Unnes.J.Biol.Educ. 9 (3) (2020)

Journal of Biology Education

http://journal.unnes.ac.id/sju/index.php/ujbe

Improving Critical Thinking Skills and Natural Sciences Learning Achievement Through the Implementation of Problem-Based Learning Model at The IXA Grade of Junior High School 21 Semarang

Rachayuni[1]

[1] Junior High School 21 Semarang, Indonesia

Article Info

Article History:
Received: April 2020
Accepted: June 2020
Published: December 2020

Keywords:
Critical thinking, Learning achievement, and Problem-Based Learning

Abstract

This study aimed to determine the effectiveness of the implementation of problem-based learning model to improve critical thinking skills and Natural Sciences learning achievement in soil material. This study was classroom action research. The subject of the study was students at the IXA grade of Junior High School 21 Semarang in the academic year of 2018-2019. This class action research was conducted into 2 cycles, each cycle had 2 meetings. The stages of each cycle consisted of planning, taking action (acting), observing the action (observing), and analyzing the data on the results of observing the action (reflecting). The data collection technique was written test, consisting of multiple-choice tests to measure cognitive aspects and description questions to measure critical thinking skills. The data analysis of this study was a comparative descriptive technique, followed by a critical analysis of comparative descriptive results by reflecting. The result of this study showed that the implementation of problem-based learning model can improve critical thinking skills and natural science learning achievement at the IXA grade of Junior High School 21 Semarang in the academic year of 2018-2019 in soil material. This can be seen from the achievement of critical thinking skills that have increased from pre-cycle, cycle 1 and cycle 2. The average result of critical thinking skills achieved in the pre-cycle was70.83, at the end of cycle 1 was 79.86, and at the end of cycle 2 was 86.76. The lowest value of critical thinking skills in the pre-cycle was 54.00, at the end of cycle 1 was 65.00, and at the end of cycle 2 was 73.00. The highest value of critical thinking skills in the pre-cycle was 80.00, at the end of cycle 1 was 87.00, and at the end of cycle 2 was 93.00. The cognitive aspect of learning achievement achieved in pre-cycle with the lowest value was 52.00, in cycle 1 was 60.00, and in cycle 2 increased to 68.00. The highest pre-cycle value was 88.00, cycle 1 was 92.00, then cycle 2 increased to 96.00. The average grade in the pre-cycle was 74.07, in cycle 1 increased to 79.72, and cycle 2 increased to 84.97. The number of students who scored at least 75 in the pre-cycle was 72.4%, cycle 1 was 79.3% and cycle 2 was 93.1%.

Correspondence Address:
Jl Kalipepe III No. 16, Pudak Payung, Semarang
E-mail: rachayuni767@gmail.com

p-ISSN 2252-6579
e-ISSN 2540-833X

INTRODUCTION

The 21st-century learning emphasizes the learners' active roles in establishing the goal that aims to the whole activity during the learning process (BSNP, 2010). It is different than the past system: student-centered learning and the learning that needs references to aim the goals. The thinking and learning skills should be possessed by the learners.

The 21st-century learning is aimed to prepare the learners acquire 21st-century skills as follows: ways of thinking, ways of communicating, ways of working, tools for working, skill for living in the world. In order to prepare the learners to acquire the skills as required, the learning itself should provide them the chances to build creativity, critical thinking, problem solving, communication and collaboration.

The characteristics of science learning based on Illahi (2012) are as follows: 1) the learners actively participate in a science-based activity which reflects scientific method and process skill; 2) the learners are encouraged to do activity that deals with problem-solving; 3) the learners are taken into learning by doing and they can reflect it later; 4) the use of various learning models that aims the learners to understand the product and learning material through reading and writing activity.

Here is what happens in science learning at State Junior High School 21 Semarang: the learners commonly actively participate, but they are low at problem-solving and critical thinking skills. This is because the learners are not used to think, to concern, and to seek any solutions for the problems. When they are given a question, there is an answer as same as available on the book. The cognitive-based learning does not support the learners enough to solve problems which need a high understanding level such finding solution for the problems around them. This is showed by the result of the Pre Cycle critical thinking test, only 62,06% reach the Minimum Criteria of Mastery Learning (75,00 considered as the minimal level). This fact clarifies that rote learning and collecting information will only bring learners to theoretically smart but they are less applicable. It is followed by the low result for science on the biotechnology lesson. There are only 72,41% learners reach 75 (Minimum Criteria of Mastery Learning).

