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Math Acquisition Skills and Sensory Play in Toddlerhood

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A Capstone project for the Bachelor of Arts in Human Development and Family Studies

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Introduction

There is a lack of math curriculum in early childhood education (Copley, 2000). Early math skills are the best predictors for later math skills (NAEYC, 2002). Without early exposure to math, children exhibit later math acquisition deficiencies compared to their peers (Rittle-Johnson, 2017). To address this need, I have created a two-day interactive lesson on math skills for toddlers at the Child Development Center at California State University, Monterey Bay (CSUMB).

Need Statement

Math skill acquisition can be fostered through a multitude of classroom tools such as sensory play. Sensory play is also known as messy play, which includes any play that engages a child's senses (Maynard, 2009). Piaget describes young children as sensorimotor learners, which means that from birth to age two, children learn about the world around them primarily through sensory experiences (Piaget, 1977 as cited in Ojose, 2008). Young children grab, taste, and throw whatever they can get their hands on as a means to understanding the world. Due to this way of learning, sensory play has many benefits for toddlers by introducing early geometry, classification skills, and mapping or "real world" application skills (Ojose, 2008).

Fisher (2013) explains that many young children lack exposure to academics such as math which can lead to low academic competence. Fisher (2013) also explains that teachers must work collaboratively and be flexible with children within a play-based program in order to cultivate engagement, curiosity, and sense making out of their experiences. Ginsburg, Pappas, and Seo (2001) even found that children tend to naturally engage in math-related activities

during play through basic numeracy, shape differentiation, and pattern recognition. For example, geometry in a preschool environment is stimulated through wooden blocks, plastic toy shapes, sitting in a circle, and a myriad of other daily activities. Preschoolers who engaged in both guided play and free play were more accepting of the learning of "typical shapes," such as triangles, rectangles, pentagons, and hexagons (Fisher, 2012). Scaffolding through dialogue was found to be the most predictive factor of the development of early geometry skills (Fisher, 2012). While studies have shown that preschoolers are naturally inclined to be engaged in math activities, preschools focus more so on literacy acquisition. Early et al (2010) found that most of the academic instructional activities in preschool were literacy-based rather than numeracy-focused. Although early childhood experiences are believed to shape later experiences, the presence of math in the classroom is not as prominent in preschool as it is within elementary, middle, or high school.

According to Rittle-Johnson (2017), preschool math skills are linked to first grade math skills, which are then linked to fifth grade math skills as well. As children advance in their educational journeys, concepts are continually gone more in depth and built from years prior as they age. If a child does not fully understand the importance of general numeracy, then the later years of subtraction and addition will be more challenging and begins to create a disparity between the children who were engaged with math skill acquisition opportunities and activities in comparison to their classmates who did not.

Nationally, there is a need for the introduction of early math skills to toddlers. Copley (2000) found that while about 21% of preschool curriculum focuses on literacy, only about 7% of preschool curriculum focuses on math. Math skill sets are used through childhood,

adolescence, and adulthood. Just as toddlers are advised to be exposed to new foods in hopes of more accepting attitudes later on, this attitude should be practiced in the same regard to early math skills. Early et al (2010) found that children who were exposed to math early on exhibited better results later in life with both performance of math skills as well as higher engagement levels. Edens (2010) also found that the acquisition of math skills varied more so by socioeconomic status than any other factor. The National Association for the Education of Young Children (2002) claims that the best predictor of a child's mathematical performance is their knowledge at the beginning of kindergarten; which suggests that there should be mathematical interactions before K-12 schooling.

Given that preschoolers are at the beginning of their developmental journey, there are many ways to engage those developmental domains. Sensory play is an extremely beneficial learning tool for preschoolers. In order to help cultivate early cognitive development of mathematical acquisitions I provided a two day lesson on math skills at the Child Development Center on the CSUMB campus.

Learning Outcomes

At the end of my lesson, participants will be able to:

1. name the qualities of a square, triangle, and circle.
2. identify one shape they see embedded within the classroom objects.
3. classify objects by two features (shape and color).

Theory Development and Consideration of Diversity

Theory

From 12 months to 36 months, children are within the sensorimotor and preoperational stages, according to Piaget in his theory of cognitive development. The sensorimotor stage and preoperational stage differ the most with the emergence of verbal communication (Ojose, 2008). Withverbalization, children increase in their ability to process thoughts. However, in this stage, children lack concrete logic and revolve their thinking around the ego, according to Piaget. In other words, children in sensorimotor and preoperational thought are egocentric. Generally, egocentrism can be seen as the inability to separate oneself and one's own needs from the rest of the world (Kesselring, 2011). For example, children cannot tie their shoes by themselves and in return they cry, instead of asking someone for help.

