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KINDERGARTEN MATHEMATICS:

THE EXPERIENCES OF CHILDREN IN GUIDED MATH GROUPS

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Abstract

This qualitative research study examined the observed and reported experiences of teaching mathematics to kindergarten children using guided group instruction. The focus of the study was early numeracy and number sense skills. The 13 participants were taught mathematics in small guided group format. I met with each group of students between one and two times a week. The students were monitored for skill development in the areas of counting, number identification, and comparing quantities. This study discusses the development of the monitored skills through the analysis of student achievement on weekly assessments. The findings further discuss the successive development of student achievement in mathematics. The small group instruction focused on engagement, connections, and communication.

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Researcher Stance

It was 22 years ago when I fell in love with my kindergarten teacher. I knew from the first day of kindergarten that I wanted to be a kindergarten teacher just like her. I vividly remember the wall in the classroom that was titled "The Wall of Fame" display board. One day we were asked to draw a picture of what we wanted to be when we grew up. That was easy, a kindergarten teacher just like Mrs. Chomik. I still have my drawing today and I can see precisely where it was hanging in the classroom in 1987, the second row from the bottom, third one in from the left. I drew myself with short brown hair wearing a white dress, just like Mrs. Chomik. Little did I know that in 2004, my dream of becoming a kindergarten teacher would come true.

Throughout my educational journey, I was passionate about being an educator. The elementary and middle school years of my education were memorable and enjoyable. As I entered high school, I began to think more about my future and my goals. I loved school and my teachers. I loved learning and reading. I even was fond of math. It was not my favorite, but I did not loathe it. In September of 1997, my choice and viewpoints were challenged when I began my sophomore year of high school. I always was on the honor roll, but had to work hard to keep good grades. Mathematics was beginning to become difficult. I came to a roadblock my sophomore year of high school when I entered geometry class. I struggled. Equations and theorems were challenging. It seemed that everyone

was successful except for me. I was too afraid to ask for help. I completed the class and was left with a fear of mathematics.

My goals nine years ago were focused and direct. I entered college declaring a dual major in Elementary Education and Special Education. I felt that I owed my future students and myself the essential background and knowledge that would allow me to meet the needs of all students that I will someday educate. Inclusion and Special Education were becoming the focus of many school districts mission and belief statements. I chose to take the path that I felt would be most successful. In the back of my mind, right through college, I never wanted anything to do with mathematics. I took the courses I needed and never went above and beyond the requirements to challenge myself mathematically.

Looking back at that particular experience, my entire educational journey, and now my profession, I made my decision. As a kindergarten teacher, I want my students' first experience with math to be enjoyable. With the exception of participation in preschool programs, a child's beginning into the educational world is in kindergarten. Each child is unique and has had a variety of life experiences. I want my kindergarten classroom to be the foundation for my children to make connections with new learning, to ask questions, and to make discoveries as they explore their likes and dislikes. Most of all, I do not want my students to feel afraid or have that fear of failure.

Mathematical concepts that are introduced at the kindergarten level provide the groundwork for all math teaching. Math concepts develop upon one another. Building upon the base knowledge is the starting point for these early learners. Students who have a grasp of number sense will be able to apply the use of numbers in multiple contexts in more than one way, leading to mathematically based decisions. If the base is weak, the structure upon it will be unstable.

The guided reading model that is used to teach children how to read became my inspiration. Guided reading is a teaching strategy used with all readers, struggling or independent, to meet their varying instructional needs, and to teach them to read text with comprehension and fluency. Children's literacy and fluency skills develop differently. Mathematical knowledge also develops at different rates. As an action researcher, I began to research ways I could teach the basic foundation of mathematics to meet the varying levels of my students. I examined models similar to the guided reading process and made connections to the mathematical processes.

The daily journey I take as a Kindergarten teacher and action researcher can be associated with putting together an elaborate jigsaw puzzle, connecting all the pieces of data, various perspectives, and interpretations into one model for teaching kindergarteners mathematics. The interesting, powerful, and engaging attributes of kindergarten children have shaped my inquiry process.

> A primary responsibility of educators is that they not only be aware of the general principle of the shaping of actual experience by environing conditions, but that they also recognize in the concrete what surroundings are conducive to having experiences that lead to growth. (Dewey, 1997/1938, p. 40)

I believe it is important to know what the effects of teaching mathematics through the use of a guided reading model will have on building a solid foundation of mathematical skills. From these beliefs and wonderings the following question has developed: **What are the observed and reported experiences when I teach mathematics to kindergarten children using guided group instruction?**

Literature Review

Introduction

Mathematics in kindergarten should provide opportunities for discovering, thinking, talking, connecting, and problem solving. In order to meet all of those needs, it is important to understand the development of kindergarten children and their early numeracy skills. Connections between mathematics and literacy and specific teaching strategies can accomplish a solid foundation for learning. Engaging young children cognitively in learning activities is an imperative aspect of mathematic instruction, which will result in a positive learning environment with early achievement.

Kindergarten

Gifford (2004) believes that to effectively teach kindergarten children mathematics, we need to understand how young children develop their numerical abilities cognitively, physically, emotionally, and socially. These learning experiences in the numerical world become the foundation upon which the classroom teacher connects new learning, one key aspect of early mathematical teaching (Gifford, 2004; Murray, 2001).

Cognitive ability. The Pennsylvania Department of Education (2007) is committed to establishing high academic for all students pre-K through grade 12. Research-based standards are the key to laying a solid academic foundation that will provide children with the skills necessary to thrive in every phase of their

lives (The Pennsylvania Department of Education). The learning standards guide teachers' deliberate and intentional instructional practices. They support effective classroom environments and frame teachers' age-appropriate expectations for their students. Research has shown the value of active learning for both cognitive and social development (The Pennsylvania Department of Education). "Kindergarten children learn key skills of literacy, numeracy, and social problem solving through shared exploration and interaction with their environment in a naturalistic fashion" (The Pennsylvania Department of Education).

Macmillan (1990) seeks to show that children in their first year of school, kindergarten, can be guided to be aware of their own mathematical thinking. A varied approach that centers on the conceptual state and psychological needs of the child was researched through Vygotsky. "The development of the psychological foundation for instruction in basic subjects does not precede instruction but unfolds in a continuous interaction with the contribution of instruction (Vygotsky, as cited in Macmillan, 1990, p. 14). Through the research, the teaching of mathematics is emphasized by having the learner be given a strong sense of having control of his or her learning. Mathematical knowledge is perceived as being personally constructed and applied according to principles internalized by the learner. It was found that by delicately exploring a child's thought process, it is possible to gain the particular characteristics of each child's conceptual world of mathematical thinking.

Cognitive ability is not a fixed perception and is receptive to intervention at an early stage on the learning continuum. Malabonga and Pasnak (1995) researched and concluded that a group of kindergarten students showed significant greater cognitive gains when instructed in seriation, putting things in a series, and classification, classifying objects into groups, when compared to a control group instructed on academic subjects. The intervention group displayed cognitive improvement with instruction. These students did not remain static on the learning continuum.

Similar findings were found in a previous study done by Pasnak, Holt, Campbell, and McCutcheon (1991) who worked with kindergarten students in small groups of 5 children. They focused extensively on classification and seriation instruction. This resulted in significant cognitive gains. "The progressive development of concrete operational thought throughout the elementary school years involves many other abilities, but classification, seriation, are probably the key mental *operations* at the outset" (p. 5).

Kidd, Pasnak, Gadzichowski, Ferrel-Like, and Gallington (2008) comment on how kindergarten children enter school with key reasoning abilities that will promote success, however some children do not.

> Many mathematics concepts and skills require children to draw upon early abstract abilities, including the oddity principle, insertions into series, and number conservation. The oddity principle is the ability to identify the

> only item in a group that differs from all others on some dimension. Children who have not mastered the oddity principle may have difficulty learning basic kindergarten skills. For example, kindergarteners are expected to differentiate among a penny, nickel, dime, and quarter; sort and classify objects according to similar attributes (size, shape, color). (p. 166)

Developmental ability. The developmental readiness of kindergarten children requires quality experience during these early years. Young children are interested in games and activities that are rich with potential for mathematics. Seo (2003) believes that kindergarten children learn and do mathematics during play.

> Kindergartener's play often involves—at least implicitly—mathematical ideas, such as *classification* (a girl puts blocks away in categories), *magnitude* ("This isn't big enough to cover the table"), *enumeration* (a boy says, "Look! I got one hundred!" and he and a friend count to check his estimate), *dynamics* (a girl makes a flat, circular shape out of dough), *pattern and shape* (a boy builds a symmetrical structure with blocks), and *spatial relations* (a girl offers a location or direction). (p. 38)

By observing the interactive children, this allows the teacher to reach each individual child at his or her present level of understanding. Interactive play and exploration of manipulatives creates memorable experiences that will help the transfer of learning into long term memory (Murray, 2001).

Teaching Strategies

Wight (1989) investigated children's mathematical thinking through understanding children's mathematical methods and paths along which children's mathematical knowledge develops. The purpose was to extend a theoretical model of children's progression from the perceptual to the abstract concept of number. The method used was a constructivist teaching approach, an exploratory tool. It involved experimenting with ways to influence children's counting knowledge. The types of sequence counting represented a progression from greater to less dependence on sensory experience. Children who count perceptual items can only count in their sensory field (kinesthetic, visible, or auditory), and children who count motor unit items might focus less on sequentially raised fingers when counting. Learning is a process of active participation and cannot be transmitted ready-made from the teacher to the learner (Wight, 1989).

Small group instruction. Wadlington and Burns (1993) examined specific math practices utilized by teachers in gifted preschools and kindergartens within the United States. Results indicated that most teachers used unstructured activities (discovery learning, learning centers) in small groups when providing math instruction. Research says to differentiate, match learning opportunities for each child's unique abilities, interests, and stages of development.

Grouping of children for their early years of development in mathematics will be beneficial to their social, emotional, and cognitive development. Gifford

(2004) believes small group instruction will foster positive attitudes that will lead to safe risk taking and provide effective emotional and cognitive support, whereas large groups may reduce the learning focus.

Guided math. Blanke (2008) discusses that guided math is a diverse instructional strategy that meets the needs of individual learners through a structured, practical way of teaching math instruction. Guided math provides opportunities for children to participate in guided group instruction where the teacher tailors mathematical learning experiences through modeling, prompting, and asking genuine questions. The goal of guided math is to provide a foundation for being a "lifetime mathematician" (p. 7).

Guided math sessions can be conducted at a table or on the floor. The teacher meets with guided math groups 2 or 3 times a week preparing ongoing lessons and assessments carefully to provide appropriate support and challenge to each learner in the group (Blanke, 2008). These small group sessions provide personalized opportunities for student success.

Early Math Skills

Early math skills, for example number sense is based on interactions with the environment and between parents and siblings. Children's mathematical learning relies on opportunities to describe and explore relationships among objects, materials and active manipulation.

Number sense. Good number sense means that a child can move seamlessly between the real world of quantities and the mathematical world of numbers and numerical expressions (Gersten & Chard, 1999). Students who have a solid understanding of number sense can be observed using numbers in multiple contexts in more than one way, while simultaneously making mathematical based decisions.

Rowland (2008) expresses that purpose and design are the central role of math pedagogy. Evidence from research indicates that teaching mathematics in the elementary years requires a solid foundation of number sense. The development of number sense is an essential tool for students to develop higher order thinking skills.

Chard, Clarke, Jungjohann, Davis, and Smolkowski (2008) examined the development and feasibility testing of a kindergarten mathematics curriculum designed to focus on the development of early number sense, geometry, measurement, and mathematics vocabulary. They reported that mathematics differences among children in kindergarten are dramatic and may be difficult to notice, unless they are looked for specifically. Another extreme with children entering kindergarten is they do not have an understanding of quantities. This is why number sense is a key skill that leads to automatic abilities to solve basic arithmetic problems. Well-constructed math programs accompanied with key teaching strategies can lead to fluency and automaticity.

Foundational skills. Foundational math skills need to be taught in a multidimensional (Murray, 2001), multi-sensory (Gifford, 2004) approach, where activities are thoroughly chosen to provide the students with opportunities to connect numerous skills to one another (Seo, 2003).

DiPerna, Lei, and Reid (2007) investigate and provide researched-based data concluding that during their Early Childhood Longitudinal Study on the foundational skills of mathematics, kindergarten children who acquired number identification, one-to-one correspondence, counting, and grouping have provided a foundation for future academic success. There are three dimensions to classroom competencies that contribute to early academic success. The first is general classroom competency that includes social, motor, and emerging mathematics and literacy skills. The second dimension requires the ability to stay on task, persist in difficult activities, cope with frustration, and ask for assistance. The final dimension is interpersonal classroom behavior. Children need to have positive classroom behaviors when interacting with peers.

Seo (2003) describes that children should explore foundational skills through play. By allowing children to play, mathematical skills of symmetry, geometry, comparison, sorting, patterning, counting, recognizing quantities, number recognition, putting objects together, and taking them apart can be easily addressed. Gifford (2004) recommends designing instruction that can foster building a child's mathematical self-esteem to allow for the development of

connections to home and school. Children should have opportunities to explore new ideas with their peers in small groups and pairs.

