What Might Be Learned From One At-Risk Child’s Experiences In A Preschool Summer Math Program?

By

Jennifer Elizabeth Newberg

Name and signature of faculty mentor

Name and signature of second mentor (reader)

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Abstract

Early mathematics ability upon entry to kindergarten has been found to be a strong predictor of future overall academic success, even more so than early reading ability (Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov, 2007). United States students have been found to have relatively low levels of mathematical achievement as compared to international children from three to six years of age and research showed an additional achievement gap with regards to family income. This case study was conducted in an urban preschool setting in the Midwest of the United States of America. The focus of the study was to observe the difference in the participant’s awareness and improvement of mathematical concepts over a short period of time, when immersed in a math-rich learning environment. The results of this case study demonstrated an increase in the participant’s use of mathematics vocabulary in her oral language and an increase of mathematical concepts.
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Chapter 1-Problem

Introduction

Mathematics ability upon entry to kindergarten has been found to be a strong predictor of future overall academic success, even more so than early reading ability (Duncan, Dowsett, Claessens, Magnuson, Huston, Klebanov, 2007). The National Association for Education of Young Children (NAEYC) and National Council of Teachers of Mathematics (NCTM, 2002); Clements (2001) have stated that, young children are natural learners, and they observe and explore mathematics on a daily basis. Children live in a math-enriched environment where math concepts are present in everything they do. Consequently, if a child’s natural curiosity and excitement towards math exploration is not nurtured in an authentic environment, opportunities to strengthen their mathematical foundation are missed, negatively affecting opportunities at long-term academic success.

Seefeldt and Galper (2008) have indicated that during the preschool years, teachers and parents together are a very important influence on nurturing a young child’s natural curiosity and informal mathematical abilities in relation to their everyday learning experiences. Preschoolers’ brains are undergoing significant developmental change and need to be stimulated by more complex and engaging learning activities, rather than drills of rote counting or repetition of patterns. Through teacher and parental involvement, a strong foundation can be established to build upon a love for math and create a positive attitude as children explore math concepts in the future. Based on their research, it could be concluded that young children who engage in meaningful and enjoyable mathematical
learning experiences at the preschool level, are more likely to appreciate and continue to engage in mathematical learning experiences at all levels of education.

Statement of Purpose

The purpose of this research was to observe an at-risk preschooler in a math focused summer school program, over a three-week period. The results informed the researcher on how much growth a participant was able to make in a short time when using intentionally planned research-based mathematics activities that were hands-on and developmentally appropriate for their age. The researcher also informed the participant’s family of their mathematics progress and how parents could support future math learning.

Research Question

The research question in this study was, “What might be learned from one at-risk child’s experiences in a preschool summer math program?”

Definition of Terms

The following terms were defined constitutively and operationally for the purpose of this study:

- At-risk

Constitutive – often used to describe students who are considered to have a higher probability of failing academically. Based on various factors including, qualifying for free or reduced lunch, environmental risk (teen parent, incarceration, absence from the home, neighborhood they live in), severe and challenging behavior, low income, and primary language other than classroom language.

Operational – falling behind in progress towards preschool mathematics objectives after a full year of all day preschool.
• **Developmentally Appropriate (DA)**

Constitutive – the use of teaching strategies that are based on knowledge of how young children develop and learn, what makes each child unique, and the child’s community and family culture and home language.

Operational – activities that are not too difficult or too easy, but just right. The appropriate style of learning and teaching for young children, including hands on, guided, tied to student interest, whole group, small group, and play-based learning.

• **Observation**

Constitutive – a process used by early childhood educators to watch, listen to, and record children’s actions, facial expressions, body language, sounds, words and gestures, as a means of assessment.

Operational – provides information teachers can use to understand what and how a child is thinking, feeling, and learning and plan ways to support and enhance the child’s development of skills in all domains.

• **Play-based learning**

Constitutive – This learning draws from children’s natural desire to engage in experiences based on interests, strengths, and developing skills.

Operational – Teachers intentionally plan for and provide materials in interest areas for children to explore through play.

• **Authentic**

Constitutive – real or genuine; true and accurate; made to or look just like the original.

Operational – A learning experience that is relevant to the learner’s life.
Chapter 2- Literature Review

Introduction

It would seem obvious that from the moment a child is born, their world is surrounded by mathematics. Evidence of this is present throughout the early years of childhood. Preschool would seem to be an opportune time in providing children with an understanding that math is all around them. According to Copley, Jones, & Dighe, (2010) a positive attitude and a strong foundation for mathematics learning is fostered by a quality program where teachers and parents work together to further the child’s understanding of mathematics in their world. The mathematics achievement gap of an at-risk child, mathematics curriculum, and mathematics implementation are discussed further in the following paragraphs.

The Mathematics Achievement Gap of an At-risk Child

NAEYC & NCTM (2009) stated the essential starting point to address the mathematical achievement gap is early childhood, where all educational settings should include “high quality, challenging, and accessible mathematics experiences” for all students. Although educators are coming to recognize the correlation between early mathematics knowledge and later academic success, it has been found that mathematical proficiency of students in the United States was far below that of many other countries. The research found that the achievement gap was even more significant when considering children living in poverty, and those of ethnic, cultural, and linguistic minority groups.

Researchers have found, the learning environments of children from middle-income families were more rich mathematically than those of children from low-income families (Klein, Starkey, Molfese, Brown, & Molfese, (2008). In 2009, Siegler studied
the difference in mathematical knowledge between children from low-income families and children from higher-income families, upon entering school. He found a disparity in their basic mathematical skills, including counting, recognizing numbers, adding and subtracting, and measuring. Siegler (2009) correlated the disparity to low-income parents engaging in fewer and less frequent mathematical activities with their children at home, compared to more affluent parents. Early mathematics interventions are critical, as Morgan (2014) suggested that students who struggle in mathematics often “do not grow out of it” and a “wait and see” approach might only have a “wait to fail” consequence for many children. Similarly, Bahr and Garcia (2010) concluded that learning important math concepts is especially critical for children who may be at risk for academic failure; early instruction provides the foundation for subsequent skills and can minimize confusion and misunderstanding.

