Patterns playing for early childhood education: Mathematics learning for early childhood education

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Abstract. Mathematics learning for children should be conducted through playing because children’s interests are highly on games and playing is one of the main ways how children learn. Thus, games should be creatively designed to develop children’s potential. This research focused on developing mathematics learning models to improve children’s competencies in creating patterns. This study aimed to develop patterns playing model for five to six years old learners. The research was conducted for a year at one of the kindergartens in Aceh Besar, Indonesia. The study carried out in this phase was to develop the models conceptually. The findings of this study showed that patterns playing model for learners of the ages of five to six were the patterns of shapes, colors, sizes and numbers. The proposed activities were arranging objects, coloring, sticking, and making beaded bracelets. The types of the patterns playing that were developed included repetitive patterns, growing patterns and symmetrical patterns. The developed model of patterns playing can be used in learning to develop children’s cognitive aspect, namely the ability to create patterns.

1. Introduction

Early childhood is considered as golden period (golden age), specifically children whose age of 0 to 6 years old. According to Hurlock [1] the development of children’s intelligence at this age reaches 80% and therefore it should be carefully dealt with and well-planned to achieve the optimal development. As Santrock [2] explained that children grow in a sensitive period in their early years, in addition, children can easily receive certain stimulations at this age.

Education for early childhood in Indonesia is known as Pendidikan Anak Usia Dini (PAUD) which can be implemented both formally and informally. The regulation of the Ministry of Education and Culture of the Republic of Indonesia Number 137 Year 2014 mentioned that the implementation of PAUD is classified into 3 categories based on the children’s ages: 0 to 2 years old is categorized as childcare, named as Taman Penitipan Anak (TPA); 2-4 years old is categorized as playgroup, named as Kelompok Bermain (KB); and 4-6 years old is categorized as kindergarten named as Taman Kanak-Kanak (TK) [3]. Early childhood education is one of the implementations of education focusing on improving six aspects including religion and moral, social emotional, language, physic and motoric, cognitive, and art.

Children’s ability to create patterns is one of the cognitive developments. The development may occur when it is stimulated by fun activities in the classroom. One of cognitive abilities for early childhood learners of age 5 to 6 is problem solving skill, as listed in the regulation of the Ministry of Education and Culture of the Republic of Indonesia Number 137 Year 2014 about children’s
development achievement standard known as *Standar Tingkat Pencapaian Perkembangan Anak (STPPA)*, which includes the ability to create patterns.

Developing children’s ability to create patterns can be done through play. Ahmad [4] stated that children learn while playing. Children’s ability to create patterns can assist them to understand the relations between objects, shapes, and numbers [5]. Early childhood learners should be trained to form patterns as this can improve their abilities of sorting, classifying, identifying shapes, and creating graphs. The children’s ability to create patterns can be one of their basic skills in mathematics.

Preliminary studies at TK IT Azkia Cadek Aceh Besar showed that the problem that occurred at the institution was lack of mathematical games in developing early childhood cognitive abilities, especially in creating patterns. Based on this reason, the researchers were interested in investigating mathematics learning for early childhood education to improve the patterns playing model for 5 to 6 years old learners.

The research questions were as follows.

1. What were the activities of patterns playing in the learning process of early childhood learners?
2. What were the possible patterns playing models to develop children’s ability to create patterns?

### 1.1. Mathematics learning for early childhood learners

Early childhood learners are children of age 0 to 6 years old. Suyanto [6] mentioned the characteristics of the learners are: 1) highly curious, 2) having unique personality, 3) enjoying fantasies and imaginations, 4) having potential period of learning, 5) having egocentric behavior, 6) having short concentration range, and 7) part of society. Based on these characteristics, Suyadi [7] asserted that early childhood learning should be done through meaningful games designed by teachers considering the concepts and the learning process.

Mathematics is one of cognitive aspects that should be introduced to children in their early years to achieve the standard cognitive development known as *Standar Tingkat Pencapaian Perkembangan Anak (STPPA)* as listed in the regulation of the Ministry of Education and Culture of the Republic of Indonesia Number 137 Year 2014. As Hurlock [1] explained that the early five years of a child’s life seem to be the most essential period to their future development. This statement is in line with Bloom’s suggestion that children’s intelligence reaches 50% at the age of 4 and 80% at the age of 8 [8]. Therefore, children’s potentials, including mathematics, need to be developed in their early years.