Mathematics in Kindergarten

Readiness skills in mathematics vary from child to child. The experiences that children bring with them to kindergarten create a continuum of skills and developmental levels. Mastin (1996) believes that mathematics teaching and learning should relate to the real world and be integrated into other subjects. Encouraging mathematical thinking, application, problem solving, and the use of language to express ideas is considered to be a strong, solid foundation for developing mathematical skills at the kindergarten level (Mastin, 1996).

Bryant, Bryant, Kethley, Kim, Pool, and Seo (2008) examined kindergarten children who were at risk for mathematics difficulties, and concluded that they must receive mathematics instruction that include critical features of effective instruction that employs small group instruction with the use of manipulatives. Given the resources to identify children who are at high risk for difficulties, educators need to be cognizant in designing effective core instruction for the at-risk children.

Communicating and connections. Cooke and Buchholz (2005) focus on the informal strategies used by kindergarten teachers that promoted the use of math language. The strategies were identified during a three month observational period used in a classroom of low-income children who were predominantly

African-American. The National Council of Teachers of Mathematics (NCTM, 2000) states communication as an essential part of mathematical education. The standards of NCTM (2000) indicate that communication is one of the five process standards. Young children need to communicate their mathematical thinking to their peers and teachers. The kindergarten teacher who conducted the study on mathematical communication in the classroom had a class size of 20. The teacher used six informal strategies to enhance the students' use of math language: providing opportunities for self-expression informally; serve as a facilitator during center time; provide opportunities for students to connect new understanding to prior knowledge; connect administrative tasks/classroom routines to mathematics; ask a variety of questions; and encourage the use of appropriate math terms. Interactions with students send powerful messages that convey a sense of importance and belonging. Encouraging math language and creating a comfortable and inviting classroom environment encourages interactions among the students.

Children come to school with a variety of experiences that can be related to mathematics. Teachers need to offer opportunities for young children to make connections between new and prior math experiences. "Encouraging children to discuss and share ideas can enhance the assimilation of new and old experiences as well as facilitate the use of appropriate, informal mathematical communication" (Cook & Buchholz, 2005, p. 369).

Math can be fun for young children and rewarding if it is based on personal experiences. Price (1994) discusses how to make math fun and rewarding for young children through personal experiences. Price, a kindergarten teacher in Orlando, Florida, emphasizes how presenting math to kindergarten children should be done in a way that allows for students to relate the material to their own lives. The National Council of Teachers of Mathematics Curriculum and Evaluation Standards indicate a need for more real-world problems. Students are motivated by what affects them and their world.

Liedtke (1997) discusses the important components of mathematical power: thinking, talking, connecting, problem solving, self-confidence, flexibility, perseverance, and inventiveness. Liedtke (1997) discusses each component of mathematical power and how it influences the young learner mathematically. He expresses everything is possible, mathematical ideas grow slowly, and connecting is considered the key component of mathematical literacy. A major aspect of Leidtke's research is environment. Children need to be able to foster problem-solving abilities where experiences will be remembered if they produce pleasurable reactions.

Mathematics and Literacy

Research has demonstrated that children's literature can motivate students, connect mathematics to emotions, and provoke interest to provide children with a meaningful context for learning mathematics (van den Heuvel-Panhuizen & van

den Boogaard, 2008). Using big books and poems that have a mathematical foundation allows for concrete connections to be established. Gifford (2004) encourages the use of think alouds in math. This is a strategy often used in literacy and can establish positive connections to enrich math knowledge and speaking skills. Entering into the world of mathematics and literacy with kindergarteners can deepen their overall learning and construct mathematical knowledge.

Summary

A powerful opportunity exists for every teacher to contribute to the achievement of higher levels of thinking and the construction of meaning. Positive influences throughout instruction encompass a variety of techniques and behaviors. Instruction is one of the principal sources of children's mental development. An educator's job is to realize the unique nature of a child and engage in a partnership with children to recognize the fine details of each child's learning styles.

The cognitive abilities of kindergarten children, when teaching mathematics, is emphasized by having the learner be given a strong sense of control of their learning. By examining the different kindergarten classroom characteristics and instructional dimensions, experiences should provide learning opportunities for each child's unique abilities, interests, and stages of development. Small group instruction can foster the development of early math

skills. The use of strategies to enhance the students' experiences and use of math language is an integral part of mathematics in kindergarten. Strategies should provide opportunities for self-expression and for students to connect new understanding to prior knowledge.

"It is not enough to insist upon the necessity of experience, nor even of activity in experience. Everything depends upon the *quality* of the experience which is had" (Dewey, 1997/1938, p. 27). Dewey, the great educational theorist, views education through quality. The attributes that Dewey wants us to know is that the quality of the educative experience will have an impact on future experiences that may be positive or negative. The goal is to make all experiences positive for children to recall in the future when making choices that will have an immediate effect on their decisions. Dewey wants immediate and enjoyable educative experiences to promote "desirable future experiences" (Dewey, 1997/1938, p. 27). Quality not quantity is what matters in educational experiences. Children should have opportunities and experiences that are worthwhile for their future. To see them make connections and delve deeper into their thinking, allows them to feel successful.

"The main purpose or objective is to prepare the young for future responsibilities and for success in life, by means of acquisition of the organized bodies of information and prepared forms of skill which comprehend the material of instruction" (Dewey, 1997/1938, p. 18). Dewey's stance reflects that educators

are preparing students for higher education and for success in making choices that will shape their future.

Children bring a variety of readiness levels and experiences to school. It is the educator's mission to guide them on the journey.

Methodology

Introduction

In order to increase the development of foundational math skills, my teacher action research study focused on teaching mathematics to kindergarten children through guided group instruction. Throughout my study, I provided a curriculum with supportive and flexible instruction for kindergarten children to develop foundational math skills through small group instruction. I implemented a variety of formative assessment tools: student observations, field notes, surveys, and student work. I employed number sense and numeracy activities in a small group (2-4 students) format twice a week for 20 minutes over the course of 14 school weeks.

Guided math is a structured, practical way of teaching mathematics to the diverse individual learners in the classroom. By teaching mathematics to kindergarten children through guided group instruction, my children experienced mathematical activities that led to understanding, problem solving, and mastery of basic skills. There were three major points that guided my study: Support, Provide, and Engage.

- Support my students to make sense of mathematics and learn that they can be mathematical thinkers
- Provide guidance to make mathematical connections
- Engage my young learners in meaningful mathematical activities

My research made clear the foundation of my study. I researched learning trends and instructional practices in kindergarten and elementary mathematics. Small group instruction is an area that I researched to find appropriate strategies for grouping by ability and size. I found that the teaching of mathematics is emphasized by having the learners be given a strong sense of having control of their learning. Learning is a process of active participation and cannot be transmitted ready-made from the teacher to the learner. Mathematics in kindergarten should provide children with opportunities for thinking, talking, connecting, problem solving, and building self-confidence.

Setting

The elementary school in which this study took place was a medium-sized school of 550 students located in a large urban school district in eastern Pennsylvania. The elementary school is located in a suburb of middle and high-class families. The children that attend this elementary school have very supportive and involved parents. Many of the families are involved in extracurricular activities inside and outside of school.

For the purpose of this study, instruction took place in a small group setting in my kindergarten classroom. My instructional approach on a daily basis is to provide developmentally appropriate learning that encourages the growth of children's self-esteem, cultural identities, independence, and their individual strengths.

Participants

There were 13 children that participated in learning mathematics through guided group instruction. My study was conducted with my PM kindergarten children. My data were generated by five female and eight male students. Two students were Hispanic, ten were Caucasian, and one African American.

Procedures

Prior to beginning my teacher action research study, permission was secured from the Chair of the Human Subjects Internal Review Board (HSIRB) (see Appendix A), my building principal (see Appendix B), and the parents/guardians of the students involved in the study (see Appendix C).

During the first week, all participants were given a counting assessment, number identification assessment, and comparing quantities assessment. All tests were scored and recorded. From these assessments, groups were formed by ability. I had advanced, on-level, and strategic intervention levels of children. Groups ranged in size from two to four students. All groups participated in the same activities, and instruction was formatted to fit the level of need for each group.

The following concepts and skills were the fundamental goals for the guided group instruction:

- The students will be able to develop strategies for accurately counting a set of objects by ones up to 20.

- The students will be able to demonstrate one-to-one correspondence when counting groups of objects.
- The students will be able to identify the numbers from 0-20.
- The students will be able to count from 1-30
- The students will be able to identify the bigger number/quantity when given two different numbers or quantities.
- The students will explore math manipulatives and their attributes
- The students will develop language to describe shapes, position, and quantity.
- Students will work in Math Workshop individually or in pairs when guided group instruction is being implemented.
- Students will work with manipulatives during Math Workshop to practice important skills that will help them develop independence and learn to take responsibility for their own learning as they choose activities, keep track of their work, use and take care of materials, and work with others.
- The students will be able to collect and keep track of survey data.

Students were assessed through both written activities and observations. Following each day of guided group instruction, observations were recorded in the observation log with notations made on the group as a whole and on students individually (see Appendix D).

Weeks 1 through 3. The focus of activities the first three weeks was establishing who is absent, counting the students in two ways, recording the data, and making an attendance stick to represent the data. The students were counting the numbers of students in the class. These activities were done with the whole group.

By introducing the attendance routine, this provided regular practice with counting a quantity that is significant to students. By using the children's nametags, we established who was in school. Each child brought their nametag to the rug and the unclaimed nametags represented the children who were absent. We would count around the circle to double-check the count.

During the second week, I introduced the attendance stick. The attendance stick was made with snap cubes of one color and had number stickers to represent each student. To go along with the attendance stick, a chart (see Appendix E) labeled "Attendance" was used to represent the number of students in our class, the number of students here today, and the number of students absent.

The third week we focused on the calendar. Even though we did calendar daily, the focus of the calendar began the third week into the study. Every day we would determine the day of the week and the number. The calendar routine focused on patterns inherent in the calendar and its structure: the counting sequence, seven days in a week, and the repeating cycle of the seven days.

The first three weeks of the study focused on counting and quantities. During whole group instruction, we counted daily and compared quantities using the attendance stick and the calendar. Guided group instruction focused on counting quantities up to 13. We used snap cubes, pattern blocks, and geoblocks to count quantities. Assessments were given in number identification 0-20, counting from 1-30, and comparing quantities. I also gave my students a survey about guided group instruction to acquire their thoughts about numbers and counting (see Appendix F).

Weeks 4 through 6. The students are introduced to the Counting Jar, an activity that asks them to count the objects in a jar and then create an equivalent set. They will play two games in which they match objects that have at least one attribute in common, and use attribute blocks to sort a group of objects.

Throughout these three weeks, the children were introduced to more math manipulatives for counting and grouping. The term “attribute” was introduced. The children used buttons and attribute blocks to learn about how objects are the same and different. They played two games, “Button Match-Up” and “Attribute Block Match-Up.”

Weeks 7 through 9. Students were learning a new part of the counting jar activity (recording the number of objects in the jar) and continuing to count, group, and sort buttons.

Previous activities “Button Match-Up” and “Attribute Block Match-Up” were reviewed and expanded upon. The students sorted buttons and shapes by looking for characteristics that are common. During these three weeks, the children were continuing to write numbers, read numbers, count, and compare quantities. The focus of these activities were to have the students constantly practicing the three main focal points, counting, number identification, and comparing quantities.

Weeks 10 through 12. During these three weeks, I held student interviews (see Appendix G) to gain insight from the students regarding math related skills following guided group instruction.

Weeks 13 and 14. The remaining two weeks of my study, I conducted the final assessments on counting 1-30, number identification 0-20, and comparing quantities. I also gave the students the same survey (see Appendix F) I had given in the beginning of the study to see if their thoughts had changed over time.

Data Sources

Field log. The field log held daily recordings of both group and individual observations during guided group instruction, math workshop, whole group, and assessments. The daily log included specific teacher reflections on observed behaviors as well as daily success of the students. Using a two-column log format, my thoughts and comments were recorded separately from the student observations within the field log (see Appendix D).

Student work. Student work was collected weekly and examined for evidence of skill building. Most of the student work was completed during math workshop and guided group instruction. The majority of student work was with the use of manipulatives and hands-on activities.

Assessment checklists. Student assessments were given three times during the study: the beginning, middle, and end. There was a number recognition assessment, counting assessment, and comparing quantities assessment to measure their growth of early math skills.

Student survey. This student survey was given in the beginning and end of the study to acquire student impressions and insights into developing early numeracy skills (see Appendix F).

Student interview. I conducted student interviews during the last three weeks of the study to gain insight about guided group instruction (see Appendix G).

Triangulation

By using multiple sources of data, this lead to a fuller understanding of my study. Different data collecting techniques allowed me to search and arrange my field log observations, surveys, and student work, which increased my understanding of my student's discoveries.

Trustworthiness

Trustworthiness is a fundamental part of my research study. Subsequent to reviewing Arhar, Holly, and Kasten (2001), I found that as a teacher action researcher, there are many facets of trustworthiness I will ensure while conducting my study. Building a classroom environment on the foundation of respect and trust is the first ingredient of guaranteeing confidentiality. Through the use of principal and parent consent forms, I directly secured those parties recognition of the work I will be conducting and their approval in my pursuit of discovering ways for developing math skills for the children. Participants and guardians were informed that I obtained permission from the Human Subjects Internal Review Board (HSIRB) of Moravian College and received an expedited review of my study.