Mathematics Curriculum

The summer preschool study focused on teaching mathematics through the use of the Creative Curriculum model (Copley et al., 2010). The Creative Curriculum, originally developed in 1978, has been adapted and changed as current research and new insights dictate what teachers need to know to teach effectively. Supported by the Creative Curriculum model, the summer Preschool teachers used many opportunities during the day to help children build their competency in math. Preschool teachers who implemented the Creative Curriculum intentionally used many opportunities during the day to help children build their competency in math.

The Creative Curriculum contains five math components:

- number and operations
• geometry and spatial sense
• measurement
• patterns (algebra)
• data analysis

Number and operation concepts are the foundation of mathematics. This includes counting, one-to-one correspondence, understanding quantity, terms of comparison, and number symbols. Geometry and spatial sense involves recognizing and describing shapes and positions in the environment. Children gain spatial sense as they become aware of themselves in relation to other people and things. Developing an understanding for the principles and uses of measurement includes comparisons between objects (longer/shorter, heavier/lighter, faster/slower) and also comparisons to nonstandard units (the pencil is six blocks long). Patterns are regular arrangements of such things as objects, shapes, and numbers. Children figure out relationships among objects and eventually begin to generalize about numbers, as they learn to recognize regular repetition of basic units. Collecting and organizing information and finding ways to represent it are included under data analysis. Classifying, graphing, counting, measuring, and comparing are all examples of ways children use data analysis in preschool. The Creative Curriculum presents these mathematics components in ways that are meaningful to preschool children and provides teachers with the tools to help them evaluate where their students are on a developmental scale, though observation and documentation of children’s progress in meeting math objectives.

All early childhood settings should provide research-based curriculum and instructional practices that begin to build a foundation for the understanding of
mathematical concepts. In the Creative Curriculum, mathematics standards align well with a rich, play-based curriculum that is planned and implemented by reflective, knowledgeable teachers. With adult guidance, children construct important mathematical concepts when they encounter situations that encourage mathematical thinking. The NCTM (2000) defended this saying, “Adults support young children’s diligence and mathematical development when they direct attention to the mathematics children use in their play, challenge them to solve problems, and encourage their persistence.” It is the responsibility of early childhood educators to understand the mathematics standards so they continue to design curricular activities that best support learning. Jung & Conderman (2013) found when teachers routinely incorporated intentional teaching of math concepts, authentic math instruction, and effectively used mathematics manipulatives, and created an environment where children communicated mathematics ideas, children were able to see mathematics as engaging, meaningful, and an important part of their everyday lives.

Mathematics Implementation

Copley et al. (2010) stated, preschoolers are ready to learn mathematics and one of the most obvious ways to observe their interest in mathematics is through children’s play in intentionally planned centers. When Ginsberg and Seo (2004) observed children during free play, six categories of mathematics content emerged. The content observed included the following:

- Classifying (sorting)
- Exploring magnitude (describing and comparing the size of objects)
• Enumerating (saying number words, counting, instantly recognizing a number of objects, or reading or writing numbers)
• Investigating dynamics (putting things together, taking them apart, or exploring motions such as flipping)
• Studying patterns and shape (identifying or creating patterns or shapes, or exploring geometric properties)
• Exploring spatial relations (describing or drawing a location or direction)

In their study, Clements and Samara (2005) also found the variety of mathematics concepts explored during free play to be extraordinary. Free play offered a rich foundation on which to build complex mathematics knowledge. Children instinctively compared quantities, observed and made patterns, navigated through different kinds of spaces, and problem-solved in their play interactions with objects and with peers in the classroom. Children’s mathematics learning was enhanced when teachers asked questions that promoted clarification, extensions, and development of new math understandings. Clements and Samara determined that these everyday experiences worked to form the basic foundation, upon which all future mathematical understanding will be built. They concluded, a teacher’s most important roles, in respect to mathematics, are finding frequent opportunities to help children reflect on, and extend, learning that arises in their everyday play, activities, and conversations; and intentionally structuring environments that incorporate and support mathematics throughout the day.

In the Creative Curriculum, math concepts are intentionally embedded in all areas and times throughout the school day. Teachers nurture reasoning, problem solving, communicating, and representing all day long. Some experiences are planned encounters
with math concepts, while others arise spontaneously from the children’s interests in their environments. Integrating mathematics throughout the day includes: when children arrive, large group time, choice time, small group time, snack and meal time, transitions, outdoor time, rest time, and departure, as well as during conversations with children and in their oral language (vocabulary).
Chapter 3-Methodology

Introduction

A case study was used for this qualitative research. Qualitative case studies “allow the researcher to explore individuals or organizations, simple through complex interventions, relationships, communities, or programs and supports the deconstruction and the subsequent reconstruction of various phenomena” (Yin, 2003). This study focused on one at-risk preschooler’s experiences with mathematics after having been identified by her teacher as struggling in this area.

The research question in this study was: “What might be learned from one preschool child’s experiences in a summer school math program?” The purpose of the study was to observe the mathematical progress of an at-risk preschooler in a Creative Curriculum play-based summer school program over a three-week period, focused on numeracy and mathematics. The results informed the researcher on how much growth a participant made in a short time when using intentionally planned research-based mathematics activities that were hands-on and developmentally appropriate for her age.

