

The Effectiveness of Learning Design Based on Problem Based Learning Model Oriented Mathematical Critical Thinking Skills of Fifth Grade in Elementary School

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Abstract

This research is based on the low critical thinking skills shown by the low learning outcomes of students. The purpose of this study was to determine the effectiveness of learning design models based on Problem Based Learning in improving mathematical critical thinking skills of fifth-grade students in elementary schools. The research method used was quasi-experimental with a qualitative approach. The study population was all fifth-grade students of Elementary Schools in group 3 in Region II GedongTataan, Pesawaran. The research sample has 55 students and consisted of the fifth-grade student of Public Elementary School 5 GedongTataan as many as 27 students as the experimental class and the fifth-grade students of Public Elementary School 28 GedongTataan as many as 28 people as a control class. Data collection was carried out through a questionnaire and test of learning outcomes. Data analysis was performed using the acquisition of N-Gain. The results showed that the learning design based on the Problem Based Learning model was effective to improve students' mathematical critical thinking skills with the acquisition of N-Gain of 0.49.

Keywords: Learning Design, Critical Thinking Skills, Problem Based Learning.

DOI: 10.7176/JEP/11-27-11

Publication date: September 30th 2020

I. INTRODUCTION

Education reform currently leads to the industrial era 4.0 and the demands of the development of the 21st century (partnership for 21st-century skills). The National Education Association (2012:7) argues that there are 4 skills and innovations needed in the 21st century, that are critical thinking skills, creativity, collaboration skills, and communication skills.

Teachers as the spearhead of education must be able to realize learning that encourages students to engage in critical thinking. Critical thinking skills are needed by students to solve problems and make decisions in the learning process. Crawford (2005: 4) successful learning encourages students to think independently and engage in critical thinking. Germaine (2016) critical thinking means reasoning effectively, recognizing connections among systems, concepts, and disciplines to solve problems and make decisions.

Learning design designed and implemented by the teacher will play a central role in the success of 21st-century learning. Dick and Carey in Mudlofir (2017: 33) learning design covers the entire system approach consisting of analysis, design, development, implementation, and evaluation.

The research problem is the learning design that developed and implemented by the teacher has not yet led to a learning process that emphasizes critical thinking skills. The learning scenario tends to be a teacher center, so the teacher has not been able to develop ideas and critical ideas of students in learning. This affects the low critical thinking skills and achievement of students' mathematics learning outcomes.

The learning model that supports the development of critical thinking skills in students is Problem Based Learning. Raiyn, Jamal, & Tilchin Oleg (2015) Effective Problem Based Learning to develop High Order Thinking Skills and collaborative skills in students. Kumar, R, & Refaei, B. (2017) Students' critical thinking increases with the use of the Problem Based Learning model. This study aims to examine the effectiveness of learning design based on Problem Based Learning models oriented towards mathematical critical thinking skills in the fifth grade of Elementary School.

II. LITERATURE REVIEW

2.1 Learning Design

The purpose of learning design is that learning is conducive and meaningful for students. Sanjaya (2017: 66) learning design is a systematic process for solving learning problems through planning learning materials and activities that must be carried out, planning learning resources that can be used as well as planning evaluation of success. Hamdani (2011: 74) learning design is related to the understanding, improvement, and application of appropriate learning methods to produce the desired changes in students relating to knowledge and skills by the content of learning.

That is the design of learning about the development of the learning process that includes the formulation of

objectives to be achieved, strategies that can be implemented, and evaluation techniques to measure success.

2.2 High Order Thinking skills

The process of solving a problem requires critical thinking skills to process facts into a conclusion. Tomei in Sani (2019: 2) High Order Thinking skills include the transformation of information and ideas through the process of analyzing, synthesizing, or combining facts and ideas, generalizing, explaining, or arriving at a conclusion or interpretation. Stenberg & Lubart in Helmawati (2019: 133) High Order Thinking skills connect problem findings and creativity through planning activities, observation of problem development, and adjusting problem-solving strategies.