I involved my kindergarten participants by explaining to them that I am in college and need their help in completing a very important project. I assured the children that my goal is for them to be successful, and perfection is not necessary. Learning and asking questions are the goals that we will accomplish together as a team.

I was conscientious in ensuring confidentiality. I openly communicated to the children that what thoughts are shared with me are confidential, unless the information is concerning (such as abuse) and needs to be reported to the principal, guidance counselor, or nurse.

Student anonymity was secured through the use of pseudonyms. Each student was given a pseudonym for the use in my final presentation. All of the data that I collected throughout my research study was kept private and locked away in a secure location both during and after school hours. At the conclusion of this study, all data were destroyed.

I clearly informed my participants and their guardians of their right to withdraw from this study at any time. The research project would continue, however I would not include any data in my field log on any non-participants. By not participating or withdrawing, the students will not receive more or less work than their classmates who do participate, nor will their be any reflection on their report cards. Participants and their guardians understood that by signing the consent form, my purpose for conducting this research study was to improve early math skills by differentiating the instruction through the use of guided group instruction.

Building a relationship of trust was another facet I effectively conveyed at all times throughout my research. I expressed to my children that I value their input, questions, and answers. I provided my children with a survey before and after the study to compare the findings. I communicated clearly that I am not always looking for a right or wrong answer, but how they are working, thinking, and problem solving.

Throughout my study, research, and coursework I continued to be a self-reflective learner. I kept a field log where I analyzed my data regularly. By setting up my field log into columns, I was able to distinguish between my observations and my reflections. I was able to portray the evidence of my data with honesty, respect, fairness, and accuracy. After reviewing Hendricks (2006) I analyzed my observational data and field log to develop a coding system to find patterns and regularities throughout my data by designing categories of words and phrases (Bogdan & Biklen, 1998). I continued to code my field log of participant observation entries, student work, surveys, and assessment checklists. Through the triangulation of data, I was able to corroborate my data by looking at other sources of my data collection to support further evidence of the increase or decrease in student achievement. In the end, I prepared an alphabetized index of my codes, indicating log page numbers and codes that were closely related (Bogdan & Biklen, 1998). I designed a graphic organizer that visually displayed my codes in titled bins (Bogdan & Biklen, 1998). I formulated single-sentence theme statements that correlated to my bins. Each statement was supported by my data in my field log. Through discussion with my research support group members, I gained insight and made connections to the findings in my data. Being part of a teacher research support group, allowed me the opportunity to gain knowledge from others in areas of struggle that occurred throughout my study (MacLean & Mohr, 1999).

I made sure that my research did not get in the way of my classroom duties. I identified and labeled any biases that arose throughout my research to prevent any misinterpretation of my findings (MacLean & Mohr, 1999). This included my own cognitive limitations in mathematics. I maintained an accurate field log of my students on a regular basis, regardless of positive, negative, or indifferent experiences to maintain my trustworthiness. I wanted to denote the accurate story of my experience as a teacher action researcher.

Trustworthiness is a reminder to be an educator first. Throughout my journey, I remembered to stop and ask myself questions concerning trust. I want my children to have educative experiences that are prolific and creative. Dewey (1997/1938) depicts experience through education with the following:

> A philosophy of education, like any theory, has to be stated in words, in symbols. But so far as it is more than verbal it is a plan for conducting education. Like any plan, it must be framed with reference to what is to be done and how it is to be done. The more definitely and sincerely it is held that education is a development within, by, and for experience, the more important it is that there shall be clear conceptions of what experience is. (p. 28)

Summary

In order to increase the development of foundational math skills in a group of kindergarten students, my study focused on teaching mathematics through guided

group instruction. In this study, the students become familiar with the expectations for learning mathematics. Daily observations and reflections were recorded and analyzed in order to identify a common theme. Progress monitoring tools were used three times over the course of the study to provide levels of skill growth. Student surveys and interviews were given and examined to help gain insight into student feelings concerning the efficacy of guided group instruction.

My Story

Introduction

Beginning any new adventure is intimidating. There is the trepidation of the unknown. As I began this journey, I began to wonder. *Would I be able to gather enough information to generate a story worth telling? Would I discover new ideas worth reporting?* With my clipboard in hand and math manipulatives strategically placed all throughout the classroom, I welcomed my children to Math Workshop. Seated on the carpet with them, I explained that I am going to be working with them almost every day doing math activities. I further explained that we are going to be working together in math groups similar to what we do in reading groups. I detailed that I will be taking notes about what they are doing, but it was only for me to know what they needed help in or how well they were progressing. I also explained to the children that I have a letter for their mom, dad, or guardian to read about math groups. After informing the children, they eagerly put my letter into their folder to be signed.

Setting Up the Mathematical Community

There was much on my mind as the school bell rang and a new set of five and six year old children gathered in front of me. I wondered, *Who are these students? What new adventures await us? Will I be able to excite their imaginations and their quest for knowledge and independence? How will I meet their needs socially, academically, and cognitively? What will be our successes*

through my study? What will be our biggest challenge? As I took a deep breath and began my greeting, one thing was for sure, I had felt these feelings before; no matter how long I have been a Kindergarten teacher, I know the days ahead will be full of bursts of success, some frustrations, and enlightenment for both myself and my students.

By creating a classroom culture that allows students to share ideas, listen to, and learn from each other is how I captured my students' natural curiosity, and set expectations that everyone has a role in our classroom discussions. Creating a math community in kindergarten was challenging, but rewarding. I developed a discussion format that allowed me to include and validate all of my students' ideas. This was essential while working in guided group instruction. This idea of having a whole group discussion was fundamental in helping students to communicate their own mathematical thinking. This communication piece was a big part of helping my students see themselves as mathematicians and as becoming a community of learners.

Circle Time

Circle time begins our day in kindergarten. This is where we talk about the calendar and attendance. The children gather on the carpet and participate in conversation about numbers and counting. We are typically sitting in a circle to ensure that all of the students are able to see the calendar and each other.

Calendar routine. I could tell that this group of children was eager to share what they knew about numbers. The calendar is a focal point in the Kindergarten classroom, as many students are familiar with it from their work in preschool. Students chimed right in as I sang our Days of the Week song and were raring to tell me what number they thought was showing on the calendar for today. I had barely taken the reins, and we were off and running at full speed. When I asked the students what they noticed about the calendar, many seemed energized by the question. Some were shouting out answers, others were eagerly waving their hands in the air, while still others seemed silenced by all the commotion around them.

"I see letters and numbers on the calendar," said Emily.

"My birthday is in September," said Samantha.

"My Mom writes important messages on the calendar," said Timothy.

"Halloween is coming soon," said Nate.

"I see a 8," said Ricky.

"I have a calendar at my house," said Ashley.

"I just turned 6 on the Saturday," said Kira.

"I had fun at your party," said Cathy.

This conversation was spontaneous and I loved the ideas that were being generated. My students seemed so alive while talking about numbers and the

calendar. I use the calendar routine as a time to focus on helping students build relationships with each other and engage in mathematical thinking and learning.

I model how the routine works and then I select one helper per week to facilitate the routine for the class. Each day that helper leads the class in our Days of the Week song, and then determines which number comes next on the calendar. By having the calendar helper, the students come to anticipate that they will each get a turn and to recognize that they are expected to participate. The verbally precocious students learn to share the stage. The more reserved students learn that they are expected to take a turn, and that I am there, along with their classmates to support them if they are hesitant or confused. Over time, the familiarity of the routine helps ease the minds of those who are anxious.

Working with the calendar may seem simple, but it is an important first step for setting a tone of inclusion, respect, and responsibility. The dialogue that begins during calendar helps students learn that we will be talking a lot about numbers and math concepts.

Taking attendance. Every morning following the calendar routine we began counting the students in our class to determine how many students came to school today. I explained to the students that they needed to carefully look around our circle. *These are the people in our class this year. This is called taking attendance. Some days you might not come to school, because you are sick or on vacation. Every day we will need to figure out who is here and who is not here.*

Why do you think it is important for us to take attendance everyday?

"To make sure all the kids are here," said Nate.

"I know! To see how many girls and boys are here," said Jackson.

"Because you have to let the office know and then the person calls their mom," said Samantha.

I complimented the children on their answers and encouraged the children to think of a way we can figure out how many children are in school today? All the children answered with "counting." I modeled how we count around the circle and say one number as you point to each child. As I modeled, the children joined in and counted along. Everyday we labeled our *Attendance Chart* (see Appendix E).

Counting the class helps students develop strategies for counting accurately. Counting as a group often helps students go further in the counting sequence than they would go on their own. Because counting is quite complex, it involves the interplay between a number of skills and concepts.

During attendance, the class found that 13 students are present. They double-checked by counting around the circle. When Bobby looked puzzled that his number was different than his age, I helped everyone make sense of what was being counted and what the numbers meant (see Figure 1).

"I am not 7, I am 5!"

Miss Smith: We found that there are 13 children in school today. When we count things, it is a good idea to count again as a way of double-checking. One way we can double check is by counting. Here is how it works: The first person says "one" and the next person says "two."

Noah: And the next person says "three."

Miss Smith: Yes, the next person will say three and that will tell us that three people have already counted. Let us try it. Kira, you start and be the first one to say a number.

Kira: "One!"

Samantha: "Two!"

Tanner: "Three!"

Miss Smith: How many people have we counted so far? How can we tell?

Kira: "One, two, three (points to herself and her two neighbors). You just count them.

Miss Smith: "Great!" Jackson you are next.

Jackson: "Four!"

Cathy: "Five!"

Miss Smith: "Now how many people have we counted?" A few children call out five.

Ashley: "Five!"

Andrew: "I am five, too!" (He held up five fingers).

***Miss Smith*:** "Yes, you are 5 years old. Lots of people are 5 in our class. Sometimes numbers tell us how many years old people are and sometimes they tell us how many of us there are. When Andrew said five, it was because five people were counted so far. Let us continue counting on from five."

Noah: "Six!"

Bobby: "Seven! I am not seven, I am 5 years old."

***Miss Smith*:** "Yes, Bobby you are 5 years old! In fact, how many people are 5? Many of us are 5 years old in our class. We will count how many are 5 later. Who can explain to Bobby why he said the number seven?"

Kira: "It is because we counted seven people. See, I am one, but I am really 5 years old too. (She gets up to count each person in the circle). He is two, and she is three, four, five, six, and you are seven!"

At that point, I decided to let Kira continue to point to the students as they counted around the circle. Kira is a confident counter and understood the meaning of counting around the circle.

Timothy: "Eight!"

Nate: "Nine!"

Emily: "Ten!"

Andrew: "Eleven!"

Ricky: "Twelve!"

Ashley: "Thirteen!"

Figure 1. Drama: Counting around the circle.

Meet the Mathematicians

I would like to introduce the kindergarten children who began this journey with me:

Excited Emily--excited and smart, this sweet girl seemed ready to burst at the seams with answers and was always full of questions.

Rowdy Ricky--young and active, this boy is all about play and telling stories.

Bubbly Bobby--capable, but not always on task. Needs lots of attention and extra time.

Tenacious Tanner--loud and boisterous, very demanding, but has a smile and big brown eyes that make you melt.

Social Samantha--talkative and full of energy. Samantha wants to be the center of your world and loves to be called "pretty princess in pink."

Nifty Nate--genuinely nice and helpful, and always willing to help others.

Controlling Cathy--constantly wanting to take control of the situation and always has to be the first one to answer questions.

Timid Timothy--patient and hardworking, however, unsure at times and difficult to understand due to articulation deficits.

Kind Kira—smart and genuinely nice, always willing to work with everyone.

Needy Noah--smart, sweet, but craves attention, often would shut down if I was not paying attention to his need or want at his moment.

Awesome Andrew--always smiling and eager to lend a helping hand to his classmates.

Adorable Ashley--shy, sweet, and smart

Jumping Jackson--loud and always on-the-go.

These children were ready to begin their numeracy skill-building journey and take their mathematical knowledge soaring to new heights.

Math Workshop

Math workshop provided an opportunity for the students to work on a variety of activities that focused on the mathematical concept being taught and reinforced. Math workshop is not sequential. As my students moved among the activities, they continually revisited the concepts and ideas they were learning. By repeatedly working with manipulatives, my students were able to refine their problem-solving strategies, use numbers in different contexts, and bring new knowledge to familiar experiences. I designed math workshop to provide time for myself to engage in guided group instruction to teach and assess student learning and understanding on an individual or small group basis.

I designed math workshop to help students develop independence and learn to take responsibility for their own learning as they chose activities, kept track of their work, used and took care of classroom materials, and worked with

others. Students varied in the amount of structure and direction they needed as they freely explored the materials. I felt that by asking questions I provided an effective way of guiding and structuring free exploration for the students. This extended their thinking about particular materials and led them to discover new things. Inviting the students to share their constructions and designs was a natural way for them to exchange ideas with each other.

