Developing a model of teaching patterns recognition based on sorting predict-think discovery for children aged 5-6 years

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Abstract. This study aimed to: (1) determine the feasibility of concept of pattern learning model based on sorting predict-think discovery, (2) determine the effectiveness of concept of pattern learning model based on sorting predict-think discovery. This research implemented several steps developed by Borg & Gall. The research subjects consisted of teachers and 172 children in 9 kindergartens in Sleman, Yogyakarta. The data was collected by using expert validation sheets, teacher questionnaires, and observation results. The data was obtained from 5 treatments and time series. The results revealed that: (1) the results of the development of pattern learning model based on sorting predict-think discovery were very feasible to use, (2) pattern learning model based on sorting predict-think discovery is effective in developing children’s ability in recognizing pattern. The effectiveness of pattern learning model based on sorting predict-think discovery was revealed by the significant improvements, after conducting five treatments for children 5 to 6 years old. The average ability of children to recognize linear patterns was 3.36, while the average ability of children to recognize cyclic patterns was 3.17, and the average ability of children to recognize hopscotch patterns was 3.03. Hence, the ability to recognize hopscotch patterns showed a slight increase. This happened since most children still have difficulty in memorizing, especially in drawing and creating patterns. Hopscotch patterns were patterns that have never been introduced and taught by teachers to children. Furthermore, all of children’s abilities to recognize patterns had improved.

1. Introduction

Early childhood refers to children who are in the development stage, which around 0 to 6 years old. It should be emphasized that in this period, it is the most valuable time for children to enhance all of their development aspects. One of the potential aspects that the children develop is cognitive aspect, especially those who are 4 to 6 years old. This aspect is related to the children's thinking processes which involve brain activities. Thinking processes consist of several levels, starting from the lowest to the highest, such as remember, understand, apply, analyze, evaluate, and create [1]. Meanwhile, recognize belongs to remember category, as the first process that children through in thinking process. The process of recognizing needs to be obtained early in order to develop children’s thinking skills, and one of the ways which can be conducted is by studying Mathematics. It should be noted that thinking skills can be developed continuously, and the children will be able to understand various concepts such as number and operations, patterns, functions, algebra, geometry and spatial sense, measurement, data analysis, probability, and problem solving [2].

Finding and exploring patterns belong to the notion of mathematics [3, 4, 5]. These activities are the basis for children in order to develop their algebraic understanding, providing opportunities to
observe, predict, conclude, and memorize everything symbolically. According to previous research conducted by Miriam M. Lüken and Ralf, it showed that children which have low achievement will obtain some improvements in arithmetic skills after five months of learning patterns explicitly [6]. Therefore, the introduction of concept of pattern learning mathematics plays an important role in improving students’ arithmetic skills in the next level [7]. Children also develop their deductive reasoning skills when they learn to predict the next object in a pattern. In addition, children will be able to make accurate predictions about issues that occur continuously. For example, children are able to predict what they have to do after lunch (cleaning), or after bathing (wearing clean clothes) which can make children become more confident.

Previous research conducted by Melinda Rossyila Putri, Siti Wahyuningsih, Djaelani which observed the children in kindergarten Wonolopo, Tasikmadu showed that ability to sort children's patterns is not as expected. This was proved in the preliminary tests (before 19 students did the test), the average completeness of children was 36.84% (7 children) who were able to sort patterns correctly without assistance and 63.16% (12 children) children still could not copy the pattern sequence right, since the fact is that learning activities by doing lecture to sort patterns do not directly involve children [8]. Hence, the children are less enthusiastic and become passive in the learning activities.

