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DEVELOP INDUCTIVE REASONING ON PATTERN NUMBERS WITH A REALISTIC MATHEMATICS EDUCATION APPROACH IN THE NINTH GRADE STUDENTS IN MTs AL-KENANIYAH, JAKARTA

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Abstract

The Mathematic Learning on the material number patterns in class IX Junior High School in Indonesia is usually only given in the form of a patterned number sequence without concrete activities. It does have impact on the undeveloped student's reasoning ability so their problem-solving strategies became less. The difficulties experienced by students when studying this material is determining which rules of an image patterns and patterns of numbers as well as make common abstract generalization. Addressing issues related to the number of the pattern, then we need a learning innovation that can overcome the difficulties and students can develop the capability of inductive reasoning. This study raises the question of how the approaching of Realistic Mathematics Education (RME) can develop inductive reasoning grade IX MTs Al-Kenananiyah in the material Number Pattern. This research was conducted at MTs Al-Kenaniyah Jakarta using design research method. This study describes a Hypothesis Learning Trajectory (HLT) with the aim of developing local learning math theory about the learning process of students and how to support the learning process. Data analysis of the learning process of students individually and socially in the classroom as well as the role of teachers and other factors will contribute to a further improvement of HLT as input. Based on retrospective analysis, activities which have been designed earlier by using the approaching of RME make class be effective and train students to continually honing the ability of inductive reasoning ability assets so that the ability of student to reasoning inductively can be more developed. The use of context which suit a variety of patterns on each of meeting such as hydroponic container context ebb and flow pattern for the number of square and rectangular, mathmatic process that occurs in each phase of the generalization the use of model of and model for, and students active role, as well as the role of the teacher in the classroom who can guide students in constructing strategies and use inductive reasoning ability to identify simple patterns of numbers that even number patterns, odd, square, rectangular and triangular. Emerging strategies also makes it easy for students to elaborate patterns in numerical or verbal form as well as determine the general rules.

INTRODUCTION

The Ministry of Education claimed that mathematical reasoning and mathematical material are two things that cannot be separated, i.e. mathematical material conceived through reasoning and reasoning are understood and are trained through learning materials for mathematics. Broadly speaking, there are two types of reasoning, inductive reasoning and deductive reasoning. Inductive reasoning is used when the truth of a case deduced the truth for all cases.

Related with reasoning, statement of George Polya in Sadiq (2004: 10) the following was supposed to get the attention of the mathematics teacher. Polya States that:

> *Yes, mathematics has two faces; it is the rigorous science of Euclid but it is also something else. Mathematics presented in the Euclidean way appears a systematic, deductive science; but mathematics in the making appears as an experimental, inductive science.*

Polya's opinion showed his recognition of the importance of inductive reasoning in mathematical development, for development to be math in experimental and inductive. Induction is very important in mathematics because it is a good exercise to think creative, intuitive and reflective.

One of the subjects that are studied in mathematics students at the junior level is problems associated with patterns of numbers. The number (quantity) is one of the mathematical content in PISA. Matter of PISA about the number (quantity) it had a larger percentage compared to other content. Quantity in PISA deals with the relationships of numbers and number patterns included in the content of the number (quantity) is the ability of inductive reasoning, represents something in the numbers, understand the math, counting out of the head, and conduct assessments.

Results of research conducted by Sodikin suggests that the ability of reasoning grade 3 MTs in Semarang is still relatively low. The difficulties experienced by students such as in determining the rules of an image patterns and patterns of numbers, as well as the difficulty in determining the inference valid pattern from a premise as well as make common abstract generalizations (Sodikin, 2010: 46). Moving on from the difficulties experienced by students then,it will need some efforts to continue improving the ability of reasoning of students in finding number patterns.

Refer to the above opinion, one of the special learning approach implemented in learning mathematics and reasoning capabilities related to students is Realistic Mathematics Education (RME). This theory was first introduced and developed in the Netherlands in 1970 by Freudenthal Institute.

Realistic mathematics education approach is based on the concept of the Freudenthal argued that mathematics is a human activity and mathematics should be linked to the world of reality (Wijaya, 2012: 3).This Design research will answer the question: how to approach Realistic Mathematics Education can develop inductive reasoning grade IX MTs Al-Kenaniyah on the material Number Pattern?

