Play-based Learning in the Early Childhood Mathematics Classroom: Culturally Sustaining Play

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Abstract

The purpose of this paper is to explain the importance of play-based learning in early childhood mathematics classroom through culturally sustaining experiences. Approaches to providing culturally sustaining play-based learning within the classroom will be described. The intent is to provide instruction that allows students to be able to connect their imagination and real-world experiences to their mathematics learning through play.

*Keywords:* math, play, early childhood education, culturally sustaining
Classroom teachers often understand that play helps engagement within the classroom. However, in many cases, play tends to be activities such as online games that promote mathematics through memorization rather than exploration and reasoning. This paper will focus on how teachers can include play-based learning in the early child mathematics classroom, beyond online computer games. It is important that students have access to play-based learning in the early childhood mathematics classroom while experiencing a culturally sustaining environment (Zippert et al, 2019; Worthington & Van Oers, 2016). Hauser (2005) claims that kindergarten students are highly eager to learn and that play can be a powerful vehicle for learning (as cited in Vogt et al., 2018, p. 592). Early childhood curriculum often reverts to counting and memorization when in reality naturalistic play can lead to broader mathematical thinking and understanding. Children learn in many different ways and it is important to include hands-on learning experiences during mathematics (Graue et al., 2014).

Theorists are not able to agree upon one way to define the word play. Therefore, the term play-based learning can have various definitions. Vogt and colleagues (2018) state that “play can be defined as activities that are fun, voluntary, flexible, involve active engagement of the child, have no extrinsic goals, and often have an element of make-believe" (p. 592). This definition aligns with children needing to have time to play with manipulatives and new concepts through play-based learning. Children need time to choose activities to demonstrate their mathematical thinking and understanding through play (Parks, 2015).

Research suggests that play-based learning can be beneficial for all students and offers various ways to learn and display mathematical knowledge (Vogt et al., 2018, p.
Play allows children to demonstrate their learning through both telling and showing (Wallerstedt & Pramling, 2012, p. 13). Often play within the early childhood classroom is found to be a separate part of the day and used as a break from learning in the elementary classroom. Wallerstedt & Pramling (2012) claims that play is encouraged by educators in preschool but often neglected once kindergarten begins due to the push of academics in a traditional manner (p. 7). Play can be extremely powerful if designed around mathematical concepts and driven by the child’s lead (Parks, 2015). Play can be enriched when teachers enter play and assist with materials, ideas, and questioning (Samuelsson & Johanson, 2004). Parks (2015) noted that “the point is not that children will master these mathematical concepts through play, but that they develop ways of understanding the world that they will bring to their engagements with mathematics and that teachers can leverage consciously when discussing new concepts” (p. 14). Play-based learning can be joined with culturally responsive teaching to incorporate a culturally sustaining classroom. Gay (2002) proposes including cultural characteristics and experiences of diverse students to engage students in learning (as cited in Bottoms et al, 2017).

Therefore, the purpose of this paper is to explain the importance of play-based learning in early childhood mathematics classroom through culturally sustaining experiences. Approaches to providing culturally sustaining play-based learning within the classroom will be described. The intent is to provide instruction that allows students to be able to connect their imagination and real-world experiences to their mathematics learning through play.

**Review of Literature**
It is essential that students have access to play-based learning in the early childhood mathematics classroom in order to develop broader mathematical thinking and understanding. Authentic play allows for real-time experiences that can be intertwined with mathematical thinking and understanding (Graue et al., 2014).

Theories on Play

There are several theories that have guided the types of play within a classroom. Most researchers can agree that activities must be freely chosen by the child in order to be classified as play (Parks, 2015). Vygotsky believes that imagination and prior experiences are crucial to children’s learning and play. He also supports that play is an integral piece to children’s learning (Magnusson & Pramling, 2017). Van Oers highlights that play requires freedom in sense that children can freely move in and out of activities (Magnusson & Pramling, 2017). Piaget believes that through play and exploration that students develop a mathematical understanding while using ordinary objects to construct meaning. The experiences occur naturally in the course of play and exploration (Tudge & Doucet, 2004). Piaget’s theory of cognitive development explained that children move throughout four stages of mental development. Early childhood children are in the Preoperational Stage (ages 2-7 years) and gain knowledge through imaginary play using their senses (Ghazi, 2014).

Incorporating play-based learning into mathematics includes opportunities for students to work with materials that likely promote mathematical thinking. Children need exposure to new concepts through teacher guidance and then time to build on those concepts in their own play. Children working with manipulatives during play allows
students to develop mental representations which leads to abstract representations (Parks, 2015).