Pattern blocks: What are they? Pattern blocks are six geometric shapes: yellow hexagons, orange squares, red trapezoids, green triangles, blue rhombuses, and tan rhombuses. The pattern blocks are related in a variety of ways. Each block, except the trapezoid, is a regular shape; the length of every side is equal. As the students used the materials week after week, they began to notice some of these relationships. All of the students became familiar with the names of the pattern block shapes, such as the square, triangle, and hexagon. Because all pattern blocks of the same color are the same shape, it was very natural for the students to identify them by color. This was their way of identifying and distinguishing the blocks.

An interesting dialogue occurred during Math Workshop as the students freely explored pattern blocks. I joined a small group of children working with pattern blocks and asked them to tell me about their constructions (see Figure 2).

Kira: I made a flower. See the red one is the middle, and the flower part is all around with the yellow, and then green triangles are the stem part.

Ashley: Mine is a butterfly. The wings are yellow and the body is blue and the antennas are green.

***Noah*:** Mine is a person. Here is his hat. It's red. And then he sort of looks like he is dancing because these ones, these blue diamonds, are his legs.

Kira: And you used green triangles for his arms and I used them for my flower stem.

Noah: Stop shaking the table! I don't want my person broke.

Ashley: My butterfly looks like a rocket because the triangle antennas look like a rocket taking off.

Noah: Yeah! I am going to make a rocket.

Ashley: Noah, don't copy mine.

Figure 2. Pattern block pastiche.

Geoblocks. We live in a three-dimensional world, yet most of the geometry students do in school concerns two-dimensional shapes. Geoblocks are a special set of three-dimensional wooden blocks. The kindergarten children love to build with these blocks. They built towers, ramps, bridges, castles, and many other things. While the children were working in math workshop, I learned about many things that the children were noticing, such as characteristics they attended to, the relationships they recognized, and the distinctions they made. The excitement that was being generated stimulated me. I heard curiosity in their voices and saw the sparkle in their eyes. The journey was incredible to them. The discoveries that they were uncovering about shapes and numbers was allowing them to make connections outside the classroom environment (see Figure 3).

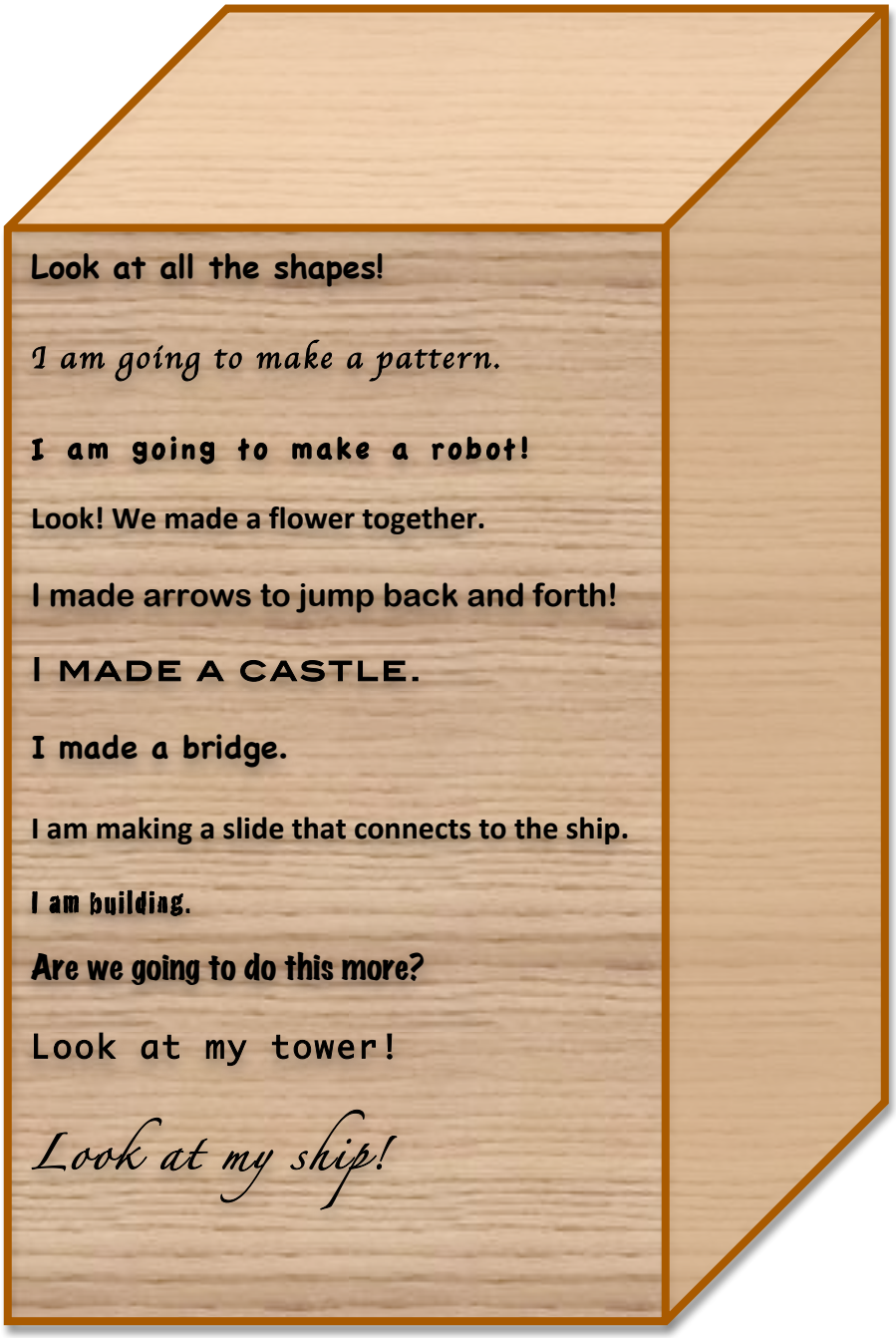

Figure 3. Pastiche of discovery with Geoblocks.

Counting is More Than 1, 2, 3

It is expected to see a wide range of number skills in kindergarten. Before I observed them counting orally, counting objects, and using numerals to record their answers, I asked them one question, *What do you like to count?* Before I could tell them to think quietly, I captured the sight of lightning bolts beaming from their eyes with excitement (see Figure 4).

I can count my fingers.
I have ten.
I have five on one hand and five on my other.

I like to count to 100.

I can count to 32.

I like to count my legos.

I like to count the bears in the counting jar.

I LIKE COUNTING MARBLES.

I COUNT MY HAIR BARRETTES.

I can count by 10's.

I count the letters in my name.

I count the blue diamonds in the jar.

I can count my books.

Figure 4. Counting pastiche.

Counting is the basis for understanding our number system and for all of the number work done in elementary school. The students learned rote counting by hearing others count and by counting themselves. However, just as saying the alphabet does not indicate that a student can use written language, being able to say "one, two, three, four, five, six, seven, eight, nine, ten" does not essentially indicate that students know what those counting words mean. Students need to use numbers in meaningful ways if they are to build an understanding of quantity and number relationships.

My focus was to have the children learn to count through ways that were engaging. Math workshop and guided group instruction were the focal point for the students to engage in counting, number identification, and comparing quantities. The children were using manipulatives to explore and discover numeracy skills.

Guided Group Instruction

In order to teach small groups of children, I needed to attain a baseline of their scores in number identification, counting, and comparing quantities. I assessed the children during the first week, seventh week, and fourteenth week of the study. I graphed their results, and placed them into small groups based on their scores. I grouped the children by strategic level, on-level, and advanced level. The strategic intervention children were going to need more practice and structure to achieve benchmark by the fourteenth week. By the end of the study, my goal was

to have my children counting to 30, identifying numbers to 20, and able to compare quantities of more than and less than.

The scores were varied. During the first week, the *Number Identification Assessment* (see Figure 5) scores showed that 4 students could identify numbers to 10, 2 students could identify numbers to 11, and 7 students could identify numbers below 10.

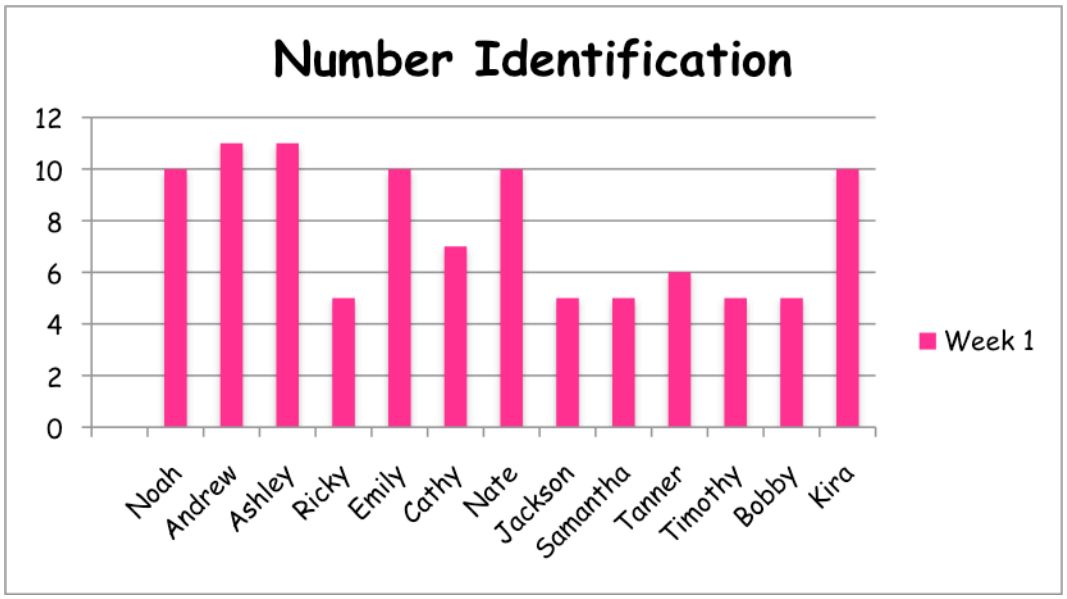

Figure 5. Number identification assessment: Week 1.

In the *Counting Assessment*, 9 children were able to independently count to 10. The remaining 4 children ranged between 5 and 7 (see Figure 6).

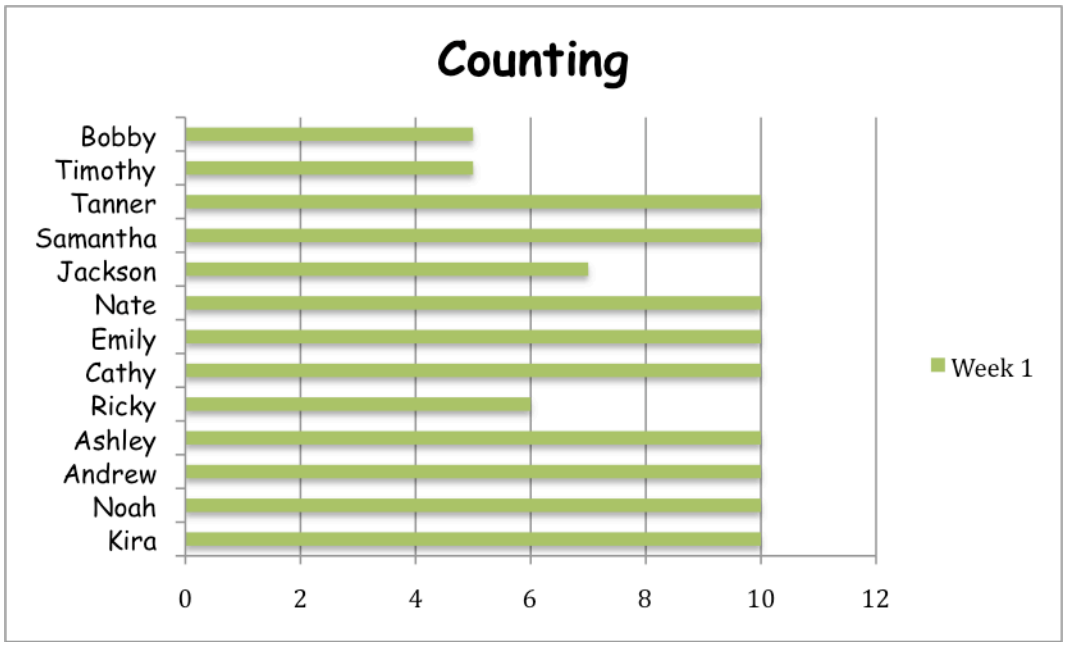

Figure 6. Counting assessment: Week 1.

The last assessment that I conducted in the first week was comparing quantities. I had the students count two groups of objects and show me which group had more and which group had less (see Figure 7). The results indicated that 6 students could accurately tell me which group had less, 7 students could accurately tell me which group had more, and 6 students could accurately complete both assessments. These assessments were done separately.