Description of the Sample

The participant of this case study was a five-year-old English-speaking Caucasian preschooler who was enrolled in the three-week summer school mathematics program. Her parents were also English-speakers so that conversations with the researcher could be barrier free. This participant was considered at risk. All students selected for this summer math program resided within zones of an urban city identified by the funding source as highest need areas. The participant had just completed a full year of all-day preschool and was identified by her preschool teacher as needing additional mathematics
support before entering Kindergarten in the fall. The participant’s classroom was taught by her school-year preschool teacher. The teacher held a Master’s Degree in her field, as well as an Early Childhood Teaching Endorsement. The classroom was also provided an assistant teacher, with an Associate’s Degree in Early Childhood. Twenty children were enrolled in the participant’s classroom, including peers from her previous class.

Instrumentation

This case study was compiled over a three-week period to observe the participants’ mathematics growth. To measure growth, a pre-assessment and interview of mathematics knowledge was given to the participant during the first week of summer school and an additional post-assessment during the third week. During this period, the subject was immersed in mathematical experiences in the classroom framed within the Creative Curriculum model. The summer school teacher was provided with 12 mathematics activities (Numbers Plus HighScope) and necessary materials. The selected activities covered the following mathematics domains: numbers and operations, patterns, measurement, and geometry and spatial sense. The activities were designed to be delivered in a developmentally appropriate format, including whole group instruction; small group instruction; and center-based free play. The teacher was also provided with a schedule (see Table 1), which guided implementation, but left the teacher with primary control. Three classrooms participated in implementing the math activities, which also allowed for collaboration and discussion between teachers. Parents received a weekly mathematics activity to keep at home that reinforced mathematical domains taught throughout the summer program.

Data Collection Procedures
Data was collected through observations and interviews for this case study.

Observations were conducted during the summer school hours of 9:00 am to 12:00 pm Monday through Thursday. The study was carried out over three weeks. Observational notes were taken daily during morning meeting, small group time, choice time, and read-aloud large group time. Table 1 showed a typical weekly schedule for the summer school program.

Table 1 Typical Week Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00-9:30</td>
<td>Morning Launch</td>
<td>Sign-in, parent conversations &amp; support, library center, and morning meeting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9:30-9:45</td>
<td>Small Groups</td>
<td>Numbers &amp; Operations</td>
<td>Geometry &amp; Spatial Sense</td>
<td>Measurement</td>
</tr>
<tr>
<td>9:45-10:45</td>
<td>Learning Centers</td>
<td>Measurement</td>
<td>Patterns</td>
<td>Numbers &amp; Operations</td>
</tr>
<tr>
<td>10:45-11:00</td>
<td>Large Group</td>
<td>Whole group story read-aloud, focus books with mathematical connections</td>
<td></td>
<td>Geometry &amp; Spatial Sense</td>
</tr>
<tr>
<td>11-11:30</td>
<td>Large Motor</td>
<td>Outside or gym play both directed and open choice activities offered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:30-11:50</td>
<td>Lunch</td>
<td>Rich vocabulary building conversations offered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11:50-12:00</td>
<td>Review</td>
<td>Review of days learning and new math concepts taught</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data Analysis

The observational notes were analyzed according to the participant’s engagement, math domains visited, and pre- and post-assessment results. Interviews with the participant and the participant’s parents also yielded valuable data for understanding the participant’s math knowledge and background. The researcher also analyzed the participant’s pre- and post-assessment scores, provided by the assessor and discussed the results with the classroom teacher. The researcher’s findings are discussed further in the proceeding chapter.
Chapter 4-Results

Introduction

This case study took place in an urban setting after a full year of preschool instruction for one participant who was identified as needing additional math instruction by her teacher. She was described by her teachers as a very quiet girl, who engaged cooperatively with her peers. Academically, her teacher stated that she was struggling to make gains and needed lots of repetition and reinforcement of mathematics concepts. This case study was developed to determine the academic gains of an at-risk preschooler over a three week period, when immersed in a mathematically rich environment. The participant was observed daily for three weeks during her summer learning experience. After consent letters were signed by the participant’s parents, two interviews took place the first week of summer school. The first interview was with the child and second was with the parents; both consisting of 6 questions each. The participant was evaluated by an assessor at the beginning and conclusion of the summer program.

Qualitative Analysis

Results from the child interview (Table 2), showed that the participants’ mathematical knowledge was behind, according to the Creative Curriculum developmental scales, despite having attended a full-year of all-day preschool. When asked how old she was, she showed five fingers, and when prompted for a verbal response, she stated she was five. She was unable to distinguish between a number and a letter, and when asked to name a number, she responded, “T, 3, 6, 5, 7.” The participant could not write any of her numbers and shared that she saw her dad write numbers at home sometimes. When asked to write numbers, made what looked like a one, a letter
M, and a rectangle. When asked how many people live in her home, she was able to tell the researcher that she lived with her mom, dad, sister and brothers, but was unable to say how many. She showed an interest in knowing how many people were in her family.

Table 2 Participant Interview Questions

<table>
<thead>
<tr>
<th>Number</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How old are you?</td>
</tr>
<tr>
<td>2</td>
<td>Which one is a number? (Have a magnetic letter A and the number 2. Have them sort more letters and numbers if they wish.)</td>
</tr>
<tr>
<td>3</td>
<td>What numbers do you know about? What are their names? (Children use these materials to answer: Unlock It! Number Locks and Number Puzzles.)</td>
</tr>
<tr>
<td>4</td>
<td>Where do you see numbers? (Outside, at home, at school, at the grocery store.)</td>
</tr>
<tr>
<td>5</td>
<td>Have you ever seen anyone writing numbers? (If yes, then ask:) Can you show me some numbers you know how to write?</td>
</tr>
<tr>
<td>6</td>
<td>How many people live at your home? (Use block area wooden people to name and count family members.)</td>
</tr>
</tbody>
</table>

During the interview, parents were asked questions regarding their feelings toward mathematics, as well as observations of their child’s use of mathematics in daily activities (see Table 3). Personal information was shared regarding a traumatic situation that affected an immediate member of their family. The parents felt this affected their ability to focus on supporting their daughter’s mathematical skills at home during the school year. Her parents provided a background on their education; dad received a Bachelors Degree in Mass Journalism and mom, an Associates Degree. The mother indicated that she enjoyed math when she attended school, however the father found math to be a difficult subject.

