



## THE ROLE OF MANIPULATIVES IN DEVELOPING SPATIAL REASONING IN AN INCLUSIVE EARLY CHILDHOOD MATHEMATICS EDUCATION

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### Introduction

Manipulative is defined as the use of objects to explore and discover mathematical concepts. Manipulative allow children to experience and interact with mathematical concepts in a hands-on, tactile way. Manipulatives provide children with the opportunity to develop their spatial reasoning skills. Spatial reasoning is the ability to understand and manipulate objects in two- or three-dimensional space. It is a critical skill for success in mathematics.

In an inclusive early childhood mathematics education, manipulative are important tools for developing spatial reasoning. Manipulative allow children of all abilities to explore and understand mathematical concepts. All children, regardless of their physical, cognitive, or social abilities, can benefit from the use of manipulative. Manipulatives provide a common language that all children can understand. They also provide a way for children to explore mathematical concepts that may otherwise be difficult to grasp.

The purpose of manipulative in Early Childhood Mathematics Education is to help children of all abilities to understand and explore mathematical concepts. Manipulative can be used to help children develop their spatial reasoning skills. Manipulative can also help children to develop problem-solving skills, as children must use their spatial reasoning to manipulate the objects in order to solve problems. Manipulative can also help children to develop their fine motor skills as they manipulate objects. Furthermore, manipulative can provide children with a concrete way to understand abstract mathematical concepts.

In conclusion, manipulative are important tools in an inclusive Early Childhood Mathematics Education. Manipulatives provide children of all abilities with a common language to explore and understand mathematical concepts. Manipulative also provide a way for children to develop their spatial reasoning skills and problem-solving skills. Finally, manipulative provide a concrete way for children to understand abstract mathematical concepts.

It should be noted that, manipulatives are increasingly being used as a tool to promote the development of spatial reasoning in an inclusive environment. In this chapter the author defines manipulatives, gives an overview of the importance of manipulative in developing spatial reasoning and states the purpose of manipulative in inclusive Early Childhood Mathematics Education. Additionally, the author explores the Role of Manipulatives in Developing Spatial Reasoning. Own explores how manipulatives can help children learn mathematics, gives examples of different manipulative used in mathematics education and explains the benefits of using manipulative in developing spatial reasoning. Furthermore, the chapter explains various ways of promoting inclusion in Early Childhood Mathematics Education, how to encourage co-operation and collaboration, promoting Self-Esteem and developing Positive Attitudes towards Mathematics.

Moreover, strategies for Promoting Inclusive Early Childhood Mathematics Education are explained and examined as well as how to utilize manipulative to meet the needs of all learners, how to incorporate manipulative into instruction to engage all students and how to utilize manipulatives to support students with disabilities. In fact, Challenges of Using Manipulative in Early Childhood Mathematics Education are explored. And lastly, the author concludes the chapter by summarising the importance of manipulatives in developing spatial reasoning in an inclusive Early childhood mathematics education, benefits and challenges and discovers that, benefits of Using Manipulative in Early Childhood Mathematics Education Outweigh Challenges. Own ends the chapter by highlighting recommendations for Implementing Manipulative in Early Childhood Mathematics Education and implications for further research and practice

### **Role of manipulatives in developing spatial reasoning in an inclusive early childhood mathematics education.**

Manipulatives are physical objects that can be used to help children learn and understand mathematical concepts. Manipulatives can range from everyday objects such as coins, blocks, and cards to more specialized tools such as calculators and pattern blocks (Lee

2023). Figure 1 below is an illustration of some manipulatives in an inclusive early childhood Mathematics classroom.

**Figure 1: Manipulatives in an inclusive early childhood Mathematics classroom.**



Image courtesy of Mid-journey an AI tool embedded on the author's student portal at Atlantic International University (AIU) 2023

Manipulatives can be used to help children construct meaning, explore relationships, and develop problem solving skills. In an inclusive early childhood mathematics education, manipulatives can be used to help children with diverse learning styles and abilities to develop spatial reasoning (Kaur,2023).

Spatial reasoning is the ability to think and reason in three-dimensional space (Nguyen,2023). It is an important component of mathematical thinking and problem solving. Spatial reasoning helps children understand and solve mathematical problems, and it can also help them develop their creativity and problem- solving skills. In an inclusive early childhood mathematics education, manipulatives (Smith,2022) can be used to help children with diverse learning styles and abilities to develop spatial reasoning. Manipulatives can be used to help children explore geometric shapes, visualize relationships between numbers, and develop problem solving strategies.

