

## Application of a Pbl-Based Modules to Increase Critical Thinking Skills and Independence Learning

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### Article Info

#### Article History:

Received January 2018

Accepted March 2018

Published August 2018

#### Keywords:

Critical Thinking Skills;

Learning Independence;

Module; Problem Based Learning(PBL).

### Abstract

This study aims to measure the effect of application of Problem Based Learning (PBL) based module to critical thinking skill and student learning independence related to reaction rate material. PBL-based module is a module that can make students think actively in searching and finding answers from a problem. This type of research is an experiment. The research design used is posttest design and sampling technique using purposive sampling. The research instruments used were: cognitive test to measure students' critical thinking skill, questionnaire of learning independence, and questionnaire of student response to learning. Quantitative analysis result of experiment class score is 77,49 with 25 complete student from 28 students and control class has average 73,62 with 22 students complete from 29 students. Correlation test obtained correlation number of 0.37 and test the coefficient of determination obtained a number of 14.31%. Qualitative analysis found that overall showed that the experimental class was better than the control class. Thus it is concluded that the application of PBL-based module affect the improvement of critical thinking skills and student independence learning.

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p-ISSN 2252-6412

e-ISSN 2502-4523

## INTRODUCTION

Chemistry is one of the clumps of science obtained through the collection of data on the experimental activities of natural phenomena and natural characteristics around the systematic way (Trianto, 2007: 103). The study of chemistry covers everything about substances that include the composition, structure and properties, changes, dynamics, and energetics of substances that require skills and reasoning in learning them (Sudarmin, 2015: 2). Setiyono (2011) in his research concluded that the learning difficulties experienced by students caused by the lack of critical thinking skills of students in solving the problems they face.

The 2013 curriculum applied in learning requires students to have competence and thinking skills to compete in the 21st century. 20 of 2016 explains that learning in the 2013 curriculum is expected to produce graduates who have the skills to think and act include creative, productive, critical, independent, collaborative, and communicative. Based on this it is necessary to be a concern for teachers and prospective teachers to develop students' critical thinking skills in learning.

Learning in schools teaches students to know the knowledge that has been compiled in the curriculum materials and teaching materials that are available. The material makes the students simply accept without critical thinking to seek and develop the thoughts they have built from the learned learning. A journey to developing critical thinking starts with having good understanding of what it is ( LeFebre, 2011: 2).

According to Paul & Elder (2005), critical thinking is a way for a person to improve the quality of thinking through the systematic technique of thinking and generating intellectual thought in ideas that are conceived. Critical thinking skills are essential abilities for life, work, and functioning effectively in all other aspects of life. The research and the various opinions about it, has been the topic of conversation in the last ten years (Patrick, 2000: 1). Critical thinking is very important in the 21st

century because in this era one must respond to change quickly and effectively, requiring flexible intellectual skills, the ability to analyze information, and integrate various sources of knowledge to solve the problem (problem solving).

Problem Based Learning (PBL) method is a teaching method that encourages students to seek and solve problems (Wiryan, 2001: 270). PBL helps students develop their thinking skills and problem-solving skills (Ibrahim & Nur, 2005). Bern & Erickson (2001: 5) explain that PBL also provide problem-solving skills and thinking skills, learn the role of authentic adults and become self-sufficient learners.

Independence is when a person wants and is able to manifest his/ her desire which is seen in action/ real action to produce something ( goods/ service) for the sake of fulfilling the needs of his life and his neighbor ( Antonius, 2002). Understanding learning by Slavin ( Anni, 2004) is a process of acquiring skills derived from experience. According to Gagne ( Anni, 2004), learning is a system in which there are various elements that are interrelated so as to produce behavioral changes. The Understanding of Independence Learning by Gibbons ( 2002) is an increase in the knowledge, ability, or development of individuals in which individuals choose and define their own goals in learning, as well as trying to use methods that support its activities.

Characteristics of Learning Independence According Thoha (1996) are as follows: a) Able to think critically, creatively and innovatively. b) Not easily influenced by the opinions of others. c) Does not run or avoid problems. d) Solve problems with deep thinking. e) When encountering a problem solved itself without asking someone else for help. f) Do not feel inferior when it must be different from others. g) Trying to work with diligence and discipline. h) Responsible for his own actions.

