E – 4

The Enhancement Ability Of Mathematical Connection In Paralellogram Material Through Learning Based On Van Hiele Theory

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Abstract

The ability of mathematical connection gets less teacher's attention, especially in elementary school. But mathematical connection ability is a math skill must be had by students well. The purpose of the research is to test the superiority learning based on Van Hiele theory to improve student's mathematical connection ability . The method used is pre-experiment by collecting data technique those are test and non test. The results of the test are : 1). Increasing the student's mathematic connection ability; 2) the implementation learning based on Van Hiele theory through some stages (information, direct orientation, explanation, free orientation, integration); 3) the student's mathematical connection ability increased after using learning based on Van Hiele theory.

Key words: mathematical connection, learning based on Van Hiele theory

A. Introduction

The ability of mathematical connection is one of five of basic abilities of math. There are several math abilities. On *National Council of Teachers of Mathematics* (NCTM) 2000, it is said that there are five standard basic abilities of math, those are problem solving, reasoning and proof, communication, connections, and representation.

NCTM (2000; 64) stated that math is not a set of separated topic and ability. Math is inseparable knowledge and it is a unity.

Suherman (2001:3) stated that ability of mathematical connection is an ability to connect one math concept or rule to another with other study fields or its application in the real life.

When someone has an ability of math connection, they can increase their cognitive ability such as rememorizing, understanding, applying something about concept toward their environment, etc. Ability of math connection can be seen after we used our knowledge and understanding before that we will be able to give conclusion about one topic connection to another.

Geometry learning about parallelogram is one of materials must be understood by elementary students. The result of introduction study showed that most of students have not understood yet about connection of parallelogram completely whereas they had learned it before. It indicates that learning which has been done is not enough to develop the ability of mathematical connection.

Based on the facts, the ability of math connection is very rarely taught at school especially at elementary. In addition most of students are only demanded to do a question and get good mark without teachers' attention about their ability of mathematical connection.

Therefore, teachers should present learning which can develop students' ability of mathematical connection at elementary specially on geometry. One of learning theory can be used to fulfill them is Van Hiele learning theory. It is in line with that stated by Husnaeni in Abdussakir (2010:02) that Van Hiele model is effective to increase students' thinking ability.

Based on those descriptions, it can be revealed the observer's problems, those are:

1. How is the learning process to improve ability of mathematical connection in material of parallelogram by learning model based on Van Hiele theory in class V of Primaryschool
2. Are there improvements of students' ability of mathematical connection leaning based on Van Hiele theory compared with Conventional learning in class V of Primary school

The purposes of this research are:

1. To describe learning process in improving ability of mathematical connection on material of parallelogram by learning model based on Van Hiele theory in class V of Primary school
2. To test learning improvement based on Van Hiele theory compared with conventional learning in improving students' ability of mathematical connection on material of parallelogram in class V of Primary School

Theoretically, this research result is expected can be a reference for the next research, especially study or research studies about problem of learning model especially learning model based on Van Hiele theory in improving ability of mathematical connection about parallelogram. Whereas in practice, this research result can be: 1. Being a motivation for students to continue learning math by being given learning about mathematical connection; 2. Being a motivation for teachers to improve their knowledge about learning theories to reach expected learning purposes; 3. Being contribution to school about learning theory about geometry learning.

B. Literature Review

1. Mathematical Connection

Mathematical connection is one of math basic skills. Shadily and Echols (Ariatna, 2013: 10) interprets 'connection as a connection relationship, a band or connection'. Thus, mathematical connection is a connection or relation on math. These relations are relation between math itself, relation with other disciplines, and relation with daily life.

The purposes of mathematical connection at school (NCTM, 2000), are:

a. To enlarge students' knowledge. Mathematical connection can enlarge students' knowledge because students not only learn about a concept but also learn about the other concepts discussed.

b. To view math as a whole not separated subject. By mathematical connection, students can know about relation between concepts in math. So that by those we can see that student's math as a whole connection.
c. To state relevance and advantage either at school or outside. Mathematical connection can teach students to understand concept and practice students' ability in solving problems of various relevant fields, either in math fields itself or outside.

Mathematical connection can be categorized to several categories, they are:
a. Mathematical connection between mathematics itself
b. Mathematical connection with other disciplines
c. Mathematical connection with daily life

2. Parallelogram

Parallelogram is a two dimension flat form. It is included rectangle flat form.