2.3 Problem Based Learning

Problem Based Learning is learning that optimizes students' thinking skills through a systematic group work process, students can empower, hone, test, and develop their thinking skills on an ongoing basis (Tan in Rusman, 2016: 229). Harvest in Rusmono (2014: 74) Problem Based Learning is a learning model that brings students involved in the learning process that requires them to identify problems, collect data, and use the data to solve problems. Arends in Mudlofir (2017: 74) Problem Based Learning syntax includes: (a) the orientation of students to the problem, (b) organizing students to learn, (c) guiding individual and group investigations, (d) developing and presenting the work,

Dina Tsybulsky & Atar Oz (2019) applying Problem Based Learning to learning is an important step, which causes students and teachers to experience success and satisfaction, develop positive attitudes towards student-centered learning, inquiry-based, and adopt some of the principles and aspects of Problem Based Learning pedagogy in pedagogical practice.

2.4 Critical Thinking Skills

Critical thinking is needed to make a decision from the problem faced. The ability to solve complex problems and make decisions based on complex situations is a high-level thinking skill (Halpern in Sani, 2019: 14). Conscience Suyomukti in Helmawati (2019: 104) critical thinking is a cognitive skill that allows a person to investigate a situation, problem, question, or phenomenon to make a judgment or decision.

Facione in Wang and Zheng (2016) classifies critical thinking skills including interpretation, analysis, evaluation, inference, explaining, and self-evaluation skills. The indicators of critical thinking skills developed by this study are as follows:

Indicators of Critical Thinking Skills	Skill Description
Interpretation	Identify or formulate a problem
Analysis	Examine ideas and identify arguments
Inference	Record the results of observations and conclude according to facts
Evaluation	Make and determine the results of an investigation

CHAPTER III. RESEARCH METHODS

The method or type of research used in this study is a quasi-experimental with a qualitative approach. The form of experiment used in this study was the pretest-posttest control group design. The design is described as follows:

Q1	Q1	X	Q2
R2	Q3		Q4

Source: Sugiyono (2017: 114)

3.1 Population

The study population was fifth-grade students in Elementary Schools in Group 3 Region II GedongTataan, Pesawaran.

3.2 Samples

The research sample is fifth-grade students of Public Elementary School 5 GedongTataan totaling 27 people as experimental class and fifth-grade students of Public Elementary School 28 GedongTataan totaling 28 people as a control class.

3.3 Data Collection Techniques

a. Test Technique

In this study, the test used is an objective test by selecting multiple-choice items that are relevant to the basic competencies and indicators that have been formulated. The test consists of an initial test (pretest) and a final test (posttest).

b. Non-Test Technique

The non-test technique used in the form of an instrument consisting of;

1) Questionnaire

The questionnaire in this study was intended for classroom teachers to explore data by the research problem.

2) Observation sheet

Observation sheets are used to observe the implementation of the learning process related to the activities or performance of teachers in implementing the learning design of High Order Thinking skills with the Problem Based Learning model.

3) Documentation

This technique is used to obtain the data needed by researchers such as notes, school records, and learning planning.

3.4 Data Analysis Techniques

To find out the increase in students' critical thinking skills, seen from the presence or absence of an increase in learning outcomes before and after using learning design based on Problem Based Learning model. From the data of the pretest-posttest scores obtained can be seen as an increase in learning outcomes (N-Gain). According to Hake (1999: 21), the magnitude of the increase is calculated by the normalized gain formula (normalized gain). Gain gains are categorized in the gain index criteria as follows:

Gain Index	Classification	Effectiveness level
$(g) \geq 0.70$	High	Very effective
$0.30 \leq (g) < 0.70$	Medium	Effective
$(g) < 0.30$	Low	No effective