The results of a preliminary survey conducted in two kindergartens showed that children's ability to recognize patterns is still low. Children have several difficulties in completing pattern activities, and they are not interested or attracted. Children are not actively involved in finding a concept about patterns. In addition, activities in recognizing patterns were done individually and had never been conducted in pairs. The teacher states that linear patterns and cyclic patterns had been introduced to the children with the structure of ABC and ABCD patterns, while the hopscotch pattern had never been introduced to the children. These patterns are repeated in the same sequence, from several kinds of shapes or commonly called as repeating patterns [9]. Meanwhile, the facilities in schools are not really adequate for the learning process, but there are not many learning media that focus on pattern recognition and classrooms, and it is not organized with the media which are related to patterns, which make the children become less familiar with the patterns. The teacher has never conducted a learning activity which is based on Sorting Predict-think Discovery (SPD) for pattern recognition material, since there are several obstacles experienced by the teachers, such as limitation of time and the teaching method that aim to recognize the patterns directly. On the other words, the teachers tend to use classical learning models and give children less opportunities to be actively involved in recognizing patterns and not facilitating cooperation between children.

One alternative that can be implemented is by developing the learning models which is based on SPD for pattern recognition material. SPD model is a combination of discovery learning and think pair share model which is developed based on the constructivist view theory, which was supported by Piaget's cognitive process theory, Vygotsky's social learning theory, and Jerome Bruner's discovery theory. The concept of pattern learning model based on sorting predict-think discovery has five main elements, such as the syntax, social system, reaction principle, support system, instructional impact, and other impacts as well as the role of teacher and children [10]. Pattern recognition must be started with the children's understanding itself. The way which needs to be conducted is how to facilitate the children appropriately, in order to encourage them to think, ask questions, solve problems, express ideas, and discuss ideas until they acquire new knowledge. This means that the teachers should change their teaching approach. If in the previous method the teacher did not involve children directly, it can be changed into child-centered learning in order to make the children become more enthusiastic and give active participation in learning process. In addition, in the learning process, in order to recognize the patterns, the teachers must maximize the use of attractive media in order to make the learning process has several variations and attracts children's interests. By doing cooperation with their peers, it will give the children opportunities to evaluate and improve their understanding. Thus, learning activities provide opportunities for children to obtain the knowledge through observation, and facilitating them to interact with other children through problem solving activities. Therefore the development of learning pattern recognition based on SPD model aimed to: (1) determine the
feasibility of learning model which is based on SPD model in learning pattern recognition, and (2) determine the effectiveness of learning model which is based on SPD model in learning pattern recognition patterns to children 5 to 6 years old

2. Methods
Research and development model by Borg and Gall was used in this study, consisted of several stages, such as collecting, planning, and developing preliminary forms of product, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision, dissemination and implementation [11]. The research subjects consisted of teachers and children who were 5 to 6 years old in 9 kindergartens in Sleman Regency, Yogyakarta, Indonesia.

Data analysis techniques in this study were different, based on the assessment process that was conducted, and instruments for the assessment. In preliminary study, it was conducted by interviewing the informants. The interview results consisted of qualitative data which was in form of statements, such as questions and answers. These qualitative data were then analyzed by using descriptive analysis. In the process of developing the model, quantitative descriptive data were obtained by using Likert scale formula, and converted by using these following criteria:

| Interval Score | Criteria          |
|----------------|-------------------|
| $Mi + 1.5 SDi \leq M \leq Mi + 3.0 SDi$ | Very Feasible     |
| $Mi + 0.5 Di \leq M \leq Mi + 1.5 SDi$ | Feasible          |
| $Mi - 1.5 SD \leq M \leq Mi + 0 SDi$  | Quite Feasible    |
| $Mi - 3.0 SDi \leq M \leq Mi - 1.5 SDi$ | Less Feasible     |

In testing the effectiveness of the model, an operational test was analyzed by using Kruskal Wallis Test. This test was used as an analytical tool to test the research hypotheses that assess the mean differences from treatment 1 to treatment 5. The final result of this analysis was: if the probability of significance was > 0.05 then there was no significant difference in those five treatments, while if the probability value significance was <0.05, then there was a significant difference in those five treatments that had been conducted, so the hypothesis was accepted.

