Learning Mathematics through Everyday Play in Prekindergarten

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In today's fast paced early childhood classrooms, mathematics play activities in prekindergarten settings are not consistently supported. Administrators and educators have discussed with great intensity and passion about incorporating mathematics play in prekindergarten classrooms. Both groups discussed the benefits and reservations of incorporating mathematics play activities as part of daily learning. For example, some teachers stated that their daily schedule is limited due to other academic areas such as literacy and other curriculum content. However, research has demonstrated that incorporating daily mathematics play activities in prekindergarten classrooms helps children to engage in learning, develop cognitive skills, social skills, and the emotional skills necessary for school readiness as well as performance tasks in kindergarten and beyond (Clements et al., 2014). This article focuses on some of the mathematical skills and concepts prekindergarten children develop through intentionally planned play activities.

How Does Prekindergarten Promote Mathematics?

Mathematics includes many concepts and skills that help prekindergarten children organize and make sense of their world. Some of these concepts and skills learned in the prekindergarten curriculum include *matching, counting, classifying, comparing, ordering,* and *measuring* (Butera, 2014). In addition, prekindergarten mathematics curriculum includes shapes, geometry and spatial sense, numbers, and number symbols (Texas Education Agency, 2015). Promoting these mathematical skills through play activities can help prekindergarten children to develop these concepts in a fun way while also enhancing their inductive and deductive reasoning skills.

As children grow physically and cognitively, their mathematical ideas and concepts also grow and develop. Their development does not follow a specific trajectory because each child follows their own developmental path. Each developmental path follows a series or sequence of steps which each child reaches one at a time (Clements & Sarama, 2016).

How Do Mathematics Play Activities Benefit Prekindergarten Children?

Children can discriminate quantities early in their lives. Thus, one way to help them develop vocabulary is through mathematics. Mathematics concept words such as "more" or "less" enable children to learn quantity discrimination. Therefore, basic numerical concepts can be learned during the play. Children can acquire precise number words and the number sequences, including counting the number of objects in a set. Therefore, teachers can help children to grasp these complex mathematical concepts through play.

Trawick-Smith, Swaminathan and Liu (2016) stated that play activities enhance mathematical thinking and other complex cognitive development in children. However, some prekindergarten

teachers are reluctant to include mathematics play. They tend to spend more time on teacher-centered instruction rather than incorporating child-centered mathematics play activities.

Other teachers provide limited time for children to learn mathematics through play activities or learning centers. They tend to focus more on content and other academic learning. Prekindergarten classrooms that support daily mathematics play activities are engaging in high-level free play mathematics activities. These high-level free play mathematics activities enable children to develop autonomy and self-regulation skills. Therefore, learning mathematics through play should be incorporated daily as intrinsic mathematics classroom instruction.

Mathematics play activities are essential to develop academic, social, emotional, and career development which helps prekindergarten children to grasp mathematics concepts in the following categories: Classifying, exploring magnitude, enumerating, investigating dynamics, studying patterns, and exploring spatial relationships (Wichstrom et al., 2019). Prekindergarten teachers incorporate mathematics play activities in a fun way across all subjects, including literacy and vocabulary development. Research supports that incorporating daily mathematics play activities in prekindergarten curriculum has a positive effect for later learning in kindergarten and beyond (Stebler et.al, 2013). Mathematics education in kindergarten develops verbalization, reasoning, and problem-solving skills. Children from four to six years old demonstrate enormous progress in their mathematics acquisition through play activities.

Mathematics play activities promote executive functions such as self-control of thinking, behavior, and emotions. Teacher interactions may assist children to develop self-regulation processes, including self-talk to guide thinking and problem solving (Trawick-Smith et al., 2016). Incorporating mathematics play activities enable prekindergarten teachers to use scaffolding strategies and help children understand complex mathematic concepts. There are three types of learning experiences: *naturalistic, informal, and structured*.

Naturalistic Learning Experiences

Naturalistic learning experiences are initiated by the child during their daily activities. For example, children can use their senses and muscles to learn about mathematics concepts such as *shape, size, time,* and *amount*. Mathematics play activities enable children to learn these concepts in a natural setting. Examples of naturalistic play are listed below.

