Creative Mathematical Games: The Enhancement of Number Sense of Kindergarten Children Through Fun Activities

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Abstract. The research departed from an issue found regarding the number sense of kindergarten children and as a solution to this problem, the research proposes the use of creative mathematical games in the teaching and learning. Departing from the issue and the offered solution, the following problems are about Children’s ability of number sense before and after the implementation of creative mathematical games; the forms of creative mathematical games in improving children’s number sense; the implementation of creative mathematical games in improving children’s number sense; and the factors possibly affecting the implementation of creative mathematical games. This study use action research method. The data were collected through observation, interview, and documentation and then qualitatively analysed using thematic analysis technique. The findings show that children respond positively to the creative mathematical games. They demonstrate fairly high enthusiasm and are able to understand number as well as its meaning in various ways. Children’s number sense has also improved in terms of one-on-one correspondence and mentioning and comparing many objects. The factors possibly affecting the implementation of these creative mathematical games are the media and the stages of teaching and learning that should be in accordance with the level of kindergarten children’s number sense.

1. Introduction
The important role makes mathematics to become a science which should be introduced and it has to be taught to every individual starts from pre-school to high school level [21]. Furthermore, [21] stated that mathematics learning for young learners is aimed to stimulate the thinking ability of the children so they are ready to learn mathematics for the next step and the children are able to master various mathematical science and skill which enable them to solve problems in their daily life. Based on this, it is implied that mathematics learning for young learners is a medium to develop their simple thinking skill which can help the children to understand several concrete concepts, yet it is not intended to allow the children to have academic skill as soon as possible. The learning process is more likely to the ability of solving problems that exist in their surroundings. Another important aspect that needs to be developed and facilitates the children in mathematics learning is number sense or the sensitivity of numbers[6].

Number sense is an intuition about numbers and matters related to numbers. It can be broadly defined as understanding of the meaning of numbers and the relationship between numbers [10]. Some aspects of number sense skill possessed by the children are the ability to mention the sound of numbers, mention the sound of number sequences, do one to one correspondence, connect sound to the symbol of numbers, count concrete object, compare the amount of objects, do the addition by combining group of objects and do the subtraction by separating the group of objects[3]. Those number senses skills are a part of the children’s thinking skill. A child with a good number sense, one of
which, will have the ability to do correspondence between the sound of numbers and concrete objects so it can bring meaning to the numbers[6].

Number sense problem of the children which is frequently found is related to quantity and counting [2]. A research conducted by[19]also shows that one of the problems faced by the kindergarten students is the ability to count and recognize the sequence of numbers. The number sense problem is frequently happened in several organizations of Early Childhood Education Program. Based on the observation conducted by the writer, some children seem to have difficulties in understanding the changes in number of objects and the sequence of numbers. For example, the children may not be able to count in sequence from larger numbers such as 10, 9, 8 and so on. The children also experience confusing in distinguishing ordinal concept like the order of number such as first, second, third and so on with cardinal concept to mention the amounts of objects such as one object, two objects, three objects, and so on. The number sense problem is not a negligible problem since several researches state that number sense is very important in developing mathematics learning for early childhood students. Jordan [9] says that difficulties in mathematics learning at kindergarten level is not on the children’s problem in memorizing mathematics concepts, but it is more likely on the lack stimulation of number sense possessed by the children. Another research conducted by[1] shows that number sense can help facilitate the child in the operational activities of quantity and number systems. Some statements from those researches imply that number sense has a great influence to the increasing of the students’ understanding in mathematics learning. So, it can be said that number sense skill is an early foundation of the skill and the mastery concepts of mathematics at higher level. On the other hand, the number sense skill of every child might be different because of the different surroundings and cultural background. Adults around the children can provide appropriate stimulation for the development of the children’s number sense so that the children are able to develop it optimally.

One of the promoted activities to learn the mathematics concepts for young learners is creative game, because learning by playing games can help the children to understand various concepts of mathematics through fun and meaningful activities [17]. Creative mathematics game is a creation of mathematics learning through playing ([12]; [15]). According to [16] the activities of playing, including games, are able to encourage the children to develop their logical thinking skill and understand mathematical process such as addition, subtraction and other concepts. The description above implies that the creative mathematics games can help the children to understand the concepts of mathematics including the children’s number sense aspect. Based on the description, the writer intends to make the creative mathematics game as a solution to the problem of number sense in Kindergarten.