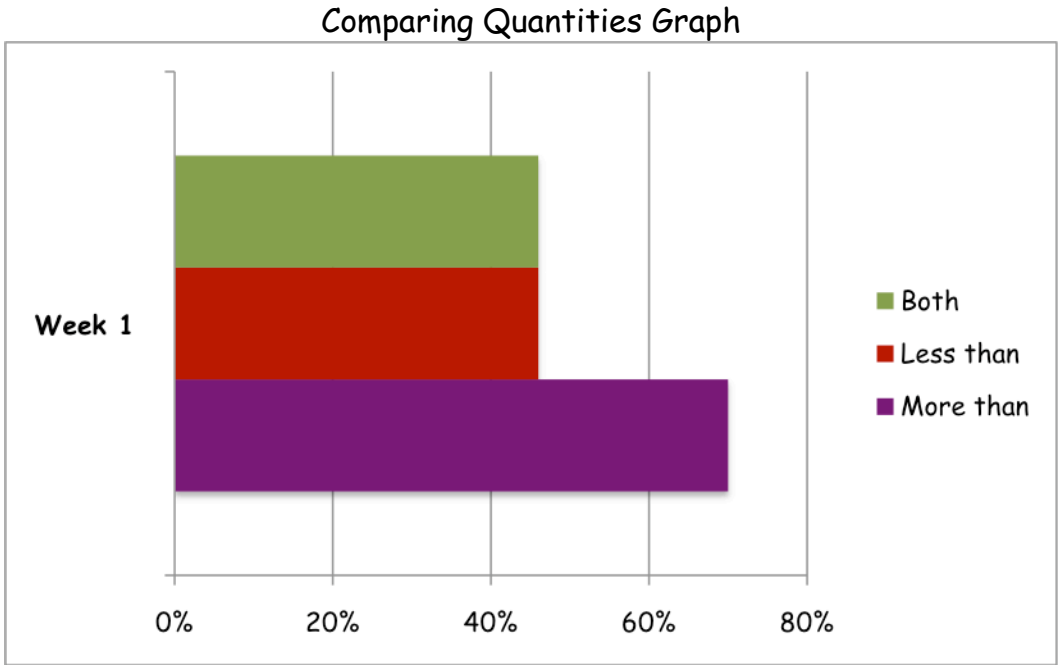

Figure 7. Comparing quantities assessment: Week 1.

My baseline data showed me that my students have varying abilities in number recognition, counting, and comparing quantities. The differing abilities were to be expected, considering that all children enter kindergarten with multiple experiences.

With this information now identified, I was satisfied with the activities that I chose for the children. I had grouped the children into 4 groups. The strategic intervention group was Timothy, Bobby, and Ricky. The on-level groups were Samantha, Tanner, and Cathy and Emily, Noah, and Jackson. The advanced group was Nate, Kira, Andrew, and Ashley. With groups now formed, I was able

to focus on an activity with each group of children. I worked with each group one day a week, except, I worked with the strategic group two days a week.

Counting to 13. The first activities that were my focus were counting to 13. During guided group instruction each week, we worked with geoblocks, pattern blocks, and counting bears to work on our counting skills. With the strategic intervention group, I started off small. We worked with counting groups of 5, counting groups of 9, and finally counting groups of 13. I used a lot of modeling techniques with the strategic group. After I modeled counting, I had the children practice as I listened to them count their groups of 5, 9, and 13. At times I noticed Timothy skipping the number 4 when counting. Also, Timothy experienced trouble organizing his groups of 5, 9, and 13. I was happy to be able to give this group two guided lessons a week versus one.

My on-level groups were counting groups of 13 almost immediately. Through modeling and practicing, the children grasped counting to 13 quickly.

The advanced group of children, Kira, Andrew, Ashley, and Nate, were breaking their groups of 13 into smaller groups. They were showing high-order thinking skills as a team. The children worked together to show me a group of 10 and 3. The children also demonstrated their understanding by showing me groups of 5, 5, and 3. I was very pleased with the progress of all 4 groups. Every group, with the exception of the strategic intervention group was meeting the benchmark of counting to 13 or beyond (see Figure 8).

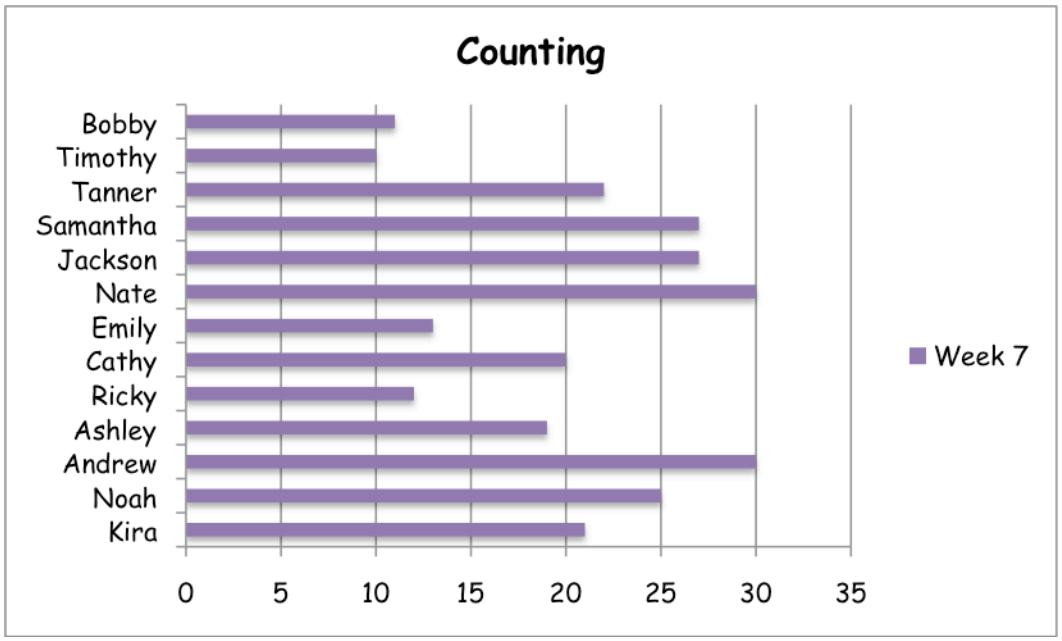

Figure 8. Counting assessment: Week 7.

The counting jar. The counting jar activities focused on all three areas: counting, number identification, and comparing quantities. During guided group instruction, I had a clear jar. Inside the jar I placed a certain number of bears, geoblocks, or pattern blocks. Each child had to estimate the number of objects inside the jar, record his/her answer, and then check the answers by counting. I was able to establish who could accurately count and write their numbers. There were number reversals at times with the 3, 5, and 7. I modeled the correct way to write the numbers using flashcards and student's work to show accuracy. I

recorded the ideas the children were thinking inside the counting jar (see Figure 9).

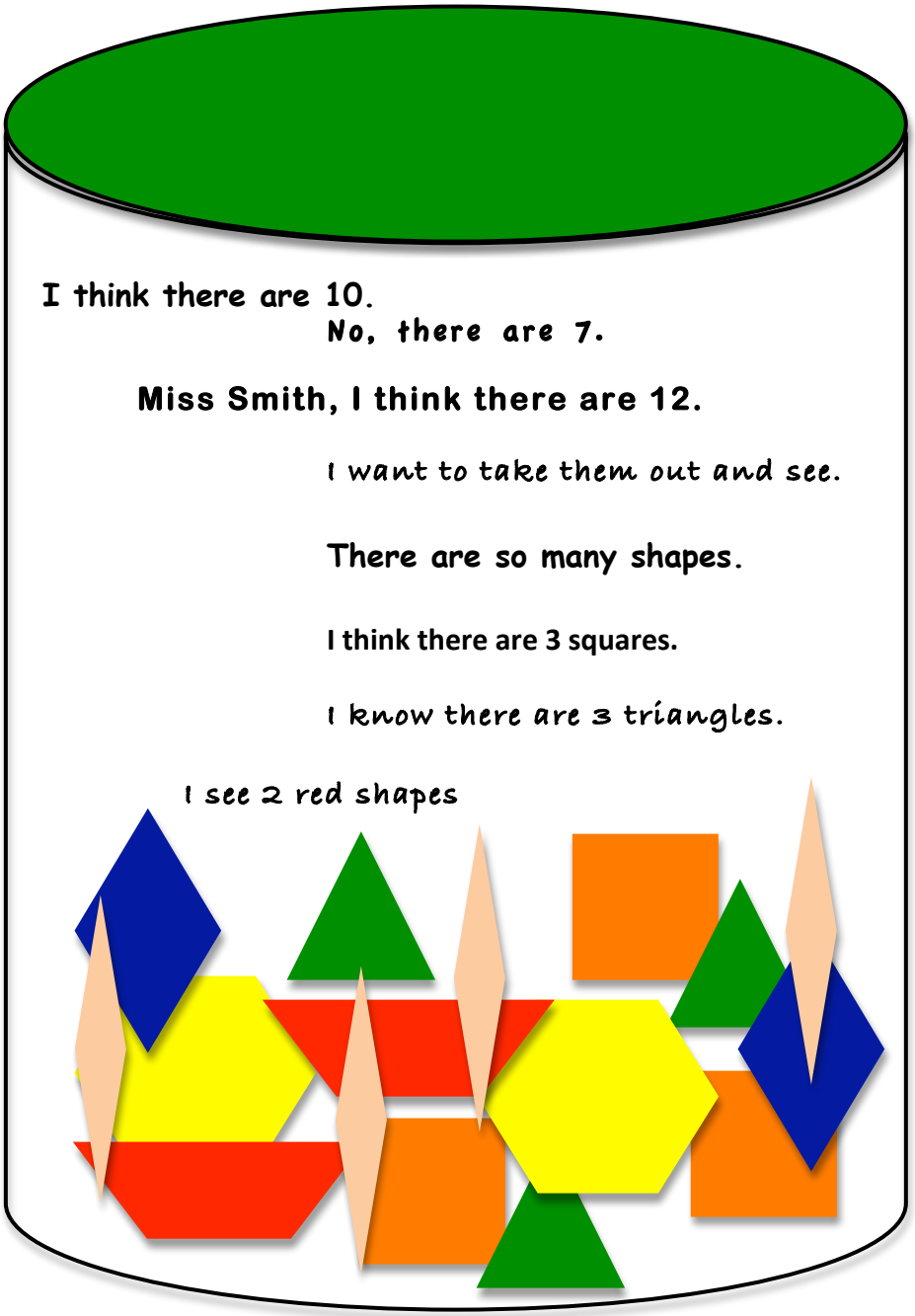

Figure 9. The counting jar.

Some students tried to count the pattern blocks within the jar. Others suggested to take the blocks out of the jar to count them. The counting jar activity focused on the development of counting a set of objects, creating sets of a given size, and recording the quantitative information. Their number identification skills were assessed at the conclusion of the counting jar activities (see Figure 10).

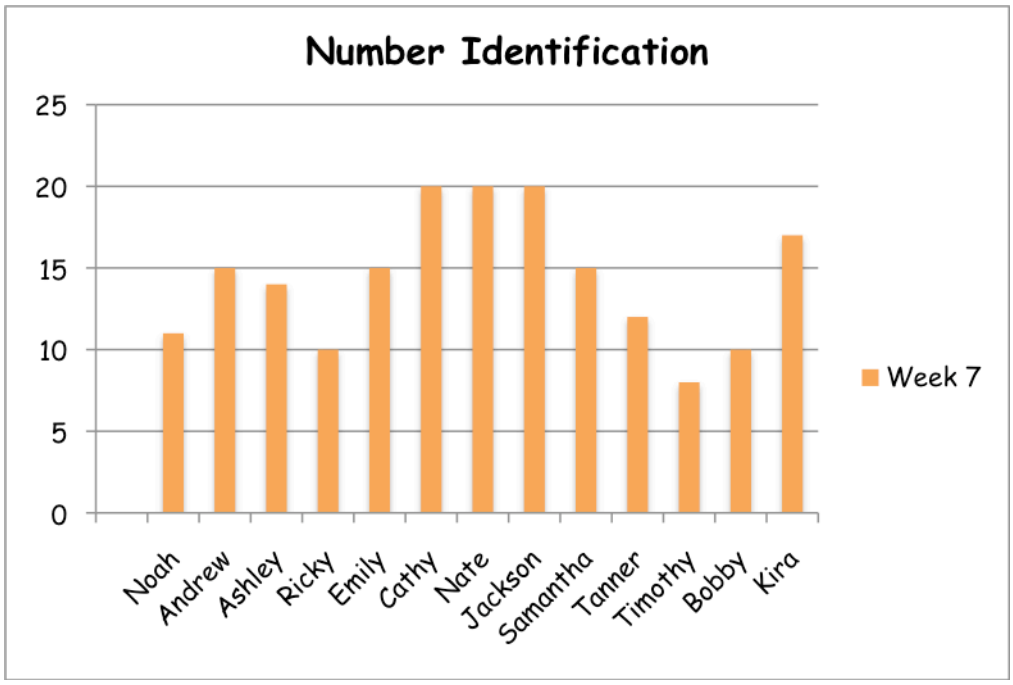

Figure 10. Number identification assessment: Week 7.

The scores show definite growth in the students number identification skills. Over half of the children were able to identify numbers above 10. The counting jar activity combined all areas of numeracy skills. I assessed their number identification skills by counting and recording their data.

Comparing quantities was the other area where the children had considerable growth from the Week 1 data. The data went up from 6 children to 10 being able to identify quantities of *less than*, 7 children to 11 able to identify quantities of *more than*, and 10 children who were able to complete both assessments accurately (see Figure 11).

