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To cite this article: W D Andika *et al* 2019 *J. Phys.: Conf. Ser.* **1166** 012019

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# Playing board games with mathematical self -concept to support early numeracy skill of 5-6 years old children

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**Abstract.** Many studies have found the benefits of playing board games is that it develops children's early numeracy. On the other hand, however, mathematical self-concept has an important role in developing early numeracy. This period of time has become a part of 36 participants of the activities of playing board game and mathematical self-concept is an important element in improving children's early numeracy. In this study, play activities board games from linear board games and circular board games and mathematical self-concepts with the experiment research design. The results show, playing linear board games better than circular board games ( $F_{\text{count}} 5,62$ ) and the study has proven playing board game and mathematical self-concept significantly ( $F_{\text{count}} 6,69$ ) can support early numeracy skill of 5-6 years old children. So, for supporting early numeracy skill, teacher must identify children's mathematical self concept to choose appropriate board games.

## 1. Introduction

Lately the cultivation of mathematical concepts in early childhood is done by writing numbers. Supposedly, the preliminary counting is the basis for early childhood mastering mathematical abilities by doing activities of counting objects close to everyday life. Doing the activity of counting objects makes the child able to master the early numeracy skill through objects around. A major concern of mathematics for early childhood is when doing activities in everyday life starting from the home environment numeracy [1]. A number of researchers have reported that the activity of counting objects in the home is very important in developing children's early numeracy [1,2]. Actually starting counting is something that is easily understood by children 5-6 years because the mathematical concept is very close in their environment.

Developing early childhood counting skills should be done in a fun way, namely by playing. Board games are the right choice for developing early childhood counting skills. Recent evidence shows that Number Board Games in preschool children have mastery of preliminary numeracy skills [3]. Previous studies have reported that Linear Board Games have an effect on increasing knowledge and acquiring preliminary numeracy skills in preschoolers compared to Circume Board Games [4,6] especially in children with low-income parents [5]. Studies from Linear Number Board Games show the importance of being applied to the context of classroom learning [5,7]. Existing research acknowledges the important role played by Board Games called "Shut Box" proven to be able to train mathematical abilities of children 6 years through video analysis [8].

In addition, another factor that influences children's early numeracy is a mathematical self-concept. Mathematical self-concept appears hand in hand with children's early numeracy. Previous research comparing



board games and self-concept has found them theoretically proven to have an effect on early numeracy skills, but there is a relationship between preschool children's mathematical self-concept, gender, and early numeracy skill which is illustrated by children's achievement [9,10]. A number of researchers have reported that preschool children's mathematical self-concept is a subcomponent of academic self-concept [11] which can be measured by standard instruments The Self-Descriptions Questionnaires (SDQP) [10-13].

Highlighting the shortcomings or weaknesses of previous studies, most previous studies focused on the influence of board games on numeracy skill [3,8]. No previous studies have investigated the math self-concept at the level of preschool children, because it turns out that several journals identify the emergence of math self-concept in early childhood [12,20,21,25]. Furthermore, unlike previous researchers, board games in this study have been modified so that they can be adapted to any learning theme and look more attractive with colorful colors and numbered images called Thematic Board Games. Most importantly, there has been no detailed empirical investigation, the game of linear or circular thematic board games, which is suitable for children's mathematical self-concept that is appropriate or inappropriate which influences children's early numeracy

## 2. Methods

### 2.1. Participant

The participants were 36 of B Class kindergarten students (especially children aged 5-6 years), one of the two classes assigned into two experimental groups. The mathematical self-concept questionnaire was categorized into high self-concept groups if the score is in the highest 27% score range [15]. Mathematical self-concept groups that are not appropriate if the math self-concept score is the lowest 27% range.  $36 \times 27\% = 9$  samples in each cell [27]. This study used an experimental model [30] with the design of Treatment by level 2 X 2. The following is described in table 2 Design of Treatment by level 2 X 2.

### 2.2. Instrument

In this study there are two kinds of data that must be collected, namely: (1) Data on early numeracy skills (2) Data on mathematical self-concept. To obtain data regarding the early numeracy skill was measured using pretests [30] with the total of 15 items. While to measure mathematical self-concept is by using questionnaires [16] in the total of 15 points.