2. Experimental Method
The research location of this study is Preschool UPI and the method is action research by Kemmis and MC Taggart [14]. Kemmis and MC Taggart’s research design consists of four components as follows:

- Planning. The researcher made coordination with the teachers about implementing the creative math games to improve the children’s number sense in kindergarten.
- Implementation. The researcher implemented the creative math games in the learning process.
- Observation. The next phase was observation to figure out how far the children’s number sense develops as well to control the implementation of the creative math games.
- Reflection. The reflection phase was performed by the researcher to discuss and evaluate the results of the activities that had been carried out.

The data collection technique in this research employed three techniques, namely observation in the forms of field notes, interview, and documentation. The data obtained were analyzed through a qualitative approach by using thematic analysis.

3. Result and Discussion

3.1. The Initial Condition of the Number Sense Ability of Children
Findings in this research is advanced on the Number sense ability of the children prior to the implementation of creative math games in Preschool UPIIs in the state of mentioning numbers and the sequence of numbers. The findings show that some of the students experienced difficulties when doing one to one correspondence, in which they had not been able to perform correspondence of sounding numbers and things that represent the number values, thereby being an obstacle to them in understanding the meanings of some particular numbers. The students also experienced difficulties in comparing the numbers of objects and administering simple summation and subtraction regarding the objects.

The difficulties found in the findings are typically the problem with number sense that was experienced by the students. Theoretically, children at the age of 4 to 6 years old should have been able to do one to one correspondence and carry out simple numeration [3]. Deheane [6] suggests that the potential of number sense is already owned by children since birth and infancy. It is in line with the statement of [18] that every child has the potential of number sense though could be in different state, which one of the causes is due to the different stimulation they get. A good stimulation could enhance the development of number sense ability in children in as well a good way, and vice versa. The problem of number sense that was experienced by the students in Preschool UPI is partially caused by lack of efforts made by the school in developing their children’s number sense ability neither through the forms of programs nor the other activities. The math learning is sometimes carried out in the forms of student worksheets whereas, according to [21] the math learning process for young children should better be presented in the activities that attract the children’s attention and through the use of authentic media. In different notes, [13] also notes that math learning process presented to children regardless of their needs and interests will probably be less meaningful or even meaningless for the children.

3.2. Creative Mathematical Games to Enhance the Number Sense of Kindergarten Students
The selection of math games to be carried out in the research did not take any direct implementation for granted but going through the discussion and workshop conducted by the researcher with the school and teachers. The games should be in corresponding with psychological principles of children in terms of the game rules, players, media selection, as well as the length of time needed to perform the games ([5]; [7]; [11]). The brief description of the four games is as follows:

- **Fishing For Fun.** Fishing for fun game is created by the group of Green Apple Lessons [23] which aims to help children be able to enhance numerical literacy or numeracy, reading numbers, correspondence, and memorizing. The media used in this game are ten paired picture cards of cats and fishes. The game takes place for about 10 to 15 minutes with pretty simple rules, that children pair the picture cards of cats and fishes with the same numbers. Once the children found the pairing cards, then they may take both of the cards, but if not, then they are asked to put the cards back into the original place.

- **Five Little Monkeys.** Five little monkeys game is created by Eileen Christelow which aims at helping children enhance their skills in numeracy, reading numbers, correspondence, and practicing simple numeral operation [3]. The media used in this game are five little monkeys board, beam or pin, and dice. The game is carried out by storing the beam or pin into the boxed on the board that has been provided with the number on the dice that came up.

- **Dominoes Modification.** Dominoes modification game is developed by [19] with the aims to help children in counting, corresponding, and comparing various objects as well as in simple numerical operation. The media used in this game are ten domino cards that have been modified in the forms and the dot illustrations on the cards. The dots are tailored to the theme taken, which in this research is the illustration of donuts.

- **My Numerical Carpet.** The initial idea of making this numerical carpet is to introduce the concept of numeric, its symbols, and simple numerical operation by using objects. My numerical carpet is created by [15]. The media used in this game are numerical carpet with
The four creative math games as presented above are redesigned in order to be able to provide stimulation in various aspects of number sense on children gradually. It aims to equip children with optimal number sense ability and thereby the children could pass every stage required. It is as noted by [20] that math learning for very young learners should consider the stages of concept they could attain from the beginning to the end, so there will be no missing stages or phases and could help them understand the concept thoroughly. A similar conception is noted by [4] that young children learn math from the very simple things around them.