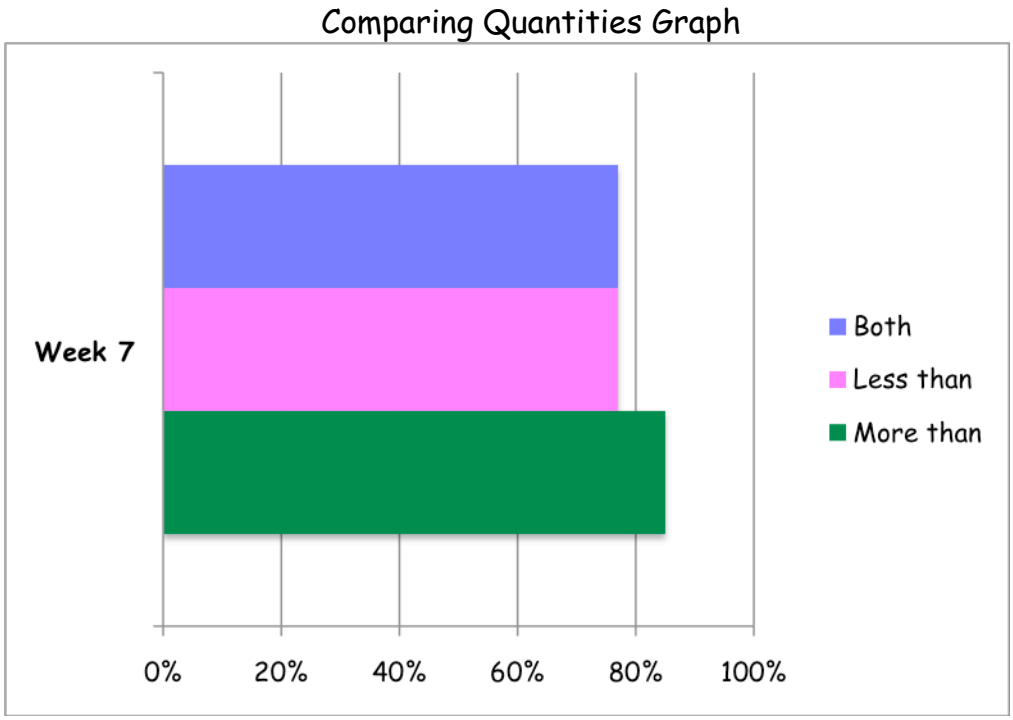

Figure 11. Comparing quantities assessment: Week 7.

Button match-up. In the group instruction that had already taken place, I was very pleased with the amount of growth I was seeing. In the final weeks of my study, I focused heavily on counting to 30 and identifying numbers to 20, as well as comparing quantities. The final activity was "button match-up. The

children used buttons to count and compare. During group instruction, the children began sorting the buttons by their attributes (see Figure 12).

Figure 12. Button-Match-Up.

It was interesting to observe the children sort, count, and compare the buttons. As I assessed the children, I asked them to do multiple things with their

buttons. One thing that I had them do was to make 3 groups of 10 buttons. After they made their groups, I asked the children to count all of their buttons to see how many they had in all (see Figure 13). I was thrilled with the results, 11 out of 13 children counted to 30! I knew that Timothy and Bobby were still going to need more practice, but they made growth from the previous weeks and I was so proud of all of the students.

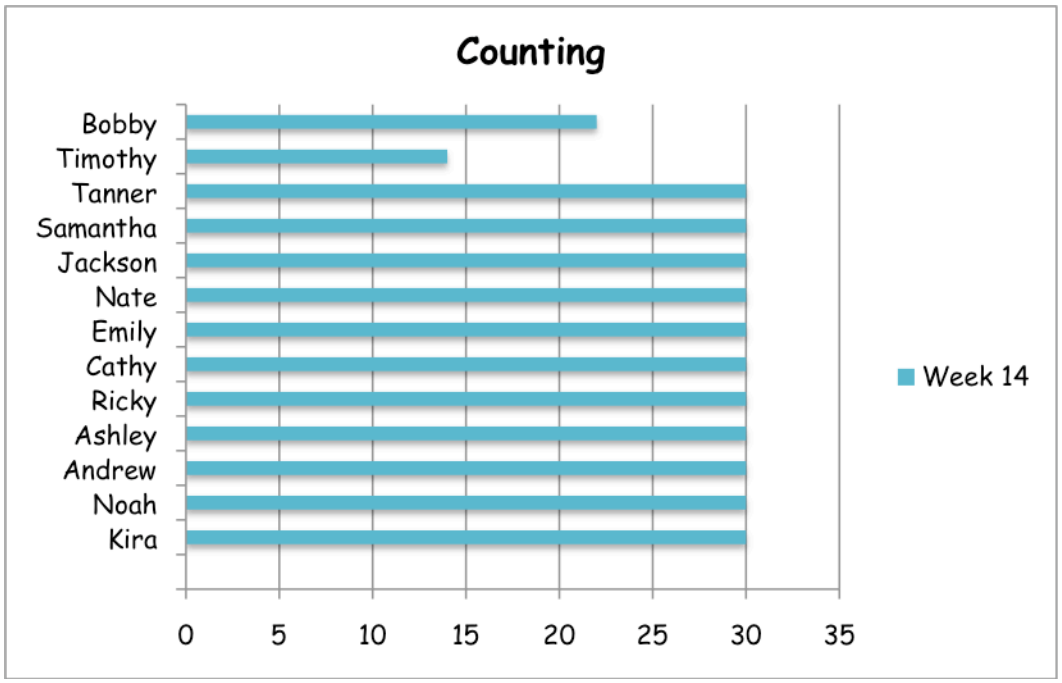

Figure 13. Counting assessment: Week 14.

As the children continued to sort, count, and record numbers during group instruction, I did the final assessment on number identification. The results were in, 10 out of 13 children identified their numbers to 20 (see Figure 14).

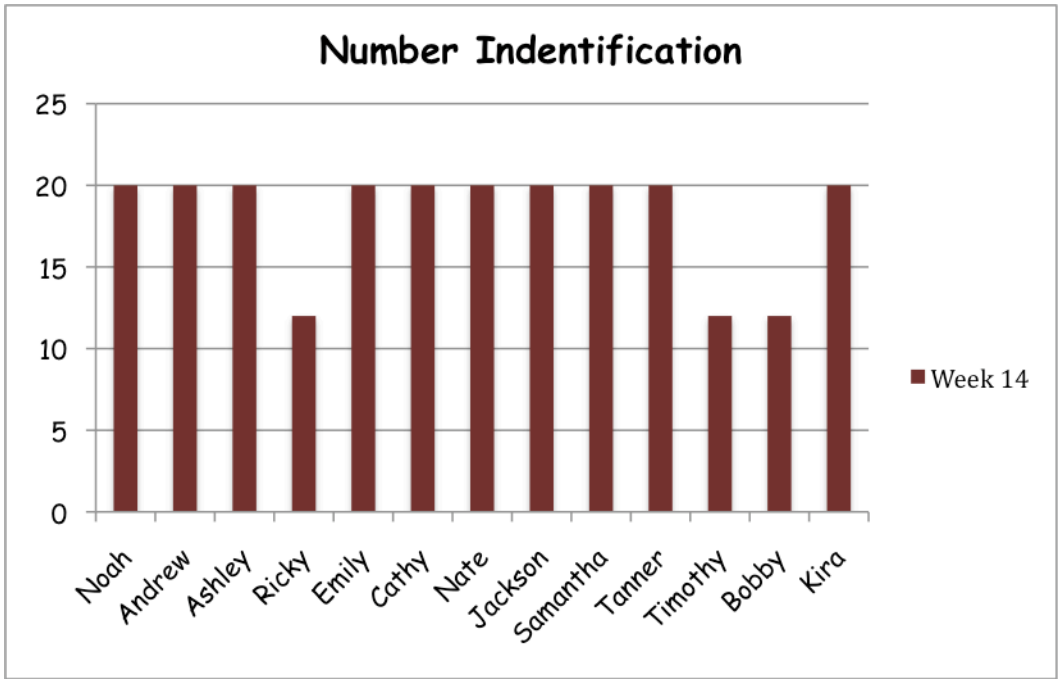

Figure 14. Number identification assessment: Week 14.

Again, I knew that the strategic intervention children were showing growth, just not at the same rate as the other 10 children. Bobby, Timothy, and Ricky were going to need continued support, practice, and modified lessons in number identification.

Through Button-Match-Up, I assessed the children for the final time in comparing quantities. I gave them the number 12. The children had to count 12 buttons. After they counted 12 buttons, they had to show me two groups: a group with *less than* 12 and a group with *more than* 12 (see Figure 15). The growth was considerable from the seventh week assessment. The *less than* scores increased

from 10 to 11 children, the *more than* scores increased from 11 to 12 children, and 12 children could accurately complete both assessments.

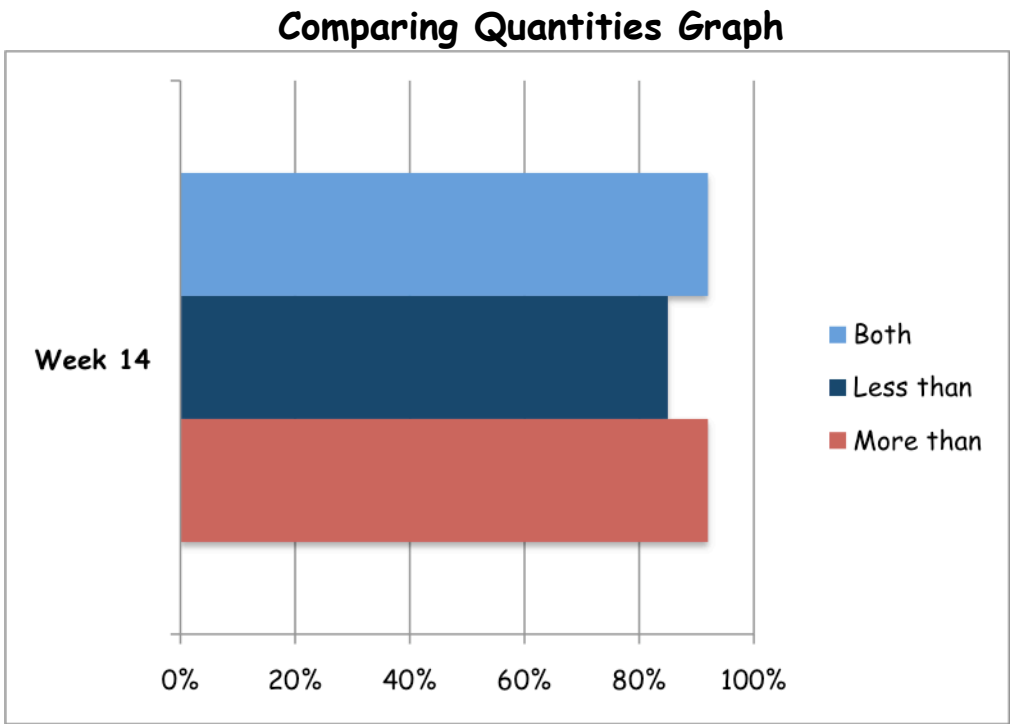

Figure 15. Comparing quantities assessment: Week 14.

Do You Like Math?

The answer is yes (see Table 1). It is here where my story comes to an end. Growth was substantial. I saw numeracy development on a daily basis. The journey was full of discoveries and connections. The children enjoyed mathematics and worked whole-heartedly to achieve growth that was momentous. It was a journey that I would embark on again.

Table 1

Survey Results

Kindergarten Students	Do you like Math?	Do you like working in groups?	Do you like math workshop?
Bobby	Yes	Yes	Yes
Ricky	Yes	Yes	Yes
Timothy	Yes	Yes	Yes
Samantha	Yes	Yes	Yes
Tanner	Yes	Yes	Yes
Jackson	Yes	Yes	Yes
Nate	Yes	Yes	Yes
Emily	Yes	Yes	Yes
Andrew	Yes	Yes	Yes
Kira	Yes	Yes	Yes
Avery	Yes	Yes	Yes
Cathy	Yes	Yes	Yes
Noah	Yes	Yes	Yes

Data Analysis

Data analysis is a way of "working with data, organizing them, breaking them into manageable units, synthesizing them, searching for patterns, discovering what is important and what is to be learned, and deciding what to tell others" (Bogdan & Biklen, 1998, p. 157). This is the essential purpose of the journey I embarked on with my kindergarten students. Since qualitative research is a repetitious process, my data analysis occurred during the study, through insights to educational philosophers, and after the completion of the study.

Analysis Done During Data Collection

"Every teacher is unique, every inquiry is unique, and, hence, every piecing together of the inquiry data to create a picture of the learning that has occurred is unique" (Dana & Yendol-Silva, 2003, p. 103).

Field log analysis. To systematically collect my data, I kept a field log of the inquiry process. The daily log included specific teacher reflections on observed behaviors as well as daily success of the students. I examined and re-examined the data contained in the log to consistently gain new insight that would allow me to format my next step while being cognizant of exactly where I was and had been. My daily log allowed me to add more activities into my guided group instruction, so as to facilitate the students in making explicit connections to numbers related to their everyday life.