They had noticed their daughter trying to count during play with her siblings. They stated their daughter pretends to count while playing hide and seek, or while playing family games such as Monopoly, Life and other board games. When asked if they noticed their child using numbers in her everyday language at home, they gave
examples of her pushing numbers for the elevator at the hospital; when she told her age; asked how long it’s been; order of the seating arrangement in the car; and fighting with siblings over taking turns. When asked about their daughter noticing shapes in her environment they realized they had never really discussed shapes with her, or pointed out shapes and named them with her. They were able to recall the participant using the words ‘taller’ and ‘bigger’ and that she stated at one time that she weighed more than her brother. It was also noted that they had never seen her write any numbers while at home.

Table 3 Parent Interview Questions

<table>
<thead>
<tr>
<th>Number</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On a scale of 1-5, with 5 being “dislike” and 1 being “love it” rate your feelings about mathematics.</td>
</tr>
<tr>
<td>2</td>
<td>Did you ever notice your child counting?</td>
</tr>
<tr>
<td>3</td>
<td>Did you ever notice your child using number words in their language at home? (For example: I am 2 years old, I have 3 strawberries, My brother is taller than me, I have more juice in my cup, The ball went across the street.) Can you think of an example?</td>
</tr>
<tr>
<td>4</td>
<td>Does your child notice shapes in his/her surroundings? (For example: a stop sign, circles on a traffic light, cereal box, window, door, shapes of fruits and veggies.)</td>
</tr>
<tr>
<td>5</td>
<td>Has your child ever commented on the fact that he/she is growing? (For example: My shoes are too small, the grass is getting long/taller, My clothes are too small, or not being able to reach things that are too high for them.)</td>
</tr>
<tr>
<td>6</td>
<td>Have you ever seen your child write any numbers at home?</td>
</tr>
</tbody>
</table>

The participant was pre-assessed on the following mathematics objectives from The Creative Curriculum:

- Objective 20: Uses number concepts and operations
- Objective 21: Explores and describes spatial relationships and shapes
- Objective 22: Compares and measures
- Objective 23: Demonstrates knowledge of patterns

The participant was able to count to ten (skipping the number five), identified numbers to five, and instantly identified quantities of one and two. It was noted that she
was able to follow simple directions related to proximity (used positional words such as beside, between, next to, in, on, under, up, and down). The participant was able to match two identical shapes and identified a few basic shapes (square, triangle, circle, star, and heart). It was documented that she was able to make simple comparisons between two objects; was beginning to compare and order a small set of objects as appropriate according to size, length, weight, area, or volume; knew usual sequence of basic daily events and a few ordinal numbers. Lastly, the participant demonstrated her knowledge and interest in simple patterns in everyday life, was able to copy simple patterns, and extended and created simple repeating patterns. According to the Creative Curriculum developmental scales, the participant scored below age level expectations for all areas of math, with the exception of patterning.

The participant was observed following classroom expectations and routines. Her attention was perceived to be on the teacher and her peers when they discussed mathematics concepts. Similarly, when they were asked to participate as a group, she appeared to be engaged and responded to the questions posed. She was observed interacting with her peers throughout the summer school session.

The teacher began each day with a morning meeting, which consisted of a question of the day and morning message. A math objective was highlighted in the daily message time to focus attention on a particular concept that would be taught. For example, messages of the day included:

• We will write numbers today.
• We will measure how far things go.
• Today we will learn about shapes.
• We will find numbers in the newspaper.

Questions of the day consisted of items that interested preschool age children, asking them to vote for their favorite of a group of items (shape, animal, dessert, candy, number, etc). The teacher incorporated a Number Bag, which went home with one child each day. The child picked a number, then found that many of an item to share with the class the following day. When it was the participant’s turn, she brought the bag to circle time, and with the teacher’s help, counted to ten while she showed the number to the class. She took out ten items from her bedroom. She made a point of telling the class that she had bunk beds, which she shared with her sister, and that she enjoyed playing with all of her toys. Another morning, the participant and her peers were asked if anyone was wearing a pattern. She raised her hand and showed her fingernails and read the ABAB pattern that was made with her nail polish.

Small group instruction included all four of the math domains. Each day a different objective was taught in a research-based, small group activity provided by HighScope’s Numbers Plus. One of the small group lessons asked students to measure small, medium, and large items, then use a straw to blow the items with one giant blow of air. The teacher asked them to predict which item would go the furthest and why. The participant predicted the largest item would go the furthest, however after experimenting, concluded that the smallest item traveled the furthest. During another small group activity, students planted grass seeds. Children had to follow directions for planting and charted for growth over the three weeks. The teacher asked the participant to put two scoops of dirt into her cup. She successfully counted the two scoops and put them into her cup. This activity had a very high level of engagement from the small group and the
A geometry activity took place on the playground and around the school, where the participant was asked to look for shapes in her environment. The researcher noted discussions about cones, spheres, cylinders, squares, circles, and rectangles between peers and the teacher.