When the skill of language is developed, it opens the opportunity for a deeper understanding of the significance of objects, interpretations of ideas, and overall better communication skills both verbally and non-verbally (McCluskey, 2018). The emergence of language helps guide the development of imagination as well symbolic thinking. Preoperational thought is also when the emergence of categorizational skills is believed to develop. During the preoperational stage, children are believed to develop more rational behaviors such as problem solving skills (Ojose, 2008). Thompson (1990) suggested that cognitive development during this time continues with a bit more detailed questions from teachers within teacher-student interaction. Being able to differentiate two different objects while also being able to distinguish similarities is believed to be the biggest mathematical development of preoperational thought (Ojose, 2008). Lan

My project intends to evoke the use of language in order for children to distinguish both similarities and differences in regard to shapes. Students will be able to identify and match shapes by understanding the qualities of each shape, utilizing numeracy skills of counting the amount of lack of sides each one has. Students will also be able to utilize problem solving skills in order to discriminate between shapes of different colors. The children my project intends to serve are just beginning preoperational thought and I will be emphasizing the use of sensory learning in order to engage in teaching skills of identification, categorization, and application. My project will be assisting in the building blocks of preschoolers' early math acquisition skills at the CSU Monterey Bay Child Development Center.

Consideration of Diversity

Culturally speaking, the idea of shapes, sizes, and how they are categorized may be subjective to Western culture (Unsworth, 2005). The idea that red, blue, and yellow are primary colors is quite subjective as well; as universally we see in the world in the colors of red, blue, and green (McBride, 2008). An even bigger conflict that arises is the idea of categorization. Chiu (1972) found that while American kids were more likely to categorize objects by similarity, Chinese kids were more likely to categorize items by relationship. Chiu (1972) explained this phenomenon by how children are prompted to learn at early ages. While American children come from an individualistic society oriented around themselves in order to place meaning, Chinese children are oriented in viewing the world with emphasis on the connections within their environment. This suggests that people who identify with Eastern cultural backgrounds take on a holistic approach in regard to categorization and classification of objects.

Chiu (1972) argues that American children are self-orientated and Chinese children socio-orientated. In other words, Western values vary greatly from those with Eastern backgrounds such as China. American culture prompts young children to think egocentrically, while Eastern culture prompts young children to think collectively. Being that America is a Western society, on the contrary, some of these families may identify with Eastern backgrounds at home. Suggesting that students with home lives rooted in Eastern cultures may already be prompted to categorize objects socially; as direct class instruction of Western methods have not yet been taught and practiced. Western methods are seen as analytical and rule based; whereas Eastern methods are seen as holistic and situational depending on the environment (Unsworth, 2005). I recognize that my lesson is about categorizing by shape and color; but some students may be prompted to categorize by another holistic attribute such as how they feel about the item.

Informational data on the families who have children at the CSU Monterey Bay Child Development Center was not available. This included information on: priority enrollment, family structure, ethnicity, religion, socioeconomic status, and education level. According to the Early Development Services organization, they serve 400 families both with and without special needs, the overarching organization of the CSU Monterey Bay Child Development Center. In California, most of the families with enrolled preschoolers have an education, are above poverty level, are proficient in English, and are non-minority (Melnick, Titilayo, Gardener, Maier, & Wechsler, 2017). While it is likely the CSU Monterey Bay Child Development Center reflects this, the only assumption safe to make is that the families more than likely have one or more members who are college educated.

Method

Day 1

For day one, I arrived at 9:35am and began my lesson at 9:50am. I laid out my organization chart and sat in front of it while the teachers announced that I had an activity. My lesson was intended for any interested kid; while eight were present, only six of them were actively engaged. The children and I created a circle around the organization chart as intended. With the six children we had a conversation about our favorite colors. This prompted the students to take turns in both sharing their favorite color as well as waiting in order to listen to other's. After everyone shared their favorite color, I pulled out play-doh and asked them "what color is this?" for red, blue, and yellow playdoh (see Figure 1). The conversation about both favorite colors and playdoh lasted for about five minutes. Then I had each student verbally tell me which color playdoh they wanted. Taking turns around the circle, each student identified each color (red, blue, and yellow) through obtaining playdoh. After each student had playdoh I asked if anyone knew what a heart was. After a few moments of silence I showed the six students a foam heart. One student immediately said, "red!" to which led the transition by me saying, "yes, a red heart!" I then showed them a yellow heart and asked them what shape it was. I repeated the question a few times in order to get everyone to respond in order to see if they were grasping what I had said so far. I then explained how objects could be the same shape, but not the same color. Asking them to point to the same color playdoh, I asked what color each heart was again. After doing this for about five minutes I told them I had a trick, and showed them a blue triangle. The foam shapes used came in the colors of red, blue, and yellow in the shapes of circle, square, triangle, and heart (see Figure 1). Two of the students immediately pointed to the triangle on the