IV. RESULTS AND DISCUSSION

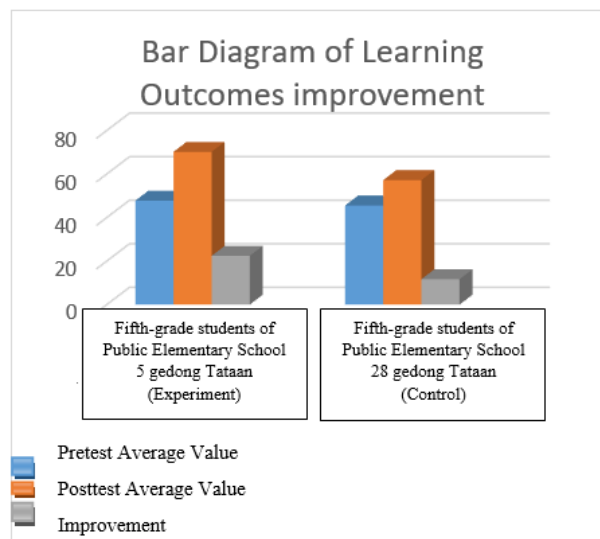
Results

Pretest implemented before the learning process takes place, both in the experimental class or the control class intending to measure the students' initial critical thinking skills. *Posttest* is held at the end of the learning process in each class, to find out whether or not there is a change/increase in students' critical thinking skills before and after using learning designs based on Problem Based Learning model. *Pretest* and *Posttest* results can be seen in the following table:

Class	Average value		Enhancement	%
	<i>Pretest</i>	<i>Posttest</i>		
Experiment Class	47.78	70.19	22.41	46.90%
Control class	45.56	57.22	11.67	25.37%

There is a difference in the improvement of learning outcomes based on the results of the pretest-posttest that has been done between the experimental class and the control class. The increase that occurred in the experimental class was greater when compared to the control class. This means that there is an increase in critical thinking skills in experimental class students after the learning process is implemented using a learning design based on Problem Based Learning models.

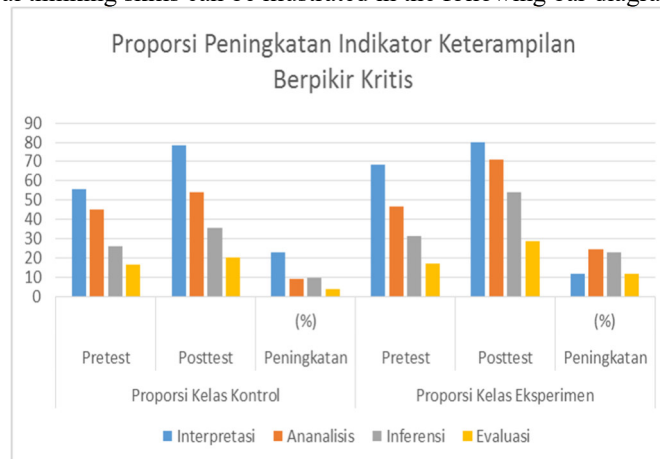
Improved learning outcomes that occur in the experimental class and control class can be seen in the following diagram:



The proportion of improvement in indicators of critical thinking skills in the experimental class and the control class can be seen in the following table:

Indicators of Critical Thinking Skills	The Proportion of Control Classes		The Proportion of Experiment Classes	
	<i>Pretest</i>	<i>Posttest</i>	<i>Pretest</i>	<i>Posttest</i>
Interpretation	55.56	78.52	68.15	80.00
Analyzes	45.19	54.07	46.67	71.11
Inference	25.93	35.56	31.11	54.07
Evaluation	16.30	20.00	17.04	28.89

An increase happens in every indicator of students' critical thinking skills. The skills of Interpretation, Analysis, Inference, and Evaluation of students in the Experiment class are better than the control class. This is because during the learning process with Problem Based Learning students in the experimental class are accustomed to solving problems in groups, by learning to identify problems, formulate problems, find solutions and conclude the results of problem-solving and evaluate them when presenting their work in front of the class. Improved students' critical thinking skills can be illustrated in the following bar diagram:



The effectiveness test is seen based on the learning outcomes obtained after the learning process using learning designs based on the Problem Based Learning model of mathematical critical thinking skills. The following are the results of the N-Gain analysis obtained based on the results of the Pretest-Posttest conducted:

No	Class	<i>N-Gain</i>
1	Experiment	0.49
2	Control	0.20

N-Gain in the experimental class is 0.49 normalized in the medium classification. That is, the level of effectiveness is in the effective category. Furthermore, the analysis carried out is to compare learning outcomes before and after learning by using a paired t-sample test (Paired t-test). Before the t-test analysis is performed, the analysis requirements test is carried out that is the data normality test. Normality test using Kolmogorov-Smirnov. The test uses the Statistical Package for the Social Sciences 25 program. The results of the normality test can be

seen in the table following:

Tests of Normality							
		Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Student Learning Outcomes	Experiment Class Pre-Test (PBL)	, 186	27	, 017	, 937	27	, 105
	Post-Test Experiment Class (PBL)	, 162	27	, 065	, 935	27	, 091
	Pre-Test Control Class (Conventional)	, 159	28	, 068	, 939	28	, 105
	Post-Test Control Class (Conventional)	, 129	28	, 200 *	, 954	28	, 244
* This is a lower bound of true significance.							
a. Lilliefors Significance Correction							

Significance value (sig.) for all data > 0.05. In the experimental class, the results of the pretest showed a value of 0.186 with a significance of 0.017, while the posttest results showed a value of 0.162 with a significance of 0.065. So, it was concluded that the research data had a normal distribution. Thus, paired sample t-tests can be performed.

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		The mean	Std. Deviation	Std. Error Mean	95% Interval of Difference	Confidence of the			
					Lower	Upper			
Pair 1	Pre_Experiment - Post Experiment	-22,407	7,890	1,518	-25,529	-19,286	-14,757	26	, 000
Pair 2	Pre_Control - Post Control	-11,786	11,802	2,230	-16,362	-7,209	-5,284	27	, 000

The calculation results obtained are as follows:

T-count that obtained is -14,757 with a significance of 0,000 < 0.05, then H₀ is rejected and H₁ is accepted.

Then it can be concluded that the design of learning based on Problem Based Learning models is effective for improving mathematical critical thinking skills of fifth-grade students in elementary schools.

DISCUSSION

Learning design based on Problem Based Learning oriented critical thinking skills containing learning scenarios that focus on learning activities in solving contextual problems with systematic Problem Based Learning steps. Learning design based on Problem Based Learning is oriented towards mathematical critical thinking skills in the fifth grade of Elementary School starting with the provision of contextual problems that are close to the environment of students. Furthermore, students are facilitated to be active in groups to identify problems, formulate problems, and solve problems to be concluded so that they produce new knowledge. The new knowledge or new work obtained is passed on to other groups for evaluation. After learning with Problem Based Learning, students become more active in learning processes and can develop critical thinking to solve problems. This learning design, by the characteristics of learning Problem Based Learning proposed by Tan in Amir (2016: 12) Learning using Problem Based Learning begins by giving problems, learners in groups actively formulate problems and identify their knowledge gaps, learn and report solutions from the problem.

The learning process that requires the habituation of students to solve and solve contextual problems makes students able to build new knowledge independently which is the result of the interaction of students with their environment. This is under the statement of Sumiati & Asra (2009: 15) which explains that learning is the process of constructing knowledge based on the experiences experienced by students as a result of their interaction with the surrounding environment.

The effectiveness of Problem Based Learning to improve students' critical thinking skills in this study, is supported by several studies that have been done before. Saputri, Arnita Cahya, et al. (2019) writing the results of the Problem Based Learning model research shows that the calculation of the average score of the acquisition of critical thinking skills in the experimental class is higher at 0.66 compared to the control class at 0.51. Research conducted by Veldez, Joseph E, Bungihan, Melfei E. (2019) to confirm the results of the study showed that: (1) the level of problem-solving skills before and after their exposure to the non-problem Based Learning approach was generally very low; (2) the level of problem-solving skills was initially very low but comparatively improved for the better after being exposed to Problem Based Learning; (3) there is a significant difference between the level of students' problem-solving skills in the Problem Based Learning group and the non-problem Based Learning approach; (4) The Problem Based Learning approach is proven to be more effective than the non-problem Based Learning approach.

V. CONCLUSION

Based on the theory and relevant research results, it can be concluded that the design of learning based on Problem Based Learning models is effective for improving students' mathematical critical thinking skills.

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