THE STUDY OF THEORY

Realistic Mathematics Education (RME)

RME refers to the opinion of the Freudenthal said that Mathematics is a human activity, this indicates that Freudenthal does not put human as a finished product, but

rather as a form of activity or process of constructing mathematical concepts. The following is a characteristic RME made reference in the application of mathematical learning in class. There are five characteristics developed by Treffers (Wijaya, 2012: 21): "the use of the context, the use of a model for progressive mathematics, utilize student construction result, interactivity, Connectedness.

Reasoning

One of the math skills (doing math) that is closely associated with the characteristics of mathematics is reasoning or logical thinking ability. Shurter and Pierce in Dwirahayu (2007: 58) stated that the reasoning (reasoning) is a process of accretion of logical conclusions based on the facts and the relevant sources, transformation process which is given in a particular order to reach a conclusion. Whereas, Keraf in Yuniarti (2007: 11) States that the reasoning is the process of thinking which seeks connecting facts or evidences that are already given to gain a conclusion.

Inductive Reasoning

Broadly speaking there are two types of reasoning, inductive reasoning and deductive reasoning. According to Suriasumantri, inductive reasoning is a process of thinking that withdrawl of the General conclusions on the basis of knowledge about the specific things that start from a set of facts (Dwirahayu, 2007: 60). Inductive reasoning starts by examining the particular circumstances and to the withdrawal of the General conclusions, which are called inductive generalization process. These include reasoning observations of specific examples and find patterns or rules that the underlying disease. The General conclusion of induction is called generalization. Conclusions in the generalities are probalistics which means may be right or may be incorrect

According to Mason (Sodikin, 2010:13), Generalization consists of four steps, they are:

First step: Perception of generality, students know the pattern.
Second step: Expression of generality, students are able to elaborate a rule or a pattern, either in numeric or verbal form.

Third step: Symbolic expression of generality, students produce a rule or general pattern.

Fourth step: Manipulation of generality, is that student are able to implemented a rule or pattern in every math problems.

Number Pattern

Find the pattern number is an exercise that can enhance the ability of inductive reasoning in giving (inductive reasoning). The notion of pattern can be formulated as an arrangement that has the form of one form to the next form. The number is used to indicate quantity (a lot, a little) and size (heavy, light, long, short, wide) of an object. The number is indicated with a sign or symbol called numbers. Some of the cases that we often encounter is a number that is composed of other numbers that have a particular pattern, then that is called a pattern number (Moh, 2007: 142-143). In other words the pattern Number is the order numbers with certain rules.

Local Instructional Theory

Local instructional theory is the theory of the learning activity or set of tools that can be used for learning mathematics on a specific topic. Local instruction theory on research of design research is still in the form of a conjecture (conjecture) that consists of three components: learning objectives, plan learning activities and props used during instruction. In this study, the learning sequence number patterns in class IX, namely: (1) understand the shape of growing pattern, (2) determine the rules of the pattern of number of even and odd numbers, (3) determine the rules the number of square pattern and the number of rectangles, (4) determines the number of triangular pattern rules.

Hypothesis Learning Trajectory

Hypothesis learning trajectory is a theory of development local instructions which have been described in the previous section. Hypothesis learning trajectory serves as a bridge connecting between the theories of learning in practice with RME class. Hypothesis learning trajectory is used as a guide to teachers and researchers during the experiment in class. Hypothesis learning trajectory later become a guide in analyzing learning process during the retrospective analysis.

The activity of composing a dining table and seats

Learning objectives: students can understand the mathematical form of a pattern developing (growing pattern).

Material used: paper pictorial arrangement of the table and seats.

Description of the activity of learning

Teacher shows a picture which he carried, a dining table and chairs (Figure 1). Then the teacher explains the picture which he carried in front of the class and say ”One dining table can be surrounded by four seats, plus one dinner table again and attach the ends with first table then the number of seats become six as in the following image”.

