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THE EXPLORATION OF INDONESIAN TRADITIONAL GAMES AS THE CONTEXT IN LEARNING FACTOR NUMBERS

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Abstract

The main goal of this research is to explore the Indonesian traditional game as the context which is for acquiring the concepts of factor numbers. This research was held in the first semester 2010/2011 with a total number of 20 fourth grade students. Realistic Mathematics Education (RME) as the basic principle in teaching and learning processes of this research. With RME tenets, PMRI in Indonesia has an important role for a new pedagogy in mathematics classroom whereas students are encouraged to construct mathematical idea within their daily life. The research was conducted by design research methodology, comprising namely preliminary design, teaching experiment, and retrospective analysis phase. The discussion in classroom present to get information of the students' understanding about factor numbers through their experiences in playing bekel game. The result of this research shows the use of Indonesian traditional game as the context in learning factor numbers. So, the students can explore their understanding in learning process.
Key word: Realistic mathematics, design research, Indonesian traditional games, factor numbers

1. Introduction

Learning mathematics plays an important role in the live of individuals and the importance of mathematics in elementary school cannot be overemphasized. One of the focuses implementation in curriculum, called KTSP, stressing on concerning students' learning process. In the guide line curriculum, it was stated that mathematics in elementary school its defined students' activity, to communicate their mathematical idea, in learning process. Students are allowed to use their efforts in solving a mathematics problem even using their language or symbol. Students must be active in exploring and developing their knowledge (Hadi, 2005). Teachers act as facilitators who guide students toward the construction of students' knowledge itself. One of the current paradigms in the era is theory of Realistic Mathematics Education (RME). RME was introduced in Indonesia approximately ten years ago. RME is a theory of learning and teaching mathematics that was introduced and developed by the Freudenthal Institute in the Netherlands. RME later was adapted by Indonesia, which is then called *Pendidikan Matematika Realistik Indonesia* (PMRI). PMRI is suitable with Indonesian's condition (Sembiring, 2008). PMRI is a learning approach that uses the real world as a first step to develop mathematical ideas and concepts.

To explain the ideas and the concepts of mathematics it can be done with the exploration of the local context as a starting point. As the basis of students' knowledge, the context becomes the first step in learning mathematics (Zulkardi and Ratu Ilma, 2006). The local context can be a traditional game that is associated with learning and mathematical concepts. As we know elementary students cannot be separated from the world game. According to Monks (Pitajeng, 2005) revealed that children and games are two terms that can hardly be separated from each other. Traditional game could become as starting point to explore student's knowledge which is their experience in playing game. The previous research about Indonesian traditional games, Wijaya (2008) used "gundu" game and "bentik" games for acquiring the concept of linear measurement. Due to the students' experiences of game within their daily life, it is possible to use Indonesian traditional game, particularly in Palembang, for supporting in learning factor numbers.

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This research reports the initial try out of exploration Indonesian traditional games in grade four PMRI classrooms in learning factor numbers. The focuses point in this research is how students can explore their understanding for acquiring the concept in learning factor numbers by using Indonesian traditional games. The explanation will be given details from their strategies and conversation between teacher and students.

2. Literature Review

PMRI is the starting point from the context or real situations that emphasize the learning process, discuss and collaborate, and then arguing with their classmates to solve problems either individually or group. In this approach the teacher's role is a facilitator, moderator or evaluator but as facilitator which provides learning experiences and encourages students' reasoning. Gravemeijer (1994) revealed that the role of teachers should also change, from validator (stating whether the work of the student correctly or incorrectly) to be someone who acted as guide who appreciate every students' contribution. Philosophy PMRI is an adaptation of the philosophy of RME that is based on the ideas explored and developed by Hans Freudenthal. Two important views of him are (1) mathematics must be connected to reality, and (2) mathematics as human activity "(Zulkardi, 2002). The first view stated that the mathematics should be close to students and relevant to situations in daily life. Furthermore, the second view had the meaning that students are given an opportunity to learn within activities of math (guided opportunity) then students are expected to find (re-invent) the concept or mathematical principles or find a model. To organize these experiences we use mathematics which is called mathematizing. Freudenthal said that there are two mathematizing, which is mathematizing from mathematical experience of reality and mathematizing from mathematical experience of mathematics. Then Treffers formulated the idea of using the term of Freudenthal which is called mathematizing horizontal and vertical (Van den Heuvel-Panhuizen, 1996).

