Involve Me!

Using Developmentally Appropriate Practices to Support a Rigorous Kindergarten Program

The Effects on Engagement and Attitude

by

Jessica Miller

A Dissertation Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Approved August 2019 by the
Graduate Supervisory Committee:

Erin Rotheram-Fuller, Chair
Wendy Oakes
Melanie Wheeler

ARIZONA STATE UNIVERSITY

December 2019

ABSTRACT

Chi and Wylie's (2014) Interactive Constructive Active Passive Framework (ICAP) was used as the foundation of a teacher led intervention using small group instruction with manipulatives during mathematics instruction to provide developmentally appropriate instruction to kindergarten students in a rigorous academic program. This action research mixed-methods study was conducted in a full-day self-contained kindergarten classroom to ascertain the effects of this mathematics instruction method on students' levels of engagement and attitudes. Over the course of six months, twenty mathematics lessons were recorded to gather data for the study. Quantitative data included measuring time-on-task, teacher behaviors ICAP level, student behaviors ICAP level, as well as a Student Attitude Survey that was conducted at the conclusion of the study. The Student Attitude Survey was presented in a modified Likert Scale format due to the age and reading ability of the participants. Qualitative data was gathered in the form of lesson transcripts. Twenty-two students and one classroom teacher participated in the study. Students ranged in age from five to six years old, and eleven participants (50%) were male. The results of the study showed that the use of small group hands-on instruction in mathematics had a positive effect on student engagement based on students' time-on-task during the activity, as well as positive student attitudes toward mathematics as indicated on the Student Attitude Survey. Lesson transcripts and both teacher and student ICAP rubrics provided further support for the innovation.

DEDICATION

The saying goes, "It takes a village to raise a child." The truth is, it takes a village to help a doctoral student complete a dissertation! I could not have done it without my village. So here is a special thank you to all of my village members.

The lights of my life-

Faith, for being the best student editor a mother could ask for. You willingly read each chapter and offered insightful feedback. Because of you, I know about Oxford commas.

Drew, who listened to me endlessly fill him in on my progress (whether he wanted to hear it or not) while trapped in the car alone with me driving to countless baseball and football practices. I will always remember your words of encouragement, “You got this, Ma!”

Ella, who never once doubted her mother could do this! You were always the first one to volunteer to allow me to practice my interviewing skills. Thanks for being my best cheerleader!

Andy, my husband, who was the glue that held everything together! My cheerleader, my shoulder to cry on, my drill sergeant, the one who picked up the slack when I couldn’t do it all, and my calming influence when I was going crazy. You are my hero!

ACKNOWLEDGMENTS

Dr. Erin Rotheram-Fuller, dissertation chair, Thank you for being the calm in the eye of the storm. You were the knowledgeable presences that I needed throughout the entire process.

Dr. Wendy Oakes, committee member, thank you for accepting my committee member request out of the blue. You brought a researcher's perspective to the process and made me think of things from a different perspective.

Dr. Melanie Wheeler, committee member, I have had the privilege of working with Dr. Wheeler for many years, you are one of the most knowledgeable, professional, and generous people I know. You are an example of what an educator should be!

Erica Callaway, Justin Harbin, Jonathan Borgwing, Karen Guerrero, and Amanda Ryan Romo, fellow LSC members, thank you for sharing this adventure with me. Your input has been invaluable!

Alison Zuniga, critical friend, thank you for reading as many of my papers as I have. Thank you for sticking with me throughout the entire program.

Mrs. Marcy Whitcomb, kindergarten teacher, you have been my friend and colleague for over a decade. You have been a great sounding board and problem solver. You were my "go-to girl" when I needed someone who really understood the workings of kindergarten and my young learners. Thank you for being one of my strongest supporters.

Mrs. Crystal Freed and Mrs. Laura Hartlaub, kindergarten teachers, thank you for allowing me to use you as my support system during this process. As busy educators, you still found time to answer my questions and participate in my interviews. Thank you!

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

LARGER AND LOCAL CONTEXT

"Play is often talked about as if it were a relief from serious learning. But for children, play is serious learning."