The goals of science learning as required by Standar Isi Departemen Pendidikan Nasional (2006) are to develop the comprehension of science concept and principal which is beneficial and applicable for the daily life; to spread the curiosity, to implement scientific inquiry in order to build the scientific thinking, attitude, and activity and to bring them into communication as well. Developing thinking skill should reach critical thinking skill. The critical thinking skill is a skill to find out information, to analyze the fact resulted in idea to make a logical-right-must-to-do decision.

Critical thinking is the ability of thinking in digging up information, analyzing facts, and generating ideas to make logical, correct and necessary decisions to find solutions to solve problems. Critical thinking skills can be trained through science learning, namely by providing a stimulus in the form of problems that are directly related to life to find solutions (Moore & Parker, 2009). According to Johnson (2007), critical thinking skills can be trained through scientific work to solve problems. Based on Johnson (2007), the steps to build critical thinking are as follows: 1) defining the problem, 2) establishing the objective point of view from the problem, 3) desemesterining the right reason for a discussed issue, 4) breaking assumptions that can lower the argument, 5) using a clear language, 6) having accurate evidence to give a reason, 7) thinking of a right decision, 8) seeking an indication from the conclusion to avoid bad things that happened during the decision-making. Critical thinking in this study is related to the ability of students to define problems that occur related to the role of land for life, skills to explore problems by compiling hypotheses, the ability to gather information, dig facts and generate ideas to obtain solutions to solve problems.

Problem-Based Learning method is aimed to bring the learners to be able to deal with the issues happened daily and to give them the experience so that they can develop their critical thinking skill. This is as Fakriyah (2014) stated that the learners increase their critical thinking skills as they are used to analyze various problems with Problem-Based Learning. Yatim (2009) stated that *Problem-Based Learning* helps the learners to actively and independently develop their critical thinking skills for a problem-solving through information seeking to find a rational and authentic solution. Problem-Based Learning highlights the high- order thinking skills in which a teacher helps the learners to decide on what they want to acquire.

Rusman (2010) stated the steps of Problem-Based Learning are as follows: 1) formulating problem that will be solved, 2) analyzing the problem to critically analyze using various points of view, 3) formulating hypothesis (to formulate problem-solving based on what the learners know), 4) collecting data (to seek information to solve the problem), 5) doing a verification (to formulate conclusion as the accepted and rejected hypothesis), 6) formulating problem-solving recommendation (illustrating the result of hypothesis clarification and the result of conclusion).

Sanjaya (2010) stated the excellence of Problem-Based Learning are as follows: 1) Problem-Based Learning is a good technique to understand the materials within the learning, 2) Problem-Based Learning can stimulate the learners to discover a piece of new knowledge, 3) Problem-Based Learning can improve learners' activities, 4) Problem-Based Learning can help learners to implement the knowledge that they know to their daily lives, 5) Problem-Based Learning can advance learners' knowledge as being the self-evaluation towards the learning result or process, 6) Problem-Based Learning helps the learners to improve their thinking skills while they are facing something, 7) Problem-Based Learning develops the critical thinking skills and skills to adapt with the new knowledge, 8) Problem-Based Learning gives the learners chances to apply their knowledge into their real lives, 9) Problem-Based Learning enhances learners' interest. This research aims 1) to improve the critical thinking skills of IXA graders in the 2nd semester on Academic Year 2018-2019 at State Junior High School 21 Semarang through implementing Problem-Based Learning and 2) to increase the science learning result of IXA graders in the 2nd semester on Academic Year 2018-2019 at Semarang State Junior High School 21 Semarang through implementing Problem-Based Learning.

RESEARCH METHOD

This research was a classroom action research that took place at Semarang State Junior High School 21 on Academic Year 2018-2019 from January to April 2019. Classroom action research according to Arikunto (2006), consists of four activities carried out in a repetitive cycle. Activities in each cycle include: a) planning, b) implementing actions, c) observing, and d) reflecting. The Classroom Action Research Process can be seen in Figure 1