Furthermore, in line with RME, PMRI has five basic characteristics that are followed in learning process (Gravemeijer, 1994). Those are explained:

1. Phenomenological exploration or the use of contexts
   The phenomena by which mathematics concepts appear in reality should be the source of concept formation. The process of exploring the appropriate mathematical concept from a concrete situation is called conceptual mathematization. This process forces the students to explore the situation or context, find and identify the mathematical concept, schematize and visualize discovering pattern, and developing a model result a mathematical concept. By the process of reflecting and generalizing, the students will develop a more complete concept. Then it is expected that the student will apply the concept to the other aspects in their daily life, reinforce the concept.
2. The use of the models or bridging by vertical instruments
   Learning mathematics often need a long time and moving from various abstractions. In this level we use models as a bringing vertical instrument. Kinds of this model might appear variation, namely the concrete form of object, picture, schemes, etc which is intended as a bridge from concrete to abstract form then from the abstract to other abstract. This knowledge that are similar with real problem is called "model of" and knowledge from own model to a formal abstract is called model for.
3. The use of the students own productions and constructions or students contribution
   The students should be suggesting creating things. By making their own production students are forced to reflect on their learning process. The students' show their statements when they are encouraged to construct and produce their own solutions. In addition reason that own contribution of the students can form an essential part of assessment.
4. The interactive character of the teaching process or interactivity
   Obviously interaction between teacher and students is an essential part in instructional process. Explicit negotiation, intervention, discussion, cooperation and evaluation are essential elements in a constructive learning process in which the students' informal methods are used as a

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standard to attain the formal ones. In this interactive instruction, the students are engaged in explaining, justifying, agreeing and disagreeing, questioning alternatives and reflecting. In classroom activity the students are encouraged to discuss their strategies and to verify their own thinking rather than focusing on whether they have the right answer. Such activities can enable students to depend less on the teacher to tell them whether they are right or wrong. Hence, the students find opportunities to develop their confidence in using mathematics.

5. The intertwining of various learning strands
   The integration of mathematical strands or units is essential. It is often called the holistic approach, which fits in applications, and implies that learning strands should not be dealt with as separate and distinct entities. Instead, an intertwining of learning strands is exploited in solving real life problems. One of the reasons students has difficulty to apply mathematical idea because it is taught separately each other. In that case students cannot connect in other subject.

3. Methodology

This research used a design research as methodology. According Gravemeijer and Eerde (2009) that design research is one of the method researches that aim to develop local instructional theory and cooperation between researchers and teachers to improve the quality of learning process. Furthermore, Wang & Hannafin (in Simonson, 2006; Wijaya 2008) also defines a design research as a systematic but flexible methodology aimed to improve educational practices through iterative analysis, (re)design, and implementation, based on collaboration among researchers and practitioners in daily life settings, and leading to contextually-sensitive design principles and theories. In this method comprise three phases specifically design, teaching experiment, and retrospective analysis. Gravemeijer and Eerde (2009) also illustrated the reflexive relation between thought experiment and instructional experiment in design research. In Figure 1, it shows that reflexive relation.

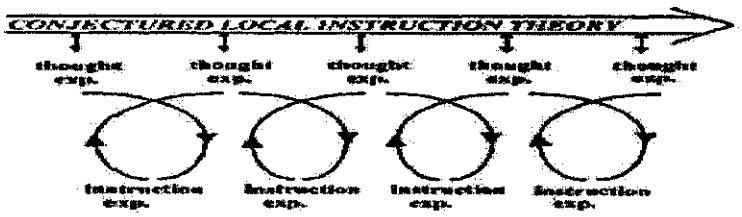

Figure 1. Reflexive relation between thought experiment and instructional experiment in design research (Gravemeijer & van Eerde, 2009)

This research was conducted to design activities that accompanied the learning objectives. Then these activities connect with students' experience in this research that would be connected by using Indonesian traditional game to achieve understanding concept of factor numbers. In this paper contains the main discussion on the concept of factor numbers. Note that all the activities were designed collaboratively by teacher, lecturer and researcher. This research pointed out the interplay between what happened in the classroom during teaching experiment and analysis students' behavior and thinking could not be exclusively separated (Widjaja et al, 2008).
The focuses of this research is to know and to explore their knowledge about traditional games, namely the bekel ball game. Afterward they could connect it to get the concept of factor numbers. The students were given opportunity to play the games approximately fifteen minute to remember remain how to play the game in their own role. The design of this game was given after all students have experiences how to play the games. The second step is that the teacher gave intervention about the games role to guide that this game would attain the concept of the factor numbers. The last step is that they could explain what they were doing. Furthermore, it will be presented in the next section.

