groups;	Teachers encourage students to get the right information, carry out experiments, and seek explanations and solutions
phase 4 Developing and presenting artifacts/exhibit	Teachers assist students in planning and preparing the appropriate artifacts such as reports, video footage, and models that help them to pass them on to others.
phase 5 Analyze and evaluate the process of overcoming the problem	Teachers help students to reflect on their investigations (investigations) and the processes they use.

Data analysis techniques used in this research are by using SPSS. The analyzed data is the data pretest and posttest. Data were analyzed using descriptive analysis and inferential statistical analysis of inferential statistics to test the research hypothesis. Before testing hypotheses, parametric prerequisite tests first, the normality test, and test data group homogeneity variants. If the prerequisites are met then the test will be performed parametric test if it is not met, then using nonparametric tests.

C. Result and Discussion

1. Result

The implementation of this research was conducted in four stages: pre-study, initial data collection, learning activities, and data retrieval end. The first step is pre-research activities being carried out at this stage is the observation in school. The second phase conducted by researchers is the initial data collection activities being carried out at this stage is to conduct



a pretest on the material excretory system. A third phase of the learning activity, the performed experimental class learning model and grade control PBL learning method used is lectures. In this third stage of observation for student activities. And for the fourth stage is the final data collection or posttest.

a. Critical Thinking Ability Test Results Students

The variable studied in this research is the ability to think critically. The problem is given for a pretest and posttest were 30 questions. The results of the pretest and posttest as a whole can be seen from the table below:

Table 2: Results of Descriptive Analysis Research

Results of Descriptive Statistics	classroom Control		class Experiment	
	pretest	posttest	pretest	posttest
the ideal value	10	10	10	10
The minimum value	1.47	6	2,67	7.71
The maximum score	4.70	7.57	4.41	9.42
Average	3.53	7.03	3.71	8.67

From the results of the above descriptive analysis prerequisite test is then conducted tests of normality and homogeneity test using SPSS. The result can be seen in the table below:

Table 3 Results of Statistical Analysis

	a	t		Decision
Normality test	0.05	TO	0.183	Normal
		KK	0.149	Normal
homogeneity test	0.05	0.868		Homogeneous



Independent test sample t-test	0.05	0,000	There is a difference between the control and the experimental class class
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If seen in the table above for homogeneity test sig value is $0.868 > 0.05$, which means the data is homogeneous and to test for normality can be seen significant value for the control group and the experimental group $0.183 > 0.149$ because $\text{sig} > 0.05$ then the normal distribution of data. Because research data already meets the prerequisite test then tested the parametric test of independent samples t-test. The results of the independent test samples t-test were 0.000. Because $0.000 < 0.05$, it can be concluded that there is a significant difference (real) between the control and the experimental class. From the above results, it can be seen that there are significant differences between critical thinking skills in the control class and experimental class.

b. Observations Activities Students Thinking Ability

Observation of students' critical thinking skills activities carried out during the learning takes place. The observation sheet of students' critical thinking are presented in the table below:

Table 4: Observation Sheet Of Students' Critical Thinking

No.	Aspect is measured	1	2	3	4
1	analyzing the problem				
2	focusing problems				
3	Searching for information				
4	Communicate / present problem				
5	Give an opinion on the topic of the problem				
6	Appreciate different opinions				
7	Provide alternative solutions for the problem which is the subject of discussion				
8	Choosing the right solution to solve the problem				

Note: 1 = never; 2 = rarely; 3 = frequently; 4 = always

Data from observation of the students' critical thinking skills activities are presented in the table below:



Table 5: Data from observation of the students' critical thinking skills activities

Aspect	Control				Experiment			
	1	2	3	4	1	2	3	4
	Low		High		Low		High	
analyzing the problem	16		11		10		21	
focusing problems	17		10		10		21	
Searching for information	15		12		10		21	
Communicate / present problem	16		11		10		21	
Give an opinion on the topic of the problem	16		11		9		22	
Appreciate different opinions	16		11		11		20	
Provide alternative solutions for the problem which is the subject of discussion	16		11		10		21	
Choosing the right solution to solve the problem	16		11		10		21	
total score	128		88		80		168	
Average	16		11		10		21	
percentage%	59.25		40.75		33.33		66.67	

From the results of the activity observation sheet of students' critical thinking skills obtained results on the control class as much as 59.25% expressed the ability to think critically low and 40.75% high student critical thinking skills while the experimental class as much as 33.33 declared critical thinking skills are low and 66,67% of students' high critical thinking skills so can be concluded that the PBL learning activities of students' critical thinking skills better than the class that uses the conventional method/lecture.

2. Discussion

Based on the results of research and data analysis can be seen that the use of the model PBL can enhance students' critical thinking skills significantly. From the results of the test or observation sheet, the visible activity of critical thinking skills in the experimental class is higher than in the control class. The improved critical thinking skills of students in the experimental class students are higher than the control class because they



are supported by using the model PBL learning activities that make students more active in their learning and build their knowledge through various activities, such as discussion groups. Following the opinion of Ametembun (2006) that the PBL model trains students on the use of a repeatable process for evaluating what they know, identifying what they need to know, gathering information, and collaborating to evaluate the hypothesis based on the data they have collected. This is supported by research Rica (2012) which indicates that the learning outcomes of students in learning science through the model PBL increased.

