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LEARNING DESIGN ON THE INTEGERS ADDITION AND REDUCTION USING "KAKISAMBE"

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Abstract

One aspect in mathematics according to the Kurikulum Tingkat Satuan Pendidikan (KTSP) at the primary school level is a number. Learning numbers tend to form an understanding of notation, symbols and other forms of representing so it can support students' thinking and understanding to solve problems. Realistic Mathematics Education Indonesia (PMRI) is an alternative approach to learning that can be used by mathematics teachers in developing students' abilities to think, reason, communication, and problem solving both in lessons and in everyday life. The purpose of this study was to determine the strategies that students use in understanding the concept of operations of addition and subtraction of integers using the media game "kakisambe". The method used in this study is the research design of learning through the stages of preparing for the experiment, teaching experiments, and retrospective analysis.

Keywords: PMRI, media game "kakisambe", Design Research.

INTRODUCTION

Knowledge acquired in primary school children (SD) will greatly affect the next education level. This is in line with the hierarchy of learning proposed by Gagne (Wena, 2009). Similarly, a child's mathematical knowledge. Dealing with abstract mathematical ideas/concepts arranged hierarchically. To learn a concept that is based on the concept of the other, one needs to first understand the prerequisite concepts, without understanding the prerequisite concepts that people may not understand the new concepts well. Students who do not understand the basic concepts will find it difficult to understand his new subjects, as a result many students who do not like math.

Less preferred by students' math may be influenced by material factors or the learning process. In terms of materials, mathematics is an abstract science. For kids abstract mathematics will be increasingly felt if the material is made far away from everyday life. Even according to Van den Heuvel-Panhuizen (Caritas, 2012) when children learn mathematics apart from their daily experiences the children will quickly forgotten and can not apply mathematics.

One aspect in math at the primary school level is a number. According to the National Council of Teachers of mathematics (NCTM) (Walle, 2008) learning numbers tend to form an understanding of notation, symbols and other forms of representing so it can support students' thinking and understanding to solve problems. Learning numbers is important for primary level teaching other topics. In the second semester of fourth grade number is aspect summing and subtracting integers.

At primary school teaching integer operations are usually carried out by several methods such as the number line, the use of pipes and pieces of positive integers-negative integers. But in general the teachers using the number line.

In Praktek Kuliah Lapangan (PKL) in Pusat Pengembangan Pemberdayaan Pembelajaran dan Tenaga Kependidikan (PPPPTK) Mathematics in Yogyakarta 19 to 26 November 2012 and the 2nd International Symposium on Mathematics Education Innovation 22 to 23 November 2012, the authors found a variety of media are used in learning mathematics particularly the operations of addition and subtraction of integers, among others: the integer pipeline, sweet and spicy candies, pieces of positive-negative, and the game "mamuntebal".

Some research suggests that the use of props / media can enhance students' knowledge, among others, Charity (2012) which uses Traditional Games Tepuk Bergambar (PT2B) in the arithmetic operations of multiplication and division of numbers, the results of Experiment Teaching PT2B suggests that context can stimulate students to understand knowledge them about the concept of number operations, also Pransisca (2010) who uses a slide rule was found to increase the understanding of the concept of integers. The above studies indicate that there is an increased understanding of the students using props / media.

In addition to the use of props / media other thing to note is that the learning approach used. The approach chosen should be able to make students actively construct new knowledge. PMRI approach is an alternative solution that could be used for that purpose. PMRI refers to the concept of Freudenthal in Realistic Mathematics Education (RME). Two important perspectives of Freudenthal is (1) mathematics must be connected to reality; and (2) mathematics as human activity. (Zulkardi & Ilma, 2010).

Although learning PMRI adapted from learning Realistic Mathematics Education (RME) developed by Freudental Institute in the Netherlands, but in the implementation PMRI adapted to the local cultural context and conditions that occurred in Indonesia (Sembiring, 2010). Therefore used in the learning context PMRI labored to form the context of having experienced or can imagine in the minds of students.

