IndoMS. J.M.E
Vol.2 No. 1 January 2011, pp. 41-54

Building counting by traditional game: A Mathematics Program for Young Children

Nasrullah, Zulkardi

Abstract

In line with design research, the use of Bermain Satu Rumah (BSR) as traditional game to support children's counting classroom wherein students are encouraged to construct mathematical understanding. Number in traditional games is an interesting aspect that is helpful for children to encounter numerous situations that bring them into contact with sounds, symbols and meanings that relate to numbers. Bermain satu rumah as starting activity would be media to enhance student's sense of number as well as to be used as learning material. By developing *model-of* problem of bermain satu rumah as traditional context, resultative counting is counting a number of things with the aim of determining how many are there (the result) that can be showed by using addition and multiplication concepts. Student's thinking on their level exhibited us their successful conservation when they were in the last grade. The progress of understanding by game, especially bermain satu rumah, is concrete effort to support number learning in primary school. Using game in learning process, for instance, mathematics learning for primary school can be a mathematics program for young children.

Key words: *Resultative Counting, bermain satu rumah, Mathematics Program*

Abstrak

Melalui penelitian desain, penggunaan Bermain Satu Rumah (BSR) sebagai permainan tradisional untuk mendukung kegiatan pelajaran membilang anak dimana mereka akan terpacu untuk mengkonstruk pemahaman matematis. Bilangan dalam permainan tradisional merupakan aspek menarik yang membantu anak untuk mengalami berbagai situasi yang mengajak mereka untuk bersentuhan dengan suara, simbol, dan arti yang berkaitan dengan bilangan. Bermain satu rumah sebagai aktivitas awal bisa menjadi media untuk meningkatkan kepekaan bilangan anak sekaligus materi pembelajaran. Melalui pengembangan masalah *model-of* dari bermain satu rumah sebagai konteks lokal, membilang resultatif melalui membilang sejumlah garis bersilangan bertujuan untuk menentukan berapa banyak (hasil bermain) yang dapat ditunjukkan dengan menggunakan konsep penjumlahan dan perkalian. Cara berpikir siswa pada tingkatannya menunjukkan kepada kita tentang kemajuan konservasi siswa sesuai dengan kelas terakhir mereka lalui. Perkembangan pemahaman dengan permainan, khususnya bermain satu rumah, merupakan usaha nyata untuk mendukung pembelajaran bilangan di sekolah dasar. Menggunakan permainan dalam proses pembelajaran, misalnya, pembelajaran matematika untuk sekolah dasar dapat menjadi suatu program pelajaran matematika untuk anak-anak.

Kata kunci: *Membilang resultatif, bermain satu rumah, program matematika*

Introduction

Mathematics is a way of thinking (Reys, Robert E., Suydam, Marilyn N., & Lindquist, Mary M., 1984). It provides us with strategies for organizing, analyzing, and synthesizing data, largely but not exclusively numerical. That's why mathematics couldn't be seen as a concrete object in order to make it real when people are talking about it. Number becoming one thing that people always talk until now is an object for mathematics. Number on mathematics is an object used to count and measure. In early age of young children, the phenomenon of conservation of number reflects how children think. Moreover, we will come true to the fact of number sense for children when they used to solve their problem.

Traditional games can be the true example to show number used to support the rule of games in daily life in Indonesia. The games are exciting activities not only for the children, but also adults who need to get refreshing from their busy activities. Indonesia is the rich country from traditional games, but it's not clearly anymore to make sure many children to do play traditional games. Since many modern games come to Indonesia, many of them are gradually not to play the traditional games. They like to play modern games, such as PlayStation, online game, etc. in which children can do by their self without go outside of home (Nasrullah, 2011).

