

Effectiveness Of Van Hiele Theory-Based Stad Method To Mathematics Learning Outcome

Rosyad Jati Pramono, Nursiwi Nugraheni, Farid Ahmadi

Corresponding E-mail: rosyadjatip@gmail.com

Abstract

This study was being underlied by Mathematics learning outcomes of the second grade of SDN Gugus Gajah Mada which is low. This study was intended to know the effectiveness of STAD model based from van hiele theory towards mathematics subject learning achievement of the 2nd grade students of Elementary Schools (SD) Cluster Gajah Mada Wonogiri. To achieve this objective, this research used quasi experimental research with the type of nonequivalent control group design. The subjects of this study were the 2nd grade students of SD Cluster Gajah Mada Wonogiri. They were sampled by using cluster random sampling. As the data were collected, they were analyzed by using one tailed proportion test, namely z test, t test, gain test and N -gain. The t test shows the comparison of count = $2.98 > t_{table} = 1.68$ which meant that H_0 is reject, while H_a is accept. The results showed that the mathematics learning achievement of the 2nd grade students of SD Cluster Gajah Mda Wonogiri who achieved the treatment of STAD model based from van hiele theory achieved the passing grade (KKM) score, and STAD model based from van hiele theory than TPS.

Keywords: STAD; Van Hiele Theory; effectiveness; mathematics.

1. INTRODUCTION

Curriculum for Primary School/Islamic Primary School contains the subjects designed to develop the competencies in order to meet the the school necessities to provide the students with various critical thinking skills. In the Decree of Minister of Education (No.22/2006) on Standard of Content for Primary and Secondary Schools, it is stated that subject of Mathematics needs to be provided to all the students beginning from primary school to provide the students with logical, analytic, systematic, critical, and creative thinking as well as the collaboration skill. Those competencies are needed in order that the students will get, process, and use information to survive in the always changing, uncertain, and competitive life.

The problem of the poor learning outcome of the students in the implementation of Mathematics learning is supported by the data of the initial test result of the subject of Mathematics. From the acquired data of the initial test result, overall, of 198 students, 39 (19.7%) meet Minimum Mastery Criteria, and the remaining 159 (80.3 %) have not met Minimum Mastery Criteria. The determined Minimum Mastery Criteria is 75. The initial test conducted aimed to find out the students' initial ability in the subject of Mathematics for the lessons in Semester I. The initial test conducted to the students consists of 6 questions, i.e. C1 to C6 questions (remembering, understanding, applying, analyzing, evaluating, and creating or making) in cognitive area according to Bloom Taxonomy.

The poor Mathematics learning outcome of the students until today should be fixed in order that the education in Indonesia gets better. With many types of learning models, theories of learning, and the

existing approachesm the teacher should apply it in his/her teaching. One of the applicable learning methods to solve the issue is Student Team Achievement Division (STAD). A learning method will be helpful when supported with a theory of learning,

One of theories supporting the Mathematics learning is Van Hiele Theory. Van Hiele Theory is a theory of Mathematics which talks about the lesson of geometry.

The research concerning the effectiveness of *Student Team Achievement Division* is supported by the study conducted by Oktavianti (2014: 96-102) showing that the application of cooperative learning mainly mass media-guided and mass media-assisted-based STAD dan *Snowball Drilling* will improve the students' activeness and achievement on subject of Social Science of grade III students in SD Tumpangkrasak 2 District of Jati Kudus Regency. Another study supporting the effectiveness of *Student Team Achievement Division* method is the one conducted by Hastuti (2017: 133-143) showing that there is a type of cooperative learning method called *Student Teams Achievement Division* (STAD) able to improve the discussion skill in subject of Indonesian language of grade IV students in SDN 01 Adirejo.

Based on the fact above, then the research question of the research in general is: Does Van Hiele theory-based STAD effectively raise the Mathematics learning outcome of the grade II students in SDN Gugus Gajah Mada Wonogiri?

The objective of this experimental research in general is to find the effectiveness of Van Hiele theory-based STAD to Mathematics learning outcome of the grade II students in SDN Gugus Gajah Mada Wonogiri.

2. RESEARCH METHODS

Design applied in this research is quasi experimental design in nonequivalent control group design. This type of experimental design is the development of true experimental design, which is difficult to apply. It is called quasi experimental as is this design, I could not control all external variables that influence the process of the experiment (Sugiyono,2015: 116). The target population of this research is the grade II students of SDN Gugus Gajah Mada Wonogiri i.e. 198 students.

