Research Topic:

Using Tangrams to facilitate children’s mathematical skills
SECTION 1: INTRODUCTION
1.1 Introduction

When children are actively involved, they are manipulating with real objects, exploring, reflecting, interacting, making decisions and communicating with other children and adults to construct knowledge and ideas from their experiences (MOE, 2007). All these highlight to early childhood educators that it is important to aptly engage children in their classrooms.

In year 2000, the National Council of Teachers of Mathematics (NCTM) published a set of standards that recognizes that prekindergarten children have an informal mathematical knowledge base, and are ready to pick up mathematical concepts (Charlesworth, 2005). Mathematical understanding and skills are important to help children make sense of their world outside of school and help them construct a solid foundation for success in school (NAEYC & NCTM, 2002). In the preschool years, besides picking up academic skills such as reading, writing and number or mathematical skills, children should also develop broader cognitive skills such as the ability to ask questions, think for themselves and to sort out puzzles (Shanmugaratnam, 2003). This action research will focus on a puzzle known as tangrams and the benefits it can bring to the children.

In the Chinese Language, “tangram” literally means “seven boards of skill”. It is a dissection puzzle which consists of seven pieces, called tans. The objective of the tangram game is to form a specific shape with all seven pieces without any overlapping (Wikipedia, 2008). Playing with tangrams actively involve children as they manipulate the pieces into various shapes. This makes it exciting to children and it fosters sharing among them. Having such high interest in the activity will also help promote positive attitudes towards mathematics. Playing with Tangrams can help children to develop their skills of a geometry vocabulary, shape identification, shape orientation, and discover relationships between and among the seven pieces. Such experiences are especially important for young children to recognize and
appreciate geometry in their natural world (Bohning & Althouse, 1997). Nevertheless, we researchers have noticed a lack of proper usage of tangrams in our classrooms and recognize that there is a need for teachers to learn the proper way to use tangrams in the classroom to enhance children’s mathematical skills that are mentioned above.

1.2 Area of Focus

In review of the current practices in Singapore preschools, little is known about the implementation of tangrams in early childhood classrooms. Tangrams are simply left at learning centers, or provided as a transitional activity to keep children occupied. It is also used to keep some children busy while the others struggle to finish up their work. Often, children use the pieces for pretend play instead of forming specific shapes with them. Without adequate instructions, many children fail to use the tangrams in the intended manner and lose experiences that could sharpen their thinking skills, develop positive attitudes toward geometry, shape identification and orientation skills, and foster an understanding of basic geometric concepts and relationships (Bohning & Althouse, 1997). The children are missing out on the benefits that Tangrams can offer.

This study aims to inform how we as teachers can maximize the use of tangrams, and determine how the seven geometric shapes can be an appropriate manipulative for children to gain mathematical understanding.

1.3 Objectives of study

This action research is carried out with the intention to show that tangrams can be used to enhance children’s geometric mathematical skills. Children will be aided in geometry vocabulary, shape identification, shape orientation and discover relationships between the seven tangram pieces. Ultimately, we want this to translate into a more meaningful usage of tangram pieces that have been left abandoned at learning corners in schools.
SECTION 2: LITERATURE REVIEW
2.1 Tangrams and Children’s Learning

According to Corry (1996), Piaget’s theory is based on the idea that children actively acquire knowledge through their own actions. Knowledge is invented and re-invented as the child develops and interacts with their surrounding world. Piaget believes there are three types of knowledge, namely physical, logical-mathematical and social-arbitrary, that children will acquire. Physical knowledge involves information about objects which is gained through its observable properties. Logical-mathematical knowledge is abstract knowledge that must be invented and social-arbitrary knowledge is culture specific knowledge learned from within one’s culture group. Logical-mathematical knowledge cannot be developed until physical knowledge is attained (Corry, 1996). The colour, shape, size and texture of an object are used to construct the abstract knowledge that is important for the early foundations of mathematical thinking (Copeland as cited in Smith, 2001).

Using Tangrams is ideal for teaching mathematical skills as it provides a concrete way to learn physical knowledge of math in order to understand geometric concepts. Study suggests that tangrams are suitable manipulatives for children to use to acquire geometric knowledge. Furthermore, problem-solving strategies are explored and it enhances their spatial sense. Only with much exposure to many shape examples and discussion of their attributes will children be able to combine, subdivide and change shapes to develop their spatial sense (Bohning & Althouse, 1997). During the activity, children have fun thus developing a positive attitude towards mathematics. It is also ideal for testing children’s spatial abilities (Butler, 1994).

Tangramming activities require one to assemble figures from *tans*. Children are challenged to arrange and rearrange the seven tans into pictures of birds, animals, fish, people and designs. This simple act of manipulating the seven *tans* encourages communication between the children as they talk about the “what and the how” (Bohning & Althouse, 1997).
Some reactions from children during tangramming are: “There is nothing to show us where it goes, except experimenting with where it don’t go”; “…. Shapes can make other shapes!…..I try to cut out the picture with my mind, so that I can see which shape goes where”; “It seemed impossible when I was doing it but now, it seems clear” (Youtube, 2007). It is also possible for children to use tangrams to illustrate their thoughts, giving children an alternative expressive skill in language (Bohning & Althouse, 1997). However, we recognize that locally, tangrams are not used to their full potential and that there is paucity in research involving preschoolers using tangrams as a manipulative.