Most kids know the game of snakes and ladders Indonesia, checkers, or Monopoly. Therefore, researchers would like to design a learning summing and subtracting integers by adopting the games combined with the number line method, which is called "Kakisambe" (same left-right difference). By using the game "Kakisambe" math students will better appreciate the real nature and based on clear facts. So that children more easily understand the topics and learning more meaningful.

Research question in this study is How trajectory learning in the learning material integers using the game "Kakisambe" can evolve from the informal to the formal stage in fourth grade?

Of the problem are formulated, the study aims: 1. Knowing the students' understanding of concepts in the operations of addition and subtraction of integers using the game "Kakisambe" in the fourth grade. 2. Produce learning in the learning trajectory integers material using the game "Kakisambe" in the fourth grade.

Methods that use in this study is *Design Research*.

MAIN SECTION

1. Learning Mathematics

According to the Ministry of Education (2006), the purpose of learning mathematics in school is that the students have the ability to: (1) Understanding mathematical concepts, explains the relationship between concepts and apply concepts, or algorithms, flexibly, accurately, efficiently, and accurately in solving problems; (2) Using the pattern and nature of reasoning, mathematical manipulation in making generalizations, compile evidence, or explain ideas and statements, (3) Solve problems that include the ability to understand the problem, devised a mathematical model, solve the model, and interpret the obtained solution; (4) Communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; (5) Have respect for the usefulness of mathematics in life, which is curious, attention, and interest in studying mathematics, as well as a tenacious attitude and believe in solving the problem.

To achieve the goal of learning mathematics is seen also in the characteristics of mathematics learning, it can be concluded that the study of mathematics students should learn the material are arranged in a certain order, in which the students must have the ability to learn or understand the material and to resolve problems mastering the material prerequisites for making it easier The next study material. Atmosphere of learning in mathematics should be conditioned so that students are more actively or directly involved in the learning process in understanding a concept. To change the process of learning from a teacher-centered (teacher center) to be centered on the student (student center) then PMRI is one alternative solution that can be used.

2. Realistic Mathematics Education Indonesia (PMRI)

PMRI initiated by a group of mathematics educators in Indonesia. Mathematics learning process performed directly on the formal stage by giving the formula and require to memorize the formula without any meaningful activity has made students fear and avoid math. This is one reason that led to mathematics educators trying to reform mathematics education (Sembiring, et al, 2010).

Freudenthal PMRI refers to the concept of mathematics as a human activity. Therefore, philosophy PMRI also an adaptation of the philosophy of RME is based on the ideas explored and developed by Hans Freudenthal. Two important perspectives of Freudenthal is (1) mathematics must be connected to reality; and (2) mathematics as human activity "(Zulkardi & Ilma, 2010).

PMRI learning is not only concerned with the end result, but rather focuses on the processes that occur during the learning takes place. PMRI more emphasis on process skills, active students in discussions, collaborate, and interact during the learning process. Context is used in a learning context PMRI endeavored that ever experienced by students or can be imagined in the mind of students (realistic).

Principle PMRI

PMRI learning principles in accordance with the principles of RME (Gravemeijer, 1994; Zulkardi, 2010), namely:

1. Guided reinvention and progressive mathematization
2. didactical phenomenology
3. Self developed models

Characteristics PMRI

PMRI principles more broadly defined by its characteristics (Gravemeijer, 1994; Zulkardi, 2010), namely:

1. Use of Context (The use of contexts)
2. Usage Model (Use of mathematical models for concept construction)
3. Use of Outcomes and Contribution to Student Self (Use of students' creations and Contributions)
4. Interactivity in the learning process (Students activity and interactivity in the learning process)
5. Integrated with other learning topics (intertwining mathematics concepts, aspects, and units)

Mathematics is taught to the students will be more meaningful when linked to other learning topics. PMRI a holistic approach that does not separate mathematics with others but rather an attempt to connect with the various aspects of a problem that can be solved. Intertwine is an integration of various topics in learning. Learning will be done mutually linking between the various concepts of mathematics and other learning topics. Learning units can not be achieved separately so that linkages and integration should be explored in problem solving.