The sampling method applied in this research is cluster random sampling, and I chose two samples of the target population, i.e. one experimental group and one control group. The two samples are grade II B students of SDN 1 Gedong i.e. 23 students as experimental classroom, provided with STAD method and grade II students of SDN 3 Gemawang, i.e. 22 students as control classroom, provided with TPS method. Independent variable (X) in this research is STAD method (variable X1) and NHT as control classroom (variable X2). The dependent variable (variable Y) is this research is Mathematics learning outcome. This research uses several data collection methods, i.e., Documentation, interview, observation and test. Instruments needed in this research are quantitative instrument (test) to measure the learning outcome. The learning outcome data then got analyzed using the learning completeness test using one party proportional test, the effectiveness test using right party t-test and learning outcome raise test using N-Gain.

3. RESULTS AND DISCUSSION

The research end results comprise the pre-research data analysis, initial data analysis, and final data analysis. Pre-research data analysis was conducted to find out the early situation of the target population by doing data analysis, i.e. normality test and homogeneity test. The pre-research data is then presented in the following table:

Table 1. Pre-Research Data

Class	N	Average	Deviation Standard	Best Mark	Poorest Mark
SD N I Gedong A	25	70	20.31	95	15
SD N I Gedong B	23	42.65	18.55	90	25
SD N Gedong III	11	42	15.03	65	25
SD N Gedong IV	20	39.65	15.24	65	20
SD N Gedong V	13	46.53	11.25	65	30
SDN Gemawang I	18	39.72	20.96	85	20
SDN Gemawang II	10	35	14.52	55	15

SDN					
Gemawang III	22	42.5	18.62	95	20
SD N Pondok I	29	44.5	18.38	75	15
SD N Pondok II	14	30	13.15	60	15
SD N Pondok IV	9	22..22	9.71	45	15

Normality test is used to find if the samples are normally distributed or not. The normality testing on the pre-research data against the population uses Lilliefors test because $N < 30$. Criteria of the testing is that if $L_{count} < L_{table}$, then it can be said that the data are normally distributed. The normality test result of pre-research data can be seen as follows.

Table 2. Normality Test of Pre-Research Data

No.	Class	L Count	L Table	Test Decision	Criteria
1.	SD N I Gedong A	0.06	0.17	Ho Accepted	Normally Distributed
2.	SD N I Gedong B	0.06	0.19	Ho Accepted	Normally Distributed
3.	SD N Gedong III	0.03	0.24	Ho Accepted	Normally Distributed
4.	SD N Gedong IV	0.001	0.19	Ho Accepted	Normally Distributed
5.	SD N Gedong V	0.005	0.23	Ho Accepted	Normally Distributed
6.	SDN Gemawang I	0.05	0.22	Ho Accepted	Normally Distributed
7.	SDN Gemawang II	0.05	0.25	Ho Accepted	Normally Distributed
8.	SDN Gemawang III	0.08	0.19	Ho Accepted	Normally Distributed
9.	SD N Pondok I	0.05	0.17	Ho Accepted	Normally Distributed
10.	SD N Pondok II	0.05	0.22	Ho Accepted	Normally Distributed
11.	SD N Pondok IV	0.09	0.27	Ho Accepted	Normally Distributed

Homogeneity test was conducted to find out if the population has the similar or different variants in order to get assumption that the homogenous or heterogeneous population has nearly equal ability in case of absorbing Mathematics lessons. The homogeneity test in this research uses the Barlett method. The testing criterion is if $\chi^2_{count} < \chi^2_{table}$, then we can say that the data are homogeneous. The homogeneity test result of the pre-research data are presented as follow.

Table 3. Homogeneity test Pre-Research Data

No.	Class	χ^2 Count	χ^2 Table	Test Decision	Criteria
1.	SD N I	13.69	18.3	Ho	Homogenous

	Gedong A	Accepted
2.	SD N I Gedong B	
3.	SD N Gedong III	
4.	SD N Gedong IV	
5.	SD N Gedong V	
6.	Gemawang I SDN	
7.	Gemawang II SDN	
8.	Gemawang III SD N	
9.	Pondok I SD N	
10.	Pondok II SD N	
11.	Pondok IV SD N	

After conducting the pre-research data testing, then pretest is conducted with 10 essay-type questions. The pretest result is shown as follows.