Coding analysis. "Coding is a procedure that disaggregates that data, breaks it down into manageable segments and identifies or names those segments" (Dana & Yendol-Silva, 2003, p. 90). As I analyzed my data sources, I used my observational data and field log to develop a coding system to find patterns and regularities throughout my data. I designed a coding index of words and phrases. In the end, I prepared an alphabetized index of my codes, indicating log page numbers, and codes that were closely related. I designed a graphic organizer that visually displayed my codes in titled bins. This led to the formation of single-sentence theme statements that correlated to each bin.

Student work analysis. Student work was collected and examined for evidence of skill building and also as a way of gathering multiple points of view during the process (Hubbard & Power, 2003). Most of the student work was completed during math workshop and guided group instruction. The majority of student work was with the use of manipulatives, hands-on activities, and games. Number identification, counting, and comparing quantities assessments were given in the beginning, middle, and end of the study.

Survey analysis. In the beginning of the study and at the end of the study, I had given a student survey to acquire student impressions and insights into developing early numeracy skills. I read, coded, and reflected upon these surveys.

Mid-study methodological memo. At the midpoint of the study, I examined the data and wrote a methodological memo indicating the progress until that time. Sub-questions were generated, which highlighted new areas of focus for observations. By writing this memo, I generated informed decisions for the remainder of my study. I was able to gain self-awareness into how the data collection interrelated with the analysis and connections.

Analysis of the Educational Philosophers

In order to analyze my study with broader educational viewpoints, I wrote several analytical memos that connected my study to the works of educational philosophers. Through reading and interpreting the works of Dewey, Freire, Delpit, et al., and Vygotsky, I was able to connect fundamental quotes and ideas of their educational beliefs to happenings in my guided group instruction. These memos enabled me to examine my data from various educational standpoints, reflecting upon the impact of specific data within the framework of these authors. I was able to increase my insight into the student learning that was taking place.

Analysis After Data Collection

"Data analysis is a way of 'seeing and then seeing again.' It is the process of bringing order, structure, and meaning to the data, to discover what is underneath the surface of the classroom" (Hubbard & Power, 2003, p. 88).

Field log analysis. At the end of the data collection process, I continued to read, examine, and code my field log. I reread my log several times to break it apart and make meaning. Ely, Vinz, Anzul, and Downing (1997) affirmed this by stating, "Qualitative analysis requires that the researcher go back again and again over the accumulated log material in a process that for many has a cyclical feel" (p. 175).

Student work analysis. During the closing stages of my guided group instruction, I gave all participants the number identification, counting to 30, and comparing quantities assessments for the final time. I created graphs to compare each student's scores. I created reports of my findings as to the overall level of student growth.

Interview analysis. At the end of the study, I conducted individual interviews to expand my insight into the student's perception about math. These interviews were examined for changes in feelings, both positive and negative.

Bins and themes. As I completed all of the on-going data analysis, I returned to my field log and searched for recurring patterns within the data to create a system of bins for grouping my codes (Ely, Vinz, Anzul, & Downing, 1997). I arranged my bins by creating a graphic organizer to visually showcase how I saw all of my codes connect (see Figure 16). After continuous reflection, themes transpired from my collected works.

Literary devices. In telling the story of my journey, I employed the literary device of pastiche that allowed me to uncover essential meaning within my field log. Through pastiche, "I was able to recognize and better understand rare events and put them in perspective within the context of the whole body of data" (Ely, Vinz, Anzul, & Downing, 1997, p. 170).

Summary

Analysis of data was an ongoing process. The data I collected were carefully and considerately triangulated to make connections of what was happening throughout my study. Through different lenses, I examined participant observations, student work, and interview and survey data. By staying focused on my research question throughout my study, I was able to clearly analyze and code my findings.

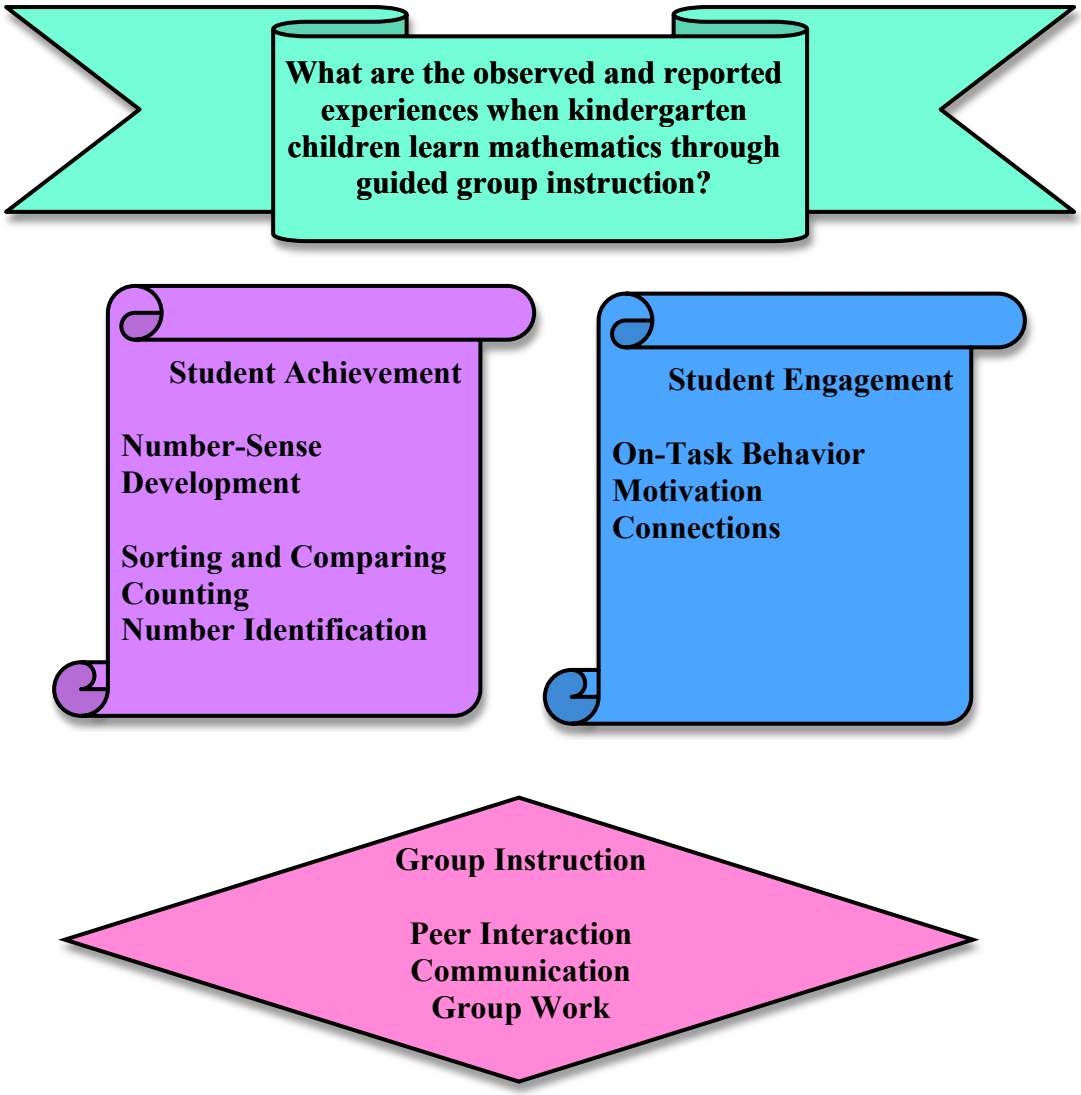

Figure 16. Graphic organizer of bins and themes.

Findings

Introduction

I have come full circle back to my research question: **What are the observed and reported experiences when kindergarten children learn mathematics through guided group instruction?** There were three main areas of concentration that I focused my instruction: counting, number identification, and comparing quantities. By teaching the students through guided group instruction, I found that the students' growth in mathematics increased over the course of my study. Student achievement, student engagement, and communication were all linked to the successes of guided group instruction.

The Data Tells the Story

The students were assessed throughout the study on number identification to 20, counting to 30, and comparing quantities during week 1, week 7, and week 14. Each child made growth each week, some more impressive than others (see Figures 17-19). In addition to the mathematical growth, a variety of themes emerged throughout my field log.

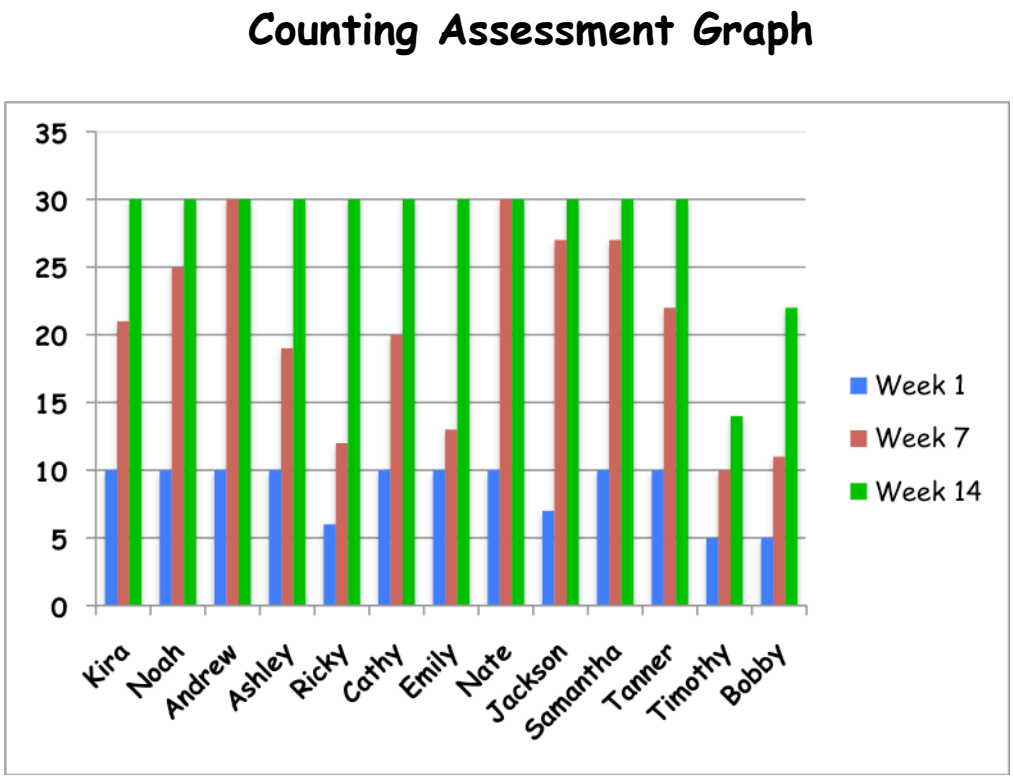

Figure 17. Counting assessments.

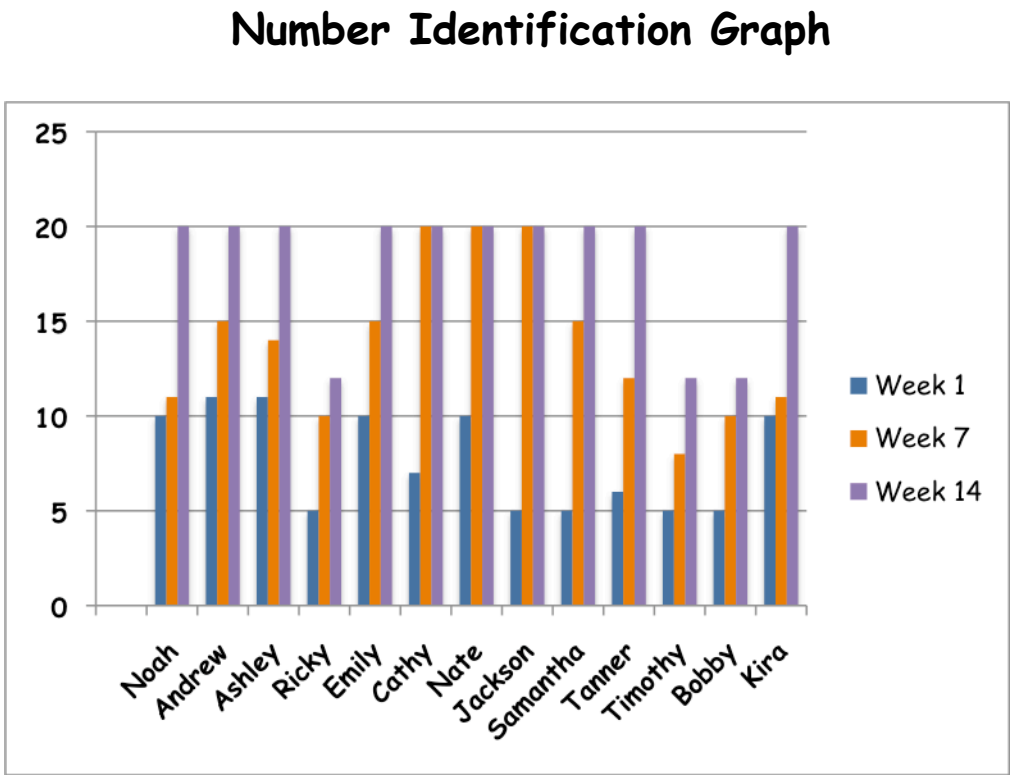

Figure 18. Number identification assessments.

