ANALYSIS OF MATHEMATICAL CONNECTION ABILITY IN LINEAR EQUATION WITH ONE VARIABLE BASED ON CONNECTIVITY THEORY

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Abstract

The objective of this study is to analyze mathematical connection ability in linear equation of one variable then looking for the reason of this connection. Using by observation, test, and documentation methods, this qualitative study will describe achievement of mathematical connection ability and its reason in linear equation of one variable first grade student of State Junior High School 16 Semarang. Observation, test and interview instrument is developed to measure mathematical connection ability based on connectivity theory. This study expresses that average score of mathematical connection ability between concepts in high materials is 94%, mathematical connection between medium topic is 55%, ability to connect mathematics with other lesson is lower, 40% and ability to connect mathematics with everyday life is the lowest ability, with average score 2%. Based on data from observations and interviews mathematical connection ability is low because teacher has not done learning concept principles; (1) learning is done in an effort to construct or build their own experience, (2) prioritizing active process, (3) embed learning in social experience context, (4) prioritizing real-learning in relevant context or contextual.

Key Words: Mathematical connection, Constructivism, active, contextual

Introduction

Mathematical connection ability is ability to connect inter-concepts in mathematics and connect mathematics concept and non-mathematics concept. Mathematics is not partitioned in separated various topics, but this is a unity. Mathematics can't be separated from other science and problem of everyday life (NCTM, 2000:275). Therefore, ability to connect mathematics becomes important measure of success in learning mathematics. Concept of mathematical connection has been investigated long time ago by WA Brownell in 1930, but at that time concept of mathematical connection is limited only in arithmetical connection (Bergeson, 2000:37).

According to Brunner based on his constructivism theory, the best way for student to learn a concept in mathematics is constructing a representation from a concept or a principles before. Constructivism according to Piaget is a learning process that started from real experience of student, that experience is reflected individually. Vygotsky says that students have to pay attention to social environment in construct a concept in order to further develop. Learning philosophy according to constructivism is building knowledge step by step, then the result is expanded through limited context and through the process. Hence, constructivism is actually philosophy of contextual learning. Knowledge is not a set of fact, concept or principle that ready to be picked up or remember (Baharuddin, 2012: 116). There are several things that need attention in constructivism learning (Jauhar, 2011: 37), these are (1) prioritizing real learning in relevant context (contextual), (2) give priority to process, (3) embed learning of social experience learning, (4) learning is an effort to construct experience. The principles of constructivist learning are: (1) knowledge is built by students actively and understanding is an adaptive process (Symeou, L., 2005: 18; Criestie, 2005), (2) learning is individual interpretation of the world, emphasizing problem solving and understanding, use of assessment authentic, experience, setting and contain of learning is presented holistically (Crstie, 2005), (3) pressure of learning process is on student and pressured in process than result, (4) curriculum emphasize student participation and, (5) teacher is a facilitator (Aunurrohman, 2009: 25; Soeparno, 1997: 66).

According to Brunner there are four principles about learning way and teaching mathematics that called theorem. These theorems are construction theorem, notation theorem, contras and variation theorem, connectivity theorem (Suherman E., 2003; 44-47). Connectivity theorems explain that there is a strong connectivity between concepts in mathematics, not only contain but also the formula in the concept. A material can be a prerequisite for other materials, or a certain

concept is needed to explain other concept. As in the determination of the board area, student needs prerequisite knowledge about rectangle area.

In mathematical connection ability, students are required (1) to connect inter-topics in mathematics that connect inter-concept or principle in the same topic, (2) connection between topics in mathematics that connect one material and other materials in mathematics, (3) connection between mathematics materials and other science, (4) connection between mathematics and everyday life which can be found by students (NCTM, 2000:64). Ability to connect mathematics is in compliance with connectivity theorem that is constructivism theorem and connectivity theorem which is explained by Jerome S Brunner and supported by Jean Piaget's theorem of cognitive development and Vygotsky that build about constructivism.