**Play-Based Mathematical Learning**

Children need formal mathematical lessons to have exposure to new concepts and time to build off that knowledge during play-based activities. Allowing children to have repeated exposures to manipulatives allows students to build confidence, competencies, and creativity which leads to developing more complicated scenarios (Parks, 2015). Worthington & Van Oers (2016) mention that sustained play encourages ideas to be explored and developed. Sustained play also allows for students to circle back to previously taught concepts (p. 59). Play-based learning promotes students’ engagement with materials in real-world scenarios and mathematical conversation with peers. Children often demonstrate understanding through play, both verbally and nonverbally. For example, Zippert and colleagues (2019) found that spatial relations, enumeration, and magnitude is often verbally expressed, while pattern and shape understanding is often expressed nonverbally (p. 2). Children should also have an opportunity to come together each day and converse about their mathematical thinking during play (Parks, 2015).

**Culturally Responsive Teaching**

In order to make play-based mathematics meaningful, it is important for teachers to understand student interest and diverse backgrounds. Implementing culturally responsive teaching in the classroom can help students build their identities and allows for students to make meaningful connections to their learning in the mathematics classroom. Ukpokodu (2011) defines culturally responsive teaching as an approach that uses students’ cultural knowledge as an integral part of the planning and teaching process.

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to increase student engagement (p. 48). Teachers displaying culturally responsive pedagogy in their classroom highlight cultural characteristics, experiences, and perspectives of ethnically diverse students to develop culturally sustaining environments (Bottoms et al., 2017). Culturally responsive teaching has the capability of making math successful for students with non-dominant cultural backgrounds when connected to their identities. The National Council of Teachers of Mathematics has developed standards regarding teachers’ understanding of how students’ diverse backgrounds influence their learning in mathematics (NCTM, 2008).

**Home Connection**

Children begin learning math well before entering the school system. The child’s home environment can play a large part in the impact of student’s mathematical thinking. Each child brings to school a strong sense of personal cultural knowledge and it can be made evident through play. It is important to learn and acknowledge their culture within the classroom in order for all students to know they matter and are welcome (Worthington & Van Oers, 2016). Children enter kindergarten at many different levels of mathematical thinking exposure depending on their home learning environments (Vogt et al., 2018). Mathematical thinking from a young age can be used as a predictor for later success in school (Cohrssen & Niklas, 2019).

**Long-term Impact**

Children’s early mathematical experiences are connected to their mathematical understanding and begin to build the foundation to their cognitive development (Tudge & Doucet, 2004). It is evident that early mathematical understanding and foundation is linked to long-term success for students (Claessens, 2009; Cohrssen & Niklas, 2019;
Hofer et al., 2013). Incorporating play-based learning in mathematics at a young age can encourage conceptual knowledge that leads to a deeper understanding. Play-based learning during mathematics encourages students’ curiosity and enthusiasm while allowing students to work through challenges that builds knowledge needed for abstract mathematical thinking needed throughout life (Piccolo & Test, 2010). The skills learned in early childhood mathematical settings are highly connected to later mathematical outcomes (Duncan et al. 2007; Grussing & Petter-Koop 2008, as cited in Vogt et al, 2018).

**Traditional Curriculum**

Focusing on traditional curriculum within the classroom does not meet the needs of most students and is missing sufficiently challenging material. Often times traditional curriculums teach content that students already know and therefore only benefit a portion of the class. Traditional curriculum that is taught as a whole group tends to leave higher level students with a sense of boredom. Play-based learning in mathematics serves all children and is considered to be more fun (Vogt et al., 2018). Play-based learning fosters naturalistic play experiences that expands mathematical thinking and understanding in an age-appropriate manner (Graue et al., 2014). Ukpokodu (2011) suggests that traditional curriculum, policies, and teaching practices do not engage diverse and low-income students (p. 48).

**Application**

**Types of Play**

When creating play-based learning in the classroom there are several types of play to consider. Children may choose their own play or enter an adult-initiated type of play.
By choosing their own play, it aligns with Parks’ (2015) emphasis on play needing to be freely chosen by the children involved (p. 5). Within the classroom setting it can be common for children to enter play through an adult-initiated type of activity, which can also be referred to as guided play. In this case the adult is structuring the play but leaving much control to the children (Vogt et al., 2018).

