The Impact of Visual Thinking Approach to Promote Elementary Students' Problem Solving Skill in Mathemathics

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Abstract

This study aims to examine the influence of visual thinking learning to problem solving skill. Quasi experiments with the design of this non-equivalent control group involved Grade V students in one of the Elementary Schools. The design of this study was quasi experimental nonequivalent control group, the research bullet used the existing class. The results of research are: 1) improvement of problem soving skill. The learning did not differ significantly between students who received conventional learning. 2) there is no interaction between learning (visual thinking and traditional) with students' mathematical skill (upper, middle and lower) on the improvement of skill. 3) there is a difference in the skill of language learning that is being constructed with visual learning of thought in terms of student skill (top, middle and bottom).

Keywords: *Visual Thinking, Problem Solving, Primary School*

1. INTRODUCTION

Mathematics is one of the basic sciences that has a very important influence in life, because mathematics can prepare and develop students' skill to think logically, flexibly, and precisely to solve a problem that occurs in their daily lives (Fendrik, 2015: 80) So that a student is able to solve the problems he will face in everyday life.

The weakness of Indonesian students' problem-solving skill cannot only be seen from the results of the TIMSS survey in 2016, which ranked Indonesia 44th out of 49 countries. The TIMMS score obtained by Indonesia is the knowledge domain of 395 from the international average score of 505, the application domain of 397 from the international average of 505 and the reasoning domain of 397 from the international average of 504. The results of the domain Mathematical content on numeric material is 399 from the international average of 506 (TIMMS 2015). The score shows that Indonesian students are not familiar with problems that require high-level thinking such as application problems and reasoning in terms of proof of theorem, the use of mathematical reasoning to solve problems, generalizing processes, solving geometry problems, mathematical modeling. Furthermore Wardhani in Ayu Z (2017: 67) said problem solving is a

skill that needs to be taught and the teacher must work through learning problem solving skills that include four steps of problem solving strategies.

Furthermore, according to Rusman in Fendrik (2016: 173) so far learning is still dominated by the view that knowledge as a fact to be memorized. Basically knowledge is not just just theoretical, but how that knowledge becomes a learning experience that can solve the actual problems that occur in our environment that must be sought ways to overcome them.

The problem solving standard according to NCTM (2000) is that students are able to build new mathematical knowledge through problem solving, solving problems that arise in mathematics and other contexts, applying and adapting various strategies that are suitable to solve problems, and monitor and reflect on the process of mathematical problem solving.

The first element in problem solving theory knows the meaning of the problem. According to Wahyudin (2008), problem solving describes the process used by someone to respond to and overcome various obstacles or obstacles when a solution and method of solving are not immediately apparent.

Cai and Lester (2010) suggest several criteria for using the problem, namely: problems are needed in high-level thinking and problem solving, play a role in developing students' concepts, creating opportunities for teachers to assess what their students have learned and the difficulties they experience,

problems can be achieved by students using a variety of different coping strategies, connecting mathematical ideas, helping to improve mathematical skills and providing opportunities to practice important skills.

One variation of learning that can be done to overcome difficulties in solving student problems is the approach of visual thinking learning. Visual thinking can be an alternative source for students working in mathematics. As expressed by Ariawan (2017: 4) said that Visual Thinking can be an alternative to facilitate students in learning mathematics.

Consciously or not, we often think visually in everyday life. For example, when asked about the address of a place, we will more easily convey information about the address by pouring it in the form of a map (picture). Visual thinking has a close connection with problem solving skill. Some strategies for solving problems presented by Krulik and Posamentier (2009) are making diagrams and tables. Making visual representations, in the form of diagrams, sketches, tables and drawings can make it easier to understand the problem, make it easier to get a general picture of problem solving and analyze problems and understand how the elements in the problem are related. Visualization allows students to identify problems in a simpler form, problem solving and then formalize the understanding of the problem provided and identify the methods used for similar problems. Through visual thinking, problem solving can be directly obtained, even without doing calculations.

It is expected that visual thinking in mathematics learning can be a bridge that can improve problem solving skill.

This study aim to investigate the effect of the visual thinking learning approach to improve primary school students' problem solving skill.

2. METHOD

This study aims to examine the effect implementing a visual thinking approach and its influence on problem solving skill. According to Sugiyono (2010) research like this is an experimental research. Experimental research is a method of research conducted to find out the effect of certain treatments.

To find the magnitude of the improvement in student problem solving skill, both classes were given pretest and posttest. Pretest is given before the learning process in this study begins, while post-test after the whole learning process is complete. The pretest given aims to find the initial skill of the two groups. And the posttest is given aims to determine the extent of the influence of learning given on improving students' problem solving.