Figure 1. Dining table and chairs

The teacher asks “If the dining table plus one more and attached with both your existing table what is the number of seats?” Then teacher assigning students make further arrangement consisting of four to five tables. Students are given the opportunity to discuss how to increase seats happened. Then the teacher directs students to understand that the number of seats required having a pattern of increasingly grow in line with the increase of the number of tables that attached. The pattern is an example of a growing pattern. The teacher asked “How the growth pattern seat?”

The activity of giving the ordinal number of houses

Learning objectives: students can understand the mathematical form of the even and odd numbers patterns, students can determine the formula of the n for even and odd numbers pattern.

Description of the activity of learning:

The teacher gave the students a problem about the story. Yani and Desi's mother had a house in a residential complex Pondang Permai Jalan Perum Pondang. Due to the newly built, home dikompleks that includes the House Mom Desi Mom Yani don't have numbers. From the information obtained from Mr. head of Environment that the setting is the number of house numbers even for homes on the right side of the street and odd numbers for the House on the left.

This enumeration rules starting sequentially from a smaller number and so on respectively. Given the blueprints of the House on JL. Perum Permai Pondang as follows:

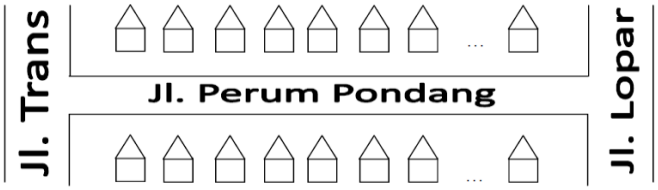


Figure 2. Blueprints

Then the teacher assigning students to give house numbers on the housing in accordance with info given. Teachers say “Give the number for 5 consecutive first House on the right and the left side of the road public corporation Pondang!”. After giving students the task of further house numbers that describe the pattern that is formed, the teacher said ”from the numbers that show house numbers that you wrote it, how the pattern? Explain!” Possibilities there are students who use the strategy:

Even Number ⇨ $2 = 2 * 1$, $4 = 2 * 2$, $6 = 2 * 3$

Odd Number ⇨ $1 = (2 * 1) - 1$, $3 = (2 * 2) - 1$, $5 = (2 * 3) - 1$

The next teacher’s task from the above strategy is likely to steer students to find a general pattern or make generalizations from the number of even and odd numbers. The teacher directs students to find the generalizations by doing the questioning. The teacher said: “If the order of the 3rd House on the right side has a pattern of $6 = 2 * 3$ and $5 = (2 * 3)$ on the left side, what about the order of the most extreme homes on both sides of the road public corporation?”

Farming activity with the Ebb and Flow Hydroponics System

Learning objectives: students can determine the pattern of square numbers and the number of rectangles. Students are able to understand the shape of a square number patterns and the number of rectangles. Students can determine the formula of the nth square number patterns and to the number of rectangles.

Materials used: image media or container of ebb and flow hydroponic systems, the circle made of coins.

Description of the activity of learning:

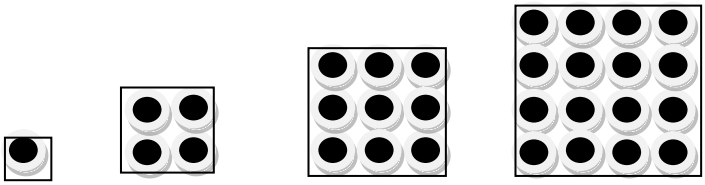
The teacher explains to the students that now many systems to farm is growing along with the development of science and technology, one that ebb and flow hydroponic systems. Ebb and flow or commonly known as tidal systems is one of the unique system of hydroponics because the principle it works i.e. plants get water, oxygen and nutrients through the pompaan of the sump is pumped past the media then moisten

plant roots (pairs), then over time the water with nutrients will go down (downs) back through the media to a shelter. The ups and downs can be set using the timer according to the needs of the plant, so the plants will not be inundated or lack of water. Then the teacher showed the shape of the container for the farm with the ebb and flow hydroponic systems

Figure 3. Hydroponic system

Teacher shows two types of pots which are structured to plant crops according to the area of the container. The following series of pot-the pot:

Type 1:



Type 2:

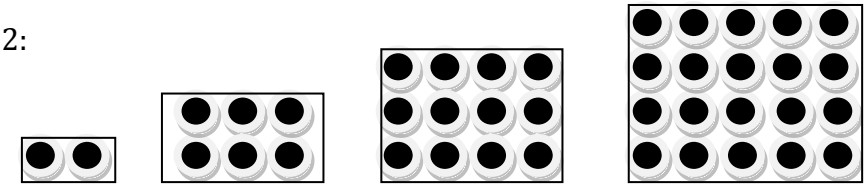


Figure 4. Types of pots

Then the teacher give the questions to the students and ask them to discuss their answers. Teacher says “are the number of pot-pot on type 1 and type 2 form a pattern? Write down the pattern.” Based on both the type of the given set of pots, the teacher directs students to discover that type 1 is a square pattern and type 2 is a rectangular pattern. Teacher says:”from both types of the pot can you find the difference?”. Possibilities there are students who realized that a series of pot to form up a square and rectangle.

The teacher continued with assigning students model the type of containers for the next order. Then the teacher asks students to calculate how many roundabout on the fifth order of type 1 and type 2. The teacher asks”How many number of pots on the fifth order of type square and rectangular type?”. Activities continued with a direct students find many pots are required on the order of n by using the help tables in the given LKS.

Composing a pyramid human activity

Learning objectives: students can understand the mathematical form of triangular numbers patterns, students can determine the formula of the nth triangular number for pattern.

Description of the activity of learning:
Students are given the opportunity to learn in a group of 4 people. Then the teacher giving the issue of context (all groups get the same problems) which will be solved, namely as follows "have you ever find cheerleaders (cheerleader) doing the sports highlights in a game (such as basketball)? Often in force they form a pyramid of men, the one standing between pemain-pemainnya, so that at its height just stand alone. In the Figure below be considered that the human pyramid peak. Human pyramid is the highest ever made in 1981 in Spain. The height is 9 levels. How will they make a pyramid? Whether it's human pyramid-shaped pyramid? Please specify the exact form to explain it! How many people when the high level 2, and level 3?"

Figure 5. Human pyramids

The teacher asked each group to seek a settlement of the question of the methods or the way they each. If completed, the teacher asked several groups with their respective representatives to determine the answer to the question by giving the reason. After listening to the response from students, teachers ask questions "See the pattern. How is the relationship of the number of people in the human pyramid with a large number of levels? How many people when the rate by as much as 9? You guys are trying to determine the number of people at a certain level, without having to know a lot of people at that level before? Explain that!"

RESEARCH METHODOLOGY

Design Research Method

The methodology used in this study is a research method of design was first developed by Hans Freudhental in the Netherlands. Design research aims to develop the theory of the learning process as well as means or ways to support the learning process at both the individual learning process, learning in a classroom, in the community a community of teaching professional or in a community school that is seen as a unified organization.

There are three phases in the design research process mutually form either cyclic in each phase as well as in the overall process of design research activities, the first phase of thought experiment (preparation and design), the second phase of instruction experiment (experiment teaching), the third phase of a retrospective analysis

The Validity and Reliability of Data

On the research of this type of design research, to prove the research results can be proven correct and reliable required validity and reliability.

Validity

Research of design research has two types of validity, internal validity and validity of the ecology. Internal validity is performed to validate the correctness of the results

during the research findings as well as the conclusion of the arguments and interpretations are taken. According to the Gravemeijer and the Deniyanti Cobb (2009: 13-14), design research should also provide an explanation (results) that thorough about what happened in class that gives the possibility of adaptation for other people in different situations, and is referred to as the ecological validity or validity of ecology.

Reliability

There are two types of reliability in research design research i.e. internal and external reliability reliability. Reliability is defined as the internal reliability for this research is taking place. Gravemeijer and Cobb in Deniyanti (2009: 13) external reliability reports on the study should be described so that it can be traced back or repeated by other investigators that both success and failure, the result is the procedure, the framework concept is used, as well as the reasons for researchers in taking a decision

ANALYSIS RETROSPECTIVE

Interpretation Framework

The framework interpretation is the part that describes the methods used in analyzing data, namely data research results in the form of a set of learning process in a community class associated with the development of the matematisasi process. Gravemeijer suggests two important criteria that fall within the framework of interpretation, namely:

1. A framework for interpreting the development of mathematical thinking of students as a whole in a class.
2. The framework for menginterpretasi development process think math students individually.