Improving student learning outcomes There was significant because the model PBL has a syntax that facilitates students to be active in constructing knowledge through a problem that is presented. Improving student learning outcomes could not be separated from an increase in students' learning activities as proposed by Hamalik (2002) that an increase in the activity of learning will improve learning outcomes. In line with the opinion of the majority of students that find it easier to understand the material given by the model PBL and make students more active and independent in group discussions. Learning activities PBL models starting with the orientation of students to the issues presented and they are required to solve the problems related to the excretory system is in LKS. The problem that presented a real problem with the real world, thus students are responsible for learning (Hmelo 2004). Thus, students feel involved in the problem by formulating the topic of the problem so that students will each put forward ideas with the group. This is supported by the opinion of Tan (in Rusman 2012) that the PBL model optimizes students' thinking skills through working together in groups so that students can empower, hone and test the thinking capacity on an ongoing basis.

The division of tasks within the group occurred during the investigation to solve the problems presented. The questions related to issues of excretion LKS system require students to apply their knowledge in solving the problem. This makes students seek information from various sources such as books, articles, and the Internet to find answers on



issues such as problems with the kidney excretory organ, make a description of the kidneys, and so on. Then students discuss the findings of the answers they received from the source. After the group discussion ended, then it is followed by class discussion. Students present the results of discussions with the group to solve problems, and other students evaluate the problem-solving process (Rusman, 2012), therefore, when students communicate the results of the discussion in class, other students pay attention to the answers given to given feedback/questions.

In the control class, the learning system is still centered on the teacher to direct the learning model. In the control class, students are not actively involved in the learning process as compared to the experimental class given the PBL model. The students are less active in the learning process led to the critical thinking skills they are poorly trained, as can be seen in the average value of the experimental class of 8.67 which is much better than the control class with 7.03. Critical thinking must be able to give reasons for the decision made and to be able to make the students answer questions about the decision-making (Harsanto 2005). In the experimental class, the teacher directs students to the problems that occur in the environment, and then the students independently process the problem and find a solution to solve the problem. This is following the opinion of Sudarman (2007) which states that the learning approach that uses real-world problems as a context for students to learn about critical thinking and problem-solving skills, as well as to obtain knowledge and key concepts of the course material or subject.

Critical thinking skills in this research is a skill to use aspects of thinking which consists of six indicators, namely: (1) the question is clear, precise, and accurate to the problem; (2) collect, investigate, assess and process relevant and valuable information; (3) think reflectively / analogy; (4) create a logical conclusion (reasonable), broad and deep; (5) open-minded; (6) can communicate the results of thinking, solutions to problems and suggestions. The above indicators associated with the processes in the material studied the excretion system. An excretory

system so that the material can be understood, the student should be able to see the problems that often occur in the excretory system in detail covering identify problems with the broad and deep,

PBL learning model is designed to be able to stimulate students active in learning, independent learning, able to develop the ability to identify problems, formulate problems, an evaluation that led to the specific problem-solving efforts. PBL learning begins with the teacher handed problematic situations to the students and ask them to analyze them, then determine their solutions, so students are encouraged to engage more actively in the lesson and develop their critical thinking skills.

In the PBL learning model, students are formed into small groups to work together to solve specific problems. This group discussion process will stimulate students to interact with members of the group, they also learn to work together to solve the problem with a mutual discussion between group members, thus indirectly critical analytical skills, and students will be formed. States that critical thinking skills can be honed through cooperation. Cooperation can provide an opportunity for students to engage in discussion, is responsible for the lesson, so once they become critical thinkers.

The ability of students in formulating the problem has increased due to the problems presented in the PBL learning model is a real-world problem that is happening around the neighborhood students, so that students more easily understand the problem and then pour it into a formula problem. This is following the opinion of Arends (2008) that PBL is effective in developing thinking skills and problem-solving skills. The results of this study are also consistent with previous research by Tohirin (2014) which states that the model PBL can enhance students' critical thinking skills. In addition to the results of research conducted Tayyeb (2010) and Shaer (2014) also showed that the PBL learning model is proven to improve students' critical thinking skills.

PBL learning model is one of learning that challenges students to find solutions to real-world problems that can be solved in groups. PBL leads students to learn independently to develop the ability to think



critically and able to analyze the problems that exist in the real world. Moreover, in the opinion of Curry in Sungur (2006) saying that the model PBL can enhance critical thinking skills and new knowledge that is useful for the long term. PBL learning process characterized by problems (can be submitted by students and teachers), and students identify problems with friends groups to help each other so that they can collaborate in finding solutions to problems. Learning through PBL with heterogeneous group members allows students to exchange ideas, work together to solve problems that can ultimately improve critical thinking skills. Thus the application of PBL also assists students in improving critical thinking skills.

D. Conclusion

Based on the results of data analysis and discussion can be concluded as follows: there is a difference in students' critical thinking skills significant material excretory system using the PBL learning model and the conventional method possible. It is seen from the average value posttest experimental class students are at an average of 8.67 were higher than the control class that is 7.03 likewise using a hypothesis test results independent test samples t-test. The results of the independent test samples t-test were 0.000. Because $0.000 < 0.05$, it can be concluded that there is a significant difference (real) between the control class and experimental class, which means there is a significant difference between critical thinking skills in the control class and experimental class. The average critical thinking skills of students in the class PBL is better than the control class, this happens due to a combination of PBL gives students more opportunities to talk to each other and work together in groups to analyze a given problem, so that the critical thinking skills they are developing, while in class conventional students are not facilitated to build their knowledge.

The results of the observation sheet also show that the critical thinking skills of the experimental class are higher than the control class is for high-level critical thinking skills experimental class is 66.67, while the control class 40.75. This happens because the experimental class using the model of PBL so most students find it easier to understand the material

given by the model PBL and make students more active and independent in group discussions. Learning activities PBL models starting with the orientation of students to the issues presented and they are required.

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