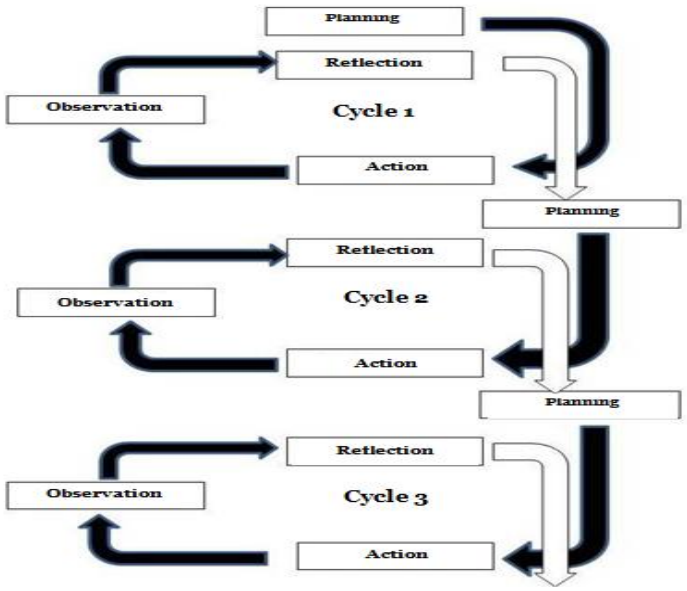

Figure 1. The classroom action research process

This study aims to improve critical thinking skills and science learning outcomes for class IXA at SMP Negeri 21 Semarang in the second semester of the 2018-2019 academic year through the application of a problem-based learning. This research will stop when the success indicators of this research are achieved at least 80% of all students reach the predetermined KKM which is 75 and there is an increase in critical thinking skills in each cycle. The research implementation plan is as follows:

1. Cycle 1
   a. Planning, at this stage the activities are compiling a lesson plan implementation, worksheets with material on the role of soil for life for the first meeting and material on the physical properties of soil for the second meeting, preparing learning media that support the material, compiling an analysis sheet of students' critical thinking skills , and prepare evaluation questions that are used at the end of the cycle as an indicator of success.
   b. Implementation of action, is the stage of implementing the planning that has been done before. Learning activities are carried out in groups, using a problem-based learning model with direct

observation in the environment. Cycle 1 ended with the implementation of a formative test. The implementation of the action is displayed in the form of notes from analysis of critical thinking skills and student learning outcomes.

c. Observation, carried out to determine the process of implementing learning in class related to the activities of students. The events that arise during the implementation of learning in the classroom are evaluated and the problems that arise are used as material for reflection.
d. Reflection, at this stage the results of observations and evaluations are analyzed as reflection material which will be used in determining improvements in the next learning cycle. This aims to make improvements in the next cycle. The improvements made were to change the groups evenly based on the results of the analysis.

2. Cycle 2
   a. Planning, rearranging learning tools is carried out by paying attention to the results of the reflection of the previous cycle in the form of revision of the lesson plan, compiling student worksheets with material on the role of plants in preventing erosion, and material identifying soil constituent components for the second meeting, and preparing evaluation questions used at the end of the cycle. as an indicator of success.
   b. The implementation of the action, the implementation of learning is adjusted to the results of the reflections that have been carried out in the previous cycle. Learning activities are carried out according to the planning that has been done before using a problem-based learning model with direct observation methods in the environment. The learning implementation ends with a formative test at the end of cycle 2.. The implementation of the action is displayed in the form of notes on the results of the analysis of critical thinking skills and student learning outcomes.
   c. Observation, carried out to determine the process of implementing learning in the classroom related to the activities of teachers and students. The events that occur during classroom learning are evaluated and the problems that arise are used as material for reflection.
   d. Reflection, the results of the observations are analyzed which will then be used as a reflection which will be used in determining improvements in the next learning cycle. This aims to make improvements in the next cycle.

RESULTS AND DISCUSSION

The Early Condition

Pre-cycle learning on the science used lecture method and discussion group. This was done before a classroom-action. The teacher presented the material using a power-point presentation and gave the learners essay about the problems in implementing biotechnology later. The pre-cycle critical thinking test result showed there were only 62,06% of the learners who reached the Minimum Criteria of Mastery Learning (75). The pre-cycle learning result was still low as well. The highest score was 88. The lowest score was 52.
The average is 74,07. Mostly learners got 76. There were only 21 learners or only 72,4% reached the Minimum Criteria of Mastery Learning.