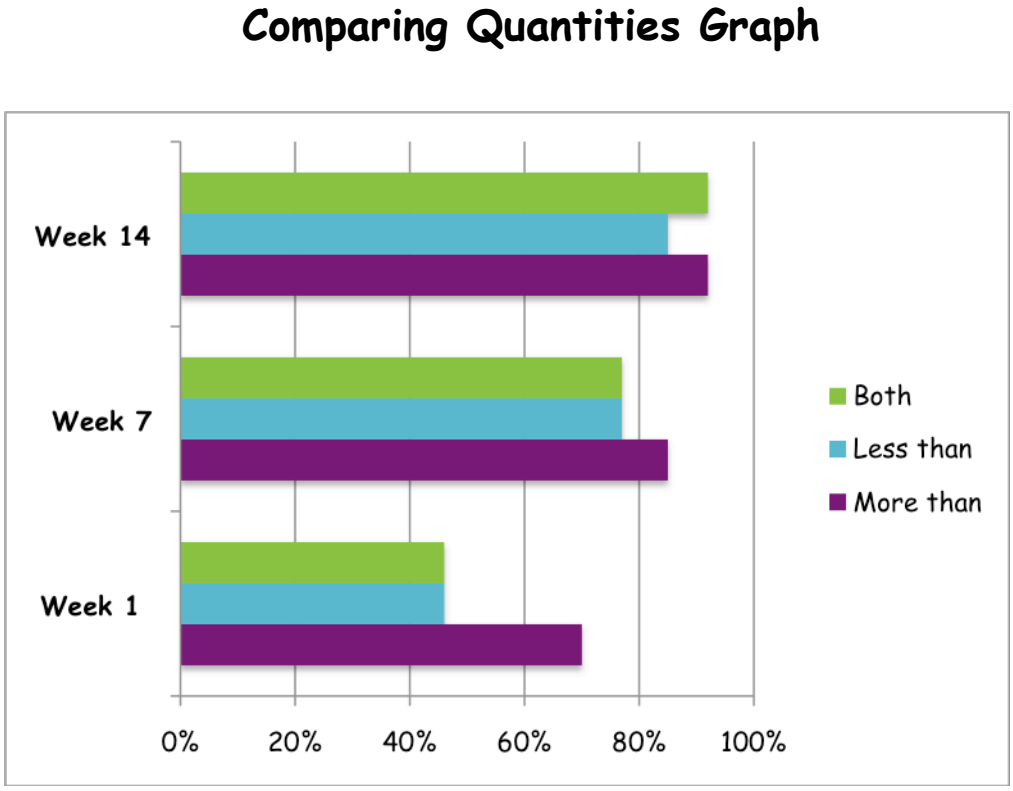

Figure 19. Comparing quantities assessments.

Student achievement. *Kindergarten students build upon their achievement in number-sense concepts through continuous development of the skills in number identification, comparing quantities, and counting.*

Dewey (1997/1938) tells us "It is not enough to insist upon the necessity of experience, nor even of activity in experience. Everything depends upon the *quality* of the experience which is had" (p. 27). Dewey views education through quality. The attributes that Dewey wants us to know is that the quality of the educative experience will have an impact on future experiences that may be positive or negative. My goal was to make all experiences positive for children to recall in the future when making choices that will have an immediate effect on their decisions. Dewey wants immediate and enjoyable educative experiences to promote "desirable future experiences" (p. 27). Quality not quantity is what matters in educational experiences. Guided group instruction provided my children with opportunities and experiences that were worthwhile for their future. Making connections and delving deeper into their thinking, allowed them to feel successful and be successful.

Encouraging mathematical thinking, application, problem solving, and the use of language to express ideas is considered to be a strong, solid foundation for developing mathematical skills at the kindergarten level (Mastin, 1996).

Student engagement. *Teacher-to-student and Student-to-student interaction is an essential component of on-task behavior and motivation during math workshop and guided group instruction.*

Freire (2003/1997) shared that "Knowledge emerges only through invention and re-invention, through the restless, impatient, continuing, hopeful inquiry human beings pursue in the world, with the world, and with each other" (p. 72). Freire is expressing that teachers need to allow students to explore and discover learning. Teachers are not to be "depositors" of knowledge and students are not to be the "depositories" (p. 72). Through math workshop and guided group instruction I provided the children with a manifold of opportunities to learn that maximized the students' creative powers and stimulated their interests through self-exploratory learning where the teacher facilitated and the children pursued their opportunistic learning.

By observing the interactive children, this allowed me to reach each individual child at his or her present level of understanding. Interactive play and exploration of manipulatives created memorable experiences that helped the transfer of learning into long term memory (Murray, 2001).

Communication and connections. *Kindergarten students are able to communicate their mathematical connections, through peer interaction during group instruction and math workshop.*

"Language arises initially as a means of communication between the child and the people in his environment" (Vygotsky, 1978, p. 89). Teacher action research is all about turning the classroom into an interactive environment that brings each other together to form a bond of trust. Throughout this journey, I presented my children with educative experiences that allowed for teacher to-student, student-to-teacher, and student-to-student communication to occur.

Math workshop and guided group instruction promoted communication development. The opportunity to learn mathematics through small group instruction allowed the children to develop relationships with their peers and their teacher.

"The teacher's thinking is authenticated only by the authenticity of the students' thinking" (Freire, 2003/1970, p. 77). Communication is the key to learning, which holds meaning and allows children to make discoveries and create ideas that lead to success in their education. Freire relates that our students' reasoning confirms our beliefs as educators. We cannot think for our students, we can only communicate with them. Communication promotes cognitive development that produces genuine and valid learning to take place right in front of us. Communication is not dominating, it is liberating.

Throughout my study, the children were communicating with each other on a daily basis. They were learning from each other and making connections. Through teaching the building blocks of mathematics, I allowed my children

multiple opportunities for communication, reflection, and noticeable growth in their early math skills. “Encouraging children to discuss and share ideas can enhance the assimilation of new and old experiences as well as facilitate the use of appropriate, informal mathematical communication” (Cook & Buchholz, 2005, p. 369).

We had multiple conversations about numbers and counting, which stimulated the children to want to navigate even more into the world of numbers and counting. Their creative minds were supported through learning in small groups.

Children should have opportunities to explore new ideas with their peers in small groups and pairs.

“Without dialogue there is no communication, and without communication there can be no true education” (Freire, 2003/1970, p. 93). If we do not dialogue and communicate with our students, learning and connections will not occur. There would be no foundation to education.

Group instruction. *Group instruction is the key teaching strategy to enhance peer interaction, peer assistance, communication, and overall growth in learning mathematics.*

“Teacher talk and student talk are essential components that determine the quality of learning in the classroom” (Kohl, 2002, p. 147). Communication is the key to learning, which holds meaning and allows children to make discoveries

and create ideas that lead to success in their education. Communication also promotes cognitive development that produces genuine and valid learning. Guided group instruction encouraged an open and giving environment that supported participation and communication amongst all. This allowed multiple opportunities for communication that led the children to their academic growth.

The growth that occurred over 14 weeks was amazing. The children's academic performance in counting, number identification, and comparing quantities was positive.

Gifford (2004) believes small group instruction will foster positive attitudes that will lead to safe risk taking and provide effective emotional and cognitive support, whereas large groups may reduce the learning focus.

Conclusion

Freire's notion of dialogue is the foundation to early math skills. The on-going dialogue that took place on a daily basis led to numerous mathematical-based conversations that were critical in facilitating skill advancement. Through dialogue, my students were engaged and on task. I saw positive self esteem build, along with peer assistance and risk taking. The children were engaged in problem-solving dialogue, which embraced their number-sense development. All of these findings contributed to the positive growth made by the children.

Next Steps

In examining the structure of this study, I was very pleased with the outcomes that occurred. The growth in counting, number identification, and comparing quantities was surprising and rewarding. Those imperative first experiences in kindergarten lay the foundation for all future interactions with numbers. The connections that emerged week after week aided in the development of the student's growth in number sense knowledge that is vital to higher level mathematical skills and problem solving.

The major component that took me by surprise was the communication that transpired. I would like to further my study and investigate the effects of group instruction on communication development. The National Council of Teachers of Mathematics (NCTM, 2000) states communication as an essential part of mathematical education. The standards of NCTM (2000) indicate that communication is one of the five process standards. Young children need to communicate their mathematical thinking to their peers and teachers.

Another possibility would be to further my research to understand the power of mathematics combined with literacy. Research has demonstrated that children's literature can motivate students to connect mathematics to their emotions and incite interest to provide children with a momentous context for learning mathematics (van den Heuvel-Panhuizen & van den Boogaard, 2008). Using books and poems that have a mathematical basis allows for concrete

connections to be established. Gifford (2004) encourages the use of think alouds in math. This is a strategy often used in literacy and can establish encouraging connections that could enrich math knowledge and speaking skills.

No matter what avenue chosen, a positive difference was and can be made in children's learning.

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Appendix A

MORAVIAN COLLEGE

July 13, 2009

Amy E. Smith
4166 Pawnee Circle
Schnecksville, PA 18078

Dear Amy E. Smith:

The Moravian College Human Subjects Internal Review Board has accepted your proposal: "The Experiences of Children in Guided Math Groups: Teaching Kindergarten the Building Blocks of Mathematics." Given the materials submitted, your proposal received an expedited review. A copy of your proposal will remain with the HSIRB Chair.

Please note that if you intend on venturing into other topics than the ones indicated in your proposal, you must inform the HSIRB about what those topics will be.

Should any other aspect of your research change or extend past one year of the date of this letter, you must file those changes or extensions with the HSIRB before implementation.

This letter has been sent to you through U.S. Mail and e-mail. Please do not hesitate to contact me by telephone (610-861-1379) or through e-mail (browerg@moravian.edu) should you have any questions about the committee's requests.

George Brower
Chair, Human Subjects Internal Review Board
Moravian College

Appendix B

Dear [redacted]:

I am completing a Master of Education degree at Moravian College. My courses have enabled me to learn about the most effective teaching methods. One of the requirements of the program is that I conduct a systematic study of my own teaching practices. This semester, I am focusing my research on mathematics. The title of my research is ***The Experiences of Children in Guided Math Groups: Teaching Kindergarten the Building Blocks of Mathematics***. My students will benefit from participating in this study by having the opportunities for thinking, talking, making connections, building problem solving skills, achieving success, discovering new ideas, inventiveness, self-confidence, and perseverance in learning the building blocks of mathematics.

As part of this study, students will be asked to work individually, in pairs, and in small-guided math groups to practice math activities. The *Activities* during each session contains one to three activities, organized as work for the whole class, pairs, small groups, and/or individuals. The students will share and compare methods and results in small groups or whole class discussion. During *Math Workshop* the students will work in centers on activities individually, in pairs, or in small-guided math groups to practice related activities. *Assessments* will be conducted on the students through written activities and through observation. At the end of the study, all students may provide survey feedback pertaining to guided math groups.

The data will be collected and coded, and held in the strictest confidence. No one except me will have access to the data. My research results will be presented using pseudonyms – no one's identity can be used. I will store the data in a locked file cabinet and on my "password only" locked laptop computer. At the conclusion of the research, the data will be destroyed.

Grades and related classroom activities will be unaffected by students' decisions. However, students must participate in all regular class activities, for example, math lessons and math workshop. Non-participants will be excluded from the data collection process. In no way will participation, non-participation, or withdrawal during this study have any influence on any aspect of the class.

We welcome questions about this research at any time. Every child's participation in this study is voluntary; refusal to participate will involve no penalty or consequence. Any questions you have about the research or about the process for withdrawing can be directed to me, Amy E. Smith, [redacted] my advisor, Dr. Charlotte Rappe Zales, Education Department, Moravian College, 610-625-7958, crzales@moravian.edu.

Sincerely,
Miss Amy E. Smith

I attest that I read and understand this consent form, and received a copy. I grant permission for Amy E. Smith to conduct this teacher action research study in her classroom.

_____
Principal's Signature and Date

Appendix C

Dear [redacted]:

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We welcome questions about this research at any time. Every child's participation in this study is voluntary; refusal to participate will involve no penalty or consequence. Any questions you have about the research or about the process for withdrawing can be directed to me, Amy E. Smith, [redacted] my advisor, Dr. Charlotte Rappe Zales, Education Department, Moravian College, 610-625-7958, crzales@moravian.edu.

Sincerely,
Miss Amy E. Smith

I agree to allow my son/daughter to take part in this project. I understand that my son/daughter can choose not to participate at any time.

_____
Parent/Guardian Signature and Date

_____
Student Signature and Date

Appendix D

Field Log: Date
Math workshop:
Guided Groups:

Students	Observation	Reflection

Appendix E

Attendance:

We have _____ students in our class.

_____ student's are here today.

_____ student's are absent.

Appendix F

Guided Math Groups Survey

Do you like math?

Do you like working with Miss Smith in guided math groups?

Do you like the activities Miss Smith does with you in guided math groups?

Do you like math workshop?

Appendix G

Individual Student Interview Questions

1. Do you like Math? Name something that you like to do with numbers?
2. What is your favorite thing to do in math workshop?
3. What is your least favorite thing to do in math? What do you not like?
4. When do you like to count?
5. What do you like to count?