-Mr. Rogers

National Context

In the United States of America, most children attend kindergarten prior to advancing to first grade (Smith, Rogers, Alsalam, Mahoney & Martin, 1994). Though kindergarten is not mandatory nationwide, many states require local districts to provide either full-day or half-day kindergarten programs as an option for students and families. According to *The National Center for Educational Statistics* (NCES), twelve states require school districts to offer full-day kindergarten programs, while 34 states require school districts to offer a half-day kindergarten program (NCES, 2014). This means that 46 out of 50 states have identified kindergarten education as important enough to place requirements upon local school districts to provide either full or half-day programs for students (See Appendix A).

Time spent in kindergarten classrooms provides the necessary foundation for future educational success. Many states have put in place early childhood learning standards and kindergarten standards to facilitate the education of children attending preschool and kindergarten programs. These types of early learning standards have become common in the United States (Scott-Little, Lesko, Martella & Milburn, 2007). Implementation of learning standards provides guidance for districts desiring to build and support kindergarten programs. Additionally, standards provide a measure of accountability for kindergarten programs.

The proliferation of kindergarten programs and accompanying standards points to the importance of providing high quality, developmentally appropriate educational experiences for young children. Negative consequences can occur when the appropriate level of instruction is not provided to students. Developmentally inappropriate activities may cause students to exhibit stress behaviors, such as crying, outbursts, self-comforting and avoidance behaviors (Jackson, 2009). Developmentally inappropriate practices may include a high level of teacher-directed tasks, highly structured classes, large group work, paper-pencil tasks, rote learning and standardized assessments (Jackson, 2009). These developmentally inappropriate activities may prevent children from adequately expressing and developing their learning. Johns (2015) found, specifically in the subject area of math, that kindergarten students express their understanding through oral expression, drawings, and gestures more effectively than using traditional methods of assessment (p. 1022). One developmentally appropriate practice that is on the decline in kindergarten classrooms is play (Lynch, 2015). Play is a developmentally appropriate format in which kindergarteners can learn. Through play, kindergarten students are able to develop skills that will support future academic growth (Bodrova, 2008). These skills include symbolizing, problem-solving, self-regulation and identifying authentic purposes for reading and writing (Bodrova, 2008). Kindergarten and early childhood education experiences lay the groundwork for future academic success.

The above stated factors underscore the importance of kindergarten programs and learning at a national level. As this study was conducted exclusively in the state of Pennsylvania, a snapshot of the context at a state level is provided in the following section.

State Context

Currently, within the state of Pennsylvania, the government does not require children to attend kindergarten, nor does it require districts to provide full-day or half-day kindergarten programs to families (NCES, 2014). However, the majority of school districts voluntarily offer some type of kindergarten program. Within Adams County, Pennsylvania, where the study was conducted, all six public school districts provide some form of kindergarten education for students. (Bermudian Springs School District, Conewago Valley School District, Fairfield Area School District, Gettysburg Area School District, Littlestown Area School District, Upper Adams Area School District) (See Table 1). Although Pennsylvania does not mandate kindergarten for children, if a child is voluntarily enrolled in a kindergarten program by the parents, the child is required to follow the compulsory attendance laws set forth by the state of Pennsylvania (Commonwealth of Pennsylvania v. Kerstetter, 2013).

Table 1.

Adams County School District Kindergarten Programs

School District	**Type of Kindergarten Program Offered**
Bermudian Springs SD	Full-Day Kindergarten (all students)
Conewago Valley SD	Full-Day Kindergarten (all students)
Fairfield SD	Full-Day Kindergarten (all students)
Gettysburg SD	Full-Day Kindergarten (all students)
Littlestown SD	Full-Day Kindergarten (all students)
Upper Adams SD	Full-Day Kindergarten (all students)

Source: https://datacenter.kidscount.org

At the time of this study, Pennsylvania had early learning standards for pre-kindergarten and kindergarten programs. The state included infant-toddler standards that started at birth and went up to 36 months of age. After 36 months of age, children transitioned into the pre-kindergarten standards, which then transitioned into the kindergarten standards (Pennsylvania Department of Education, website, 2017). The Kindergarten Standards booklet created by the PA Department of Education indicated that these standards were designed for a full-day kindergarten program, and that accommodations would be needed for a half-day program format. The PA Kindergarten Standards included "approaches to learning through play" (PA Department of Education, 2017). A full listing of all Pennsylvania State Standards can be found at http://www.pdesas.org/Standard/View#. This study specifically explored kindergarten students' attitudes about and ability to engage through developmentally appropriate activities, specifically the use of hands-on manipulatives in a small group setting.