chart, which transitioned the lesson to the sorting shapes activity. The chart was made from a plastic storage lid along with black felt shapes as well as purple tape that distinguished each organizing column (see Figure 1). I explained the characteristics of each shape by using gestures to count the amount of sides or lack of sides each shape had; a square has four sides, a triangle has three sides, and a circle has no sides. I explained each shape three times, then held up shapes along with asking which shape it is. Some students verbally responded and some students pointed to the chart. I then had each student take turns picking a shape and categorizing it themselves (see Figure 4). If students categorized it wrong I had them count the sides with me. Some students were able to categorize very quickly while others needed a bit of scaffolding. In order to test my first learning outcome for the final time, we went around the circle twice, which took about 10 minutes. Then I had them create their own shapes with their playdoh, and some even used the foam shapes as templates. Their shape creations took between one to five minutes depending on the child. As they were finished I had them share their shape with me. Shapes ranged from circles, hearts, to shapes named after themselves. Before I left, one student came back and started to categorize the shapes on his own. In my active observation I noted that he unpromptedly categorized each object by shape as well as size. I had him narrate what he was doing, as a big part of my lesson is evoking communication. He did this for a little less than five minutes, but gave me an opportunity to see my lesson's effectiveness in a one-on-one style.

Day 2

The second day I arrived around 9:30am and began my lesson around 9:45am. My lesson took place outside as the first day did, but the weather was exceptionally different. Due to it being cloudy, shortly upon my arrival one of the teachers took about half of the students inside

the classroom. I had four students participate on day two, only two of which were from the day prior. My lesson started as planned with questions that prompted categorization of the same foam shapes and the same plastic categorization chart (see Figure 2). After about five minutes I adapted my lesson plan by utilizing the *Foxy Learns Shapes* by Roger De Clerk (see Figure 3). *Foxy Learns Shapes* is a picture book that displays a myriad of shapes embedded within objects such as boats, doors, kites, houses, and the sun. I went through about three pages in the book with the four participants. First reading the sentences from the book and then having them point to the shapes within the objects just read about. Then I had them take turns identifying shapes on their own. I chose four shapes for each participant to show me examples of; a red triangle, blue square, yellow circle, and a blue triangle. After ten minutes I reintroduced the plastic categorization chart; pulling out random shapes from the buckets and having them categorize it. After about five minutes my lesson was not sensory engaging enough which led to an early transition of the shape scavenger hunt activity. Between two students, the items brought back were books, a block, a flower, and a water jug with a circle opening (see Figure 6). The physical real life example I showed was a tape roll; I then directed the students towards the sandbox as well as the turf box but only two students were able to identify a shape embedded within their playground. During the last five minutes, each of the four students received two shape stickers. In order to get one that had to verbally tell me which one they wanted using verbal skills to classify the stickers by shape and color (see Figure 5).

Results

My first learning outcome was that participants would be able to name the qualities of all three shapes of a circle, triangle, and square. During my sensory sorting activity, they classified

circles, triangles, and squares. Each student got a turn classifying by themselves as well as observing others. Students had the exposure to both practicing verbalization of the three shapes, as well as naming the basic physical attributes of the foam shapes. See Figure 4 for pictures of the identification process. This learning outcome was partially met; while all six participants could identify a circle [100%], only four could identify a triangle [66.67%], and five could identify a square [83.33%]. See Table 1.

My second learning outcome of participants being able to classify by both shape and color was not met. This learning outcome was introduced during day one but measured during day two. This resulted in none of the four participants being able to classify all four shapes; while on average 71.14% could classify by color, only 25% could classify by shape (see Table 2). Some participants confused one shape for another shape, as well as confusing shapes for colors. See Figure 5 for pictures of the classification process.

My third learning was that students would be able to identify at least one shape embedded in a classroom object. This outcome was tested, but also introduced on the second day of my lesson. I decided to test if participants could identify one shape embedded within a classroom object two ways. Utilizing the scavenger hunt, I found that 50% of participants (see Table 3) were able to identify a shape within a classroom object. See Figure 6 for examples. Even with guidance, some students still were not able to grasp this concept, so I adapted my lesson plan. I had the same four students then verbally identify stickers within *Foxy Learns Shapes.* This method of testing application skills resulted in 75% of participants meeting the learning outcome (see Table 3).