**Table 1.** Indicator of early numeracy skill of children

No.	Aspect	Early Numeracy Skill
1	Numbers 1-10	Counting Comparing Matching Ordering
2	Concrete Number Operation	Concrete Addition Concrete Substraction

The results of the instrument testing were carried out by determining the item validity and instrument reliability. Testing the validity of the items of the mathematics self-concept instrument is calculated by the Product Moment "r" correlation formula, because the instrument is a non-test instrument. The criteria for testing the validity of the points by comparing the coefficient of counting correlation significance level of 0.05 with the number of samples [30]  $n = 36$  obtained the results of table prices = 4.15. The coefficient of self-concept variable is equal to or more than 0.7, so reliability is acceptable and if the results are below 0.7, the reliability of an instrument is not reliable, or if the coefficient of reliability results close to 1.0 then the instrument gets perfection.

**Table 2.** Indicator of children's mathematical self concept

No.	Aspect	Early Numeracy Skill
1	Children's perception of math skill	Counting Comparing Geometry Ordering Measurement
2	Self response to math	Favorite Interest

### 2.3. Experiment Procedure

In this study, there are designs that are carried out for two groups that are suitable and concepts that are not in accordance with by applying linear and circular game boards. Before being given an action, children are given early numeracy skill pretest [30] and a questionnaire for the initial exam. During the learning activities, a group of children with self-concept in accordance with them was given the activities of linear board games and circular board games, on the other hand groups with mathematics that did not match each of the activities of linear board games and circular board games. After learning activities, to see the early numeracy skills and board game experience which are suitable for children's mathematical self-concept. Then a post-test [30] for early numeracy using a test is used to compare the early numeracy to run the playing board games.

## 3. Result and Discussion

The purpose of this study was to examine the effect of linear games boards and circular board games on children's mathematical self-concept in terms of supporting the early numeracy skill that the start of kindergarten children in class B. There were four tests in this study, as follows:

### 3.1. (Main Effect ( $A_1 > A_2$ ))

*Differences children's early numeracy between group of children that was given to play Linear Board Games and group of children that was given to play Circular Board Games.*

Based on the calculation of variance analysis on the differences between the two media effectiveness in playing board games overall that  $F_{count} = 5,62 > F_{tabel} = 4,08$  at significance level  $\alpha = 0:05$ , thus  $H_0$  is rejected and the alternative hypothesis  $H_1$  is accepted. It is concluded that there is a significant difference between the groups of children who are given the activity of playing board games by using the media Linear Board Games with a group of children that was given the activity of playing board games with the media Circular Board Games against starters numeracy skills of children. Therefore, the early numeracy skill given by Linear Board Games ( $X = 80.74$  and  $s = 12.91$ ) is significantly better than the one given by Circular Board Games ( $X = 72.59$  and  $s = 10.20$ ). The result of the study shows that overall the early numeracy skill of children that was given by linear board games was better compared to the group of children given by circular board games.

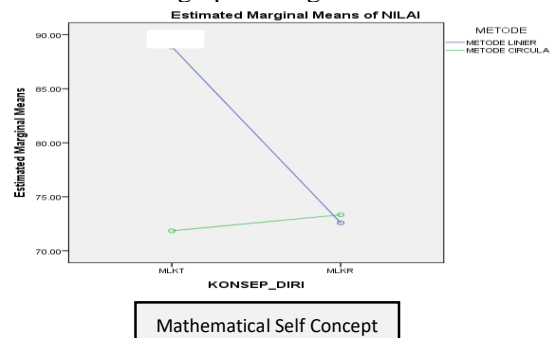
The experiment in this study at the same time is to test and support previous relevant research. Linear Board Games give effects on increasing knowledge and the acquisition of basic counting in preschool children compared with Circular Board Games [4,6,14,17,18]. There are several reasons including: (1) Linear Board Games make it easy for children to map the layout of represented numbers from parallel boards, compared to circular boards. So that it is easier for children to understand the sequence and estimation of numbers and symbols, number comparisons, simple problem solving around concrete additions and subtractions. (2) Besides that, Linear Board Games are easier for children to manipulate because they are made of magnetic boards [28] compared to Circular Board Games made of wood. Therefore, children have easy access to manipulate [19,29], adjust, move, move pictorial numbers when counting on Linear Board Games. (3) The present of numbers