If students can connect mathematics idea, their mathematics understanding will be deeper and longer because they can see connection between one topic and other topic, connection between topic in mathematics and other science, and connection between mathematics with everyday life experience (NCTM, 2000:64). Connectivity theorem according to Brunner express that there is a strong connection between one concept with other concept, not only the contain but also the formula that used. . A material can be a prerequisite for other materials, or a certain concept is needed to explain other concept (Suherman, 2003). Therefore, mathematical connection ability is needed to be trained in the school.

Method

This qualitative descriptive research, the data analyzed is a description of indication which is observed, is not always figured by numbers and it does not always refuse or receive hypothesis. The research is held in VII class of SMPN 16 Semarang with 32 students.

Collecting data uses test, observation, and interview method. The developing of PSLV material test is based on the connectivity theory to measure four connections of mathematics ability, i.e. the connection inter concepts in one mathematics material, the connection inter topics in mathematics, the connection between mathematics concept and other science, and the connection between concept and everyday life. Mathematical connection ability test is given after learning linear equation of one variable material and the result is analyzed to see the mathematical connection ability. The instrument of observation and interview is developed to discover more the

cause of the weakness of the mathematical connection ability. Observation and Interview is held after analyzing the ability of the finished test.

Data-analyzing is done through qualitative-descriptive technique. Descriptive statistic is used in analyzing mathematics connection ability which is produced by mathematics connection ability test in linear equation of one variable material. The descriptive-quantitative analysis is based on the average score, maximum score, percentage of the connection ability and category of the connection ability in every connection indicator which is shown in table form. Mathematics connection ability category is divided into three levels i.e. low level with <55%, medium level with ≤55% score <75%, and high score with >75%. Qualitative data is collected through observation and interview that will be used to see the cause of the mathematics connection ability. The interview is for the student who made mistakes in doing the mathematics connection ability test.

Finding and Discussion

As it can be seen from table 1, the average of connection ability between concept in one material is high, 94%, connection inter-topic in mathematics is medium, 55%, connection between mathematics concept and other science is 40% and connection between mathematics and everyday life is 2%. Generally, mathematical connection ability is low, 34,96%.

Table 1. Percentage for Mathematical Connection Ability

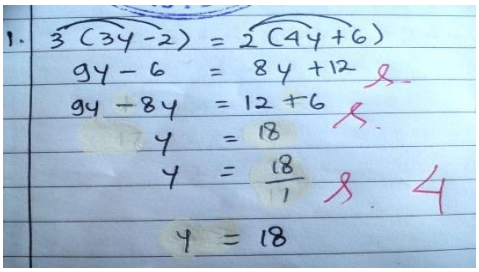
No.	Items for connection mathematical ability	Average score	Maximum score	Percentage (%)	Category
1	Connection inter concept in one material of mathematics	7,523	8	94	High
2	Connection inter topic in mathematics	14,52	26	55	Medium
3	Connection between mathematical concept and other science concept	12,16	30	40	Low

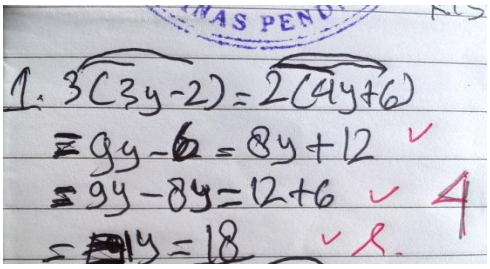
4	Connection between mathematics and everyday life	0,694	36	2	Low
Total Average		34,96	100	34	Low

Based on analysis of mathematical connection ability above, description about the result of students work and analysis of the cause of mathematical connection ability can be seen based on connection indicator below:

1. Connection inter concept in one mathematical material

There are 2 question with maximum score 8 to measure connection ability inter concept. Indicator of inter concept connection are concept about open sentence, linear equation of one variable, equivalent. From 32 students, there are 30 students that can answer correctly. From the student answer who answered correctly, there are some steps to answer the question. Several example from students answer can be seen below:



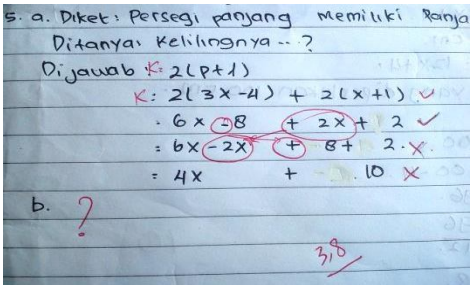


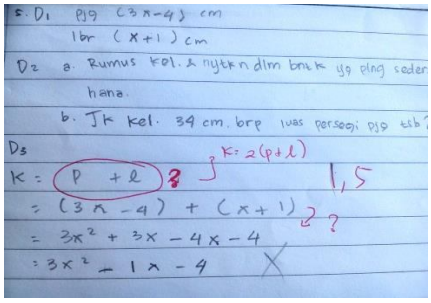
The average of connection ability inter concept in a linear equation of one variable, high rank with the percentage of 94%. Based on learning observation and interview data, mathematical connection ability inter concept in one material is high due to; 1) teacher engage student to remain and review material that support linear equation of one variable using answer and question to review al Gebra

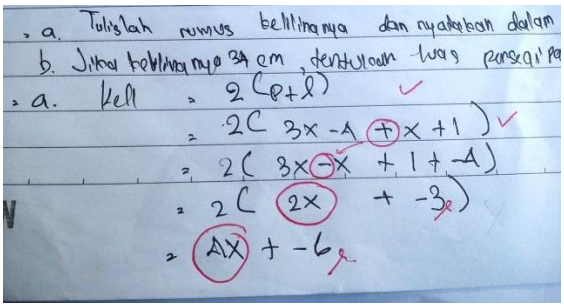
arithmetic and also give question about the definition of variable; 2) teacher explain by answer and question of basic concept of linear equation of one variable in detail; 3) student is engage to build their own knowledge when identified variable until determine the value of variable in linear equation of one variable. This learning process made active learning and meaningful as a principles of constructivism. It is suitable with learning philosophy of constructivism theorem. Constructivism theorem is students build their own knowledge step by step, and then it is expanded through limited context and through the process (Baharuddin 2012:116).

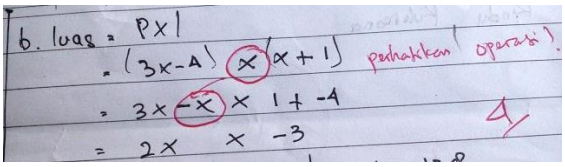
2. Inter topic connection in mathematics

Indicator of connection inter topic in mathematics are linear equation of one variable, equivalent, solution set of linear equation of one variable. Four question of linear equation of one variable is for measure inter topic connection ability in mathematics, there are connection between circumference and area of field, connection between concept of number of angles and area of field, connection between concept of number of angles and concept of number with total score 26. The average ability of inter topic connection in mathematics is 55%, 32 student can answer correctly and the other give wrong answer. Several example of wrong answer of student can be seen below:









The mistakes which done by students in problem solving related to inter concept connection ability in mathematics are the mistakes in determine equation about roving formula, determine equation about area formula, determine solution about roving equation, determine equation about number of angles concept, doing arithmetic operation of equation, careless about "+" and "-" signs. Most error which is done by students is determining equation about roving and area formula.

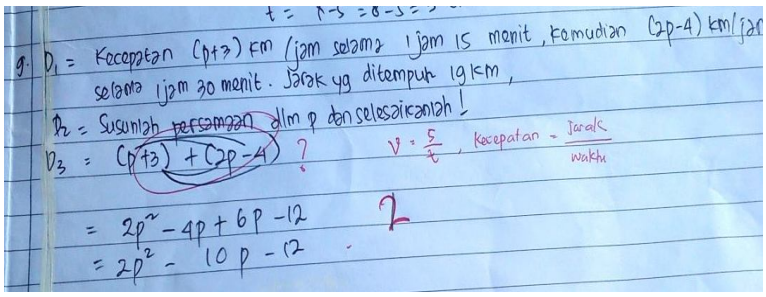
Connection ability inter topic is not optimal yet, second meeting observation data show that teacher have taught contextually by giving problem about linear equation of one variable that related to another area, such as roving of field. However, learning implementation which using speech method, students cannot build their own knowledge independently. Besides that, teacher doesn't do question and answer maximally as in first and second meeting. The teacher has not shown that to make student active to build new concept from concepts which have understood before.