Learning media that can guide students to become actively learn independently, one of which is the module (Purwanto, 2007: 23). The module is also called the media for self-study

because it has been equipped with instructions for self-study. That is, the reader can do learning activities without the presence of teachers directly. The language, pattern, and other complementary properties contained in the module are arranged so that the module is the language of the teacher or the language of the teacher teaching the students (Diktendik, 2008: 3). Supardi (2011) states that to produce a good module then the arrangement must be in accordance with the criteria set, one of which is self instructional which means able to make independent learners, where one of the characters contained in the instructional self is contextual that the materials presented related to the atmosphere or context of the task and environment of its users.

In order to demonstrate the effect of PBL-based module implementation on critical thinking skills and student learning independence, it is necessary to compare with the usual lecture and discussion models. The formulation of the problem to be solved in this research is whether the application of PBL based module affect the level of critical thinking skills and student learning independence. The purpose of this research is to know whether there is influence of PBL based module application to critical thinking skill and student learning independence related to chemical reaction rate material.

## **METHODS**

This research was conducted at Ahmad Yani Islamic Senior High School in Batang District from October to November 2017 at the rate of chemical reaction. The subjects of this study are students of class XI SMA Islam Ahmad Yani Batang in the academic year 2017/2018. Sampling is done by using purposive sampling technique. The data collection model is done by documentation model, test, and questionnaire.

The research instruments used are critical thinking skill assessment, self study independence questionnaire, and student response questionnaire. The independent

variables in this research are the application of PBL based module in the experimental class and the application of learning with the lecture model in the control class. The dependent variable in this research is the critical thinking skill and the level of student's learning independence. Data on the results of critical thinking skills is obtained through a written test at the end of the learning process. Control variables in this study are curriculum, same teacher, chemical calculation material, and the same number of hours of study.

Data analysis was done by qualitative and quantitative analysis. Qualitative analysis is used to analyze the level of student's learning independence. Quantitative analysis to analyze students' critical thinking skills with hypothesis test consist of: (1) Test of difference of two mean of two parties, (2) Analysis of influence between variables and (3) Determination of coefficient Determination. The data used for the initial data analysis is the value of UAS Semester of students of class XI. Homogeneity test to determine the uniformity or variance of samples taken from the same population. Determination of the sample in this study was done by cluster random sampling technique. The sample used is the experimental class class with the number of students 28 and the control class with the number of students 29 students. The learning in the experimental class uses PBL and control class modules using conventional learning. The conventional learning model is also called the lecture model, since it has been used as a means of oral communication between teachers and students in the learning and learning process (Isjoni & Ismail, 2012).

Posttest data is taken at the last meeting of learning activities. Posttest activity is used to know the knowledge of students after getting treatment (Nasution, 2006). Problem posttest has been determined index of difficulty, validity, and reliability of the problem.

## **RESULTS AND DISCUSSION**

Analysis of pretest and posttest data of critical thinking skill obtained by mean of pre

test value of student of sample class which did not differ significantly. This indicates that the sample departs from the same state. Analysis of post test data of students' critical thinking skill in each class showed significant difference. Aspects assessed in this study are students' critical thinking skills and learning independence. Critical thinking skills are measured using posttest problems. Post test data on each indicator of critical thinking skill of experiment and control class students is presented in Table 1.

Based on the average comparison test with the help of software R using Student's t Test and 5% significant level obtained that the value of p-value = 0.038 less than 0.05 which means that H0 is rejected, so it can be concluded that the average students' critical chemical thinking skills taught PBL-based modules are better than the average students' critical chemical thinking skills taught by direct learning models. Quantitative analysis of learning comprehension test obtained by mean of experiment class

learning result is 77,49 with 25 complete student from 28 students and control class have average 73,62 with 22 students complete from 29 students. Overall the value of students studying with PBL-based Modules gets a better grade. Because according to PBL according to (Duncan & Al-Nakeeb, 2006) is a learning environment that embodies some of the principles that enhance active learning, work in groups, and get fast feedback.

PBL encourages students to learn the basic principles of problem solving, the problems that are used are real problems that students often encounter in everyday life. Duch et al. (2001); acknowledge that; PBL is a pedagogical strategy that challenges students to 'learn to learn', as they work cooperatively in small groups to find answers to real-world problems. It is generally accepted that PBLs make students think critically and analytically, and also to seek and use appropriate learning resources (Duch et al., 2001).