Cycle 1

Learning cycle 1 is carried out based on problem-based learning stages and refers to the lesson plan. Aims to improve critical thinking skills through scientific work through problem-based learning. The average value of critical thinking skills achievement in cycle 1 meeting 1 was 76.17, cycle 1 meeting 2 obtained an average value of 79.86 critical thinking skills, The highest value of critical thinking skills in cycle 1 meeting 1 84.00, cycle 1 meeting 2 87.00, and the lowest value in cycle 1 meeting 1 60.00, cycle 1 meeting 2 65.00. This means that the average value of achieving critical thinking skills has increased.

The learning result increased in cycle 1. The highest score was 92. The lowest score was 60. The average score of the class was 79,72. There were 23 learners or 79,31% reached the Minimum Criteria of Mastery Learning. Based on the result achieved in cycle 1, it was affirmed that the learning result on the cognitive aspect did not fit the indicator (no less than 80% of the IXA graders in the 2nd semester on Academic Year 2018-2019 achieved the Minimum Criteria of Mastery Learning (75). Thus, it was decided to continue on the cycle 2 with giving an action improvement.

Cycle 2

The average value of the achievement of critical thinking skills in cycle 2 meeting 1 is 83.41, cycle 2 meeting 2 becomes 86.83, the highest value in cycle 2 meeting 1 is 90.00, cycle 2 meeting 2 is 93, 00.00, and the lowest value in cycle 2 meeting 1 was 67.00, cycle 2 meeting 2 was 73.00. This means that the average value of thinking skills achievement has increased. The increase in critical learning outcomes that students can achieve at meetings is a result of habit and continuous practice to define problems, explore problems by compiling information, information that can be learned and practice, to generate facts and generate ideas to get solutions to solve problems. This is in accordance with the opinion of Johnson (2007) and Moore & Parker (2009) who say that students' critical thinking skills can be calculated through scientific work by providing a stimulus in the form of a problem to find a solution.

Based on the result, affirmed that cycle 2 was successful since the learners' critical thinking skills and learning results achieved the indicator (critical thinking skills increased in every cycle. There were no less than 80% of the learners in the 2nd semester on Academic Year 2018-2019 at State Junior High School 21 Semarang achieved the Minimum Criteria of Mastery Learning (75).

The implementation of Problem-Based Learning in critical thinking skills

The indicator of the achievement of critical thinking skills specified in this study is an increase in critical thinking skills in each cycle. The improvement of pre-cycle critical thinking skills, the end of cycle 1, and the end of cycle 2 can be seen in Figure 2.

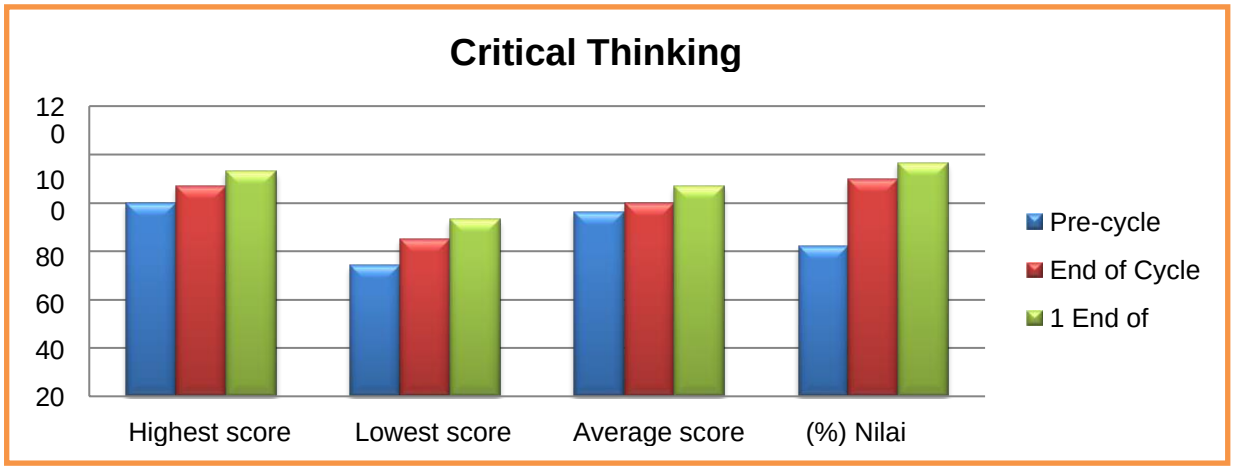

Figure 2. The learners' critical thinking skills in pre-cycle, end of cycle 1, and end of cycle 2.