An impressive aspect of traditional games can be developed to support children thinking when they are learning is number. It is related with mathematics for children on primary level. Thus, number in traditional games is an interesting aspect that is helpful for children to encounter numerous situations that bring them into contact with sounds, symbols and meanings that relate to numbers (Treffers, 2001). Especially, if they were learning mathematics, they would do counting through playing game. Therefore, when they are in this situation, developing of number can be referring to build their sense of number. By exploring the knowledge that they have after playing, some *model-of* problems constructed into mathematics program is developed based on the result of game. The program in this case talked about experiment that is designed by instructional rule of the game and by mathematical questions into cyclical learning activities.

Traditional Game as Situational Material

The first example is taken from a teaching experiment in grade 3, where the students we gave them situation to play a traditional game from Sulawesi. In this context, students as player should understand the rule of playing game. When you want to play BermainSatuRumah, you have to know some tools that are used. The first is usitan to determine who has opportunity to draw crossing line on their rumah. Then, the players have to know when they can move to the next rumah if they have completed their crossing line based on how many of usitan that they need. It means the player who has completed crossing line can move to the second rumah by putting number on each of rumahs.

Figure 1. (Left) students are playing with their pairs, (Right) one of result of playing game is rumah with ordered number on the roof

The use of traditional game as starting point for learning process can be helpful to the children developing counting skills (Reys, Robert E., Suydam, Marilyn N., & Lindquist, Mary M., 1984). Today's children have experienced many direct attempts, primarily while playing game (e.g. BermainSatuRumah), to develop counting skills, and classroom activities should be designed to build onto these experience. When the students are facilitated to do activities like in the figure 1, then we ask them to determine how many of crossing line that they have until the last. The student's respond that we hope is they will show their ability of counting.

Figure 2 would for instance be evidence that students mean to what they have about ability of counting. Conservation of number that students did on their worksheet reflects how they think about the problem. Koni wrote numbers under every rumah that she got after playing with Ica as an opposite player. Conservation by writing numbers for each of rumahs to show their thinking in order to determine how many wins they get as long as they play. Before some numbers are added each other to find out their wins on the game, we may think those numbers come from the numbers that she wrote under each rumah.

Sense of number would be an important thing that influences the way of thinking in Koni's mind. She understood the magnitude of garisbersilangan, and then can represent them as number. Although she can't count all directly, Koni know what she should do first. Adding by using addition becomes the next strategy to make sure how many wins that she found.

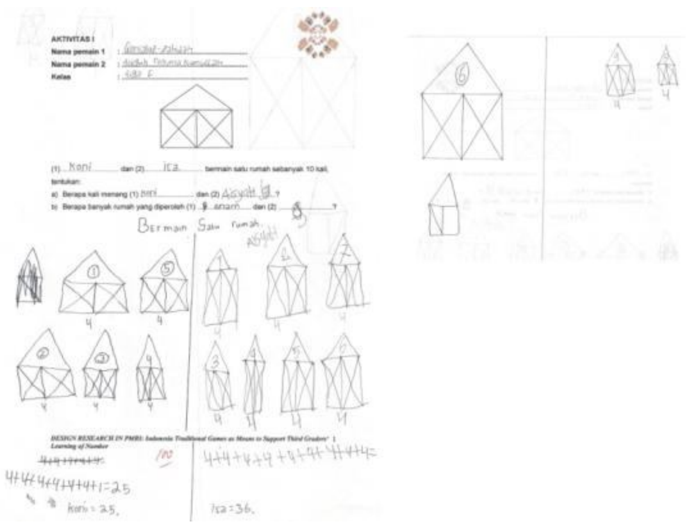

Figure 2. One of student's response developed by understanding of playing game

From playing game, either Koni or Ica has showed their thinking of counting. Belongs to counting in form of numbers, sense of number becomes bridge to support their understanding of conservation of attribute on the game. It means that bermainsaturumah as starting activity would be media to enhance student's sense of number as well as to be used as learning material.