Discussion

My project was partially successful. I was able to practice moving away from egocentrism by prompting students to take turns and be nice while others were taking their turn. I was also able to guide the practice verbalization, another emergence of preoperational thought, by engaging their sense of sight. Most importantly, I was able to start early exposure to basic math skills such as numeracy, shapes, and colors. The main reason why I do believe my project wasn't a failure was because I was able to be part of the early exposure in both my two day lesson, as well as the *Foxy Learns Shapes* book I left for their teachers to continue practicing.

The main advantage of my lesson was that the semester prior I worked with all of the same kids. During the semester prior I did have the opportunity to work with both the young toddlers and infants; as well as even getting the opportunity to work with the Pre-K room twice. With this being said, I took the advantage of essentially "priming" the young toddlers with the aspects of my lesson I knew I wanted to execute. This included telling them what shape blocks were, telling them what color items they were playing with were, and counting out loud with them. Me working with the students the semester prior was also an advantage for the simple fact that I had built a relationship with them. On the contrary, the last advantage was that I was not with them every day. I depict this as an advantage because students didn't have a bias or assumed agenda as to what I was supposed to be doing with them. It allowed for me to be creative and improvise when needed because nothing was expected.

However, not being with these same students everyday can also be seen as a disadvantage. Children this young of age are widely known for needing routine. This includes the routine of caretakers, such as teachers! This disadvantage was depicted through the number

of students who actually participated in my activity. Interesting enough, both the first and second day of my lesson plan, the students that participated were all students that tended to play with me more during my service learning. Another disadvantage was that this was not my class not set the precedent in. In other words, whereas I have taught for multiple years and each year I create ground rules with my students; this was not my class to do so. I had to conform to the behavior expectations of their teachers. All of the students' first language was also not english, which was a clear disadvantage being that my lesson was taught in english. Branching off from that, the biggest disadvantage was that not all of the students were verbal. Some could talk in full sentences, while others said “red” like “wed.”

All in all, I was able to bring early math exposure to the young toddlers at the Child Development Center. At least one student met each of my learning outcomes, but none of the students who participated met all three. While not all students were able to categorize each object, they were able to distinguish differences of color or shape overall. I believe my lesson with playdoh went the best, as that was the activity each student was most engaged in. One student even noted that her red and yellow playdoh she had mixed together turned orange, while two other students noted that their red and blue playdoh mixed together turned purple. I believe my lesson will help serve as part of the foundation of their math skills, as well as related skills such as art or architecture. If I had to do this project again, I would look into how to use more embodied cognition in doing this lesson. Engaging their senses of touch and sight seemed like the best method; but I think next time the material could be learned through more interactive physical gestures and movements.

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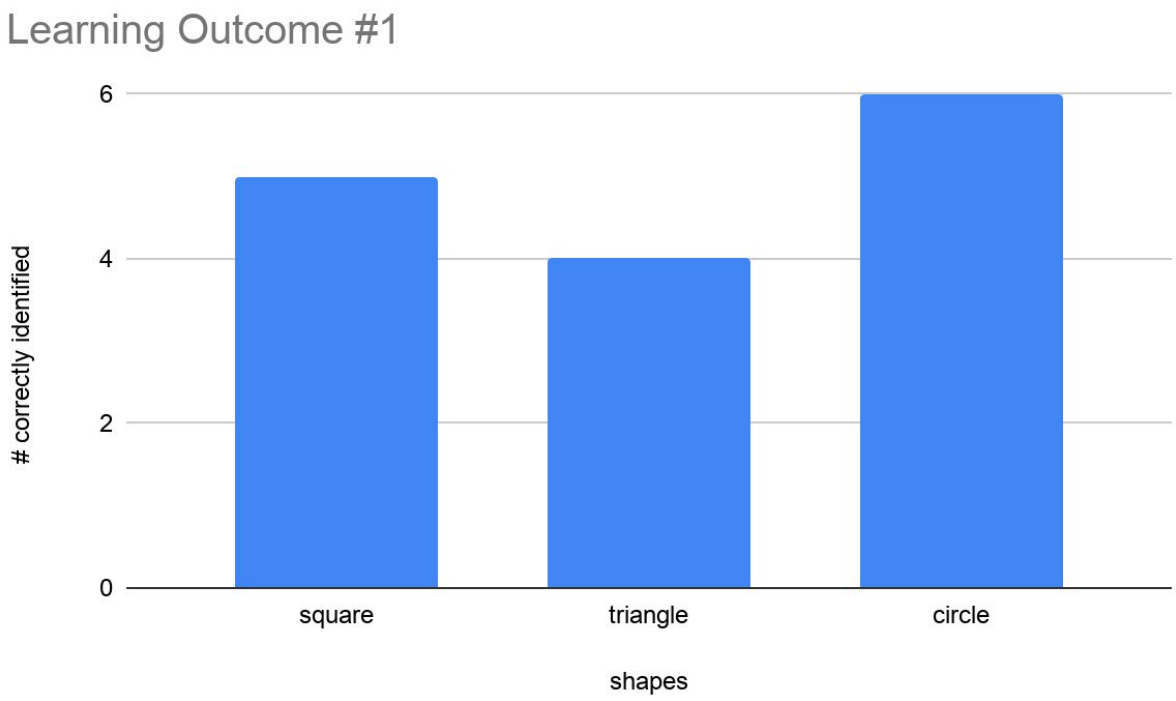
Table 1