Educative games can be employed to introduce mathematics to children as they learn by playing and trying. The main principle of early childhood learners is learning by playing or playing by learning, as Risalddy [9] affirmed that teachers need to design playing activities by incorporating educative elements in order to ensure learners learn and to create a fun learning. Mathematics learning should be conducted using games allowing the learners to work and learn both by themselves and in group. Mathematics learning could be carried out in an integrated way using certain themes related to the learners’ life and experiences. Mathematics concepts for 5 to 6 years old learners are about shapes, colors, sizes, and patterns. The achievement levels are: 1) classifying objects based on their shapes, colors, or sizes; 2) Introducing patterns AB- AB, ABC-ABC and ABCD-ABCD; 3) Arranging objects in five different sizes and colors, 4) creating patterns.

### 1.2. Patterns playing

Educative games play an important role in the implementation of learning activities in the early childhood education as children learn from playing [9]. The playing activities designed to improve their abilities are related to the concepts of shapes, colors, sizes and patterns conducted by the patterns playing activities. The patterns that are created include repetitive patterns, growing patterns and symmetrical patterns [10].

Repetitive patterns are obtained from repeating objects based on their colors, shapes, or sizes. The ABC-ABC patterns are from the objects repetitions based on colors, such as red, yellow, green, red,
yellow, green, red, yellow, green, etc. The shapes of ABC-ABC patterns are from repeating the objects based on shapes, for example triangle, circle, square, triangle, circle, square, triangle, etc. The shapes of ABC-ABC are created from repeating sizes, for example arranging pencils based on sizes, short, medium, long, short, medium, etc.

Growing patterns are obtained from the objects growth based on their colors, shapes, and sizes. For example, gradation or degradation colors, such as arranging objects from large to small sizes; short to long; little amount to many and vice versa.

Symmetrical patterns are created from reflections of objects based on colors, shapes, and sizes. The symmetrical patterns based on colors, for example red, yellow-yellow-red (ABBA). The patterns based on shapes, for instance leaf and wing shapes. Based on sizes, for example large, small, small, and large. The activities of patterns playing can be applied by involving learners individually or in group to continue the sequencing based on colors, shapes, and sizes. The activities can be conducted by arranging objects, coloring, sticking, and making beaded bracelets which in turn lead to repeating, growing patterns and symmetrical patterns.

2. Method
Research and Development method was applied in this study. This method was chosen in accordance with the aims of the study which was to develop patterns playing model to be implemented in early childhood’s learning.

Patterns playing model developed in this research was conceptual and procedural. However, the focus was only on the conceptual model. The phase of development model used in this research was Constructivist Instructional Design (CID) [10] and the steps for developing the model referred to Borg and Gall [11]. The development of this playing model was based on the constructivism theory designed by Piaget and Vygotsky (social constructivism). The development process is known as 4D (Divine, Design, Development, and Dissemination).

The research was conducted in one of early childhood schools in Aceh Besar, Indonesia. The school was chosen mainly because of its lack of mathematics games designed for classroom activities. This study was carried out for one year and the subjects for this study were 5 to 6 years old learners in the school. Data collected for this research were the result of discussion with expert team, the result of the design of patterns playing, and the test result of the effectiveness of patterns playing model. For data analysis, descriptive qualitative was implemented.

3. Result and discussion
The research findings were in accordance with the aims of this study: developing patterns playing model for 5 to 6 years old learners. Based on the results, some findings were identified: (1) the assessment instrument could be used in the activity of creating patterns for 5 to 6 years old learners, and (2) the designed model of patterns playing was for 5 to 6 years old learners.

3.1. Model adaptation
The model development of patterns playing was conducted by adapting learning activities which were normally implemented in the research location (PAUD). They were: coloring, arranging objects, sticking and making beaded bracelets. The four activities were developed into patterns playing model to enhance learners’ cognitive aspects. This model is one of alternatives for integrated activities to develop other aspects of learners’ development.

Furthermore, educative patterns playing were organized in this study. The playing activities needed to fulfill certain criteria namely: (1) having specific aims, (2) incorporating learning activities, (3) using didactic methods, (4) using media/educative equipments, (5) having playing procedures and (6) having assessment instrument. The sixth criteria were used as reference to analyze the activities of patterns playing.