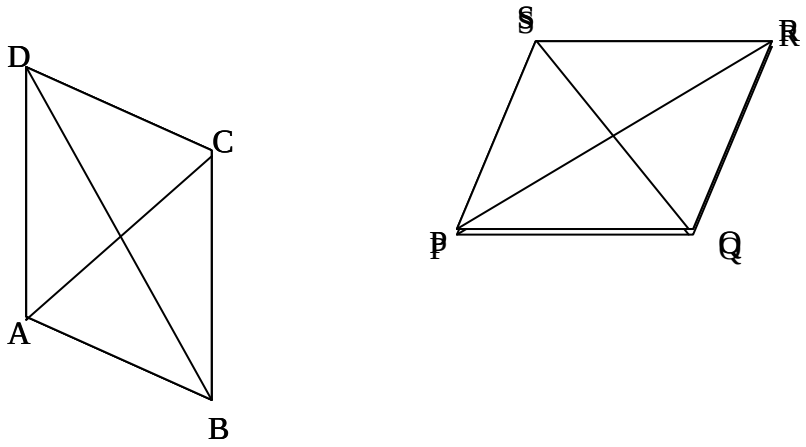

Figure 1.1
Parallelogram

Characteristics of parallelogram:
a. it has two pairs of parallel sides which every pair of sides is parallel and has same length (AB// DC, AD//BC and PQ//SR, PS//QR)
b. the opposite angle is same size (<DAB = <BCD, <ABC = <BCD and <SPQ = < QRS, <PQR = < RSP)
c. the four angles is not elbow angles with close angle is 180^0
d. the two diagonals bisect each line segments to the same length.

In flat form, parallelogram, there is relation or connection with other flat forms. The relation or connection can be seen from following diagram.

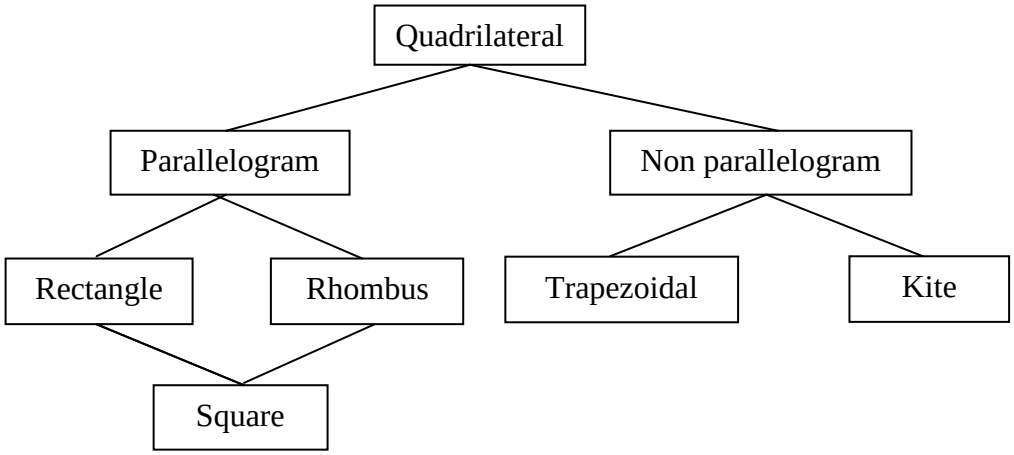

Figure 1.2
Diagram of Quadrilateral

From figure 1.2 it can be made meaning as follow.

1. Parallelogram is Quadrilateral that have two pair of sides, which every pair of sides is parallel and has same length.
2. Rectangle is a parallelogram that the four angles are elbow.
3. Square is a rectangle that the four sides have same length.
4. Rhombus is a parallelogram that the four sides have same length.
5. Square is a rhombus that the four sides have elbow angle.

3. Van Hiele Theory

D'Augustin and Smith (1992), Crowley (1987:5) in Nur'aeni Epon said that:

A. "level development of student's geometry thinking advances from one level to the next involves five phase, or a result from organized teaching to five learning phase". They are explained as follow:
   1. **Phase 1: Information** , by discussing, teacher identifies what has been known by students about a topic then students are oriented to the new topic. Teacher and students are involved in discussing and activity about objects, analyzing about the props done, questions are showed and special vocabulary are introduced. Students are usual to know material they had analyzed (for example, analyzing example and non example).
   2. **Phase 2: Guided Orientation ,** students do questions involved various different relation from system will be formed by using material 9 for example, folding, measuring, analyzing symmetry, etc), teacher makes sure that students step specific concept.
   3. **Phase 3: Explicitation ,** students realize relation system of topic learned and try to expressed the system by their own words. Teacher helps students in using

true and accurate vocabulary. Teacher introduces relevant math terms (for example, expressing special characters of a geometry form).