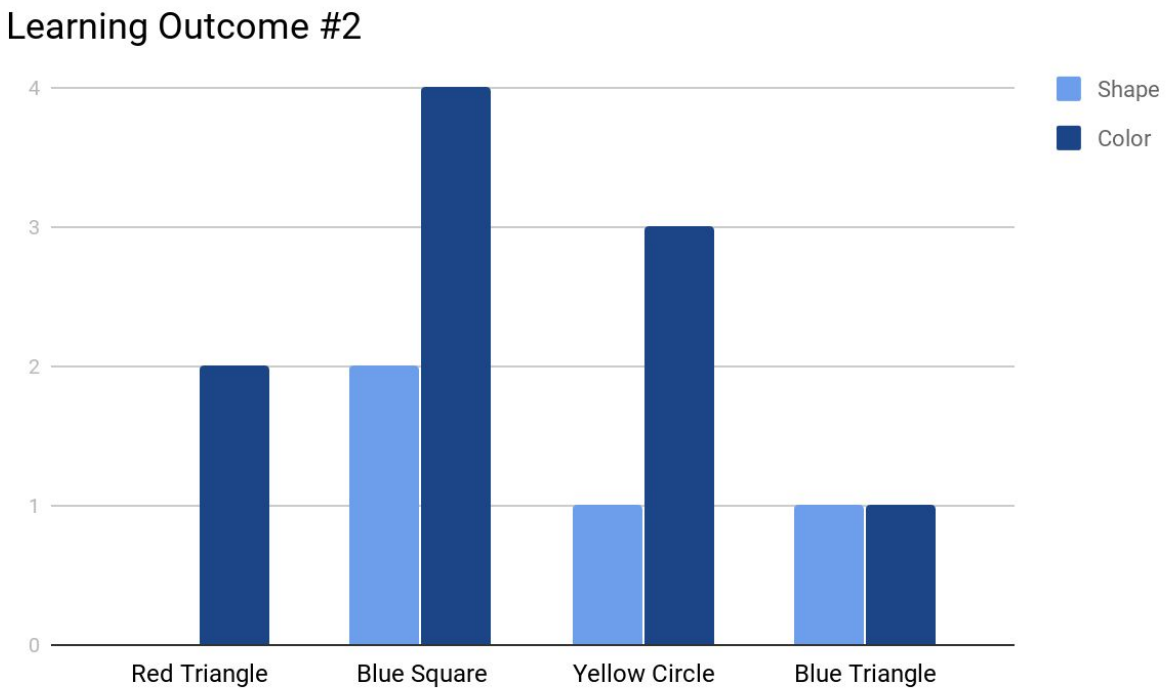
Learning Outcome One Data



Note. Data derives from the six students who participated in day one of the Sensory Learning Shapes activities. Learning Outcome One: Students will be able to name the qualities of a square, triangle, and circle.