Inter topic ability in mathematics, it is needed active learning of students centered (Slavin, 2010). Besides active learning, student is encourage to build their own knowledge in learning process step by step, which the result is expanded through limited context through the process. Knowledge is not a pack of fact, concept or principle which is taken or remembered. Human should construct knowledge and give meaning through real experience (Baharuddin 2012: 116).

3. Connection between mathematics concept and another science

Indicator of connection between mathematics concept and other science is discharging mathematics model having economic correlation such as counting the mass of thing in order to get

economic value, Physics field correlation such as counting velocity, art project field correlation such as trading. From three things to measure this ability connection, the maximum score is 30. From 32 students, 20 students give answer correlated with Economic field, 14 students give answer correlated with art project and 1 student gives answer correlated with Physics and it is not correct yet. The other students give blank answer whereas. The average of connection ability between mathematics concept and other field is low. It is only 40%. This is the one of student's answer.

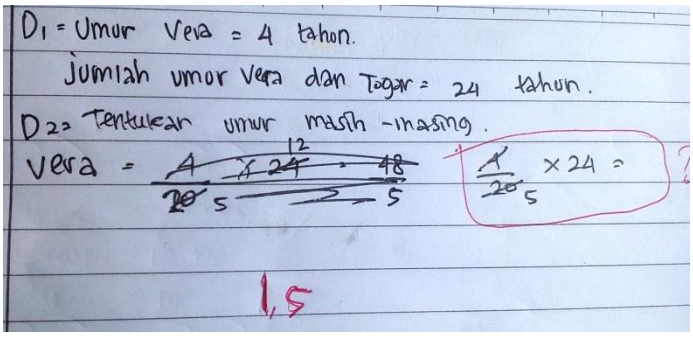


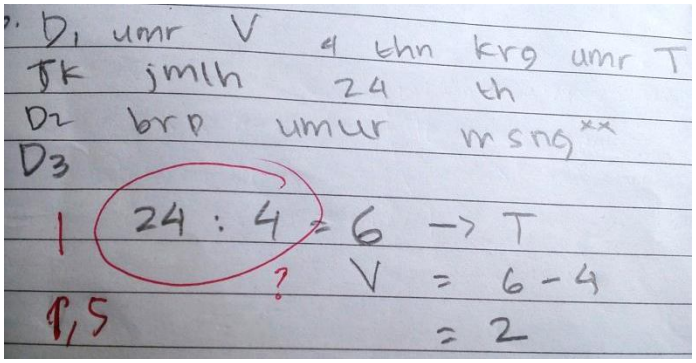
From the works above, it's shown that the student does not understand other field concept neither economic, art project nor velocity. V=s/t in order to s=v x t (distance=velocity x time). This data, which is powered by interviewing student who could not answer anymore, says that the difficulty in making linier equation model is caused by not knowing velocity equation in Science field.