3. Game "Kakisambe" (Right Left Same Difference)

"Kakisambe" is used as a medium to assist students in learning integers. The props that double as props bilangan rounded arithmetic operations and mathematical tools educational games. By using this media is expected that students get excited to learn math, and the concept of addition and subtraction of integers can be embedded properly. Games as a medium of learning involves students in the process as well as the experience and appreciate the challenge, inspired, creative and motivated to interact in activities with fellow students.



Figure 2. Sambe foot game board

As learning aids, "kakisambe" is a model of the use of the number line to complete the arithmetic operations of addition and subtraction of integers. This game consists of a game board that contains an image twice the number line are two back to back

double decker perpendicular, it shows that this game can be played up to 4 players. In each quadrant there is a rectangular field that is a place to put a prize or reward if you can answer the questions correctly. There is a place card challenge circle, and the point 0 is located the center image.

Basically this game is a way to use the same as doing integer arithmetic operations by using the number line. Each player in turn playing with the cards about to be done on the number line, then move the pawn / puppet on the number line.

Number line used is the number jump from -10 to 10. By using a number line is expected that students remember that the numbers are located on the right is greater than the numbers are on the left. If you move to the right numbers will increase, whereas if moving to the left means diminished.

Number line owned by player-1 back to back with the 3rd player, allied at the point 0, which is the central point of the number line players. It is also useful to remind students about the opposite of a number. Two numbers is said to be contradictory if the two numbers are the same numbers but opposite sign, the sum of two numbers is equal to zero. Number 3 on the number line player-1 is the opposite of the existing -3 on the number line-3 player.

Pawns or puppets that are used to mark useful steps taken by the player. Every time start working on a count always starts from zero. This game is only required on one pawn or the puppets are used interchangeably.

The cards are arranged randomly challenge then stacked, contains matter which must be resolved by the time the player turn. The player takes the top card, reads and showed it to other players, and then resolve the existing problems. Besides matter, these cards also contain information about the number of questions and the number of points. Matter of numbers, a player who acts as a judge can direct match with the answer key. Number of points as a reward / gift tailored to the level of difficulty of the questions.

As a reward if you can do it right, then right to receive one or more points in the form of seed gift or stamp to be filled on the field / plot points of each player. Conversely, if the player is not able to answer the question correctly, then the player gets no points. On the field, there are 25 small plots, but at the start of the game participants can agree to that will determine how many plots they wear or how long the game.

Determining the winner is the player who plots a full point ahead, or players who have points / seed gift most. Each player and learn from each other with regard to the jury (peer learning) when another friend to play, in the sense in determining the truth or falsity of the completion of a matter, but a student who does not participate in the game can be positioned as a "jury chairman" as well as the waiter in the game The.

The game is named "Kakisambe" stands for Left Right Same Difference, which is the basic concept of integer arithmetic operations. Players apply the basic concepts of arithmetic operations that is moving to the right if positive integers, to the left for negative integers, passed in the same direction with a second number to the sum, or in a different direction with a second number for reduction. For example, as follows:

$4 + (-7) = \dots$, then the completion of the game by using the tool "Kakisambe" is: starting from the center of the zero point, move the puppets are four steps to the right and hold left seven steps, so that the pions stop in -3 points. So $4 + (-7) = -3$.

RESEARCH METHODOLOGY

1. Research Methods

In this study, researchers used a method of teaching research design. Design research is a systematic study of designing, developing and evaluating educational interventions (such as programs, instructional strategies and materials, products and systems) as a solution to solve complex problems in educational practice, which also aims to advance our knowledge of the characteristics of interventional-the intervention as well as the design and development process (Plomp & Nieveen, 2007).

In the research study design, study implementation process is guided by an instrument called the Hypothetical Learning Trajectory (HLT). When learning is done not in accordance with the design that has been designed, it is necessary to re-designing (thought experiment) against the HLT and then carried back to the HLT test (instruction experiment). This process goes on and on depending on the time of the experiment.