This study involved two classes, namely the experimental class and the control class. The experimental class is a class that gets learning with a visual thinking approach and the control class is a class that receives conventional learning. Whereas the design of this study is a quasi experimental nonequivalent control group, because students who were respondents in this study were not randomly selected, but the researchers used the existing classes. Research design diagram like this according to Ruseffendi (2003). are as follows :

$$O \quad X \quad O$$
$$O \qquad O$$
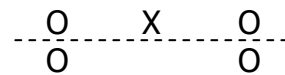
Information:
O = pretest and posttest
X = visual thinking learning approach

The population in this study were elementary school students. Determination of the sample is done by purposive sampling, namely the sampling technique based on certain considerations (Sugiyono, 2010).

The experimental class and the control class which is the sample in this study were selected based on the consideration of the mathematics teacher at the school by taking the existing class. This is also because the school does not allow randomization of existing classes due to concerns that can disrupt the learning process. The samples selected in this study were fifth grade students lementary school.

3. RESULT AND DISCUSSION

After implementing visual thinking approach in mathematics learning so we got data. It obtained pretest, posttest and n-gain about students' problem solving skill that shown in Table 1.

Based on Table 1. it is known that the average initial problem solving skill (pretest) of the control class is greater than the experimental class pretest score, with a difference of 0.44. This contrasts with the mean score of problem solving skill after learning

(posttest). The mean posttest score of the experimental class is much greater than the average posttest score of the control class, the difference reaches 4.12. This shows that the improvement of problem solving skill in the experimental class is greater than the control class. The average initial problem solving skill (pretest) of the control class is greater than the experimental class pretest score, with a difference of 0.44.

Table 1. Problem solving skill data

Group	N	Visual Thinking Approach						N	Traditional Learning					
		Pretest		Postest		N-gain			Pretest		Postest		N-gain	
		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s		$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	S
Upper	8	3,25	2,49	12,88	4,61	0,54	0,37	10	3,44	1,67	5,78	1,79	0,13	0,12
Middle	15	3,27	2,76	9,20	4,28	0,35	0,22	16	3,33	2,52	5,22	2,62	0,11	0,11
Lower	8	2,25	1,67	7,38	3,02	0,28	0,19	9	3,67	2,00	6,00	2,17	0,14	0,12
Total	31	3,00	2,42	9,68	4,46	0,38	0,27	35	3,44	2,16	5,56	2,30	0,12	0,11
Ideal Score = 20														

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Students who join learning with a visual thinking approach, increase the skill to solve the problem of the upper group problem most than the other two groups. The upper and middle groups of students in this experimental class are in the medium category, while the lower group is in the low category. In addition, for students who obtain traditional learning, it is precisely the lower-class students who have the most problem-solving skill compared to the other two groups, although the increase in the three groups is in the low category.

The improvement of problem solving skill in the experimental class is greater than the control group for all students' mathematical skill, and the overall average is in the medium category, while the normalized gain of the control class as a whole is in the low category. Data distribution in the control class is not much different from the experimental class. The posttest of the experimental class spreads wider, while the n-gain value of the spread control class is narrower compared to other data scores, both in the experimental class and in the control class.

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low category. Data distribution in the control class is not much different from the experimental class. The posttest of the experimental class spread wider, Table 1. also shows that the pretest score of the problem solving skill of the control class is greater than the experimental class viewed from the mathematical skill group (upper, middle and lower), although the difference is not too large. In the experimental class, students in the lower group obtained the smallest average pretest, posttest and n-gain scores compared to the upper and middle groups. This is different compared to the control class, the three groups of students (upper, middle and lower) in the control class have a mean that is not much different, both the average pretest, posttest scores or the increase scores. That is, mathematical skill only play a role in the class that receives learning with a visual thinking approach compared to the class that receives conventional learning. It also appears that learning (visual thinking and traditional) is more instrumental in improving problem solving skill than students' mathematical skill (upper, middle and low). This implies that the role of the teacher in learning is more meaningful than the variables before the research is held. While the n-gain value of the spread control class is narrower compared to other data scores, both in the experimental class and in the control class

Mean similarity test nalysis of problem solving pretest score aims to see whether there are significant differences in initial skill between the experimental class and the control class. Before testing the similarity of the pretest average, it is checked whether the average pretest score data is normally distributed and homogeneous. If the pretest mean data is normally distributed and homogeneous, then the t-test is continued, whereas if the data is normal but not homogeneous then the t-test is used and for non-normal pretest scores the non-parametric U Mann-Withney test is used.