Resultative Counting

The process of resultative counting can be seen as a synthesis of the development of counting number and numerosity number (Gravemeijer, 1994). Counting a quantity one-by-one to determine the total number (resultative counting) is a complex skill developed by trial and error (Buys, p. 27 emergent numeracy). Combining both of counting number and numerosity number is being supposed to combine both of ordinal and cardinal numbers. So far we may think important considerations in number development and described how children think about the numbers 0, 1, 2, …. The emphasis has been on finding a correct number name for a given group. This aspect of number, cardinal number, answers the question, “How many?” Another important aspect of number emphasizes arranging strings in an order and is known as ordinal number, it answers the question, “which one?”

Developing number needs fundamental knowledge in order to do resultative counting. The ability of knowing attributes. According to learning structure, reference number (numerals), counting number (number sequence), numerosity number (1 – 1 correspondence) are basis of fundamental knowledge which supporting resultative counting that requires countable objects to map one by one on the number sequence, and that the last number is conceived as a cardinal number.

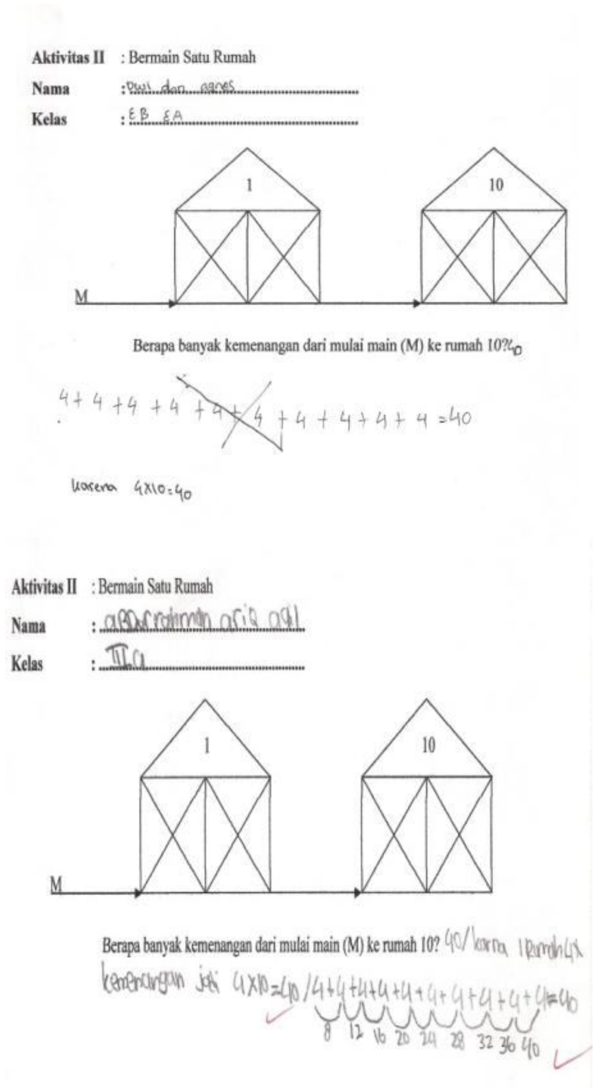

Figure 3. Student’s strategies to solve problem *model-of*

Problem *model-of* developed by the result of playing games, like in figure 3 that shows what students would do to solve the question “how many wins start from play (M) to rumah 10?” In this case, two answer sheets showed the same answer, that is 40. Although the answer is similar with both of them, they have various strategies to determine the number 40. Dwi and Agnes used addition and multiplication concepts to support their counting, and also Abdurrahman Ariq Aqil who even writes another form like number line pattern to bridge his thinking before come to the number 40.

Based on Dwi and Agnes’ answer we may know that they interpret for every rumah containing 4 wins. Because the question should be answered by showing wins for 10 rumahs, they wrote on the worksheet “4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 = 40.” But, another answer following the addition strategy that is multiplication strategy, in this case, they exhibit their understanding of repeated addition as multiplication. It can be seen below the number model that they wrote we may be understood the meaning of “karena 4 x 10 = 40.” The crossing line that lies on the middle of Dwi& Agnes’s answer may be evidence of doubtfulness, and the additional word of “karena” may be the main reason to determine “how many wins”. So, multiplication concept can be come first before they determined number sequence of 4 as much as 10.