**Table 1.** Post test scores on Student Critical Thinking Skills Indicators

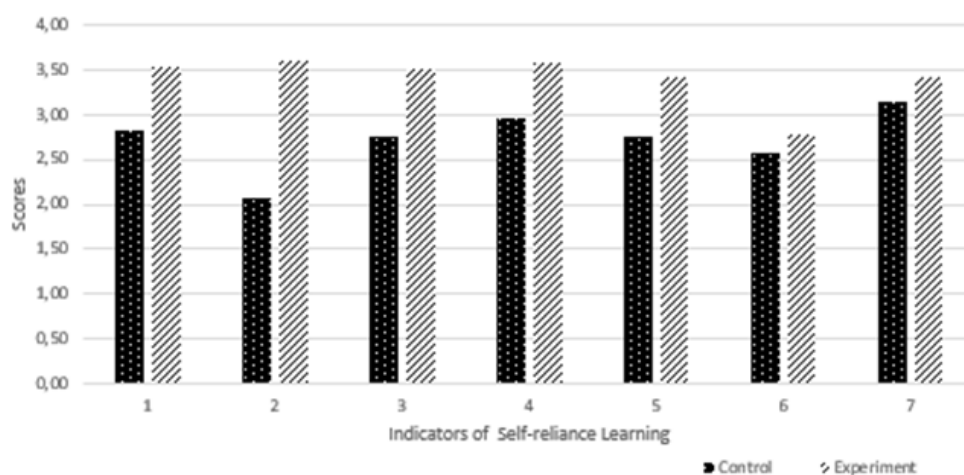
Class	Indicators				Average scores
	Provide Simple Explanation	Provide futher explanation	Make Interference	Make strategies and tactics	
	Experiment	16,79	32,32	16,39	
Control	15,24	29,07	15,90	25,90	73,62

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The next test is hypothesis testing. To test the hypothesis, to know the influence and magnitude of the effect of PBL based Module on the ability of critical thinking with biserial correlation coefficient ( $r_b$ ) and coefficient of determination (KD). Based on the calculation obtained the coefficient of determination (KD) learning results of 14.32%. The application of PBL-based module requires students to be able to analyze the problems they find in the module and to discuss to find the solution of the problem, so as to improve students' critical thinking skills.

PBL also develops critical reflection skills in students' collaborative interactions. In addition, intrinsically interesting issues will spur discussion among members of PBL groups, as they assume responsibility for formulating problems, determining core learning materials, and selecting, collecting, and valuing information and ideas in group discussions (Hung, 2006). Graph data Post test scores critical thinking skills of experimental class students and controls are shown in Figure 1.



Indicators :

1. Students learn first before studying chemistry subject matter in school.
2. Students solve the PBL problem by searching for my own chemistry learning materials that I will study.
3. Students am looking for material from various learning sources to solve the PBL problem.
4. If there is a problem or a difficult task, students try to solve myself without asking for help from others.
5. If the subject matter students have not understood, they will try to find and review the library books to help understand.
6. Students will take the initiative to ask if there are problems / subject matter that I have not understood to friends / teachers.
7. Students am active in discussions in doing group work.

**Figure 1.** Post test scores of students' critical thinking skills

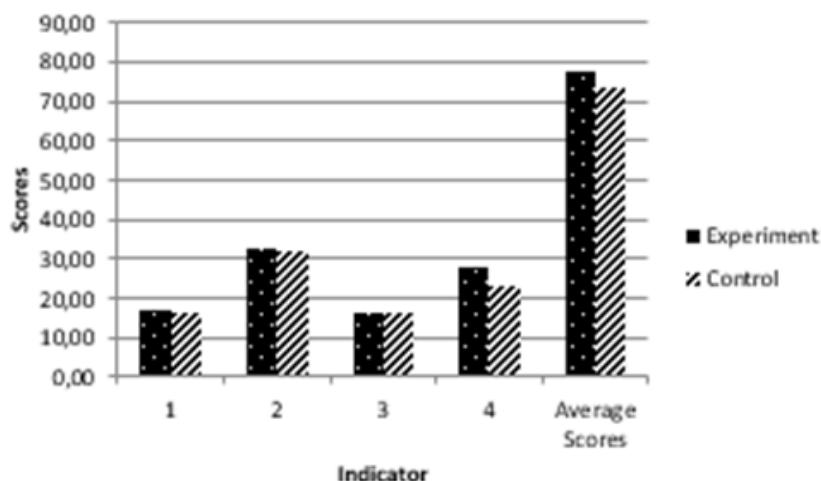
The mean posttest value of critical thinking skills indicates a higher experimental class than a control class. The module developed applying the PBL model presents the problem as the context and driving force for students to learn to solve problems (Kurniawati & Amarlita, 2013). Some researchers around the world are doing research in all aspects of education to ensure the effectiveness of PBL in building the