During the summer school sessions, the researcher noticed a spike in knowledge of mathematical concepts, as evidenced through observation of the child’s play. While working at the Toys and Games area, she stated the pizza puzzle piece was shaped like a triangle. While playing with play dough, she made birthday cakes and added toothpick sticks as candles. She mentioned to a friend that she needed “this many” while showing a handful of sticks to her peer. She attempted to count as she put the candles on. After she finished, she told her teacher, “My mom buys cakes at the store,” and she showed the cake she had made. Together, they counted the candles. Another day, while working with play dough, she worked with cookie cutters and named the shapes ‘circle’ and ‘square’. The researcher also observed the participant using positional words while working in the Block area with a wooden dollhouse. She pretended to be the mom, while a peer pretended to be the daughter. She asked her peer, “Sissy, how much longer before we go over to our friends house?” She used the words up, down, on, and in while playing in this area. The participant spent a significant amount of time in the Dramatic Play area. In this area, she used measuring spoons to add sugar and dropped strawberries into her bowl for her cheesecake, which she stated was her mom’s favorite. She noticed two peers sitting at the table and retrieved three plates and set the table for her friends. She placed one plate in front of each child and left one for herself. She said the cake would be “ready in 5 minutes.” During the final week, the researcher observed the participant
working at the writing area with a peer, drawing on whiteboards. She stated, “Yesterday my dad taught me how to draw a 2,” then wrote a number 2. She also drew shapes and wrote more numbers and seemed to express pride in her new abilities.

For read-aloud, the teacher intentionally chose literature that incorporated math concepts each day. The literature was age appropriate and promoted engagement with the text. Examples of read-alouds used by the teacher included: *Mouse Count, Chicka Chicka 1,2,3, The Doorbell Rang, Fish Eyes, and One Duck Stuck*. Each of the read-alouds asked the children to participate with the text in various ways, including: realia, props, and movement. Overall, the participant was engaged during read-alouds and responded when promoted and called upon. Her attention was noted to be appropriate for the time spent on the rug.

With the culmination of summer school, the participant was given a post-assessment by an evaluator who came into the classroom. The pre- and post-assessments were identical and the participant was assessed in the classroom, while the other children worked. On the post-assessment, the participant was able to identify numbers 1-5, same as her pre-assessment. She was able to count from 1-13, without missing any numbers and did not make any gains with quantities over 5. She was able to use positional words to tell about where her object was in relation to herself and followed simple directions given to her by the evaluator. She remained on the same level as the pre-assessment when asked to name shapes. She showed a better understanding when assessed on comparing and measuring, although scored the same. Finally, the participant demonstrated a knowledge of patterns, successfully creating and extending more complex patterns than her pre-assessment. Overall, improvements were made, but the post-
assessment did not show a significant growth in knowledge.

The participant’s pre- and post-interview responses reflected a very basic background in mathematical concepts. In the post interview, she was able to verbally tell her age without additional prompting, or use of fingers. She continued to have difficulty distinguishing a letter from a number, pointing to the letters in the word ‘house’, instead of the numbers on the microwave at the Dramatic Play area. The researcher asked the participant to name a big number she knows and she pointed to and named the number 5. When asked about numbers, she mentioned her watch and how there was “a number 1 inside.” She then proceeded to talk about the “2 circles” on the sides that “help to change the numbers.” When asked to write numbers, she wrote the numbers 1, 4, and 5, she responded that sometimes she knows how many her neighbor writes with chalk. She also stated that she had worked on writing numbers at home with her dad over the weekend. The participant was much more comfortable completing the interview the second time and had an easier time relaying knowledge. She also seemed excited to share what she had learned.

Conclusions

At the conclusion of the study, the researcher informed the participant’s family of her mathematics progress and provided suggestions to support mathematics learning at home. The family was very thankful to have their daughter’s strengths and weaknesses discussed with them, and expressed appreciation for ideas and support materials that were given to them each week by the summer school teachers. The parent interview was eye opening to the parents in this study, in that they were able to notice concepts they missed
teaching early in their child’s first four years, and in turn discussed providing extra support at home for their daughter, especially in the area of mathematics.

The researcher observed that the participant seemed most engaged with mathematics when it was self-initiated, and when perceived that it had meaning in her life. Through intentional mathematics experiences in the classroom, the researcher saw gains in the participant’s mathematics vocabulary during free play authentic activities, provided by the teacher. When mathematics skills were reinforced at home, she was eager to demonstrate what her dad had worked with her on and also loved to tell about her sister, especially during her choice time play. The participant had frequent opportunities to reflect on and extend the mathematics that arose in her everyday mathematics activities.
Chapter 5-Recommendations

Introduction

This case study was performed over a three-week period, interviewing and observing one at-risk child’s summer learning experiences in a mathematics rich environment. Parents willingly gave consent for their child to participate in this research project, which documented the participant’s awareness and growth in mathematical knowledge. The principal researcher, who was not the classroom teacher, saw an intentional exposure to mathematical objectives through small and large group instruction, choice time, intentional conversations, and in read-alouds chosen by the teachers. Parents also played an important role outside of the classroom that benefited the participant’s progress toward meeting age level expectations.

Implications and Action

This study was conducted over a very short period of time, therefore the amount of time the researcher had to observe, interview, and analyze the progress and gains made on the assessments, could be better documented if expanded over a full school year. The teachers involved in this summer learning opportunity had just completed a full school year, where two of the classrooms were all day. If this study was conducted over a full school year, teachers could provide their students with specific mathematical interventions throughout the school day. Another study could include looking into providing specific interventions to children who were identified as needing more mathematics instruction after a full year of preschool. Early mathematics interventions are critical, as Morgan (2014) suggested that students who struggle in mathematics often “do not grow out of it” and a “wait and see” approach might only have a “wait to fail”
consequence for many children. Bahr and Garcia (2010) concluded that learning important math concepts is especially critical for children who may be at risk for academic failure; early instruction provides the foundation for subsequent skills and can minimize confusion and misunderstanding. More classrooms could be involved with the study, as well as expanding the participant number from one to a whole classroom of children. All children are unique in their learning abilities, so the results would look different if another child and their family consented to be a part of the case study.

The topic of preschoolers’ and their rich experiences involved with learning mathematics, continues to be a topic studied by researchers. There is always room for further research regarding preschool mathematics and curriculum, specifically around mathematics objectives. This study used the Creative Curriculum to incorporate mathematics into all areas of the summer school day, as well as HighScope’s Numbers Plus curriculum that provided research-based mathematics small group lessons. Further research might look into the fidelity of the lessons taught by the summer school teachers and if they actually did teach the research-based lessons given to them to guide their instruction and focus around the five math objectives.