cards [23,24,26] on Linear Board Games as a random tool in science Board Games also makes children easier to match numbers and symbol numbers compared to Circular Board Games that have arrows as a random tool in playing Board Games. This is because on the card there are number numbers and symbols that are in line with the Linear Board Games lane, so that children easily match numbers and symbol numbers in Linear Board Games. It is different from the Circular Board Games pointer arrow, although it is more interesting to play but the child has difficulty matching numbers and symbols.

### 3.2. (Interaction Effect (INT A X B))

#### *Effect of Interaction between playing board games with mathematical self-concept on the early numeracy skill*

The result of ANAVA calculation [30] can be seen that the value of the test results of the second hypothesis presented in the ANAVA table on the interaction line AXB shows that  $H_0$  is rejected based on the value of  $F_{count} = 6.69 > F_{tab} (0.05: 1: 36) = 4.08$  thus it can be decided that there is a significant interaction effect between playing board games and the mathematical self-concept of the child's early numeracy skill. The research data obtained an average the early numeracy skill between groups of children who have the suitable self-concept given to play Linear Board Games ( $X=88.89$ ) and the group of children who have incompatible self-concept that was given to play Linear Board Games ( $X=72, 59$ ). For the average score, the result of the early numeracy skill of the group of children who have the suitable mathematical self-concept that was given to play Circular Board Games ( $X=71.85$ ) and the child who has an inappropriate mathematical self-concept that was given to play Circular Board Games ( $X=73, 33$ ). The result shows that there was an influence of the interaction between the forms of playing board games with the mathematical self-concept of the early numeracy skill. The following is a picture of the results of a line graph through the 2 x 2 ANAVA interaction test.



**Figure 1.** Interaction effect graph

The chart above shows the intersecting lines. This means that there is an interaction between the variables of playing board games and mathematical self-concepts of children's early numeracy skill. The testing of the second hypothesis is supported by several relevant studies examining the influence of Board Games on early mathematical abilities of children [5,6,14,17,18]. The experimental group that was given Linear Board Games had a higher initial early numeracy skill than the group of children that was given to play Circular Board Games [23], which proved the influence of Board Games on the early mathematical abilities of children. Explicitly, this tests the theories of experts who were described earlier, that playing Board Games and the self-concept of mathematics have an effect on the early numeracy skill.

The reason for playing Board Games which is the intervention of this research is a fun and concrete counting activity, so that it positively influences the child's early numeracy skill, besides that the child's mathematical self-concept is also proven to affect children's early numeracy skill because self-concept in kindergarten children is in the "representational mapping" stage. In which, children start to make a logical relationship between one aspect and the others, which means that the kindergarten children are able to describe themselves either as in a suitable manner or not in accordance with their mathematical abilities and what they think

regarding activities related to mathematics. Therefore, both of these theoretically and practically variables have been proven to influence children's early numeracy skill.

#### 4. Conclusion

After the interaction was found, it can be interpreted that the two media board games have a different effect on the early numeracy skill. Tested from the early numeracy skill of the group of children who have the appropriate mathematical self-concept given linear board games having higher value than circular board games, whereas in the students who have inappropriate mathematical self-concept given circular game board has higher value than linear board games. Overall, it can be concluded that playing board games and mathematical self-concepts can develop early numeracy skills. However, there are limitations in this study, in data collection sometimes there are children absent so they have to wait for the complete presence of the children. In applying board games to children, the teacher as the driving force in the classroom must connect between activities and themes that are running in an innovative, creative and fun way. The implications of the research on the application of linear board games are suitable for improving the results of initial counting abilities. In addition to the application of instructional media provided, individual internal factors that are related to the early numeracy skills are mathematical self-concepts. Research has examined the effect of playing board game and children's mathematical self-concept on the early numeracy skill of kindergarten children aged 5-6 years. For further research, it is better to look for other variables tailored to the needs and characteristics of kindergarten children.

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