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Participants

This research was held in SD N 119 Palembang, which joined PMRI since 2004, the term of the academic year of 2010/2011. The reason why this research was held in this school is that there is the partner school PMRI. A total of 20 fourth grade elementary school took part in this research.

4. Discussion

At the beginning the teacher asked about Indonesian traditional games. It was done in order to know the students' knowledge about games in Indonesia. Some students said the games that their know, for instance "*kelereng*" game, "*engklek*" game, *karet* game and "*bekel*" game, but some students said that the modern games like play station, internet game and computer game. The students are engaged in the activity, and they discussed with their friend which games were usually doing in daily life. The situation in this class was interesting. The students began with giving their comment of each game that was doing at their home.

Figure 2. The teacher asked the students about Indonesian traditional games

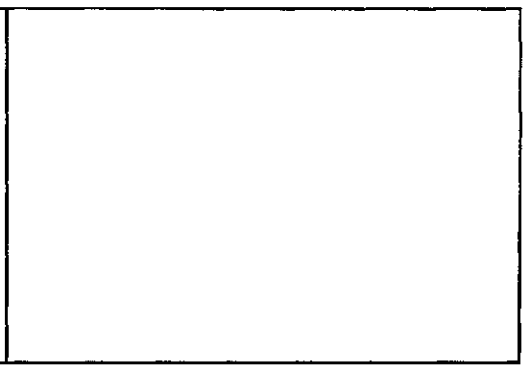

Figure 3. The students were discussing about Indonesian traditional games

The discussion about their knowledge in Indonesian traditional games is recorded in the following script:

Teacher : *Which of you know about our traditional games?*
Kholis : *What is it, Mom?*
Teacher : *Traditional games are usually games that you are doing with your friend*
Rendi : *Kelereng*
Ferdi : *Play station*
Slamet : *No, "gundu" and "engklek"(in Palembang language gundu game is kelereng game)*
Teacher : *Any other game?*
Salsa : *yeye, mom. (in Palembang language yeye game is karet game). I ever played it with my sister*
Teacher : *Have you played it?*
Salsa : *Yes Mom, because my sister asked me to become her partner*
Teacher : *Do you like it?*
Salsa : *Yes Mom.*
Teacher : *Any other game again?*
Kurnia : *Bekel, mom. I ever saw the bekel ball in my house.*
Teacher : *Have you played it?*
Kurnia : *Not yet mom.*
Laila : *Yes, with my sister, Mom*
Ayu : *Yes, I ever played it. I won at that time.*

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From this conversation we knew that the students' knowledge about traditional game was varied. The changing condition in this city might influence the students' knowledge about traditional game even though some students still know about it. This was the initial step to know how far their knowledge about traditional games in Palembang. The following discussion is about students' experiences in playing bekel ball. The teacher asked about the role of their game to know how their understanding about this game.

Teacher : *Ok, if you ever played this game, could you explain the role of this game? (The teacher showed the tool of bekel ball game)*
Laila : *the first step, we took the beads one by one. Then I caught the ball after the first bounce back.*
Teacher : *Oke, is there anybody who could do like Laila said?*
Mamat : *Yes, mom. I could do it*
Teacher : *Oke, I would give you the time approximately 15 minute to play this game then we would discuss what you get from this game*

Figure 4. Teacher shown the tool of bekel ball game for the students

Figure 5. The student played bekel ball games while he eliminated the bead one by

Figure 6. The students played bekel ball games while they eliminated two-two of the bead

Afterward the students worked together in small group. They discussed about the role of the game. For this research the class consisted of four groups. To get information and understanding of students, teacher as facilitator began to give them probing question. Later, she guided the students by using her role.