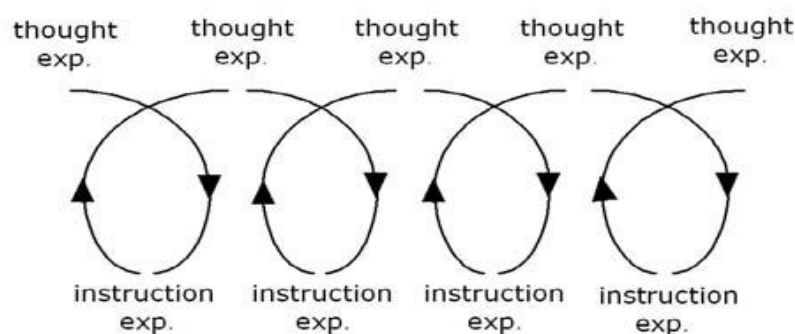


Figure 2. *Cyclic Process* (Gravemeijer & Cobb, 2006)

According Gravemeijer & Cobb (2006), research design consists of several phases, namely design preparation (preparing for the experiment), the experiment teaching (teaching experiment), and retrospective analysis (retrospective analysis).

a. Design Preparation (Preparing for the Experiment)

1. Preliminary Design (Preliminary Design)

At this stage, the researcher initial ideas, starting with studying various literature review before designing learning activities during the study.

a. Literature Review

b. Students Navigate the Initial Capabilities

c. Designing Learning Allegations track or Hypothetical Learning Trajectory (HLT)

2. Research Experiment (Pilot Experiment)

The research trial is a bridge between the stage and the initial design stage experiment teaching. The purpose of this research experiment is to test early HLT. The main objectives of this phase is to collect data to support early compliance with the HLT. At this stage will get advice and discussion with the teacher models. It is intended that the HLT can achieve the goal of learning objectives for student teachers more aware of the condition of the sample in the study.

b. Teaching Experiment

At this stage of experiment teaching is done collecting data to answer the research questions. The process that takes place in research trials and stresses that the idea can be modified when the alleged accommodate reasoning and learning ability of students in the classroom. This is where the core of the research data obtained.

Before conducting learning activities in the teaching experiment, researchers and teachers held a discussion on learning activities conducted on the day. During the learning process, while the allegations can be modified as HLT revision for the next activity. Furthermore, after the learning activities, researchers and teachers of the model to reflect the learning activities that have been performed.

During the implementation phase of teaching experiment, researchers conducted data collection by using photos and videos, student work, student activity sheets observation and also a few students selected to be interviewed.

c. Retrospective Analysis (Retrospective Analysis)

In a retrospective analysis, HLT is used as a guide and major reference in answering research questions. HLT compared to what goes on in learning to investigate and explain how students can generalize from gaming activities "foot sambe" activity leading to the concept of addition and subtraction of integers. In addition, the HLT was also compared with the data generated to describe the development of strategies used by students and students' thought processes in solving problems.

2. Data Collection Techniques

Based on the methods and procedures used in this study, the data collection techniques used in this study are:

- The written test
- observation
- interview
- Recording video and photos
- field notes

3. Data Analysis Techniques

Design Research is a qualitative research method, the technique of data analysis in this study was done qualitatively by considering the results of the data collection has been done. In addition to analyzing the test results of students' writing, data analysis methods research design was done by comparing the results of observations during the learning process that has been designed with HLT. In a retrospective analysis that has been designed HLT role compared with their

lessons so that students can do an investigation and described how students acquire concepts of addition and subtraction of integers.

CONCLUSION

At the time this paper was written, this new research will be carried out so that there are no results that the authors report, while the research plan are as follows:

Subject, Place, and Time Research

The subjects were fourth graders Integrated Islamic Paradise Elementary School (SDIT) Bina Ilmi Palembang, amounting to 24 students, consisting of 13 male students and 11 female students and involved a teacher who taught in the classroom. The research was conducted in the second semester of academic year 2012/2013. Researchers have devised a schedule for implementation of the research described in the following table:

No	Stage	Time	Description
1	<i>Preparing for The Experiment</i>	March-April 2013	Reviewing the literature and designing HLT.
2	<i>Teaching Experiment</i>	April-May 2013	Collecting data to support.
3	<i>Retrospective Analysis</i>	April-May 2013	Analysis of research.

Table 2. Research Plan Implementation Schedule

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