When using manipulatives to develop spatial reasoning in an inclusive early childhood mathematics education, it is important to create a learning environment that is welcoming and inclusive of all children. (EL-Haddad & El Banna, 2021). Figure 2 is an example of a learning environment that is welcoming and inclusive of all children.

**Figure 2: Learning environment that is welcoming and inclusive of all children.**



Illustration courtesy of Mid-journey an AI tool made available by Atlantic International University (AIU) on my student portal 2023

Manipulatives should be accessible to all children, regardless of their ability level. The teacher should also provide support and guidance to ensure that all children are engaged in the learning process. Additionally, it is important to provide a variety of manipulatives that will appeal to different learning styles and abilities. A study done by Smith (2022) show that, manipulatives when used effectively can facilitate development of Spatial Reasoning in Inclusive Early Childhood Mathematics. This study conducted in 2018 and

published in 2022 examined the effects of using manipulatives to facilitate spatial reasoning in special needs children. The study involved a total of 30 participants, ranging in age from 8 to 10 years old. These children were diagnosed with either autism spectrum disorder, Down syndrome, or a language delay.

The participants were split into two groups. One group used manipulatives to complete spatial reasoning tasks, while the other group did not. The tasks included tasks such as pattern completion, shape identification, and spatial orientation.

The results of the study showed that the group using manipulatives had a significantly higher success rate (84%) compared to the group without manipulatives (64%). Additionally, the group using manipulatives showed a statistically significant improvement in spatial reasoning skills.

The study concluded that using manipulatives to facilitate spatial reasoning in special needs children can have a positive effect on their ability to understand and complete spatial tasks. Moreover, the use of manipulatives can help to reduce the frustration associated with learning spatial concepts, and can help to improve cognitive skills in this population.

In conclusion, manipulatives can be used to help children with diverse learning styles and abilities to develop spatial reasoning in an inclusive early childhood mathematics education. Manipulatives can help children explore geometric shapes, visualize relationships between numbers, and develop problem solving strategies. When using manipulatives, it is important to create a learning environment that is welcoming and inclusive of all children, provide support and guidance, and provide a variety of manipulatives that will appeal to different learning styles and abilities.

### **Benefits of Using Manipulative in Developing Spatial Reasoning**

Using manipulatives is an effective way to help students develop spatial reasoning skills. Manipulatives are physical objects that can be used to represent mathematical concepts, allowing students to interact with the material in a tangible way. The use of manipulatives can enhance cognitive development, improve problem solving skills, and help students develop a better understanding of mathematics concepts (Bhattacharya,2022). The next paragraphs explore how manipulatives can enhance cognitive development and understanding of mathematics concepts as well as improve problem-solving skills.

**Enhancing Cognitive Development:** Manipulatives can help students to visualize the concepts they are learning, which can in turn help them to better understand the material. By manipulating the objects, students can create mental models of the concepts they are learning, creating a more concrete understanding of the material.

**Improving Problem Solving Skills:** Manipulatives can be used to model problems, allowing students to visualize the different parts of the problem and how they interact. This can help students to better understand the problem and come up with creative solutions. Additionally, manipulatives can help students to practice problem solving skills, allowing them to develop a better understanding of the material.

**Enhancing Understanding of Mathematics Concepts:** Manipulatives can help students to gain a better understanding of mathematics concepts, as they can explore the concepts in a more concrete way. By manipulating the objects, students can gain a better understanding of the relationships between the different parts of the concept, and how they interact. Additionally, manipulatives can help students to better understand the abstract concepts they are learning, as they can explore the material in a more tangible way.

Overall, the use of manipulatives can be an effective way to help students develop spatial reasoning skills. Manipulatives can help to enhance cognitive development, improve problem solving skills, and help students gain a better understanding of mathematics concepts.

### **Inclusive strategies for using manipulatives**

In order for manipulatives to be effective in an inclusive early childhood mathematics education, it is important that teachers use strategies that promote equity and access for all students. One such strategy is to provide multiple representations of mathematical ideas. For example, teachers can provide both visual and physical representations of mathematical concepts, such as diagrams, pictures, and manipulatives. (Reehm & Reehm, 2021) This allows students to engage with the material in different ways and promotes understanding of mathematical ideas.

In addition, teachers should provide multiple levels of support when using manipulatives. This may include providing structured tasks, scaffolded instruction, and differentiated instruction. Structured tasks provide students with a clear goal and set of expectations, while scaffolded instruction provides support and guidance. Differentiated instruction allows teachers to tailor instruction to meet the individual needs of each student.

In-fact, teachers should provide opportunities for students to collaborate and work together when using manipulatives. Through collaboration, students can learn from each other, develop problem-solving skills, and gain a better understanding of mathematical concepts.