The causal weakness of connection ability between Mathematics concept and other field is based on the observation that the teacher in learning process uses speech method running monotonously. The teacher does learning by giving lots of question to the students without giving them explanation to brush up the material in the previous meeting. With raw-understanding composition in previous material, which is as a condition, makes the student not understand and could not connect PSLV material with other field. In this learning, the students are not invited to construct a concept by paying attention to social environment relation. Learning mathematics must pay attention to ethno-mathematics and local education system through its connection with original culture. The significance of character and mathematics experience impact toward culture does not only build whole individual but also prepare the educator having ability in maintaining various relevance and developing high class- landscape (Maxwell and Chahine, 2013). The teacher also must build the science which has been there as result of process. The basic element process will develop more when the student is invited to interact with social culture environment because social interaction has important role to develop someone's studying (social constructive Vygotsky)

4. The connection between Mathematics concept and daily life

Indicator of connection between mathematics concept and everyday life is discharging mathematics model correlated with Economic field such as counting the mass of thing in order to get economic value, correlated with Physics field such as counting velocity, correlated with Art project field such as trading. From three things to measure this ability connection, the maximum score is 36. From 32 students, only two students who do this number incorrectly. The other students give the blank answer. The average connection ability between Mathematics concept and daily life is very low. It is only 2%. The answers of those students are





From those answers above, it is shown that the student could not understand yet the question well. On that question, it's known that the amount of Vera and Togar's age is 24, it means that V + T= 24. Then, Vera's age is 4 years subtracted from Togar's age, it means that V=T-4. But the student answers 24 divided by 6. It means that the student could not correlate the Mathematics concept with problem in daily life. The other student could not understand the question anymore whereas. It's shown by the student's work in this question i.e. blank answer with 0,694 achieved score from 36 score with 2%.

The causal weakness of connection ability between Mathematics concept and other field is based on the observation that the teacher in learning process uses speech method running monotonously. The teacher does not invite the student yet to recognize the problem in daily life by expressing it in one variable Linier Equation. As in the third indicator, that learning is done by giving lots of exercises to the student without being explained by the teacher to brush up the previous material. Besides that, the teacher guides neither the small group nor individual. Because of that, the student is like to be free and undirected in solving problem given to them. Surely this is exactly the opposite of what Piaget said, "the learning process is started by the real experience happened to someone". The experience is reflected individually. This is accordance with Osman Birgina and friends' research about the concept in high school student about Mathematics connection in real life. They feel low in teaching Mathematics connected with the real life (14,7%), whereas the student feel most of Mathematics connection in real life and professional life (88,7%) (Osman Birgina, 2009).

Conclusion and suggestion

In this study, the average of inter concept ability in linear equation of one variable has high rank, 94%. Inter concept mathematical ability is high because; 1) teacher encourage students to remain and review materials which support linear equation of one variable by answer and question method to review al-Gebra arithmetic operation and also give question about the definition of variable; 2) teacher explain using answer and question method about the beginning concept linear equation of one variable in detail; 3) student is encourage to build their own knowledge when identified variable until determine the value of variable in linear equation of one variable.

The average ability of inter topic connection in mathematics is 55%. Ability of connection inter topic in mathematics is not optimum because the teacher little contextualizing with other science, this study just connect linear equation of one variable problem with circumference of field, but implementation of learning is still using speech method, student didn't build their own knowledge autodidactly.

The average of inter concept ability of mathematics with other science is low, 40%. Connection ability is low because learning is monotonous with speech method. Teacher execute learning by giving exercise in large amount without explanation from teacher to review materials, teacher didn't challenge students to find linear equation of one variable that related to other science.

Because students didn't understand about prerequisite material, the students cannot understand and cannot connect material about linear equation of one variable with other science.

The average of mathematical connection ability with everyday life is very low, just 2%. Based on observation data, inter concept connection ability is low because teacher used monotonous method, that is speech method. Teacher didn't encourage students to recognize problem in everyday life and then implement in linear equation of one variable. Teacher didn't instruct on small group discussion or individual. Therefore, student is free and unfocused in solving a given problem.

This study gives suggestion for the importance of mathematical connection that include connection inter topic in one material, connection inter topic in mathematics, connection between mathematics topics and other science, and connection between mathematics and everyday life (NCTM, 2000: 64), there are several things that need attention and carried in mathematical learning that is (1) learning is done as an effort to construct or build knowledge from their own experience, (2) give priority to active process, (3) implant learning in social context experience, (4) give priority to real learning in relevant context or contextual (Jauhar, 2011: 37).

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