3. Result and discussion

3.1. The feasibility of learning model
The learning model in learning to recognize SPD-based patterns were validated by experts. The aspects of the assessment consisted of material component, syntax component, learning media component, and writing and language component, as can be seen in table 2.

| Assessment Aspects | Number of Items | M | Mi | SDi | Assessment Criteria |
|--------------------|----------------|----|----|-----|---------------------|
| Material           | 10             | 40 | 25 | 5   | Very Feasible       |
| Syntax             | 10             | 40 | 25 | 5   | Very Feasible       |
| Support System     | 7              | 28 | 17.5 | 3.5 | Very Feasible       |
| Language           | 3              | 12 | 7.5 | 1.5 | Very Feasible       |
| **Total Number**   | **30**         | **120** | **75** | **15** | **Very Feasible**   |

The results of the validation of learning materials, syntax, support systems, and language indicate that the learning model was categorized as "Very Feasible" to be tested. Trials were conducted twice,
consisted of preliminary field testing and main field testing in order to determine the teacher's response to the implementation of learning. The results of the implementation of learning in preliminary field testing indicated that the learning model can be implemented by the teacher and was feasible to be applied (table), while the main field testing showed that the learning model can be implemented by the teacher and was very feasible to be applied for children who are 5 to 6 years old (table).

Table 3. The result of feasibility test by teacher in preliminary field testing

| Assessment Aspects | Number of Items | M  | Mi | SDi | Assessment Criteria |
|--------------------|-----------------|----|----|-----|---------------------|
| Material           | 10              | 30 | 25 | 5   | Feasible            |
| Syntax             | 10              | 30 | 25 | 5   | Feasible            |
| Support System     | 7               | 21 | 17,5 | 3,5 | Feasible          |
| Language           | 3               | 9  | 7,5 | 1,5 | Feasible            |
| **Total Number**   | **30**          | **90** | **75** | **15** | **Feasible**        |

Table 4. The result of feasibility test by teacher in main field testing

| Assessment Aspects | Number of Items | M   | Mi | SDi | Assessment Criteria |
|--------------------|-----------------|-----|----|-----|---------------------|
| Material           | 10              | 120 | 40 | 25  | 5                   | Very Feasible |
| Syntax             | 10              | 120 | 40 | 25  | 5                   | Very Feasible |
| Support System     | 7               | 84  | 28 | 17,5 | 3,5               | Very Feasible |
| Language           | 3               | 36  | 12 | 7,5  | 1,5               | Very Feasible |
| **Total Number**   | **30**          | **357** | **120** | **75** | **15** | **Very Feasible** |

Most teachers stated that learning models in pattern recognition based on SPD are very feasible to be implemented. Thus, the learning model in pattern recognition based on SPD is very suitable to be used in learning pattern recognition, for children who are 5 to 6 years old.

3.2. The effectiveness of learning model

The effectiveness of learning models in learning pattern recognition based on SPD which were implemented for children 5 to 6 years old was based on the children's ability to recognize linear patterns, cyclic patterns, and hopscotch patterns. The assessment of children's abilities was conducted by doing observation in each activity. The average results of children's ability in each treatment can be seen in the table.

Table 5. The result of effectiveness test in 5 treatment

| Indicators             | The Ability to Recognize Pattern (obtained from the five treatments) | Average |
|------------------------|---------------------------------------------------------------|---------|
|                        | 1     | 2     | 3     | 4     | 5     |         |
| Recognize Linear Pattern | 2,76  | 2,93  | 3,5   | 3,78  | 3,84  | 3,36    |
| Recognize Cyclic Pattern  | 2,5   | 2,76  | 3,32  | 3,58  | 3,71  | 3,17    |
| Recognize Hopscotch Pattern  | 2,37  | 2,59  | 3,12  | 3,49  | 3,61  | 3,03    |

The table showed that there were any improvements in children who learn pattern recognition, based on each treatment. The indicator of the ability to recognize hopscotch pattern was an indicator that has a slight increase. It happens since most of the children still have difficulty in memorizing, drawing, and making hopscotch patterns. So far, hopscotch patterns had never been introduced and taught by the teachers to the children. Nevertheless, all of children abilities in recognizing patterns had
improved, and it can be concluded that the learning model for learning pattern recognition based on SPD was effective for children 5 to 6 years old.