Critical thinking skills consist of the ability of students to define problems, the skills to explore problems by compiling hypotheses, the ability to gather information, analyze facts and generate ideas to obtain solutions in problem solving, and the ability to apply solutions. Critical thinking skills analysis data is obtained through analysis of critical thinking skills based on student worksheets that have been adjusted to the scores of each critical thinking indicator. The results of data analysis are then presented descriptively. According to Ngalim (1994), the criteria for assessing critical thinking skills are as follows:

Table 1. Criteria for Critical Thinking Skills Assessment

score	criteria
≤ 54	Very less
55-59	Less
60-75	Moderate
76-85	Good
86-100	Very good

Based on Figure 2, the highest achievement of critical thinking skills in pre-cycle was 80.00, the final cycle 1 was 87.00, and at the end of the second cycle was 93.00. The average value of the critical skills class in pre-cycle was 76.17, the final cycle 1 was 79.86, and the end cycle 2 was 86.83. The lowest score of critical thinking skills in pre-cycle is 54.00, the final cycle 1 was 65.00, and 73.00 at the end of cycle 2. The number of students who obtained a critical thinking skill score of 75 ≤ in pre-cycle 62.06%, the end of cycle 1 was 89.66%, and there was 96.55% at the end of cycle 2. Based on the results achieved, cycle 2 is declared successful because it has reached the predetermined indicators. This is because learning activities use a Problem Based Learning model that brings students into real problems in everyday life, and helps their thinking skills. looking for data so that the solution to the problem is obtained rationally and authentically.

This is in accordance with Sohimin (2014) statement, that Problem Based Learning is able to train students to think critically, train students to apply knowledge to build solutions for problem solving. Rusman (2010) states that learning using the Problem Based Learning model involves students identifying problems, looking for information to obtain data so that solutions are obtained to solve problems. Problem Based Learning learning model will improve critical thinking skills along with the habits of students to analyze problems and find problem solving solutions. So it is clear, the application of Problem Based Learning model learning can improve critical thinking skills.

The implementation of Problem-Based Learning in learning results

The improvement of learning outcomes in pre-cycle cognitive aspects, the end of cycle 1, and the end of cycle 2 can be seen in Figure 3.

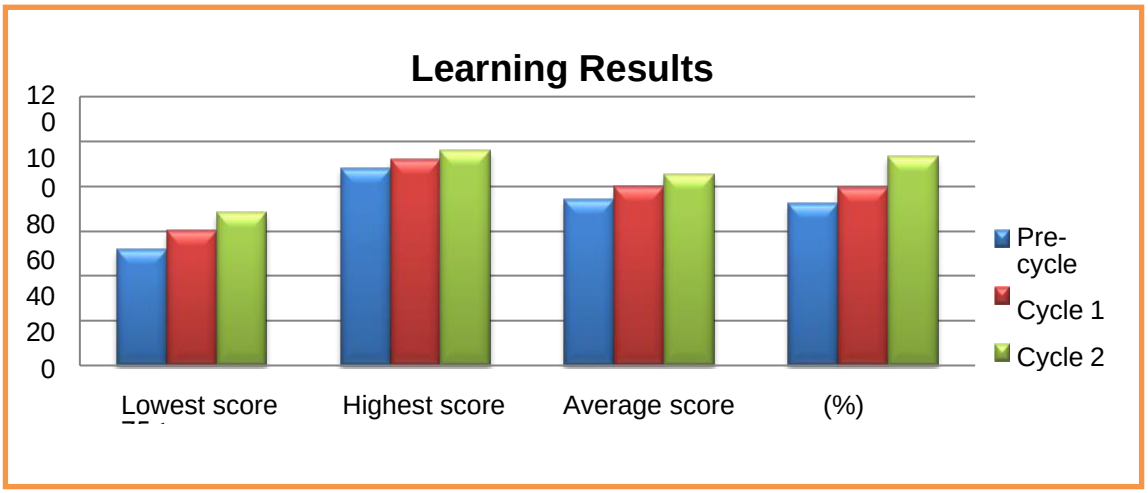

Figure 3. Learners' learning results of cognitive aspect in pre-cycle, end of cycle 1, and end of cycle 2.

The increase in learning outcomes to be achieved through problem-based learning in this study is the cognitive aspect of learning outcomes. The data on the cognitive aspects of learning outcomes were obtained from the results of formative tests in each cycle. Formative tests are arranged based on the learning objectives to be achieved.