skills of learners (Barsky, Catanac., & Stout, 2002; Braun, 2004; Brodie & Irving, 2007; Celuch & Slama, 1999; Iwaoka, Li, & Rhee, 2010; Kumar & Natarajan, 2007; Masek & Yamin, 2012; Snyder & Snyder, 2008), and all results indicate supportive of PBL effectiveness towards critical thinking skills.

The level of student learning independence is measured by spreading the

questionnaire. Questionnaire of learning independence is aimed to find out how high the level of students' learning independence in following the chemistry learning activity on the material of the reaction rate between the control class and the experimental class using the PBL-based Module applied in this research. In this

questionnaire there are 7 statements filled with students with always = SL, often = SR, sometimes = KD, and never = TP. After that it is analyzed proportionally and descriptively. The average graph of the learning independence scores is loaded in Figure 2.



Indicators :

1. Provide Simple Explanation.
2. Provide further explanation.
3. Make Interference.
4. Make strategies and tactics.

**Figure 2.** Average independence learning scores

The result of the questionnaire analysis of students' overall autonomy showed that the experimental class that applied the learning with the PBL-based module had a better level of learning independence than the control class implementing the PBL without using the module. This is in accordance with research Budiono (2006) concluded that the learning module he compiled to improve student achievement and student learning independence. In his research Tahar (2006) concluded that the higher the attitude of one's morbidity of learning, it will be possible to achieve high learning outcomes.

Based on the research that has been done, the application of PBL-based module has advantages that are: (1) create a more pleasant atmosphere of learning chemistry because the implementation of PBL-based module involves

students directly to actively engage in finding answers to problems and communication among students is more common in learning, (2) can improve students' critical thinking skills because in learning PBL-based module to make student's attention centered on learning, easier to remember and motivated to actively learn from the module provided, (3) facilitate students in solving problems because in the application of module-based PBL students are required to solve problems because in this method the students exchange information in solving the problem. This suggests that modules developed using the PBL model can attract students' interest in learning the material, in line with the PBL's goal of making learning more effective and student-centered (Strobel & Barneveld, 2009).

Other research revealed that; PBL is also effective in several learning domains, such as

knowledge acquisition (Bilgin, Senocak, & Sozibilir, 2009; Dehkordi & Heydarnejad, 2008), critical thinking skills (Sùendaq & Odabasi, 2009), enhanced independent learning skills (Du, 2006; Hmelo & Evensen, 2000), and motivation (Martin, West, & Bill, 2008). Many researchers have highlighted it; PBLs can also promote an in-depth approach to learning, not a surface approach and thereby increase institutional benefits (Biggs, 2003); increase metacognition ability (Haryani et al., 2017); enhance the creative thinking skills (Nuswawati & Taufiq, 2015; Nuswawati et al., 2017; Nuswawati, 2018), enhance active learning (De Graaff & Cowdroy, 1997; Du, 2006); enhance consideration of interdisciplinary knowledge and skills (De Graaf & Kolmos, 2003); developing management skills, collaboration and communication (Du, 2006; Kolmos, 1996, 2002); developing professional identity and responsibility development (Du, 2006; Hmelo & Evensen, 2000; Kolmos, 2010); and improve the meaningfulness of learning (Du, 2006).

## CONCLUSION

From the results of research that has been done can be concluded that the PBL-based module gives a positive effect of 14.32% on critical thinking skills of students content reaction rate and positively affect student independence.

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