2.3 Thinking skills

Cotton (1991) pointed out that, there are no universal agreements as to the precise meanings of thinking skills. There are many alternative definitions to various thinking terms like critical thinking, creative thinking, higher–order thinking. The thinking skills in children can be seen as information-processing skills, reasoning skills, enquiry skills, creative thinking skills, and evaluation skills (Taggart, Ridley, Rudd & Benefield, 2005). Critical thinking is the process of determining the authenticity, accuracy, or value of something; characterized by the ability to seek reasons and alternatives, perceive the total situation, and change one’s view based on evidence (Alvino as cited in Cotton, 1991). It is also called “logical” thinking and “analytical” thinking. Creative thinking has been defined as a novel way of seeing or doing things that is characterized by four components – Fluency, Flexibility, Originality and Elaboration (Cotton, 1991). For this action research, we plan to use the definitions in Bloom’s Taxonomy of Cognitive Domain to define children’s thinking processes.

2.3.1 Bloom’s Taxonomy of the Cognitive Domain

Bloom's taxonomy of the cognitive domain serves as the basis for educational goals and objectives of what educators would like their students to attain (Huitt, 2004). Embedded in the taxonomy is a hierarchy from less to more complex thinking skills. Generally the idea is
that if a student knows about a topic at a higher level of thinking, the more the student remembers about the topic. Also, there is the idea that the higher level of thinking is a complex combination of the lower level thinking (POPET, 2004).

There are six thinking levels in Bloom’s taxonomy. At the lower levels are knowledge and comprehension. At the knowledge level, students are expected to recall and recognize the information, ideas and principals. At the comprehension level, students are able to translate, comprehend and interpret information based on their prior learning. Moving up to more complex and mental abstract levels are the application, analysis, evaluation and synthesis thinking levels. The application level is where the student will use the information obtained to complete a task or problem with minimum direction. At the analysis level, the student will distinguish, classify and relate assumptions, hypotheses or evidence to a question. Next, at the evaluation level, students will be able to appraise, assess, or critique the information base on some specific standards and criteria. Lastly, the synthesis thinking level is where the student would be able to integrate and combine the information into an original idea, product or plan (Huitt, 2004).

2.3.2 Visual & Spatial Thinking

Visual-spatial thinking is the ability to imagine and mentally manipulate two-and three dimensional figures in one’s mind (Ormrod, 1998). Further, other studies done by Fennema & Sherman, Friedman and Threadgill-Sowder have found that visual-spatial thinking appears to be related to mathematics achievement (Ormrod, 1998). Sprafkin, Serbin, Denier and Connor (Ormrod, 2007) have found that an increase exposure to certain types of toys enhances the development of visual-spatial thinking skills. This tells us that tangramming would be an ideal activity to use for facilitating children’s spatial thinking as concrete materials are provided.
2.4 Teacher as a Facilitator

Children’s development and learning is a result of internalizing the culture and social relationships in social activities of the children with adults. Teachers are an important part of a child’s classroom. They are the ones who interact with the children and create the learning environment and activities based on a substantial understanding of the children’s development and ability levels. The teacher’s role is to provide children with high quality mathematical education to enable them to acquire the necessary knowledge and skills that they need (Varol & Farran, 2006).

When children are engaged in an activity, it is necessary to observe and listen to what they have to say, only then will the teacher be able to appropriately ask questions that elicits their thinking to involve them in problem solving (Rigelman, 2007). Therefore, appropriate questioning will serve to enhance children’s learning abilities. The teacher’s role is to see where children’s observation and questions may take them. Instead of providing solution strategies, the teacher must encourage multiple approaches, redirect, probe, reinforce, and allow time for communication and reflection about those strategies (Cotton, 1991). Instead of focusing on finding the answer, and expecting specific responses, the teacher must be ready to ask questions that uncover children’s thinking and press for children’s reasoning behind the process (Rigelman, 2007).

2.4 Definition of Research Terms

2.4.1 Tangrams

Tangrams is a dissection puzzle which consists of seven pieces of shapes called tans. The seven pieces include one square, one parallelogram, two big triangles, one medium sized triangle and two small triangles. The objective of the game is to form a specific shape using all the seven pieces without any overlapping (Wikipedia, 2008).
2.4.2 Mathematical skills

In this action research, the researchers are looking at geometry related mathematical skills. Thus, “mathematical skills” will be defined as skills like shape identification, shape orientation, geometry vocabulary and discoveries of the relationships between and among the seven pieces of tans.

2.5 Conclusion

This literature review summarizes that tangrams are useful for children to develop their geometric knowledge, mathematic and problem solving skills. Further, teacher’s facilitation during children’s everyday activities is crucial in contributing to creating learning experiences for children. We are also aware that there are different types of thinking skills and there is a process and hierarchy to it. All these information will serve as a basis for us to look into the effects tangrams will have on children’s mathematical skills.

2.6 Research questions

In this study, we attempt to address the lack of research in how using tangrams can affect children’s mathematical abilities. We will focus on implementing tangram sessions where teacher’s guidance will be kept to a minimal to observe how children will manipulate the tangram pieces. Our research questions are:

i. How can children’s mathematical skills be developed through the use of tangrams?

ii. How can teachers facilitate during tangram play sessions to scaffold children’s mathematical skills?
REFERENCES


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