- Jamal takes a spoon from the kitchen drawer in the dramatics play center. "This is big." Treyvon says, "Yes."
- Aliyah hands Valentina a block saying, "This is rectangle!"
- Mateo is playing with an apple, an orange, and a pineapple. "I have three pieces of fruits" (Holds up three fingers.)

Teachers can observe how each child is progressing based on their responses and interactions with other children. Praising the children's efforts during the play activities encourages children to learn these mathematics concepts.

Informal Learning Experiences

Informal learning experiences are led by the teacher; however, they are not preplanned. They occur when the teacher determines it is time to intervene. This can happen for various reasons such as the child makes a mistake; the child is having difficulty; or the child is on the right track, but they need some assistance from the teacher. This type of play encourages children to use their wishes, needs, and imaginations as they interact with their friends (Belknap & Hazler, 2014). Examples of informal learning experiences are displayed below.

- Ebony has a bag of plastic animals. Her teacher asks, "Do you have enough for everyone?" Ebony replies, "I don't know." The teacher asks, "How can you find out?" Ebony says, "I don't know." The teacher intervenes by saying, "I will help you. We count them."

This interaction allows the teacher to help Ebony to develop her counting skills by incorporating mathematics play activities.

Structured Learning Experiences

Structured learning experiences are specific planned activities. Teachers can plan mathematics play activities by creating an environment that provides opportunities for children to explore various mathematics concepts such as comparing, number recognition and other concepts such as geometry. Planned play activities provide many opportunities for children to create connections with mathematics (Texas Education Agency, 2015). Some examples of structured learning experiences are displayed below.

- The teacher is with an individual child at a specific time. The teacher says, "Diego, I have some block here for you to count. How many blocks are in this pile?" The child counts the blocks, and the teacher observes and helps the child.
- The teacher is with a group of four students at the pretend and learning center. Children are sorting and classifying kitchen items by sizes. Teachers asks, "Can you arrange these items in order from smallest to largest?"

These opportunities support children to explore structured learning activities. Teachers can intervene in these types of learning situations.

Play and Divergent Thinking

Play is a natural form of creativity which involves cognitive and affective processes. These processes are based on experiences of emotions and incorporation of affect themes from memory or imagination, involving creativity and play. Divergent thinking is the ability to generate a variety of ideas that children develop from their daily play experiences. Daily play activities enable prekindergarten children to utilize their imaginations by mentally transforming toys into a variety of elements or objects to explore different role-playing scenarios. Divergent play is related to children's mathematics achievement scores (Wallace et al., 2015). Divergent thinking is powerful when it is incorporated in early mathematics learning in prekindergarten classrooms. It stimulates interest in mathematics throughout play activities for all children in the classroom.

Defining Mathematics Play in Prekindergarten

Play is defined in various forms across disciplines. Play emphasizes the process or experience, which is spontaneous, voluntary, and self-motivated (Bateson, 2011). Gray (2012) describes play as an activity that is "self-chosen and self-directed; intrinsically motivated; guided by mental rules; imaginative; and involves an active alert; but non-stressed frame of mind" (p. 355). There are three types of play activities free play, guided play, and teacher-directed play (Wichstrom et al., 2019).

Free Play

Free play is defined as play that is chosen by children and centers around their activities and interests and is not chosen and directed by adults (Manning, 2019). In this type of play, children are directing their own activities, using their imaginations, and growing their critical thinking schools. As early childhood educators, we need to create a classroom full of materials that can engage students in this type of exploratory play. For example, in the creative arts center you begin by gathering bins, tubs, or baskets and label them according to the materials inside. This helps to develop an organized area and allows children to explore and work independently. The bins can be filled with different types of paper, drawing, and writing materials, paints, modeling clay and playdough, glue, scissors, twine, ribbon, pom poms, small rocks, shells, feathers, twigs, leaves, or dried flowers. The list of materials used for free play in this center is endless and can be changed or added to depending on your students and their interests.

Through their free play in the creative arts center, children are learning across many areas of the preschool curriculum. They are learning mathematics as they create patterns, shapes, rhythms, classification, sequencing, and problem-solving skills. They are learning literacy skills by drawing, writing, painting, and talking about what they have created. Science is being explored as they create with colors, textures, building, and experimenting.