4. **Phase 4: Free Orientation ,** students study with more difficult question to solve more opened question by finding their own answer in system relation (for example, knowing characters from a form, analyzing the characters of a new form, such as kite).
5. **phase 5: Integration ,** students summarize and integrate all they had learned then reflect it in their action and get analyzing about system relation that new formed (for example, characteristics of figure summarized).

B. Geometry understanding level according to Van Hiele:

Pierre and Dina Van Hiele (1995), Crowley (1987:2-3), Clements and Battista (1992) dan Ikhsan (2008:13) in Nur'aeni Epon (2010:12-15) said that in leaning geometry, someone will be through five hierarchy levels. They are, visualization, analysis, abstraction, deduction and rigor.

1. **Level 1: Visualization,** this level is often called recognition level. In this level, students Had recognized basic concepts of geometry, those are simple forms like square, triangle, rectangle, parallelogram, etc. students recognize a geometry form as a whole based on visual considering, they have not realized about those geometry characteristics. For example, a student has recognized well a square if he/she can have showed or chosen square form a set of geometric objects.
2. **Level 2: Analysis,** in this level, students have understood concept characteristics or geometric form based on informal analysis about its part and component. For example, students have known and recognize dealing sides in a rectangle are congruent, both diagonal lengths are congruent and cut same length one each other.
3. **Level 3: Informal deduction,** this level is often called as an ordering or abstraction. In this step, students logically order concept characteristics, make an abstract definition and can differ characteristics those are requirement needed and enough in determining a concept. In this level students have understood about geometry forms ordering, such as square is rectangle, rectangle is parallelogram, rectangle is parallelogram, rectangle is rhombus and rhombus is parallelogram.
4. **Level 4: Deduction,** in this level students' deduction thinking has started developing but it has not been maximal. It can understand the importance of deduction reasoning. Geometry is deductive science. Therefore, getting conclusion, proving theorem, etc must be done deductively. Such as to conclude that the number of triangle is 180^0 ;it has not been done if it is only done inductively, like cutting angles of triangle object and show that the three angles form a straight line. However, it must be proven deductively, for example by using parallel concept. In this level students have understood the

importance of undefined elements, axiom, definition and theorem. Though students have not understood why those can be axiom or theorem.

5. **level 5: Rigor,** in this level, students have understood the importance of accuracy in basic things. Such as the accuracy of axioms which cause *Euclides* geometry and what *non-Euclides* geometry is. This level is thinking level in which depth is similar with mathematist.

C. Research Method

This research used quantitative approach with experiment method. The experiment design used is pre-experimental that was *one group pre-test-post-test design*, in which purposed to compare the result between pre-test and post-test. Instrument of research used is development of teaching materials as teacher's reference to do learning process, observation sheets to know effectiveness of the use of learning based on Van Hiele theory. Ability test of mathematical connection to know student's ability of mathematical connection in material of parallelogram. Quantitative data was got from ability test of student's connection, and analysis of quantitative data was done by using statistical test. And the result of observation data was analyzed descriptively.

D. Research Result and Discussion

1. Analysis of Research Data

a. Data Analysis of Learning based on Van Hiele Theory

Learning occurred of this learning approach changed every meeting. Starting from the first meeting to the third. It could be seen from observation sheet of learning occurred that has been appropriate with planning of learning process based on Van Hiele theory, almost all of students' and teachers' learning activities ran well. Observation to learning based on Van Hiele theory occurred was done in every class learning. Observation was done to know congruence between learning planning and learning occurred used Van Hiele theory. Observation technique used was by *rating scale*, *giving check list* (√), and writing student's and teacher's activities in every stage done.

b. Data Analysis of Ability Test Result of Student's Mathematical connection

1). Development of Student's Mathematical Connection Ability

Result of normality test to *pre-test* data showed that pre-test score distributed normal and homogeny. From the *pre-test* result can be seen that there was no difference of average result of student's value from both class. *Pre-test* mean value is 25,65 and *post-test* mean value is 73,75. It was supported by test result of mean difference between *pre-test* and *post-test* value that results H_0 was accepted. It means that there was significant difference of student's mathematical connection ability between student's ability value before learning (*pre-test)* and after learning *(post-test).*