Children may choose to play independently, in parallel, or cooperatively with peers. Zippert and colleagues (2019) find that children playing cooperatively with peers demonstrates collaboration and allows for more effective problem-solving skills than playing independently (p. 3). Each type of play affords students the opportunity to communicate their mathematical understanding through conversation (Zippert et al., 2019).

Teacher Role

Teachers have many important roles in guiding students to participate in the play-based learning of mathematics. It is important for teachers to make it meaningful by setting the stage for mathematical play, providing adequate play time, entering play with children, and meeting the diverse needs of students.

Make it Meaningful

In order to make play-based learning meaningful and allow for mathematical learning within, teachers must be committed to implementing the play-based approach (Vogt et al., 2018). Children’s play should be built upon everyday experiences and should not form a gap between everyday mathematical experiences and institutionalized mathematics (Magnusson & Pramling, 2017). It is important to have a well-rounded understanding of students’ interests to build into play to encourage student acceptance.
Teachers are able to enhance children’s mathematical understanding by introducing new concepts and encouraging play that involves those new ideas afterwards (Graue et al., 2014).

**Setting Up Play**

Teachers should introduce and allow manipulatives to be used within play on a regular basis. It is important to organize materials in a way that promotes mathematical thinking and that children can easily access them. It is important to remember that children should be introduced to these tools first and then allowed repeated exposure throughout time (Wallerstedt & Pramling, 2012). Children show mathematical understanding through exploration of materials both verbally and nonverbally. Zippert and colleagues (2019) found that children often demonstrate understanding of patterns and shapes nonverbally, while the understanding of spatial relations, enumeration, and magnitude is shown verbally through conversation with peers or adults (p. 7). There are many possibilities when deciding which tools to incorporate in your mathematical learning space; below are a few ideas to set up your classroom.

**Blocks.** Children can explore many different types of blocks to promote building structures, exploring equivalent lengths, and creating 3-D shapes. A few ideas include wooden blocks, magnetic tiles, large brick blocks, and Lego blocks. To build upon these skills as the year goes on, teachers may add sets of families or animals, pictures of structures, and cars to further mathematical thinking (Parks, 2015).

**Puzzles.** Children can manipulate shapes, recognize shapes, and practice rotation skills through building puzzles. The number of pieces and complexity of the picture contribute to the difficulty of the puzzle. Children need to be encouraged to find the best
fit puzzle to encourage mathematical thinking. Once a student can easily do a puzzle from memory, they are ready to move on to the next level of puzzle. Classrooms can also use pattern block puzzles which can be scaffolded in difficulty ranging from pictures that include the color and diagram of each shape to be used all the way to a blank picture that students must fill in with shapes that they choose (Parks, 2015).

**Object Collections.** Children can be encouraged to use buckets of small materials to count, sort, compare and make sense of larger numbers. It is important that these objects are changed out often throughout the year to encourage engagement. Object ideas include mini erasers, beans, shells, bears, coins, and beads (Parks, 2015).

**Sensory Tables.** Filling up a table with small sensory items such as beans, pasta, rice, and water allows for children to engage in filling and emptying containers. This skill is important in building a basis for understanding capacity.

**Measuring Tools.** There are many manipulatives used during the year that can be incorporated into play-based learning, rather than 2-3 individual lessons throughout the year. Balances, measuring tapes, measuring cups, rulers, and scales are a few items that can encourage measuring during play (Parks, 2015).

**Play-Doh.** Children can use Play-Doh to practice comparing, build number sense, number formation, creating shapes, and dividing materials in multiple groups. To build upon skills, teachers may add pictures of objects that students can recreate or challenges that students can solve (Parks, 2015).

**Pretend Play.** It is essential that manipulatives are available to encourage mathematical thinking during pretend play scenarios, also known as dramatic play. Edo and colleagues (2009) designed activities around setting up the pretend play as a class
and making decisions together to design the space (pp. 331-333). The play can become more meaningful when teachers and students work together to decide what type of shop will be set up and come up with a plan to get the shop ready.

Children may choose to set up several different types of pretend play that encourage mathematical thinking. Examples of pretend play centers include the following:

- a café, where they practice following a recipe and handling payments;
- a doctor’s office, where they practice weighing, measuring, and taking temperatures;
- a carpentry business, where they measure blocks, use shapes and angles, and decide on the best structure that will hold up;
- a shopping mall, where they take inventory and manage payments; and
- a grocery store, where they weigh fruits and vegetables.

There are many different scenarios children can participate in, but it is important that pretend play incorporates mathematical thinking through the use of manipulatives (Parks, 2015; Worthington & Van Oers, 2016).