Then, the number line pattern in the Aqil’s worksheet would be good example to see changing of number because of numerosity. He introduced that many wins of rumahs can be represented by number model, that is 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 + 4 = 40. Then the pattern of number line can be seen when he added the first 4 and the second 4 to be 8, then 8 added by the third 4 to be 12, so forth until he showed the last number is 40. The first 4, second 4, third 4, until the tenth 4 are reference numbers that represent many wins of each of rumahs. The first 4 added by the second 4 is equal to 8 that is numerosity number to show that winning from the first rumahto the second rumah. The changing of numerosity can be seen as number sequence such as, 8, 12, 16, 20, 24, 28, 32, 36, 40. 40 is the last number of changing, it means that the number is the cardinal number of many wins of ten rumahs. Before the number come to the 4, the way to determine 8, 12, and so on is by using addition concept. Either number model by adding one by one or number line pattern by showing numerosity between the first and the next number is constructed by addition concept.

By developing *model-of* problem of bermainsaturumah as traditional context, resultative counting is counting a number of things with the aim of determining how many there are (the result) that can be showed by using addition and multiplication concepts.

Determining Position of Numbers on Incomplete Number Line

Another mathematical idea by developing material based on bermainsaturumah, nonstandard counting can be designed as informal activities before come to formal activities. A sequence of rumahs like in figure 3 can be developed in order to support student’s thinking about incomplete number line.

Starting from rumahs as result of playing game, teacher introduced problem of jemuranrumah that is “how many wins that is obtained in rumah 40?” The purpose of this problem is students can be able to recognize a number of wins for each rumah on jemuranrumah. Various problems can be given to students, they would for instance be asked to determine how many wins in rumah 20, then rumah 30. In order to determine the answer of teacher’s questions, students would do resultative counting by developing what concepts that they understand.

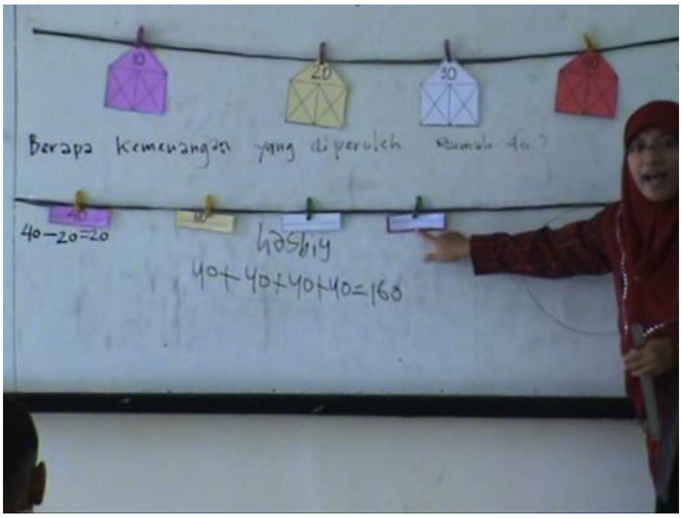

Figure 4. Teacher introduced “jemuranrumah” and “jemuranbilangan” to students

When the students are asked to find out many wins in rumah 40, some of them have different answers to solve this problem. For instance, Hasbi wrote 40 + 40 + 40 + 40 = 160, Adzin make another answer which he wrote 20 + 20 + 20 + 20 + 20 + 20 + 20 + 20 =160, Vira has different answer that 80 + 80 = 160, and the last is Ica who has answer that 80 x 2 = 160.

After students can show their thinking to determine many wins for each rumah on jemuranrumah, teacher instructed them to recognize the numbers that they found representing many wins previously. But, in this case teacher want students to identify the pattern if only the number that they are talking. Jemuranbilangan became the innovation to support student’s thinking about position of numbers on number line. Based on teaching experiment that had done which students are involved to solve what appropriate number to fulfill “jepitketiga”, teacher said!