Then quality development of student's mathematical connection ability from statistic test to mean of normal gain between *pre-test* and *pos- test*. Results from value of *Sig. (2-tailed)* or two side significant test in E*qual Variances Assumed* is 0,000, got value of *Sig.* < 0,05 or *Sig.*< α so H_0 is rejected or H_a is accepted. It means there is significant difference between mean of normal gain of *pre-test* and *post-test*. Thus the effectiveness of development of student's mathematical connection ability after learning

based on Van Hiele theory is not same. It is also supported by normal gain to all students by 0,69. Developmental quality is effective enough. So there is development of student's mathematical connection ability after learning based on Van Hiele theory.

2. Discussion

Leaning occurred based on Van Hiele theory changed every meeting. It could be seen from observation sheets of learning occurred in which has been appropriate with planning of learning process. Almost all of students' and teacher's learning activities ran well. It also could be seen from difference of learning result of parallelogram on *pre-test* (before using Van Hiele learning theory) and *post-test* data (after using van Hiele learning theory).

Mean value of student ability in math connection in material of parallelogram is on high category enough and its development quality is effective enough. Based on t-test result and its relation with Normal Gain value to *pre test* and *post test* mean, it can be got description that there has been a significant change of mathematical connection ability after learning by using Van Hiele learning theory. From learning quality side, this development is effective enough because its Normal Gain mean between *pre test* and *post test* was 0,69.

Processing result of student's mathematical connection ability test showed that: (1) there was developing mathematical connection ability after learning process based on Van Hiele theory which is effective enough; (2) development quality of student's mathematical connection ability was very high. It is effectine enough. It is appropriate with Nur'aeni E (2008, 36) that mathematical understanding ability of elementary student, especially in geometry, can be developed by Van Hiele learning stages. So it is right that to improve and develop student's mathematical connection ability must be paid attention by fit and proper learning approach.

During learning process, observer observed that student was happy and excited to follow learning based on Van Hielle theory. Observation sheet result showed that learning based on Van Hiele theory ran as the stages and gave a good response to students. They were active and challenged to analyze, realize the relation from the first to the third learning, generally followed learning well and observer can say that van Hiele learning theory is success to improve mathematical connection ability.

The fact that learning based on Van Hiele theory in the *post-test* is better than *pre-test,* it showed that learning based on Van Hiele theory in material of parallelogram can improve student's mathematical connection. It is because learning based on Van Hiele theory has been able to develop student's ability of mathematical connection in material of parallelogram.

E. Conclusion

Based on observation result, it can be concluded that: learning based on Van Hiele theory ran well and got student's positive response. It was one of improvement factors of student's mathematical connection ability. After being applied learning based on Van Hiele theory, student's mathematical connection ability was improved. It was proven by *wilcoxon* test that H_a was accepted, it means there are difference between students' understanding of mathematical connection in parallelogram before and after using Van

Hiele theory. It is supported by N-Gain result that showed that mean improvement of quality student's ability of mathematical connection after Van Hiele learning theory is effective enough.

Learning process based on Van Hielle theory in parallelogram is by following theory of geometry thinking level according to Van Hielle. There are five thinking levels passed by students. Students experienced thinking ability improvement in one level to another higher.

Learning based on Van Hiele theory has been able to develop mathematical connection in geometry especially parallelogram. Mathematical connection ability especially in elementary can be developed by Van Hielle learning stages. Learning stages based on Van Hielle theory has improved student's thinking level practically.

The improvement can be seen based on *pre-test* and *post-test*. The result means that students can connect material of parallelogram after doing learning based on Van Hielle theory.

There is significant difference of student's mathematical connection ability between *pre-test* result (before learning) and *post-test* result (after learning). It is proven from *wilcoxon* test result to *pre-test* and *post-test* result. The result showed that H_0 was rejected. It means that there is significant difference between *pre-test* and *post-test* result. It showed that most of student's ability of mathematical connection in parallelogram after learning based on Van Hielle theory is better than before in the control class. Based on the difference, it can be concluded that there is significant improvement of the use of Van Hielle learning to student's ability of mathematical connection in material of parallelogram in class V, SDN Cibatuireng, Karangnunggal, Tasikmalaya regency.

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