Conclusion

As seen in this case study, parents are such an integral part of their children’s education; working together with the teachers to support a love of mathematics; will only encourage their children to explore mathematical concepts around them now and in the future. Seefeldt and Galper (2008) have indicated that during the preschool years, teachers and parents together are a very important influence on nurturing a young child’s natural curiosity and informal mathematical abilities in relation to their everyday learning
experiences. Based on their research, it could be concluded that young children who engage in meaningful and enjoyable mathematical learning experiences at the preschool level, are more likely to appreciate and continue to engage in mathematical learning experiences at all levels of education. This summer program provided the participant with a new understanding and meaning of mathematics in her world. When all five mathematics components were intentionally integrated into the participant’s day, the foundation for mathematical learning was greatly enhanced.
References


HighScope Press


Appendix A – Letter of Consent for Participant

CONSENT FOR RESEARCH

Researcher: Jennifer Newberg (Aquinas College/Dickinson Academy GRPS teacher)

The researcher is currently working on her final project for her Masters thesis from Aquinas College. The researcher is being supervised by Dr. Carol Winkle, a faculty member in the School of Education at Aquinas College. The researcher is reading you this letter to verify your consent for your child to be a participant in her research project titled “What Might Be Learned From One Preschool Child’s Experiences in a Summer Math Program?”

Purpose of Research: This study aims to understand the benefits of a 6-week world-class preschool mathematics curriculum to engage and interest your child for future mathematics success in their school career. Research shows that preschoolers are capable and enjoy mathematics in their everyday environment. The researcher would like your permission to observe, interview, and analyze your child’s progress throughout the 6-week program. A major benefit of this research is to inform you of your child’s mathematical progress and how you can support your child at home in the area of mathematics.

What you will do: If you agree to have your child participate in this study, your child’s math progress will be tracked every day for 6 weeks by the researcher in the following ways: daily observations (M-Th. 9-12:00), an interview (6 questions, as long as their attention holds), and an analysis of your child’s pre and post-assessments. Math materials will be given to your child by the researcher for further practice and support to build upon their math strengths at home.

Potential Benefits: The results will inform you of your child’s mathematical growth over the 6-week period, by identifying your child’s strengths and providing you with resources that can be used at home before Kindergarten begins.

Potential Risks: There are no foreseeable risks associated with participation in this study. Emotionally, your child may feel excited or anxious to work one-on-one with the researcher with whom they have just met.

Privacy and Confidentiality: All information from this study will be kept completely confidential and your child’s name will never appear in the research documents. The pre and post-assessments will not include your child’s name and will be kept in a locked filing cabinet in the classroom for the summer school teacher and researcher’s eyes only. Later, the researcher will scan the data from the assessments, observations, and interview questions and save it on a password-protected computer. The paper copies will be shredded or given to you if you wish to have them. The researcher will report the findings to you at the completion of this study, and will not include your child’s name when reporting results of this study to the GRPS Director of Early Childhood and the Aquinas College School of Education.

Your rights: Your child’s participation is completely voluntary and there will be no penalty if you choose not to participate, or withdraw your child during the research time.

Cost and Compensation: There is no cost associated with your participation in this study.

Questions and Concerns: Please feel free to let the researcher know in person or via email NewbergJ@grps.org if you have any questions or let Dr. Winkle know at winklcar@aquinas.edu, or by phone at (616) 632-2434 or by mail at 1607 Robinson Rd SE, Grand Rapids, MI 49506. The researcher and supervisor will make sure that your questions or concerns will be addressed.
fully and you will be satisfied with their answers. Thank you so much for your willingness to help in this research project.

By signing this consent, I/we agree and consent to the research study as described in the above statements. If you do not authorize consent for your child’s participation in this case study, do not include your signature below.

Child’s Name: ___________________________________________
Parent Guardian signature: __________________________________
Date: ___________________
Appendix B – Letter of Consent for Parents

CONSENT FOR RESEARCH

Researcher: Jennifer Newberg (Aquinas College/Dickinson Academy GSRP teacher)

The researcher is currently working on her final project for my Masters thesis from Aquinas College. The researcher is being supervised by Dr. Carol Winkle, a faculty member in the School of Education at Aquinas College. The researcher is reading you this letter to verify your consent for you to be a subject in her research project titled “What Might Be Learned From One Preschool Child’s Experiences in a Summer Math Program?”

Purpose of Research: This study aims to understand the benefits of a 6-week world-class preschool mathematics curriculum to engage and interest you and your child for future mathematics success in Kindergarten. Research shows that preschoolers are capable and enjoy mathematics in their everyday environment. The researcher would like your permission to interview and discuss your child’s progress, as well as give you suggestions and materials to work on with your child throughout the 6-week program.

What you will do: If you agree to participate in this study, you will be asked about your child’s math experiences at home through an interview of 6 questions that could last up to 20 minutes during the first week of summer school. After reviewing both you and your child’s interview responses, the researcher will discuss with you during the third week of summer school suggestions for further math activities and practice at home (up to 20 minutes). At the conclusion of the six weeks, the researcher will meet with you again to report the growth made from the pre and post math assessments (up to 20 minutes).

Potential Benefits: The results will inform you of your child’s mathematical growth over the 6-week period, by identifying your child’s strengths and providing you with resources that can be used at home before Kindergarten begins.

Potential Risks: There are no foreseeable risks associated with participation in this study.