Table 2

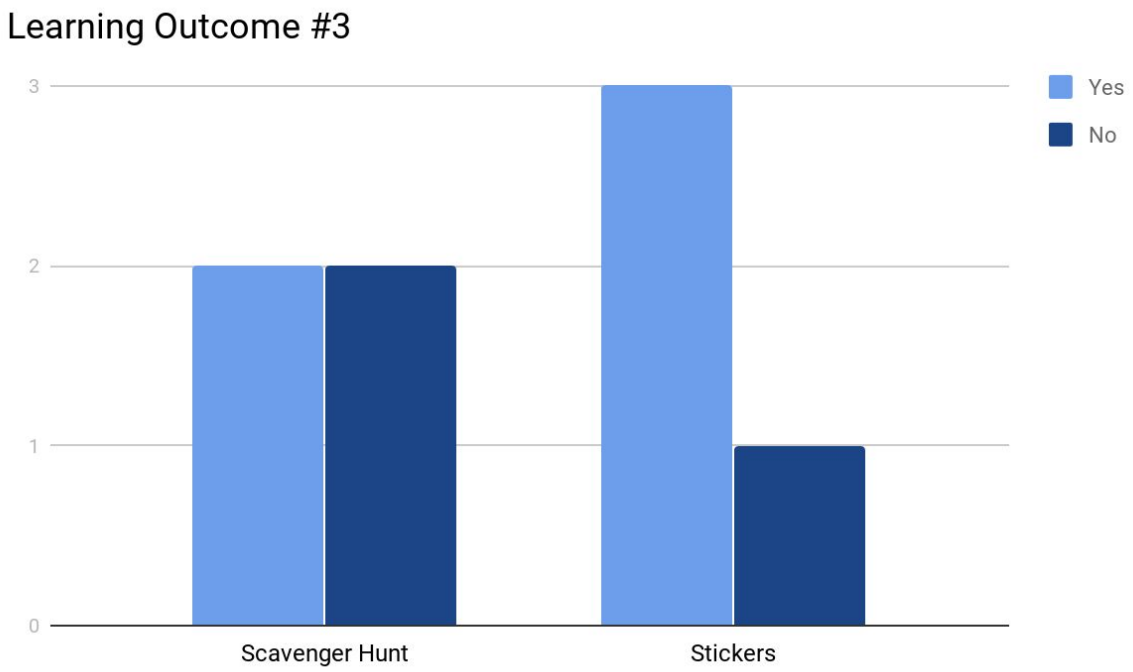
Learning Outcome Two Data



Note. Data derives from the four students who participated in day two of my Sensory Learning Shapes activities. Learning Outcome Two: Students will be able to classify objects by two characteristics (shape and color).

Table 3

Learning Outcome Three Data



Note. Data derives from the four students who participated in day two of my Sensory Learning Shapes activities. Learning Outcome Three: Students will be able to identify a shape they see embedded within a classroom object.