The result of teaching experiments and analysis of data

Following are the results of research are translated during the second phase of the experimental phase of teaching. Research results will then be analysed further. The retrospective analysis in the process of learning mathematics for teaching and experimentation phases will be explained at each meeting in the classroom.

First Meeting

At the first meeting activity is activity composing a dining table and chairs. This initial activity expected to introduce students to the concept of growing pattern that would help students to learn various pattern numbers. The teacher continued elaboration by assigning students to give the numbers sort of home according to the rules described in the student worksheet after students understand the concept of growing pattern.

Results of observations made by teachers and researchers showed that overall activity involving the context makes the arrangement of tables and chairs as well as numbering a House with even and odd number sequence were able to start a learning trajectory hypothesis students to understand the concept of growing pattern and increase the ability of his thought. The role of context also helps students reach level modeling of referential level, level of general and top levels of the formal level. A fairly good modelling capability allows students to reach the stages of inductive reasoning expected by researchers that Perception of generality, where students are able to recognize a pattern, the expression of generality, where students have been

able to decipher a pattern, either numerically or verbal pattern of even and odd numbers, as well as the symbolic expression of generality which resulted in a general rule (generalization) of both the number of patterns.

Second Meeting

Activity on the second meeting that formed the ebb and flow hydroponic containers. The use of hydroponic container context with the direction of the teacher, helps students bring up the idea that the system container shaped up flat square and rectangle. The container of this system are also thought to bring up student bridging model of situation of pot-a pot that is arrayed in the container.

Results of observations made by teachers and researchers, overall activity that involves the context of hydroponic containers in the shape of a square and a rectangle is able to begin learning trajectory hypothesis students to upgrading his thought. All activities using the characteristics of RME (context, models, interactivity and exploiting the results of construction students) help students reach the stage of expression of generality, where students have been able to decipher a rule or pattern, either numerically or verbal pattern of even and odd numbers as has been analyzed before, as well as the symbolic expression of generality which resulted in a general rule (generalization) of both the number of patterns.

Third Meeting

Teachers begin by explaining to the students learning about the cheerleader and shows Figures of cheerleader who formed a human pyramid arrangement. Context of the cheerleader who formed a human pyramid composition helps students to understand the concept of triangular numbers, from questions about the teacher wakes up to what the human pyramid of average students answered the pyramids that form a triangle. Teachers begin by explaining to the students learning about the cheerleader and shows Figures of cheerleader who formed a human pyramid arrangement. Context of the cheerleader who formed a human pyramid composition helps students to understand the concept of triangular numbers, from questions about the teacher wakes up to what the human pyramid of average students answered the pyramids that form a triangle.

Results of observations made by teachers and researchers, overall activity that involves the context of cheerleader being able to start the hipotesisi trajectory of learning students to upgrading his thought. Analysis on the overall activity shows that students are able to reach the stage of expression of generality, where students have been able to decipher a rule or pattern either numerically or verbal as well as the manipulation of the generality that students apply the rules or patterns of the various issues, in this case the students apply the general rule of the pattern number of the rectangle to get a general rule the number of triangles.

SUMMARY

The research questions research, ”How the approach to Realistic mathematics education (RME) can develop inductive reasoning grade IX MTs Al-Kenananiyah on the material Number Pattern?”. Based on the results of a retrospective analysis, instrumental in developing RME characteristics of inductive reasoning grade IX-C MTs Al-Kenaniyah in the activity of learning material pattern numbers. Following the conclusion of the results of this research: the activities on research design the

research which has been designed using characteristics-characteristics of PMRI is helpful in developing students ' inductive reasoning. Inductive reasoning abilities of students in research has experienced growth and achieve the expected stages of stage expression of generality, where students have been able to decipher a rule or pattern, either numerically or verbal pattern of even and odd numbers, the symbolic expression of generality which resulted in a general rule (generalization) of various patterns of numbers and the manipulation of generality, that the students are able to apply the rules or patterns from a variety of issues.

Suggestion

Study of design the research produced many strategies and models that are created by the students, but because researchers only focused on the development of inductive reasoning, the ability to bring up strategy of this model could be a basis for further research.

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