3.3. The Implementation of Creative Mathematical Games to Enhance Number Sense of Children in Kindergarten

The implementation of creative math games in improving number sense of Preschool UPI students is conducted into five cycles. The theme administered in this research is accustomed to the students’ needs and interests, namely animals, foods, and space. The Figures 1 and 2 are the documentation of the implementation of creative math games in improving students’ number sense in Preschool UPI.

Figure 1. The young learners playing Fishing for Fun and Five Little Monkey game. (a) They took pairing cards (both the cards have the same number of fishes), and they counting fish in the cards. (b) The young learners playing Five Little Monkeys by rolling the stuffed dice, mentioning the number the dice showing, and placing the monkey pin on the column appropriate with the number on dice.

Figure 2. The young learners playing Dominoes Modification and My Numerical Carpet. (a) Two young learners arranging dominoes from the smallest number, one to ten, and making domino effect. (b) The young learners with their teacher observing My Numerical Carpet.

The implementation of each activity as figured above was conducted in pairs or in groups. This supposed that the other aspects of children development such as social skills could also be stimulated since one of the principles of early childhood education is the comprehensive and thorough [22]. The stages of number sense acquisition become the standards in planning the learning scenario thorough creative math games therefore the children attain all the aspects. Besides, the learning activities
conducted consist of various games and plays. Those various activities are meant to support the learning process thereby not being boring and monotonous for the children, as noted by [3] that every child sometimes needs different activities to establish and develop their number sense ability. Another important point to note as reference in the implementation of creative math games is the repetition of activities that leads to the accomplishment of number sense aspect in each game. The repetition is conducted as well to recall the prior concepts therefore the children could understand more [13]. According to the discussion above, the criteria of the implementation of creative math games in enhancing number sense of children are as follows:

- Creative math games are packed in the forms of attractive thematic learning activities for the children.
- The games are aimed at developing and enhancing number sense of children but still could stimulate other development aspects.
- The games are designed to be performed in pairs or in groups.
- Learning scenario through creative math games is designed accustomed to the phases of number sense aspect the children own.
- Creative math games employed in this study consist of various kinds of plays and games.
- There are repetition of activities which aims to advance the number sense of children more in every activity of creative math games

3.4. The Factors Affecting the Implementation of Creative Math Games

Some factors that probably affect the implementation of creative math games are found when the research conducted, they are summarized as follows:

- Media. The media used in the learning activities are designed accustomed to psychological principles of children, namely containing interesting pictures and forms, eye-catching with various colors, proper in size, having soft texture, and made from materials that are safe for children ([7] 2009; [11]).
- The learning stages focuses on children’s stages of number sense.
- Teacher Behavior. The results of study show that active and fully attentive behavior of the teacher could enhance enthusiasm in the children when about to do the learning activities.
- PeerTeaching. One of the other factors that indirectly influence the success of creative math games implementation is the help and support from colleges (peer teaching). The support and help from peers are gained by the children through the learning process that is designed properly to give them opportunity to work or do activities in groups, so they could interact with each other.

3.5. Number Sense Ability of Children after the Implementation of Creative Math Games

Based on the results of study related to number sense aspect of children in Preschool UPI after the implementation of creative math games the number sense skills of the children increased. Some of the number sense ability grow after the stimulation given through creative math games such as one to one correspondence, connecting the numerical sound to its symbol, the ability to mention more objects, comparing the number of objects, and establishing simple numerical operation, either summation or subtraction with the help of objects. From the results of the study, it suggests that creative math games generate benefits that can enhance number sense of children. This is corresponding with the purposes of the creative math games for children as noted by experts that games could encourage children to advance and strengthen their mathematical understanding, find out the alternatives of problem solving spontaneously, and give opportunity to the children to communicate mathematical process as well as encourage their mathematical knowledge through some entertaining activities ([16]; [17]).

4. Conclusion

Based on the findings and discussion, it can be concluded that creative math games could stimulate number sense of children in Preschool UPI. The number sense ability of the children that is originally
not optimal grows to develop after the implementation of creative math games, so in the other words, the increase of number sense ability of the children represents the success of the implementation of creative math games.

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