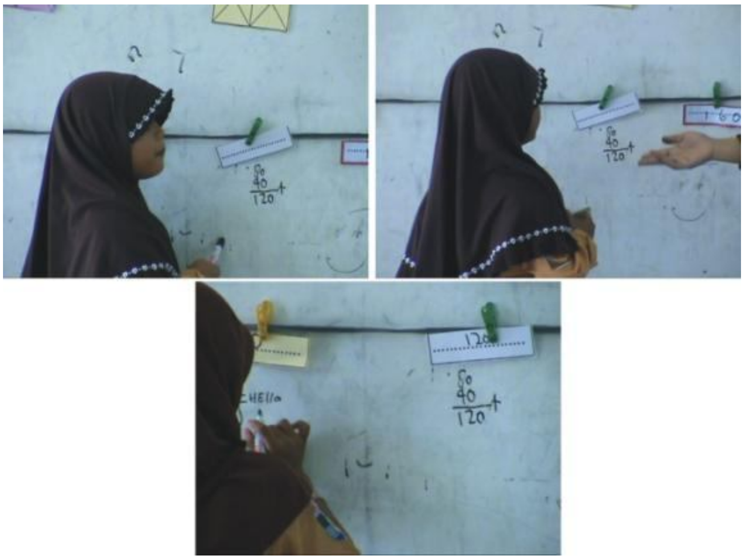

Figure 5.Ayu gives explanation to teacher about her response to the question

Response to the question that Ayu suppose is adding the first, second, third of 40. As a result of the question is 120, she wrote like

$$\begin{array}{r} 80 \\ \underline{40}\ + \\ 120 \end{array}$$

The strategy that Ayu used is adding, she understood the pattern of addition of each segment that is 40 such that the third number similar with the second and the result is 120. Ayu's response even have been asked by the others, for instance "how come you get 80?", she answered it comes from 40 + 40. Besides that, other students asked to 40 (number below 80), "how come you get 40?" In fact, this question gives different response because using context of bermainsaturumah as fundamental of their argument, for example 40 is many of wins starts from rumah 1 through 10. Based on this experiment, we probably agree what Ayu was doing to support her argument based on his experience by doing playing game. Bermainsaturumah in this case had given them learning experience that we can look at their counting based on rumahs used in playing the game.

The mathematical idea that we supposed to determining position of numbers on incomplete number line is students can recognize the attributes to conserve the numbers. Then, they can retrieve prior knowledge and basic concept in order to build their understanding of number learning. Changing from "jemuranrumah" to "jemuranbilangan" is thinking way to know their understanding of pattern that can be developed in order to determine position of numbers. By that way, students probably are in their understanding when they have problem to continue the next number based on pattern. Developing basic concept by addition or multiplying is the true evidence to prove their understanding in working with number line.

Appropriate Material for Third Graders in Indonesia

Kurikulum Tingkat SatuanPendidikan (KTSP) as referential instruction for teacher is not only on mathematics teaching, but also for other subjects that students learn in primary school. Number becomes one of aspect that is supposed to be learnt by students in order to support mathematical thinking. Belong to mathematics as subject, number is consisting of many topics, ones of them are addition, subtraction, and multiplication for number 2-3 digits. Historically, many topics related with addition, subtraction, and multiplication for number 2-3 digits had been learnt when students were in second grader. Even they have already learnt numbers involved numerals until 500.

Based on what students had on materials of subject that they experienced from learning process and given material of teacher, students already established on rich knowledge that can support their thinking in advance. In this case, we hope students can realize what they have after the learning process by developing their knowledge into development material based on the material previously.

Like what we found in the teaching experiment, we know students can do adding and multiplying as combination of thinking to solve the problem. Not only in that way, but also students can combine between the two of it and subtraction.