Figure 1. Free Play Opportunities that Engage Children

- Dress up/pretend play
- Role play
- Building with blocks, Legos, and other building materials
- Creating with multiple art materials
- Play-dough or modeling clay
- Sorting with buttons, pom poms, beads, shells into egg cartons or containers
- Felt board with story items to encourage storytelling
- Shape, color, and size sorting trays
- Measuring cups and containers at a sensory table

Free play in the preschool classroom is vital. It allows the children to work on problem solving skills, enhances cognitive development, and learning through sensory experiences (Garhart-Mooney, 2006). **Figure 1** has a list of free play opportunities that children can engage in while in their preschool classroom.

Guided Play

Guided play is a form of play in which children's activities are scaffolded by teachers, allowing children's actions to lead them to the learning objective (Weisberg & Zosh, 2018). Teachers can provide this scaffolding by arranging their classroom environment in ways that provides educational materials centered around their educational goals. Then, during guided play, teachers can respond in a sensitive manner by using open-ended questioning and allowing children to explore the materials. In the preschool classroom, guided play can support mathematics learning. For example, the preschool teacher wants the students to learn about various shapes. This can be accomplished by providing students with math manipulatives in different shapes. Children can be invited to explore these materials while the teacher asks questions to scaffold their knowledge about the different shapes. The following are types of open-ended questions the teacher could ask.

- Can you tell me about these different shapes?
- How are these shapes different?
- Can you tell me how these shapes are the same?

Guided play provides an excellent learning opportunity because it allows children autonomy and discovery in their education.

It helps to ensure children's love of learning and promote their immersion in their exploration of discovery while teachers offer their support and guidance in knowledge acquisition. Using guided play in the curriculum provides environmental and psychological factors that gently shape not only the desired outcomes in learning but also a more positive outlook toward learning itself (Weisberg el al., 2014).

Teacher Directed Play

Wickstrom et al. (2019) reported that teacher-directed play is commonly observed in early childhood classrooms. In this type of play, the teacher controls the game or play activity. Children work together in an activity designed by their teacher. Children are required to follow specific steps to play the game. The teacher monitors the game as children play and learn specific content concepts such as mathematics. Mathematics play activities allow children to build their own knowledge by exploring and playing with their friends. Thus, teacher directed mathematics play activities is not recommended in prekindergarten classrooms. Teachers provide opportunities for children to cooperate and interact with other children through play. Restricting children from make their own choices can discourage their creativity; however, teacher directed play activities may be implemented in upper grades.

Some Play Activities to Integrate in Prekindergarten Centers

Informal mathematics experiences occur during the play time. Centers provide valuable experiences for prekindergarten children to explore mathematics concepts. For example, children have many opportunities in centers to develop their mathematical thinking and problem-solving experiences, including language and vocabulary (Circle Pre-K Curriculum, 2021). Incorporating centers for children to explore and play help them to continue practicing and developing their mathematics skills. The following mathematics manipulatives and artifacts can be integrated at centers for children to explore.

- Fruits and vegetables at the science center
- Play money to purchase food at the pet store
- Blocks or geometric shapes to build homes and bridges at the construction center
- Plastic tools such as plastic hammer, screwdriver, and pliers at the pretend and learning center.

Children benefit from these centers when teachers join them by asking questions, scaffolding tasks, and helping them to use mathematics vocabulary.

Conclusion

Various studies have investigated mathematics development in prekindergarten classrooms that benefit children in kindergarten and the early years of primary school (Clements & Sarama, 2016). Developing mathematics concepts such as counting, numeracy, geometry, and understanding quantities and their relationships in prekindergarten predict children's performance and achievement in upper grade mathematics (Reid, 2016). Mathematics play activities encourage and motivate children to develop these concepts as they play and interact with their teachers and friends in the classroom. Also, it predicts children's vocabulary and literacy skills such as reading comprehension. Thus, integrating everyday mathematics play activities such as centers in prekindergarten classrooms enhance children's cognitive thinking and affective process development in a natural manner.

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