The learning model in pattern recognition based on SPD developed in this study was declared feasible and effective for introducing patterns, for children who are 5 to 6 years old. Recognizing various types of patterns was the impact of SPD-based learning patterns. SPD is a collaboration of discovery learning model and think pair share. This collaboration can be conducted in order to make the learning activities suitable with the goals.

Patterning is fundamental to mathematics [12, 13]. In discovery learning, children are encouraged to learn by themselves to discover concepts through mental processes, while the teacher is only a facilitator who gives instruction to the activities. However, in its implementation, discovery learning is lack of facilitation which can support the development of children's social attitudes. Think-pair-share is a cooperative learning model that make children work in groups or in pairs. This learning model is designed to influence children's interaction patterns. This model also introduces the idea of "thinking time or waiting time" which is a strong factor in improving children's ability to respond to the questions. Cooperative learning in think pair share model is relatively simpler because it does not take long time to arrange the seats or classify the children. This learning trains children to dare to think and respect their friends' opinions.

Learning pattern recognition based on SPD model was consisted of several activities, such as copying, drawing, and creating. According to previous research by Johnson, Fyfe, McLean, & McEldoon, it was revealed that around 75% of children can copy a pattern, and about 50% can extend it. Meanwhile, fewer than 33% of children can create patterns meaning the ability to copy and continue patterns develop earlier than creating patterns [14]. The steps of this learning model were: children pay attention to the introduction of patterns, children identify and think by themselves about the problems based on the patterns presented by the teacher, children, and couples, and predict the continuation of patterns. Children conduct several activities to recognize patterns, such as telling the results of activities, while the children get reflections of the pattern recognition activities. The social system of developing this model is to facilitate children's interaction with their partners in order to form a cooperation among the children. The reaction principle of this model is the problems given by the teacher, where the childrens was asked to think by themselves and then solve the problem together with their own partner. The support system in the implementation of this learning model used tools and materials that were attractive and safe for the children such as label paper, geometry pieces, geometry clips, tile pieces, tile sponges, paperboard, and pencils. Instructional impacts on this model were learning to be child-centered (student centered), the discovery of recognizing patterns by children independently, learning and outcomes in form of cognitive-construct. The impact of this model was developing children's thinking skills and their abilities.

4. Conclusion
This research conducted a learning model which aimed to recognize SPD-based patterns. This model was able to encourage children to be actively involved in recognizing the concepts about linear, cyclic, and hopscotch patterns. Children were asked to think by themselves and solve problems together with their partners. This was conducted in order to facilitate children's interactions with their partners, so a cooperation system among the children can be formed. Stages of learning pattern recognize based on SPD were: (1) children pay attention to the pattern recognition, (2) children think by themselves and identify problems of the patterns as presented by the teacher, (3) children and partners sort out objects and predict the next patterns, (4) children implement several activities to recognize patterns, (5) children tell the results of activities, (6) children obtain reflections about patterns.

The learning model was considered as feasible and effective in introducing pattern, for children who are 5 to 6 years old. The average ability of children to recognize linear patterns was 3.36, while the average ability of children to recognize cyclic patterns was 3.17, and the average ability of children to recognize hopscotch patterns was 3.03. Hence, the ability to recognize hopscotch patterns showed a slight increase. This happened since most children still have difficulty in memorizing, especially in
drawing and creating patterns. Hopscotch patterns were patterns that have never been introduced and taught by teachers to children. Furthermore, all of children’s abilities to recognize patterns had improved. Therefore, it can be concluded that the learning model to pattern recognition based on SPD model is effective for children who are 5 to 6 years old.

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