Privacy and Confidentiality: All information from this study will be kept completely confidential and your name, as well as your child’s name will never appear in the research documents. The pre and post-assessments will not include your child’s name and will be kept in a locked filing cabinet in the classroom for the summer school teacher and researcher’s eyes only. Later, the researcher will scan the data from the assessments, observations, and interview questions and save it on a password-protected computer. The paper copies will be shredded or given to you if you wish to have them. The researcher will report the findings to you at the completion of this study, and will not include your name or your child’s name when reporting results of this study to the GRPS Director of Early Childhood and the Aquinas College School of Education.

Your rights: Your participation, as well as your child’s is completely voluntary and there will be no penalty if you choose not to participate, or withdraw yourselves during the research time.

Cost and Compensation: There is no cost associated with your participation in this study.

Questions and Concerns: Please feel free to let me know in person or via email NewbergJ@grps.org if you have any questions or let Dr. Winkle know at winklcar@aquinas.edu, or by phone at (616) 632-2434 or by mail at 1607 Robinson Rd SE, Grand Rapids, MI 49506. The researcher and supervisor will make sure that your questions or concerns will be addressed
fully and you will be satisfied with their answers. Thank you so much for your willingness to help in this research project.

By signing this consent, I/we agree and consent to the research study as described in the above statements. If you do not authorize consent for your participation in this case study, do not include your signature below.

Participant/Parent signature: ______________________________________________________

Date: ___________________
Appendix C – Parent Interview Questions

Parent Interview Questions

As a teacher, my most important role in respect to mathematics, is finding frequent opportunities to help children reflect on and extend the mathematics that arises in their everyday activities, conversations, and play, as well as structuring environments that support these activities. Preschoolers are ready to learn mathematics and one of the most obvious ways to observe their interest in mathematics is through their play. The following questions will help me to know about your child’s early math experiences.

1. **On a scale of 1-5, with 5 being “dislike” and 1 being "love it" rate your feelings about mathematics.**

   1 2 3 4 5

2. **Did you ever notice your child counting?**

3. **Did you ever notice your child using number words in their language at home? (For example: I am 2 years old, I have 3 strawberries, My brother is taller than me, I have more juice in my cup, The ball went across the street.) Can you think of an example?**

4. **Does your child notice shapes in his/her surroundings? (For example: a stop sign, circles on a traffic light, cereal box, window, door, shapes of fruits and veggies)**

5. **When we make a pattern at school, we use different materials such as bears and cubes. We create patterns like this (Demonstrate to parent). Have you ever made patterns at home (cereal or coins)?**

6. **Have you ever seen your child write any numbers at home?**
Appendix D – Participant Interview Questions

Interview for Participant

I am Miss Jennifer and I was wondering if you would come play some games with me? I’m going to ask you to tell me with your words and show me with some toys what you know about math.

1. How old are you?

____________________________________________________________________________________________________________________

2. Which one is a number? (Have a magnetic letter A and the number 2. Have them sort more letters and numbers if they wish.)

____________________________________________________________________________________________________________________

3. What numbers do you know about? What are their names? (Children use these materials to answer: Unlock It! Number Locks and Number Puzzles.)

____________________________________________________________________________________________________________________

4. Where do you see numbers? (Outside, at home, at school, at the grocery store)

____________________________________________________________________________________________________________________

5. Have you ever seen anyone writing numbers? (If yes, then ask) Can you show me some numbers you know how to write?

____________________________________________________________________________________________________________________

6. How many people live at your home? (Use block area wooden people to name and count family members).

____________________________________________________________________________________________________________________
Appendix E – Pre- and Post-Assessment Recording Sheet

Pre-Assessment for B2B Summer Program

<table>
<thead>
<tr>
<th>Student Name: ___________________________</th>
<th>Date Assessed: ________</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective 20 Uses Number concepts and operations</strong></td>
<td></td>
</tr>
<tr>
<td>a.) Counts</td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I can count to 20.</td>
<td></td>
</tr>
<tr>
<td>I can tell how many in all.</td>
<td></td>
</tr>
<tr>
<td>I can tell what number comes next (1-10).</td>
<td></td>
</tr>
<tr>
<td>b.) Quantifies</td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I can make a set of objects (6-10) and tell about them.</td>
<td></td>
</tr>
<tr>
<td>I can tell if something has more, less, or the same.</td>
<td></td>
</tr>
<tr>
<td>I can count on to find out how many.</td>
<td></td>
</tr>
<tr>
<td>c.) Connects numerals with their quantities</td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I can tell the number by the objects.</td>
<td></td>
</tr>
<tr>
<td><strong>Objective 21 Explores and describes spatial relationships and shapes</strong></td>
<td></td>
</tr>
<tr>
<td>a.) Understands spatial relationships</td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use positional words.</td>
<td></td>
</tr>
<tr>
<td>b.) Understands shapes</td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>I can tell about shapes (2D and 3D).</td>
<td></td>
</tr>
<tr>
<td><strong>Objective 22 Compares and Measures</strong></td>
<td>Not Yet</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I can measure things.

Objective 23 Demonstrates Knowledge of patterns  Not Yet  Level 2  Level 4  Level 6

I can create a pattern.

Not Yet=No understanding  Level 2=Age 1-3  Level 4=Age 2-4  Level 6=Age 4-6
Post-Assessment for B2B Summer Program

Student Name: ___________________________  Date Assessed: _______

Objective 20 Uses Number concepts and operations

a.) Counts

I can count to 20.
I can tell how many in all.
I can tell what number comes next (1-10).

b.) Quantifies

I can make a set of objects (6-10) and tell about them.
I can tell if something has more, less, or the same.
I can count on to find out how many.

c.) Connects numerals with their quantities

I can tell the number by the objects.

Objective 21 Explores and describes spatial relationships and shapes

a.) Understands spatial relationships

I can use positional words.

b.) Understands shapes

I can tell about shapes (2D and 3D).

Objective 22 Compares and Measures

I can measure things.
Objective 23 Demonstrates Knowledge of patterns  Not Yet  Level 2  Level 4  Level 6

I can create a pattern.