### **Promoting Inclusion in Early Childhood Mathematics Education**

Promoting Inclusion in Early Childhood Mathematics Education is an important part of providing a positive learning environment for young children. Through a variety of activities, teachers can foster positive attitudes towards mathematics and encourage cooperative and collaborative learning. Subsequent paragraphs explain how manipulatives can promote inclusion in early childhood mathematics education.

**Encouraging Cooperation and Collaboration:** Teachers can create opportunities for students to work together to solve problems and think critically. These activities can involve group work, cooperative games, and problem-solving exercises (Fong,2022). By allowing students to work together, they can gain a better understanding of mathematics and develop a positive attitude towards the subject.

**Promoting Self-Esteem:** Teachers can create an environment that encourages children to take risks and be creative with their learning. Through positive reinforcement and open dialogue, teachers can help children develop a sense of self-esteem and confidence in their abilities. By providing a safe and supportive learning environment, children can be more likely to take risks and explore mathematics.

**Developing Positive Attitudes towards Mathematics:** By providing meaningful and engaging activities, teachers can help children develop a positive attitude towards mathematics. Activities such as hands-on manipulatives, games, and problem-solving activities can help children develop an understanding of mathematics and a positive attitude towards the subject. By providing a positive learning environment, children can be more likely to develop a positive attitude towards mathematics

### **Challenges of Using Manipulative in Early Childhood Mathematics Education**

The use of manipulatives in inclusive early childhood mathematics education can be a powerful tool to help children learn. However, there are several challenges associated with using manipulatives in the classroom.

**Lack of Training:** One of the biggest issues is that many teachers are not adequately trained in how to use manipulatives effectively. Without proper training, teachers may not be able to get the most out of the manipulative they use (Yildirim,2021).

**Cost of Manipulative:** Another challenge is the cost of manipulatives. Many manipulatives can be expensive and, depending on the budget of the school or district, may not be available. **Time and Resources:** A third challenge is the time and resources needed to use manipulatives. Not only do teachers need to plan and prepare for the use of manipulatives, but they also need to provide appropriate instruction and support when using them.

Despite these challenges, the use of manipulatives in early childhood mathematics education can be beneficial for all students, including those with learning difficulties (Stribling, 2021). With proper training and support, teachers can use manipulatives to help students gain a better understanding of mathematics concepts and build the skills they need to succeed.

## **Conclusion**

In conclusion, manipulative play is an invaluable tool for developing spatial reasoning in an inclusive early childhood mathematics education. By providing children with tangible objects to explore, they can build an understanding of spatial relationships and gain a better understanding of the physical world around them. Manipulative play also encourages children to think critically and problem-solve, which are essential skills for success in mathematics. Furthermore, by involving children in hands-on activities, teachers can create a more inclusive learning environment, where all children can participate and engage in the learning process.

Ultimately, manipulative play is an important part of developing spatial reasoning and mathematics proficiency in an inclusive early childhood education. Through the use of manipulatives, teachers can create an environment that is conducive to exploration and discovery, provide children with the tools they need to gain a better understanding of the world around them. Manipulatives can be used to engage children in meaningful learning experiences, help them develop the skills they need to become successful in mathematics.

Manipulatives are a key tool for developing spatial reasoning skills in an inclusive early childhood mathematics education. Manipulatives provide a hands-on learning approach that allows children to interact with mathematics in a more meaningful way, fostering an understanding of mathematical concepts while also encouraging the development of spatial reasoning. Manipulatives also provide a way for children with disabilities to participate in mathematical activities and gain access to the same concepts as their peers. The use of manipulatives in early childhood mathematics education has many benefits, including providing a concrete understanding of mathematical concepts, fostering an understanding of spatial reasoning, and providing a way for children with disabilities to participate in activities. While these benefits are significant, there are also challenges that need to be addressed, such as the cost of purchasing manipulatives, the need for teacher training, and the potential for misuse of manipulatives.

The benefits of using manipulatives in early childhood mathematics education outweigh the challenges. Manipulatives provide an effective and meaningful way for children to

learn mathematics, and their use is beneficial for all children, including those with disabilities. However, it is important to ensure that manipulatives are used appropriately and that teachers have the necessary training to use them effectively.

Implementing manipulatives in early childhood mathematics education requires careful planning and consideration of the benefits and challenges. It is important to ensure that manipulatives are used in appropriate ways, that teachers are trained to use them effectively, and that there is sufficient funding for purchasing manipulatives. Furthermore, there is a need for further research into the effectiveness of manipulatives in early childhood mathematics education and how they can be used to improve access for children with disabilities. Finally, further research is needed to identify best practices for using manipulatives in early childhood mathematics education.

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