The first criterion was related to the aims of study as listed at the regulation of the Ministry of Education and Culture of the Republic of Indonesia Number 137 Year 2014 about learner’s
development achievement standard known as *Standar Tingkat Pencapaian Perkembangan Anak (STPPA)*. The second criterion described the contents of learning (referring 2013 curriculum) that should be inserted in the playing patterns model activities. The learning contents consisted of religious moral values, literacy, science, mathematics, social emotional, and arts. The third criterion was related to implementation of didactic method and it was linked to some learning methods including fun, contextual, and meaningful learning. The fourth criterion was related to the media. The patterns playing model needed several media and equipment to support the activities. The fifth criterion emphasized that the activities of patterns playing should have clear and specific procedures. The procedures were the technical instructions for the subjects implementing the activities. The last criterion described that patterns playing model should assess both the cognitive development and the activities of the learners.

3.2. The model development of patterns playing

The model obtained satisfied the pre-defined criteria: (1) having specific aims, (2) incorporating learning activities, (3) using didactic method, (4) using media/educative equipment, (5) having clear procedures and (6) having assessment instruments. The activities were referred to the patterns which were normally implemented in the research location (PAUD): coloring, arranging objects, sticking and making beaded bracelets.

The patterns playing activities of coloring were supported by several tools such as papers, crayons or coloring pens, pictures of pearl necklace, pearl bracelet and house fences. The patterns resulted from the activities were coloring and repeating patterns.

The patterns playing activities of organizing objects were conducted by using geometry, parts of twigs, and small stones. The patterns resulted from the activities were patterns based on sizes: large to small and vice versa.

The patterns playing activities of sticking was carried out by using colorful papers in five sizes. Some equipments were required for sticking activities, such as ice cream sticks, glue and cardboards. The results of these activities were size and color patterns. The types of pattern obtained were repeating and growing patterns: large to small size and vice versa.

The patterns playing activities of making beaded bracelets were conducted by using three kinds of flowers, three colors of beads, and threads. The patterns of shape, size, color and numbers were obtained from these activities. The patterns formed were repeating and growing patterns: large to small size and vice versa.

The materials used for patterns playing in this study were both artificially and naturally created. The artificial ones were solid geometry, beads, ice cream sticks, and papers. Meanwhile, the researcher also took several natural materials such as stones, twigs, and leaves. Patterns playing model with various activities was developed to improve learners’ cognitive skills and fine motor abilities and to train learners’ patience.

The activities of patterns playing developed in this research were the activity of coloring, arranging objects, sticking, and making beaded bracelets. The patterns playing models developed were a solitaire game model, play in groups, and competition.

The model of pattern playing was designed to develop children's cognitive abilities. The developed model can be used to play alone or play in groups because children's cognitive development is influenced by social activities. This is consistent with Vygotsky's statement as cited by Kuntjojo [13] that children's cognitive development cannot be separated from social and culture activities.

Pattern playing is done through coloring, composing, sticking, and dancing. These activities are useful to stimulate the development of early childhood multiple intelligence, cognitive abilities, fine motor skills, patience and art. Therefore, learning process in PAUD institutions must be carried out in an integrated manner. This is as stated in the Minister of Education Regulation Number 146 of 2014 concerning 2013 Early Childhood Education Curriculum that learning for early childhood is carried out in a planned and integrated manner [14].
The developed model was designed specifically for children aged 5-6. The activities included the shape patterns, color patterns, size patterns and number patterns. This is in accordance with Piaget's theory that the stage of cognitive development of children aged 2-7 years is still in the Pre-Operational period which means that the child still tends to focus on the most interesting characteristics of a stimulus, the child has not been able to reflect on and integrate various characteristics of the stimulus and the child is not yet able to reason rationally [15].

4. Conclusion
Based on the results, it could be concluded that: (1) the development of patterns playing model was conducted by adapting the routine activities of 5-6 years old learners such as arranging objects, coloring, sticking, and making beaded bracelets. (2) The materials used by 5-6 years old learners for patterns playing activities were solid geometry, ice cream sticks, papers, crayons, coloring pencils, twigs, flowers, and leaves. (3) The types of patterns developed in the patterns playing for 5-6 years old learners were repeating, growing and symmetrical patterns. (4) The patterns model for 5-6 years old learners were the patterns of shapes, colors, sizes and numbers. (5) Patterns playing models with various activities were developed to improve learners’ cognitive skills and fine motor abilities, and to train learners’ patience.

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