Table 6. Initial Data of Research

Class	N	Best Mark	Poorest Mark
Experimental	22	76	41
Control	21	76	30

The normality test is used to find out if the employed data is distributed normally or abnormally. Because the amount of the samples in this research is less than 30, the formula which should be used is Liliefors test. Normality testing of the initial data of the research (pretest) against the samples (grade II students of SDN I Gedong 2B , SDN III Gemawang).

Table 7. Normality Test of the Initial Data of Research

No.	Class	Amount of Students	Deviation Standard	Average	L counttable	L	Criteria
1.	Experimental	22	59.09	10.37	0.11	0.19	Normally Distributed
2.	Control	21	56.14	9.74	0.11	0.19	Normally Distributed

Homogeneity test is conducted to find if the data variants from the analyzed samples are homogeneous or heterogeneous. The employed homogeneity test is F-test to test homogeneity of the variants of the two independent samples.

Table 8. Homogeneity Test of Initial Data of Research

No.	Class	F _{count}	F _{table}	Test Decision	Criteria
1.	Experimental	1.13	2.1	Ho Accepted	Homogenous
2.	Control				

After conducting initial data testing of the research, then the treatment was carried out for four sessions in the experimental classroom using Van Hiele Theory-based STAD and in the control classroom using TPS method. Subsequently, posttest is conducted using the similar questions with the ones in the pretest as the instrument, i.e. 10 essay questions. The posttest result is as follows.

Table 10. Final Data of Research

Class	N	Best Mark	Poorest Mark
Experimental	22	89	76
Control	21	83	61

Normality test is used to find if the employed data comprise the normally distributed data or not. As the samples amount of this research is less than 30, then the employed formula is Liliefors test. Normality testing on the final data of the research against the samples (grade II students of SDN I Gedong 2B , SDN III Gemawang).

Table 11. Normality Test of Final Data of Research

No.	Class	Amount of Students	Deviation Standard	Average	L counttable	L	Criteria
1.	Experimental	22	81.81	4.81	0.175	0.19	Normally Distributed
2.	Control	21	77.61	4.39	0.165	0.19	Normally Distributed

The homogeneity test was conducted to find if the data variants of the analyzed samples are homogenous or not. The conducted homogeneity test is F-test because it is used to test the homogeneity of variants of the two independent samples. The result of the homogeneity test is shown as follows.

Table 12. Uji Homogenitas Data Akhir Penelitian

No.	Class	F _{count}	F _{table}	Test Decision	Criteria
1	Experimenta l	1.19	2.1	Ho Accepted	homogenous
2	Control				

Hypothesis test is used to verify the acceptability of the proposed hypothesis. Hypothesis testing in this research consists of hypothesis 1 and hypothesis 2 tests. Every hypothesis testing consists of the learning mastery test using the one party proportion test, effectiveness test using right tailed t-test, and the learning outcome progress test using N-Gain.

(1) Hypothesis 1 Test

The learning mastery test aims to reveal if the test result using Van Hiele theory-based STAD method will help to meet the Minimum

Mastery Criteria. The learning mastery indicator is individual mastery achievement and collective mastery. The individual mastery is based on the Minimum Mastery Criteria, i.e. 75. While the collective mastery criterion according to Djamarah (2010:101) is the percentage of the students meeting the minimum collective mastery, i.e. 75% or more, of the amount of the students engaged in the learning process.

Table 13. Test of Learning Mastery

Amount of Student	School of	Percentage	Z _{count}	Z _{table}	Remarks
SD N I Gedong 2B	22	100%	2.70	1.64	Collectively Mastering

Based on the table above, we can see that in the experimental classroom, it is acquired: zcount=2.70. ztable of one tailed proportion test at the significance rate 0.05 equal 1.64. In the experimental classroom, zcount > ztable, it was shown that the experimental classroom meets the learning mastery criteria about 75% or more.

(2) Hypothesis Test 2

Test of learning effectiveness was conducted to find the more effective learning method between Van Hiele theory-based STAD in the classroom

Table 14. Test of Learning Effectiveness

No.	Class	N	Average	T _{count}	T _{table}	Criteria
1.	Experimental	22	81.81	2.98	1.68	Ho rejected
2.	Control	21	77.61			

Based on the test analysis, it is acquired tcount = 2.98 and ttable = 1.68 with dk = n1 + n2 - 2 = 22 + 21 - 2 = 41 and the significance rate at 0.05. As tcount > ttable, then the conclusion can be drawn that Ho is rejected and Ha is accepted. This analysis shows that the Mathematics learning outcome of grade 2B students of SDN I Gedong applying STAD is better than the control classroom, i.e. grade 2 students of SDN III Gemawang applying TPS method.

a. Assessment of learning Outcome Improvement

Gain assessment is used to find the effectiveness of Van Hiele theory-based STAD and TPS methods. Gain is the proper method to analyze the results of *pretest* and *posttest*, and is a better indicator to show the effectiveness rate

of the treatment and posttest result. The applied gain is normalized gain (*N-gain*).