1) Normality test

The hypothesis of the pretest normality test of problem solving skill and mathematical connection between experimental class and control class is:

H0: the data is normally distributed
H1: data is not normally distributed

Because the amount of data in each class is more than 30, then to test the distribution of population pretest scores used Shapiro-Wilk normality test with the help of SPSS 18 software, with a significance level. H0 is rejected if the p-value is smaller than. The results of normality tests are presented in Table 2:

Table 2. Result of Pretest

Aspect skill	Learning	Shapiro-Wilk			Conclusion
		Statistic	df	Sig.	
Problem solving	*Visual Thinking*	0,830	31	0,000	Tolak H_0
	Traditional	0,892	36	0,002	Tolak H_0

It can be seen in Table 2 that the significance value (p-value) in both classes, the class with visual thinking learning approach and traditional classes respectively for aspects of problem solving skill reaches 0.000 and 0.002. This value is smaller than the significance level, meaning that H0 which states that the data is normally distributed is rejected. Thus, the initial skill to solve problems, both in the experimental class and the control class for problem solving skill are not normally distributed

Because the initial skill to solve the experimental class and the control class is not normally distributed, it is not necessary to test homogeneity. Furthermore, for the similarity test of the solving skill, which in this case is not normally distributed, the non-parametric Mann-Whitney U test is used.

2) Test of Similarity of Pretest Mean

Similarity test was conducted to prove that there were no significant differences from the initial skill to solve the experimental class and the control class. The hypothesis of the similarity test of pretest problem solving skill is as follows

H0 : $\mu_{pE} = \mu_{pK}$

H1 : $\mu_{pE} \neq \mu_{pK}$

Information:

μ_{pE} = avarage pretest score of problem solving for experiment class

μ_{pK} = avarage pretest score of problem solving for controll class

Problem solving skill with Mann-Whitney test shown in Table 3:

Table 3. Problem solving skill with Mann-Whitney test

	Problem solving skill
Uji Mann-Whitney	470,000
Asymp.Sig.(2-tailed)	0,257
Conclusion	Acept H_0

Table 3 shows that the Mann-Whitney test significance value for problem solving skill is 0.257, this value is greater than the significance level, so H_0 is accepted. That is, there are no differences in initial problem solving skill between the experimental class and the control class

From the mean similarity test the pretest score is known that there is no significant difference in the initial problem solving skill between the experimental class and the control class. Then analyzed the improvement of problem solving skill in each class (experiment and control).

Based on the mean similarity test the pretest score is known that there is no significant difference in the initial problem solving skill between the experimental class and the control class. Furthermore, it was analyzed the improvement of problem solving skill in each class (experiment and control). In general, as shown in Table 1, the spread of increased problem solving skill in experimental class was slightly wider than the control class. Moreover,

the mean score of increasing the problem solving skill of the experimental class students showed an increase of about 0.26 more than the control class. However, it needs to be tested to prove that the improvement of students' problem solving skill in the experimental class is better than the control class significantly.

To see whether the improvement of the problem solving skill of the experimental class and the control class differed significantly and see whether there was an interaction effect between learning and mathematical skill (top, middle and bottom) on improving problem solving skill used two-way ANOVA test. The criteria used are if the significance is greater than the significance level, then H0 is accepted, in other cases H_0 is rejected. The hypothesis proposed is:

Hypothesis 1:
Improving problem solving skill of students who get learning with a visual thinking approach is better than students who obtain conventional learning.

Before testing hypothesis 1, it must be seen first whether increasing problem solving skill in the two classes is different. The hypothesis proposed is:

"There are differences in the improvement of problem solving skill of students who get learning with a visual thinking learning approach with students who obtain conventional learning".

The proposed statistical hypothesis is:
$H_0 : \alpha_1 = \alpha_2 = 0$

$H_1 : \alpha_i \neq 0$, for i = 1, 2

Information:
α_1 = average improvement in experimental class problem solving skill
α_2 = average improvement in control class problem solving skill

Hypothesis 2:
There is no influence of interaction between learning (visual thinking and conventional) and groups of students' mathematical skill (upper, middle and lower) on improving problem solving skill.

H_0 :
$\alpha_1\beta_1 = \alpha_1\beta_2 = \alpha_1\beta_3 = \alpha_2\beta_1 = \alpha_2\beta_2 = \alpha_2\beta_3 = 0$
$H_1 : \alpha_i\beta_j \neq 0$, for i = 1, 2 and j = 1, 2, 3

Keterangan :
β_1 = average increase in group problem solving skill
β_2 = average increase in middle group problem solving skill
β_3 = average increase in lower group problem solving skill

Because the data in this study is more than 30, it is assumed that the improvement in students' mathematical skill is normally distributed. This is based on the Central Limit Theorem, which reads: (1) if a population is normally distributed, then the distribution of the sample is then made for any sample size, the sample is normally distributed; (2) if a population is not normally distributed, then the distribution of the sample, then for a large sample size the distribution of the sample is normal. Result of ANOVA test two way shown in Table 4:

Table 4. Result of ANOVA test two way

	Total	df	Avarage	F	Sig.	Conclusion
Learning	1,035	1	1,035	27,592	0,000	Rejected H_0
Minimum Score	0,163	2	0,082	2,178	0,122	Accepted H_0
Interaksi	0,144	2	0,072	1,926	0,154	Accepted H_0
Error	2,287	61	0,037			
Total	7,666	67				

Based on the results of the two-way ANOVA test in the table above, it can be concluded that there are differences in the improvement of problem-solving skill between the experimental class and the control class, but there is no effect of the interaction between learning and minimum score on improving problem solving skill.