**Providing Adequate Time**

Teachers should set aside time during math for children to plan their play and help guide students towards mathematical play (Parks, 2015). It is then critical to provide ample time for students to position themselves in play. Children need time to explore manipulatives that promote mathematical thinking repeatedly over the course of the year. Encouraging repeated exposure to manipulatives allows students to build competencies, creativity, and also helps build perseverance (Parks, 2015). Worthington & Van Oers
(2016) stated that allowing sustained play episodes contributed to ideas being explored, developed, and sometimes revisited throughout time (p. 59). Once children have had adequate play-based learning time, children can come together to debrief by sharing their mathematical thinking and talk through problem-solving strategies with classmates (Parks, 2015).

**Entering Play**

Teachers must carefully position themselves within play-based learning interactions (Fleer, 2015). While entering play, teachers are able to either encourage mathematical thinking or hinder it depending on their relation to the situation. When teachers are positioned closely to children playing, the teacher is able to support them in a meaningful way. The teacher is observing and listening to the conversation taking place, which guides the teacher into knowing when to enter play (Fleer, 2015). Teachers are able to deepen children’s play by helping with materials and ideas (Samuelsson & Johansson, 2004). Teachers can include questioning that shifts the thinking to the students and can check understanding (Piccolo & Test, 2010). Teachers also have the capability of hindering mathematical thinking while entering play. Teachers should avoid immediately telling children how to think mathematically while solving problems. Think time is critical for children to develop reasoning and understanding. Teachers should also be mindful when setting up play; it is important for the child to take ownership in designing the play. It is necessary to understand the different positions that teachers and children take within play (Kravtsov & Kravtsova, 2010; Fleer, 2015).
**Above Position.** In this case, the teacher is giving the child suggestions and taking lead on how to play. There is not much choice, nor complex mathematical thinking, coming from the child in this position.

**Below Position.** The child takes the lead and tells the teacher how to play. In this role, the teacher is able to observe students’ thinking and understanding. This position allows for the teacher to see what additional information might help the child expand their mathematical play.

**Equal Position.** In this position, the teacher and child are contributing equally on play decisions. It is important to note that children’s play becomes more complex when a teacher participates equally and that the amount of play time is extended (Samuelsson & Johansson, 2004). This stage tends to let the teacher inside the children’s imaginary play and allow for higher mental functions (Fleer, 2015).

**Culturally Sustaining Play**

Teachers must acknowledge their understanding of high-quality practices and content knowledge to provide a welcoming learning environment for diverse groups of young students (Graue et al., 2014). Teachers are able to make play-based learning meaningful by connecting diverse cultures and mathematical experiences (Worthington & Van Oers, 2016). When students participate in a culturally sustaining experience, they also have a higher interest level in the material at hand and are able to learn more thoroughly (Bottoms et al., 2017). Children often choose to play and engage in activities that are connected to their previous experiences and the tools they are familiar with (Wallerstedt & Pramling, 2012).
A child’s background influences behavior and play. It is important that teachers working with children understand how valuable children’s culture and experiences are to enriching opportunities for culturally sustaining play (Worthington & Van Oers, 2016). Including students’ learning styles and tools from diverse cultures can promote engagement during play-based learning.

**Getting to Know Students**

Teachers need to spend time getting to know students and learning their interests and backgrounds. Teachers may choose to send home an interest survey to children and families at the beginning of the year or have children complete a survey in class. Using this information will help teachers relate new ideas in a meaningful way (Ukpokodu, 2011). Teachers can use this information for setting up play in the classroom by including pretend play centers that relate to their homelife. For example: Learning children’s favorite foods they eat at home and incorporating those items on the menu in the classroom café.

**Display Knowledge**

Students need to be able to show their learning in a way they feel most comfortable. Play allows students to show their competencies through showing rather than telling (Wallerstedt & Pramling, 2012). Being flexible with how children show their understanding allows for students to feel safe and a sense of belonging in the classroom. Examples of students displaying knowledge in various ways include the following:

- recognizing shape attributes by filling in a pattern block puzzle vs. telling the name of each shape;
• choosing the teddy bear that is the biggest vs. using specific vocabulary to label big, bigger, biggest; and
• grouping cars by size and color while playing vs. using a sorting mat to categorize buttons.

There are many scenarios children can display knowledge of their mathematical thinking. Children may feel more comfortable to show their thinking during play rather than direct assessment (Parks, 2015).