Teacher : *Ok, we discussed about your last activity. How do you feel now?*
Laila : *I like to play the games because I won even though I didn't finish yet*
Teacher : *Why do you said like that?*
Laila : *yeah, because I was in level three and the time was up*

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Teacher : so when you thought that you could win in this game?
Laila : when I got in level eight because my beads was eight
Teacher : so you have more time to get level eight?
Laila : yes mom
Teacher : oke, how about the other?
Mamat : Yes, mom, me too
Teacher : What do you think, when the longest elimination of the beads will be?
Mamat : in level one, mom. I must eliminate until eight times.
Teacher : does it have the remainder when you eliminated them until eight times?
Kholis : No, it was zero
Teacher : Why do you think it is zero?
Kholis : When I took the beads one by one until eight times, my beads had no remainder. So it's zero, mom.
Teacher : how about the others?
Iqbal : (confuse) I thought yes,,,
Teacher : why you're confused?
Iqbal : because at the first time I thought there are seven remainders
Teacher : Ok, let's we try again
Iqbal : (he stood in the class and tried to eliminate the beads). I understood mom, I thought while I take one bead so the others are the remainders.

This conversation was the exploration of students' understanding while playing the game. Unconsciously, they have done counting numbers, for instance they eliminated every step through guiding the role of the game. The exploration of this game appeared when the role of the game was doing by the students. The conflict was appeared when the teacher gave probing question and tried to engage the students to thinking about counting numbers. The concept of factor numbers is appeared when the students know about the numbers can be divided in which the remainder is zero. This concept could occur when students played the bekel ball game. The following discussion was recorded when the students use their thinking and understanding about their last experience.

Teacher : if we were in level one, does it has the remainder?
Mamat : No
Teacher : if we were in level two, does it has the remainder?
Kurnia : No, zero
Teacher : if we were in level three, does it has the remainder?
Kholis : Yes. The remainder is two.
Teacher : why do you say the remainder is two?
Kholis : Because I had eight beads. The first step I took three, and then the remainder was five. In the second step I took three again, then the remainder was two. So when I took again the same numbers, it would not enough. So it was the remainder (he shown two beads)

Then the teacher continued the discussion to determine which one the number has remainder and no remainder.

Teacher : so if we remembered about the role of the game, could you explain to me when the level was having remainder and no remainder?
Kholis : I am, mom
Teacher : let's try
Kholis : (thinking by using his finger) in level one, it was no remainder. In level two, it was no remainder. In level three, it was two remainders. In level four, it was no remainder. In level five, it was three remainders. In level six, it was two remainders. In level seven, it was one remainder. In level eight. It was no remainder?

ISBN. 978-979-1222-95-2

Laila : *mom. I wanted to explain too. (She said what she did in the worksheet). There were four numbers that had no remainder. There were when we took the beads one-one, two-two, four-four and eight. Besides that, there were also four numbers having remainder. There were when we took bead three-three, five-five, six-six, and seven-seven.*

Teacher : *ok. Why did you say that we took bead three-three, five-five, six-six, and seven-seven have remainder?*

Laila : *because it cannot be divided again (she shows their worksheet then she proves by using their beads)*

This conversation was interesting condition when we wanted students understand about the concept of factor numbers after playing bekel ball. We started with playing game then they had experience after playing. We lead them to find the concept of factor numbers. Laila's reason was closed ways to find the concept of factor numbers. The similar meaning is shown in formal way like if we had numbers 8 so the numbers which could be divided 8 are 1, 2, 4 and 8. The Laila's reason and her thinking was a simple language for the students in grade four. In this activity we could give the line that when the students were trying to solve the problem from their experience, then it's called horizontal mathematizing. When the students were trying to solve the problem from their language and model to formal concept, then it is called vertical mathematizing.

5. Conclusion

Exploration Indonesian traditional games have been done with initial design to get the concept of factor numbers. Our finding suggested that the students in this classroom were able to explore their understanding by getting involved with bekel ball game. They were coming up with their reasoning when the teacher gave probing questions. The idea of Kholis dan Laila is to differentiate the level when they tried to explain their interpretation about remainder and no remainder. Kholis were still thinking in horizontal mathematizing, at the same time Laila were thinking in vertical mathematizing. This condition included in PMRI that is facilitated by teacher. In our research, the teacher and the researcher tried to capitalize on students' thinking in promoting various strategies. This was supported by the main use of teacher's probing questions to elicit students thinking. The teacher formulated strategies to enable students to advance from a less to a more formal strategy. With the PMRI characteristics, each group was expected to contribute their ideas during small group and whole class discussion. All members in the class are expected to respond to other strategies and contribute to the whole classroom discussion. The teacher supports this practice by asking other students to explain and to justify different strategies.

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