Figure 1

Day One Materials

Figure 2

Day Two Materials

Figure 3

Day Two Materials Continued

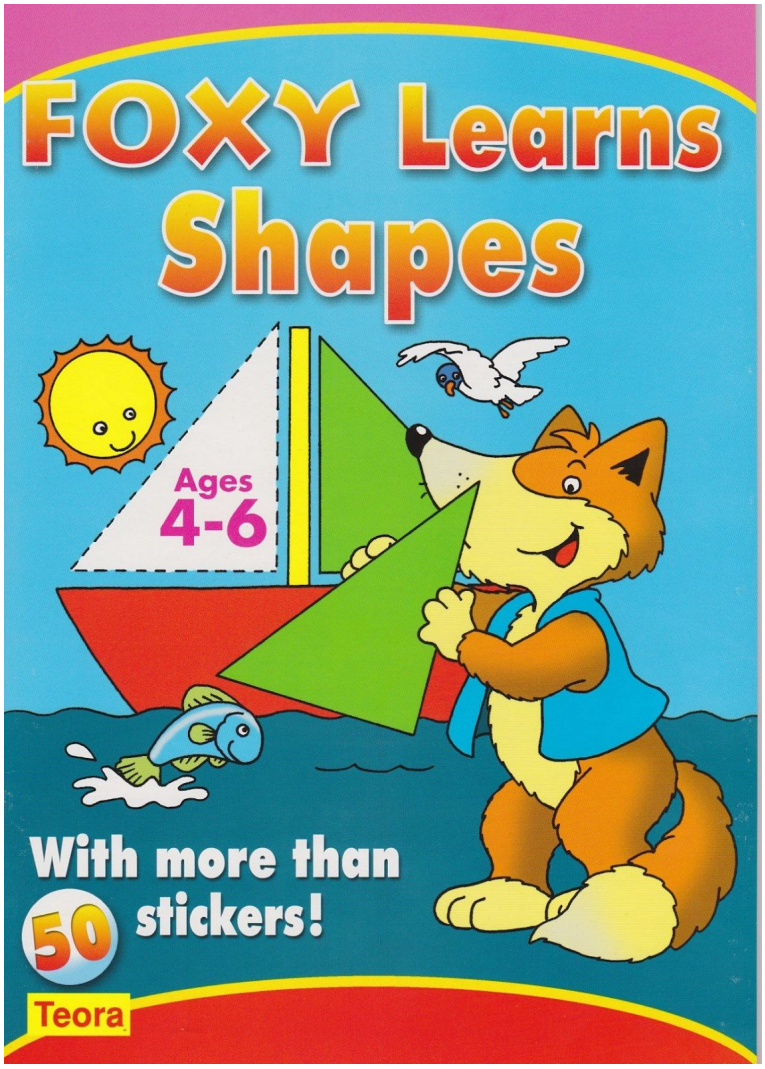


Figure 4

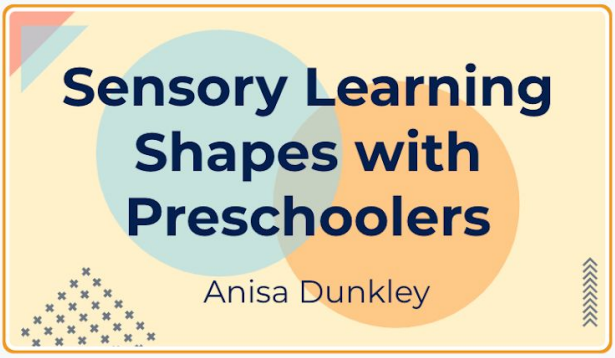
Learning Outcome One in Progress

Figure 5

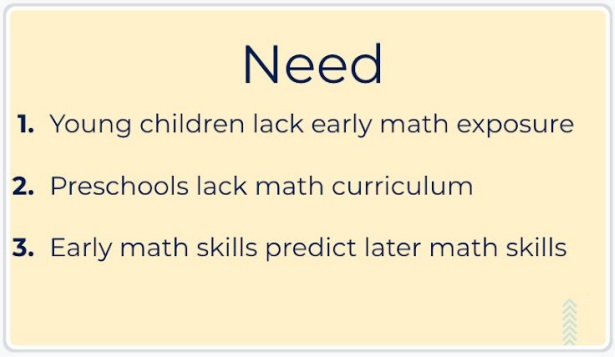
Learning outcome two in progress

Figure 6

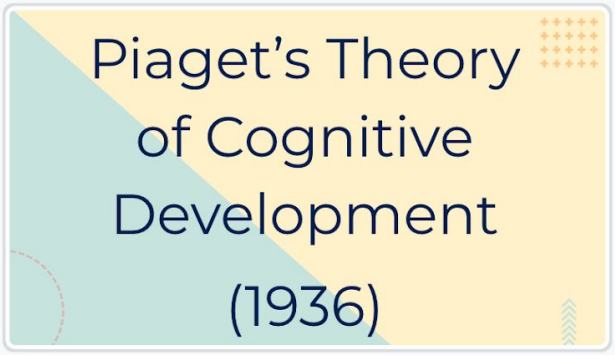
Objects found for learning outcome three


Sensory Learning Shapes with Preschoolers
Anisa Dunkley

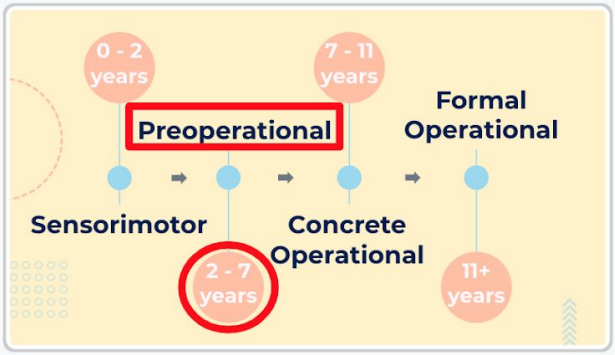
1


Need
1. Young children lack early math exposure
2. Preschools lack math curriculum
3. Early math skills predict later math skills

2


Piaget's Theory of Cognitive Development (1936)

3


0 - 2 years
7 - 11 years
Preoperational
Formal Operational
Sensorimotor
Concrete Operational
2 - 7 years
11+ years

4

	Sensorimotor	Preoperational
LEARNING STYLE	Sensory Curiosity	Language; Images
MARKERS	Egocentrism	Symbolic Thinking; Imagination

5

METHOD

6

Day 1

METHOD

- "Sorting Shapes" Activity
- Colors
- Shapes

7

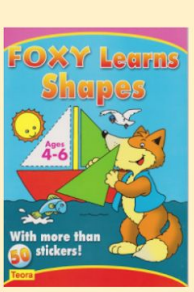
8

Day 2

METHOD

- "Shapes Scavenger" Activity
- Categorization
- Application

9



10

Learning Outcomes

By the end of my lesson students will be able to:

01 **Name the qualities of a square, triangle, and circle.**

02 **Classify objects by two features (shape and color).**

03 **Identify one shape they see embedded in classroom objects.**

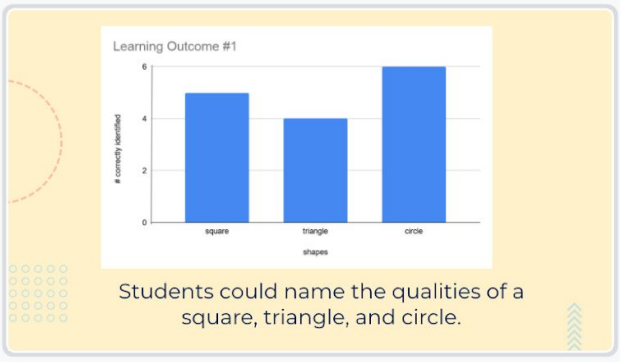
11

RESULTS

12


DAY 1
• 6 Participants
• LO 1

13


Learning Outcome #1
correctly identified
0
2
4
6
square
triangle
circle
shapes
Students could name the qualities of a square, triangle, and circle.