Working with Peers

Many minority students favor cooperative and collaborative learning styles which leads to positive learning and performance. Urban students often live in communities that are close-knit where they work and play together as family (Ukpokodu, 2011). With this being said, it is important to allow students to have the choice to work together while collaborating ideas and playing together.

Bridging the Gap Between Home and School

Teachers can bridge home and school learning together when sharing ideas about how to encourage play-based math in both settings. Children come to school with a variety of math knowledge but there is often a connection missing between home and school mathematical learning (Magnusson & Pramling, 2017). It is difficult to build mathematical competencies when learning happens in isolation, especially when school concepts are taught very differently than they are used in everyday settings (Worthington & Van Oers, 2016). Below are a few ideas in bridging the gap between home and school for mathematical learning.

Cultural Practice
When teachers take time to learn about students’ diverse backgrounds, it allows for teachers to connect home learning to the classroom. It may be helpful to send home a survey to families that will help the teacher understand how math is used in their home experiences (Worthington & Van Oers, 2016). For example: One child spends a great deal of time baking at home with their grandparent. Incorporating the idea of baking within the classroom helps that child connect their learning.

**Teachers and Parents**

Teachers can make connections with parents to understand what type of play-based learning is happening at school. This can be sent home in a newsletter, video, email, or phone conversation if needed. For example: One child may play doctor at home frequently. If parents understand that in the classroom setting children are exposed to scales, measuring tape, and thermometers to help make connections to math, parents might incorporate those tools at home for their child to build upon.

**Math Bags**

Teachers can make math bags to send home with children that include manipulatives used in the classroom. For example: A child takes home a bag with pattern blocks and families work together to build different things they can see at home. Children then come back to school and can share how they used their pattern blocks and can make connections with other children (Parks, 2015).

**Family Math Nights**

By hosting a Family Math Night at school, families are able to join in on the mathematical learning that takes place in the classroom. Families are able to transfer this information to their home learning. This type of event also allows teachers to gain
understanding of children’s mathematical experiences they have at home and allow for families and teachers to work together (Bottoms et al., 2107).

Discussion

Conclusion

Incorporating play-based learning in an early childhood mathematics classroom heavily involves the teacher’s participation. It is vital that teachers are on board with this idea in order to fully implement it successfully. Children come to school with a background of mathematical knowledge. Incorporating play-based learning allows for children to bring prior mathematical knowledge and bridge it together with new learning through meaningful ways. It is important for teachers and parents to work together to help students be successful in their learning and to obtain a greater understanding of cultural identities within the classroom. By incorporating cultural identities within play-based mathematics, students are able to authentically learn mathematical knowledge.

Limitations

There is a sufficient amount of research readily available for play-based learning in a preschool setting. There seems to be an opportunity for more research within play-based learning in an elementary setting, especially beyond kindergarten. Play is often found as a break from learning and does not typically align with content being taught within the classroom (Wallerstedt & Pramling, 2012). As students surpass kindergarten, play is often found in the form of games, such as board games and technological applications, to increase engagement (Cohrsson & Niklas, 2019; Siew, 2018). Technological applications used in the classroom often result in children practicing facts
and may not encourage conceptual understanding and mathematical conversation with peers.

**Future Directions**

Learning math in the early childhood classroom is present in many different forms, but studies show that play-based learning in math allows children to use new concepts learned in the classroom and to connect them to the world around them through play. Incorporating science, technology, engineering, and mathematics (STEM) within the classroom is a direction for teachers to encourage play and inquiry-based learning beyond the early childhood classroom. STEM encourages students to solve real world problems by applying learned mathematical concepts and understanding the importance of concepts being taught. This type of inquiry-based learning encourages hands-on learning and can be age-appropriate play for students as they move beyond the early childhood classroom (Hill-Cunningham, 2018).

Play is being displaced during learning and teachers are crucial in saving play in the classroom (Wallerstedt & Pramling, 2012). Teachers can use their learning to understand the role that the teacher plays in play-based learning in the early childhood mathematics classroom. It is important that teachers are able to make math meaningful by connecting with children and tying in student interest and diverse backgrounds. There are many ways for the teacher to set up play, such as including easily accessible math manipulatives and allowing adequate time for children to explore. Teaching children new concepts and allowing time for play-based learning through blocks, puzzles, object collections, sensory tables, measuring tools, Play-Doh, and pretend play will allow children to make connections to the world. It is important to be mindful of creating a
culturally sustaining experience for children to connect their home and school learning of mathematics.
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