Not Yet=No understanding  Level 2=Age 1-3  Level 4=Age 2-4  Level 6=Age 4-6
Activities or Stations for Assessment With Participants

Obj. 20 Uses Number Concepts and Operations
(a.) Counts
   Station 1: Rote count as high as they can (20).
   Station 2: Participants will count manipulatives (1-20) from themed jars
   Station 3: Knows how many in all (pile of ____ to count)
   Station 4: Tells what # (1-10) comes next (Lakeshore Number locks)
(b.) Quantifies
   Station 5: Instant recognition of #s 1-6 instantly (Giant rolling Die)
   Station 6: Combines and separates up to 5 objects and describes parts (5 Green and speckled frogs flannel board story)
   Station 7: Make a set of 6-10 objects and describes the parts
   Station 8: Identifies more, less and same (Basketball Toss Game)
   Station 9: Counts all or counts on to find out how many (How many ____ are there? What comes next?)
(c.) Connects Numerals to their quantities
   Station 10: Recognizes #s 1-10 by name (9, 4, 1, 7, etc.) and connects to number of objects (piles of manipulatives and # cards)

Obj. 21 Explores and Describes Spatial Relationships and Shapes
(a.) Understands spatial relationships
   Station 11: Positional words (use Lakeshore Positional word tub)
<table>
<thead>
<tr>
<th>Positional words</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>under</td>
<td></td>
</tr>
<tr>
<td>on</td>
<td></td>
</tr>
<tr>
<td>up</td>
<td></td>
</tr>
<tr>
<td>down</td>
<td></td>
</tr>
<tr>
<td>in</td>
<td></td>
</tr>
<tr>
<td>behind</td>
<td></td>
</tr>
<tr>
<td>between</td>
<td></td>
</tr>
<tr>
<td>next to</td>
<td></td>
</tr>
<tr>
<td>beside</td>
<td></td>
</tr>
</tbody>
</table>
(b.) Shapes
   Station 12: Matching shapes (Shape puzzles) and identify circle, square, triangle
<table>
<thead>
<tr>
<th>Shape</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>square</td>
<td></td>
</tr>
<tr>
<td>triangle</td>
<td></td>
</tr>
<tr>
<td>circle</td>
<td></td>
</tr>
<tr>
<td>oval</td>
<td></td>
</tr>
</tbody>
</table>
   Station 13: Describes 2D and 3D shapes using own words (Feely Box/Bag) (rectangle, star, diamond, heart, hexagon, cone, sphere, cylinder)
<table>
<thead>
<tr>
<th>Shape</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>cone</td>
<td></td>
</tr>
<tr>
<td>sphere</td>
<td></td>
</tr>
<tr>
<td>cylinder</td>
<td></td>
</tr>
<tr>
<td>hexagon</td>
<td></td>
</tr>
<tr>
<td>diamond</td>
<td></td>
</tr>
<tr>
<td>rectangle</td>
<td></td>
</tr>
<tr>
<td>star</td>
<td></td>
</tr>
</tbody>
</table>
Obj. 22 Compares and Measures
Station 14: Attribute blocks or building blocks (compare size, height, weight)
Measuring Tape, ruler

Obj. 23 Demonstrates knowledge of Patterns
Station 15: Find a pattern in everyday life (striped shirt)
Station 16: Copy simple repeating patterns (use a Drum: loud, soft, loud, soft)
Station 17: Extends and creates simple repeating patterns (Counting Bears)
# Appendix F – Observation Protocol

Observation Sheet

<table>
<thead>
<tr>
<th>Date: ______________</th>
<th>Monday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>9:00-9:30</strong></td>
<td><strong>Morning Launch</strong></td>
</tr>
<tr>
<td><strong>9:30-9:45</strong></td>
<td><strong>Small Group:</strong> Numbers &amp; Operations</td>
</tr>
<tr>
<td><strong>9:45-10:45</strong></td>
<td><strong>Learning Centers</strong> Measurement</td>
</tr>
<tr>
<td><strong>10:45-11:00</strong></td>
<td><strong>Large Group</strong> (songs/read-aloud)</td>
</tr>
</tbody>
</table>

Observation Sheet

<table>
<thead>
<tr>
<th>Date: ______________</th>
<th>Tuesday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>9:00-9:30</strong></td>
<td><strong>Morning Launch</strong></td>
</tr>
<tr>
<td><strong>9:30-9:45</strong></td>
<td><strong>Small Group:</strong> Geometry &amp; Spatial Sense</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:45-10:45</td>
<td>Learning Centers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patterns</td>
<td></td>
</tr>
<tr>
<td>10:45-11:00</td>
<td>Large Group (songs/read-aloud)</td>
<td></td>
</tr>
</tbody>
</table>

Observation Sheet

Date: _______________                     Wednesday

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00-9:30</td>
<td>Morning Launch</td>
<td></td>
</tr>
<tr>
<td>9:30-9:45</td>
<td>Small Group: Measurement</td>
<td></td>
</tr>
<tr>
<td>9:45-10:45</td>
<td>Learning Centers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Numbers &amp; Operations</td>
<td></td>
</tr>
<tr>
<td>10:45-11:00</td>
<td>Large Group (songs/read-aloud)</td>
<td></td>
</tr>
</tbody>
</table>
Observation Sheet

Date: ______________  Thursday

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00-9:30</td>
<td>Morning Launch</td>
</tr>
<tr>
<td>9:30-9:45</td>
<td>Small Group:</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>9:45-10:45</td>
<td>Learning Centers</td>
</tr>
<tr>
<td></td>
<td>Geometry &amp; Spatial Sense</td>
</tr>
<tr>
<td>10:45-11:00</td>
<td>Large Group</td>
</tr>
<tr>
<td></td>
<td>(songs/read-aloud)</td>
</tr>
</tbody>
</table>