Based on the two-track ANOVA test it is known that there are differences in the improvement of problem solving skill between students of the experimental class and the control class. Furthermore, it will be tested whether the improvement of problem solving skill of students who get learning with the visual thinking approach is better than students who obtain conventional learning. The statistical hypothesis tested is:

H0 : $\mu_{gpE} = \mu_{gpK}$

H1 : $\mu_{gpE} > \mu_{gpK}$

Information:

μ_{gpE} = avarage normalized gain of problem solving skill in experiment class

μ_{gpK} = avarage normalized gain of problem solving skill in controll class

As previously, known, the experimental class gets treatment in the form of learning with a visual thinking approach. The first thing to do to test the differences in problem solving skill of students who get a visual thinking learning approach based on minimal score is to test the normality of data distribution and homogeneity of variance posttest of experimental class problem solving skill. The results of the calculation of the normality of posttest scores on experimental class problem solving skill based on students' skill categories are presented in Table 5:

Tabel 5. Normality test in problrm solving skill

Group	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Upper	0,175	8	0,200
Middle	0,173	15	0,200
Bottom	0,301	8	0,032

The results of this study based on the factors observed and found in this study. These factors include the visual thinking learning approach to improving students' problem solving skill.

Based on the results of the pretest score data analysis showed that the initial skill of the experimental class which obtained learning with the visual thinking approach and the control class that obtained control class learning did not significantly differ in problem solving skill.

The results of processing and data analysis show that the improvement of problem solving skill of students who obtain visual thinking learning is significantly better than students who obtain conventional learning and there is no difference in problem solving skill of students who obtain visual thinking learning in terms of students' skill (top, middle and bottom) And there is no influence of interaction between learning (visual thinking and conventional) with students' skill to improve problem solving skill. That is, compared to the mathematical skill that students have, learning is done more to play a role and influence the problem-solving skill (Sari 2018).

The increase in problem solving skill through this visual thinking learning approach is in accordance with the theory put forward by Wahyudin (2008) which states that the use of diagrams, graphs and images (visualization) is a problem solving tool for students of all students' mathematical skill. These tools force students to study problem situations, because they cannot simply manipulate numbers without understanding the basic structure of the problem. Another valuable feature of graphical aids is versatility. Images can be used by students who are slow to solve problems without which they seem unsolvable, and advanced students can benefit from images in problem solving involving complex relationships. The use of diagrams mainly helps in solving problems involving speed, distance and quantity measurements.

The above is also relevant to the research conducted by Wahidin (2010) which states that the use of props or concrete objects as learning resources can make active students construct and organize their own learning by utilizing various visual-kinesthetic media that are appropriate to overcome routines boring learning.

Based on the results obtained it can be said that learning with a visual thinking approach is better used to improve problem solving skill. However, although the improvement of problem solving skill of students who get learning with visual thinking approach is better than students who obtain conventional learning, but the achievement is still low, less than 50% (only 9.68 of the ideal maximum score of 20).

The possible cause of learning failure with the visual thinking approach is the lack of practice questions given because they are too focused on learning activities and the lack of variety of questions given. Learning with a visual thinking approach causes students to increase carelessness in working on questions. This is supported by Zahar's (2009) statement that visual thinking can cause students to be less careful, even though the student is smart in mathematics. In working on test questions, students are less able to read questions which are caused by

inadequate reading of questions, misinterpretation, especially questions that do not contain numbers (question number 3) and careless in technical calculations. This is supported by the statement of Wardhani and Rumiati (2011) that Indonesian students are less able to read questions caused by inadequate reading of questions, misinterpretation or transferring questions to mechanical processes.

4. CONCLUSION AND RECOMENDATION

Based on the results of data analysis, findings and discussions that have been presented previously, conclusions are obtained, namely: 1) improvement in problem solving skill of students who get learning with a visual thinking approach is better than students who obtain conventional learning. 2) there is no influence of interaction between learning (visual thinking and conventional) with students' mathematical skill (top, middle and bottom) on improving problem solving skill. 3) There is no difference in problem solving skill of students who get learning with a visual thinking approach in terms of students' mathematical skill (top, middle and bottom). As for the advice given in this study is that teachers should be able to provide a learning process evenly to every elementary school student without focusing on certain students in helping students' problem solving skill. For students, they should follow the steps of problem solving correctly and thoroughly in the solution so that they can avoid confusion in students. Furthermore, for the school to be able to provide effective learning media that can help students in optimizing their problem solving skill.

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