Table 15. *N-Gain* Assessment in Experimental Classroom and Control Classroom

No.	Classroom	Amount of Students	Average Pretest	Average Posttest	Individual N-Gain	Average Classroom N-Gain	Criteria
1.	Experimental	22	59.09	81.8	12.02	0.54	Moderate
2.	Control	21	56.14	77.61	9.99	0.47	Moderate

To support the learning outcome improvement using N-Gain then N-Gain homogeneity then right tailed t-test. The result of homogeneity test is shown below.

Table 16. Homogeneity Test of *N-Gain* Point Experimental Classroom and Control Classroom

No.	Class	F _{count}	F _{table}	Test Decision	Criteria
1	Experimental	1.04	2.1	Ho Rejected	Homogenous
2	Control				

2. Control

Then the margin test of average N-Gain point using right tailed t-test and the results is presented below.

Table 18. Assessment of Learning Effectiveness of *N-Gain* point in Experimental Classroom and Control Classroom

No.	Class	N	Average	T _{count}	T _{table}	Criteria
1.	Experimental	22	0.546	2.22	1.68	Ho rejected
2.	Control	21	0.476			

Based on the assessment of hypothesis 2 using z-test, t test and N-Gain test it can be concluded that Van Hiele theory-based STAD is more effective than NHT in control classroom.

The conducted study shows that the application of Van Hiele theory-based STAD method in Mathematics learning will improve the students' learning outcome. The STAD is chosen because of its strengths in the learning process, i.e. the students cooperate to reach the goal by giving high respect to the group norms, the students actively help and motivate for mutual success, actively plays a role as peer teacher to improve the collective success, inter-students interaction is in line with their skill improvement in expressing opinion, improve the individual and group skills, uncompetitive, and do not keep the revenge (Shoimin, 2014:189).

The research is also supported by another research previously conducted, i.e. the study conducted by Subrata (2016: 72-78), showing that the learning of Natural science applying cooperative method mainly STAD type can increase the students' activeness in the learning. The students' activeness in cooperative learning mainly STAD type can improve the students' learning outcome. The research conducted by Maharani (2013: 1-6) shows that the students' learning outcome after answering the questions in the lesson of breadth and volume of pyramid and prism in the classroom applying character-building-based STAD method assisted by learning CDs reach the learning mastery. And the students' learning outcome in the classroom applying character-building-based STAD method assisted by learning CDs is better than the students in the classroom applying CTL method in solving the problem of counting breadth and volume of pyramid and prism at grade VIII SMP Negeri 1 Lasem.

The research conducted by Yilmaz and Koparan (2016: 129-141) shows that the students' marks before applying Van Hiele theory-based STAD method was still poor. After the application of Van Hiele theory-based STAD method, however, there is a significant change of marks. It can be concluded that the application of Van Hiele theory-based STAD method will improve the students' and the teachers' skill. Another research conducted by Suharjati (2016: 64-69) is also relevant with this research, which shows that the application of cooperative method mainly STAD type will improve the students ability to identify the characters of the polyhedrons. The research conducted by Novianti (2013: 272-276) the he study result that STAD method has impact on learning of Mathematics compared to conventional method. The research conducted by Safrina (2014: 9-20) states that the improvement of ability to solve the problem of geometry using the Van Hiele theory-based cooperative learning is better than conventional learning.

The research conducted by Al-Ebous (2016: 87-98) shows that the application of Van Hiele theory on the learning of concept geometry. The research conducted by Amrina (2013: 42-51) states that the learning outcome of geometry in the classroom applying Van Hiele theory is better than kelas learning outcome of geometry in the classroom applying conventional learning.

4. CONCLUSION

Based the conducted researches, a conclusion can be drawn that Mathematics learning outcome of the grade II students of SDN Gugus Gajah Mada Wonogiri that applied Van Hiele theory-based STAD can help the student meet Learning Mastery Criteria, Van Hiele theory-based STAD is more

effective than TPS method, the students' activeness in experimental and control classrooms after applying Van Hiele theory-based STAD and TPS method improves, and the teachers' activeness in experimental and control classrooms after applying Van Hiele theory-based STAD and TPS method improves too.

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