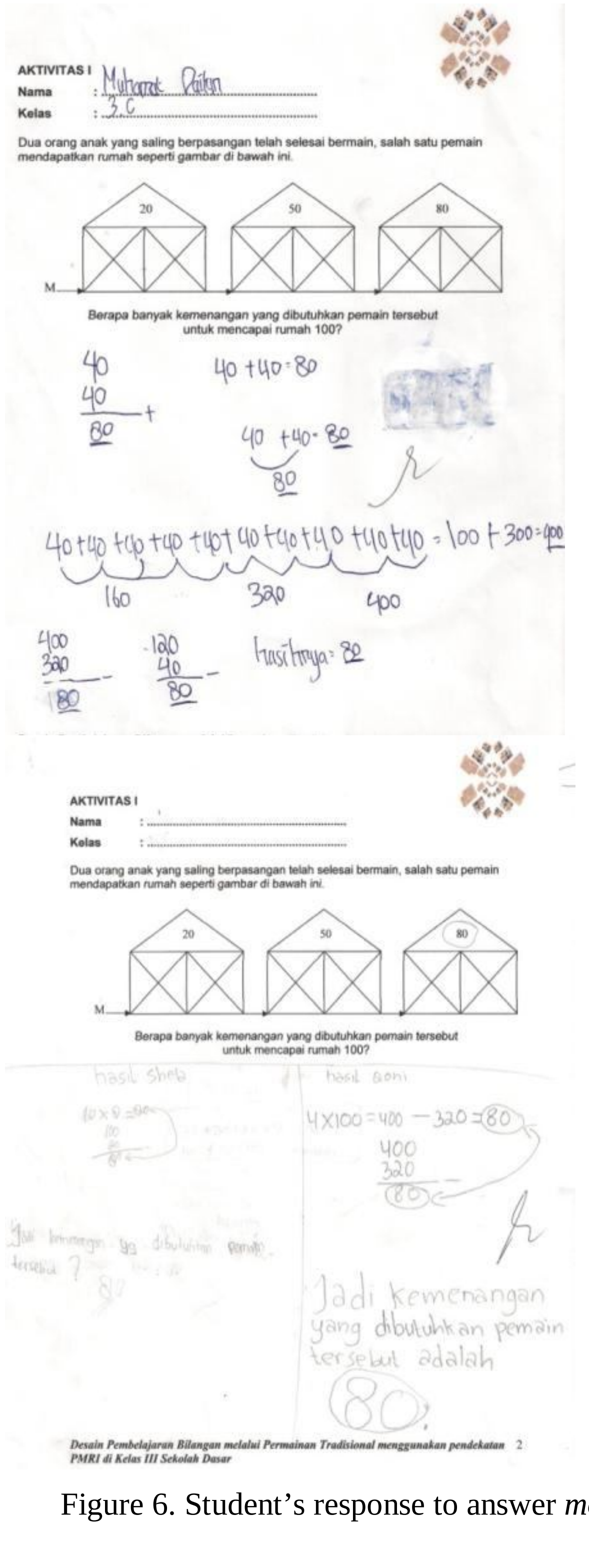

Figure 6. Student’s response to answer *model-of* problem developed by game

Figure 5 show how students think about applying mathematical concept to determine the solutions. Dailan supposed different thinking from Shela and Qoni, although they have agreed the answer is 80. For the first experience that we can see in this case, I probably get exciting level to understand their thinking in advance. It means that they have their knowledge in that level based on their experience in learning mathematics in the last time.

As interesting part from their responses, Dailan constructed his thinking by combining two concepts such as addition and subtraction. Before he comes to show the answer by using number line pattern, we may agree 40 + 40 = 80 as good answer to finish the problem. It's not over until the answer but he continued to make sure the next modeling as well as the answer previously. That's way adding 10 of 40's supported by adding in segments, it can be seen as number line. Then, we look 400 – 320 = 80 as developing his understanding of "yang dibutuhkan" in order to get the final answer as same as previous answer. The understanding of problem also showed by Qoni, she exhibited an impressed answer that we may be surprised to know. The first idea that she showed us is multiplication such 4 x 100 that means for 100 rumahs it can be obtained four times one hundred wins. If we have 80 rumahs now, it means that to reach the hundredth rumahwe need many wins that starts from rumah 81 through 100. Qoni used subtraction to make model for the illustration in which she wrote 400 – 320 = 80. Even so Shela who answered that probably agree with 80 as final decision, although she didn't make reasoning as well as Qoni.