14

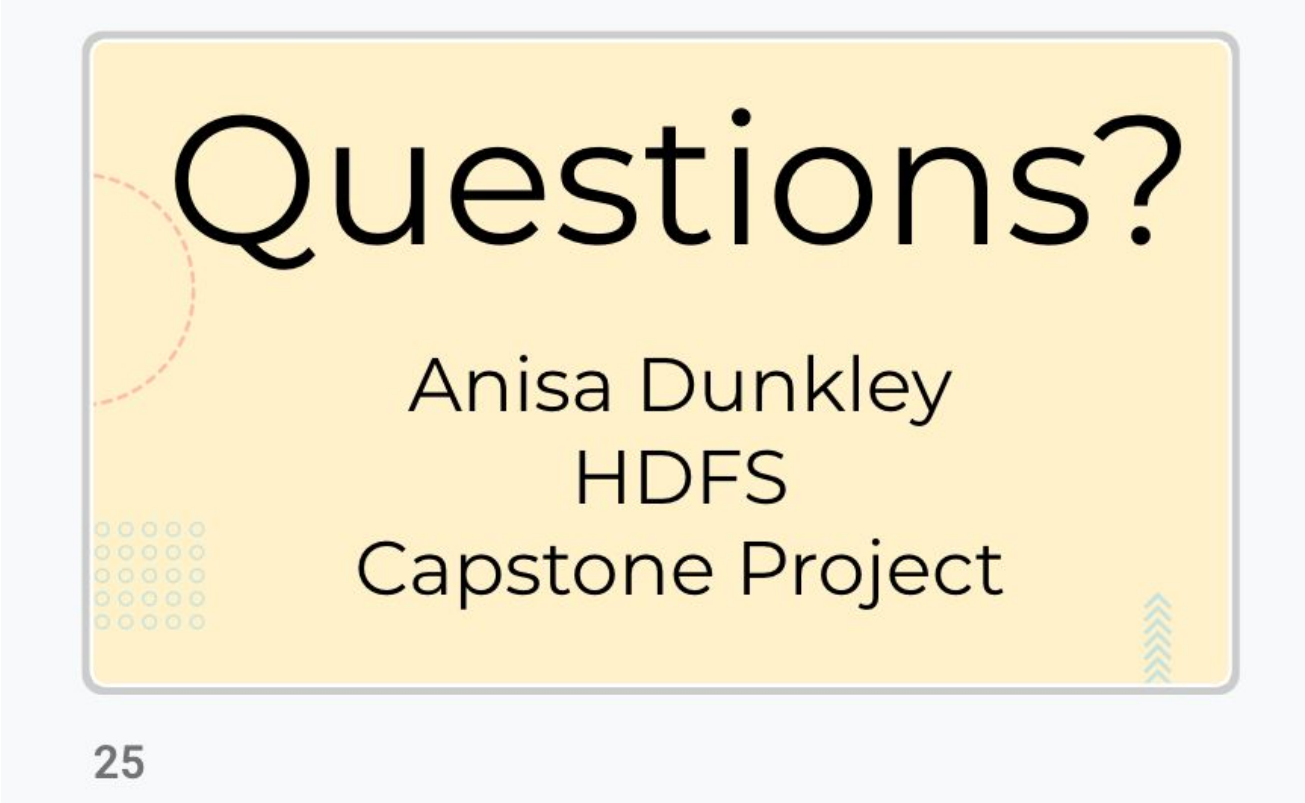
15


DAY 2
• 4 Participants
• LO 2
• LO 3

16


Learning Outcome #2
Shape
Color
Red Triangle
Blue Square
Yellow Circle
Blue Triangle
Students could classify by shape and color.
17
18
Learning Outcome #3
Yes
No
Scavenger Hunt
Stickers
Students could identify a shape embedded in a classroom object.
19
Hands Are Not for Hitting
20


DISCUSSION
21
Advantages
&
Disadvantages
22
Next time...
23
Thank You:
CSUMB Child Development Center
Jennifer Sebolino
Teacher Dulce
Teacher Monica
Dr. Rob Weisskirch
Professor Bryan Holbrook
California State University
MONTEREY BAY
Early Development Services
24


Questions?
Anisa Dunkley
HDFS
Capstone Project
25