Based on Figure 3. The lowest value of learning outcomes in pre-cycle is 52.00, in cycle 1 it is 60.00, and cycle 2 is 68.00. The highest value of learning outcomes in pre-cycle was 88.00, in cycle 1 was 92.00, and 96.00 in cycle 2. The class average value in pre-cycle was 74.07, cycle 1 was 79.72, and cycle 2 was 84.97. The number of students who achieved a learning outcome value of 75 ≤ in the pre-cycle was 72.41%, cycle 1 was 79.31%, and there were 93.10% in cycle 2.

Based on the achievements of cycle 2 on the cognitive aspects of learning outcomes, it shows that the indicators set have been exceeded because students who have reached the minimum completeness is 93.10% which is more than 80%. This is because problem-based learning is contextual and applied learning. Learning invites students to make direct observations so that their knowledge is obtained independently. According to Hanafiah & Suhana (2010), the knowledge obtained independently strengthens the knowledge acquired by students and will ultimately improve learning outcomes.

CONCLUSION

1. Problem-Based Learning can improve learners' critical skills regarding solid materials in the 2nd semester on

Academic Year 2018-2019 at State Junior High School 21 Semarang
2. Problem-Based Learning can improve learning results regarding solid materials of IXA graders in the 2nd semester on Academic Year 2018-2019.
3. Scientific activities can be a media to train critical thinking skills to develop a problem-solving.

REFERENCES

Arikunto, S., Suhardjono, & Supardi. 2006. *Penelitian Tindakan Kelas*. Jakarta: Bumi Aksara

Asriningtyas, A. N., Kristin, F., & Nugraheni, I. 2018. Penerapan Model Pembelajaran Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil Belajar Matematika Siswa Kelas 4 SD . *Jurnal Ilmiah Pendidikan Matematika*, 3(1): 1-10.

Badan Standar Nasional Pendidikan (BSNP). 2006. *Panduan Penyusun Kurikulum Tingkat Satuan Pendidikan Jenjang Pendidikan Dasar dan Menengah*. Jakarta: Depdiknas.

Badan Standar Nasional Pendidikan (BSNP). 2010. *Paradigma Pendidikan Nasional abad XXI*. Jakarta: Depdiknas

Chairani, R. P & Muchlis . 2019. Penerapan Model Pembelajaran Berbasis Masalah untuk Melatihkan Kemampuan Berpikir Kritis Peserta Didik pada Materi Larutan Penyangga Kelas XI di MAN I Sidoarjo. *UNESA Journal of Chemical Education*, 8(1): 16-21.

Fakriyah, R. 2014. Penerapan Problem Based Learning dalam Upaya Mengembangkan Kemampuan Berpikir Kritis Mahasiswa. *Jurnal Pendidikan IPA Indonesia*, 3(1): 95-101.

Hanafiah, N. & Suhana, C. 2010. Konsep Strategi Pembelajaran. Bandung: Aditama

Hartati, R & Sholihin, H. 2015. Meningkatkan Kemampuan Berpikir Kritis Siswa Melalui Implementasi Model Problem Based Learning (PBL) pada Pembelajaran IPA Terpadu Siswa SMP. *Prosiding Simposium Nasional Inovasi dan Pembelajaran Sains (SNIPS 2015) 8 dan 9 Juni 2015,* Bandung, Indonesia. 1-5.

Illahi, M.T. 2012. *Pembelajaran Discovery Strategy & Mental Vocational Skill*. Yogyakarta: Diva Press. Johnson, E.

B. 2007. *Contextual Teaching and Learning*. Terjemahan Juwiriyah Dahlan. Bandung: MLC.

Moore, B. N. & Parker, R. 2009. *Critical Thinking*. New York: McGraw-Hill Co.Inc

Purwanto, M. Ngalim.1994. Prinsi-prinsip dan Teknik Evaluasi. Bandung: Remaja Rosdakarya

Rusman. 2010. *Model- model Pembelajaran Mengembangkan Profesionalisme Guru*. Jakarta: Rajawali Press.

Sanjaya, W. 2010. *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: Kencana Prenada Media Group.

Sohimin, A. 2014. 68 Model Pembelajaran Inovatif Kurikulum 2013. Jakarta: Gramedia

Yatim, R. 2009. *Paradigma Baru Pembelajaran*. Jakarta: Kencana Prena