Based on this explanation, student's thinking on their level exhibited us their successful conservation when they were in learning process in the last grade. Teaching material influenced their progress to measure what they have in which students need developed contains that is appropriate problem. It is against with material that suppose students rather than go back to learn from the first. Combining two concepts or more is representing their knowledge at this time, so they need more problems that instruct them to do another combination of concepts.

Traditional Game as Program Material for Young Children

Modern games have changed children's choice to playing. They even dominated in many activities so that children don't know traditional games that have been modified by their ancestors as scarcely heritage that they should keep it. Start from *BermainSatuRumah* as traditional game which can be introduced students to learn number in primary school. This game had been applied in learning activities for third graders in MIN 2 Palembang. As result that we concluded that students were learning by *bermainsaturumah*, what we have as expectation they can conserve attributes of the game to suppose numeral that they can count.

By developing their sense of number, students can come to the reference number, counting number, numerosity number. These are being support components to do resultative counting. Because of experienced learning that they had been in a learning process from the teacher in previous grade, students are able to show their understanding by combing two concepts of more such as addition, multiplication, and subtraction.

The progress of understanding by game, especially bermainsaturumah, is concrete effort to support number learning in primary school. Using game in learning process, for instance, mathematics learning for primary school can be a mathematics program for young children.

Conclusion

Number in traditional games is an interesting aspect that is helpful for children to encounter numerous situations that bring them into contact with sounds, symbols and meanings that relate to numbers. Behind of learning number, sense of number becomes bridge to support their understanding of conservation of attribute on the game. It means that bermainsaturumah as starting activity would be media to enhance student's sense of number as well as to be used as learning material. By developing *model-of* problem of bermainsaturumah as traditional context, resultative counting is counting a number of things with the aim of determining how many there are (the result) that can be showed by using addition and multiplication concepts. Student's thinking on their level exhibited us their successful conservation when they were in learning process in the last grade. Teaching material influenced their progress to measure what they have in which students need developed contains that is appropriate problem. It is against with material that suppose students rather than go back to learn from the first. Combining two concepts or more is representing their knowledge at this time, so they need more problems that instruct them to do another combination of concepts. The progress of understanding by game, especially bermainsaturumah, is concrete effort to support number learning in primary school. Using game in learning process, for instance, mathematics learning for primary school can be a mathematics program for young children.

Reference

Buys, K., (2001). Kindergarten 1 and 2 – Growing Number Sense. In Marja van den Heuvel-Panhuizen, Kees Buys and AdriTreffers (eds.). *Children learn mathematics*, pp. 31 – 42. The Netherlands: Freudenthal Institute (FI) Utrecht University & National Institute for Curriculum Development (SLO).

Gravemeijer, K. (1994). *Developing Realistic Mathematics Education*. Utrecht: Technipress, Culemborg.

Nasrullah, (2011). Desain Pembelajaran Bilangan melalui Permainan Tradisional menggunakan PMRI di Kelas III SekolahDasar. *Tesis*. UniversitasSriwijaya: Tidakditerbitkan.

Reys, Robert E., Suydam, Marilyn N., & Lindquist, Mary M., (1984). *Helping Children Learn Mathematics*. London: Prentice-Hall International, Inc.

Treffers, A., (2001). Kindergarten 1 and 2 – Growing Number Sense. In Marja van den Heuvel-Panhuizen, Kees Buys and AdriTreffers (eds.). Children learn mathematics, pp. 31 – 42. The Netherlands: Freudenthal Institute (FI) Utrecht University & National Institute for Curriculum Development (SLO).

Nasrullah
State University of Makassar, Makassar, Indonesia
E-mail: ullah_01@yahoo.com
Zulkardi
Sriwijaya University, Palembang, Indonesia
E-mail: zulkardi@yahoo.com