Local Context

For thirteen years, I was a kindergarten teacher in the public education system in Pennsylvania. At the time of this study, I was working within a rural middle-class school district that covered a 75-mile radius and enrolled roughly 4,000 students in grades kindergarten through twelfth grade, with a free and reduced lunch population consisting of 41% of the student body. The majority of the student body were native English language speakers. However, there was a small population of English Language Learners with the majority of these students speaking either Spanish or Bosnian. The district was broken up into two elementary schools (grades K-3rd), one intermediate school (grades 4-

6), one middle school (grades 7-8), and one high school (grades 9-12). While a majority of the instruction was provided in a traditional school environment, a Blended Academy was also available to students. Students enrolled in the Blended Academy could complete much of their instruction online from home. The Blended Academy was not available at the kindergarten level.

Over the time that I have been employed by East School District, a pseudonym, I have seen many changes in the kindergarten program. Some of these changes included new math and reading programs, changes in staff/administration and an increase in academic rigor. Academic rigor at the kindergarten level involved the increased complexity and breadth of the information that the students are required to know and do upon the successful completion of the school year. However, the largest and most impactful change came six years ago when the kindergarten program transitioned from a half-day program to a full-day program. The children's instructional day went from 2 ½ hours to 7 hours. This transition was planned well in advance of its implementation, which included community informational meetings, building enlargement projects and curriculum development. The districtwide philosophy for the lengthened day was to provide students with "more time" and opportunities to engage in social, physical, and oral language development. (Appendix B contains the district wide brochure that was used to introduce full-day kindergarten program to district families. Time was listed seven times on page two as a benefit for implementing full-day kindergarten.) The purpose was not to have kindergarten become the “new” first grade. The theory behind the transition was to provide students with more time to participate in developmentally appropriate activities that would help develop the whole child, and not just focus on the academic aspects of learning. The program was developed to include hands-on activities, oral language development, social interactions, fine and gross motor skills and exploration of broad topics in science and social studies. At the outset of the program, it was explicitly stated by administration that the benchmark expectations would not be raised due to the increase in the length of the school day.

Six years into the full day kindergarten program, one of the goals established at the onset had not come to fruition. Along with the lengthening of the instructional day, an increase in academic rigor has occurred. (Appendix C is the brochure currently shared with parents of incoming kindergarten students. It should be noted that time was no longer listed anywhere on the brochure as a benefit of full-day kindergarten.) District benchmarks were raised at the kindergarten level in all subject areas. For example, the end of the year reading benchmark for kindergarten students was increased by two levels. The expectation for writing increased from students writing two sentences with minimal assistance to students writing four sentences in the genres of informational, narrative and opinion writing independently. In mathematics, identification of 3D shapes was added.

Due to the increased academic rigor, much of the time allotted for developing the whole child has been reallocated to in-seat instructional time needed to prepare students to meet the end of the year benchmarks. Individual teachers were left on their own to find ways to incorporate social skills, oral language development, and developmentally appropriate activities into their classroom instruction. As a result, each classroom teacher incorporated these skills differently. There was no consistent district curriculum to encompass these skills. Some teachers included activities such as exploration tubs and Genius Hour in an attempt to provide developmentally appropriate activities for their students. Exploration tubs are containers that hold a variety of materials that students can freely explore and manipulate to learn in creative ways, while Genius Hour is a time for students to explore topics of their choosing in multisensory ways. Both of the elementary schools have established discovery rooms for the kindergarten students to use twice in a four-day cycle, which allows the students to learn through creative, unstructured play. The discovery room has been developed, funded and maintained by the kindergarten teachers with the support of the building principal. However, no money or materials were provided by the district. (For a more detailed description of the discovery room visit the following site https://www.psea.org/news--events/newsstand/psea-learning-lessons/learning-lessons-discovery-room/)

My primary role within the district was as a kindergarten classroom teacher. It was my responsibility to provide instruction in all academic areas within my self-contained classroom. The only subjects taught by someone other than myself were art, music, physical education, computer keyboarding, and library. As I had been teaching kindergarten for the past thirteen years, I had direct knowledge of the changes made to the program since the transition from half-day to full-day kindergarten. I was one of the co-developers of the discovery room. At a district level, I was a member of the English Language Arts (ELA) Committee and the Language Arts Pilot Committee. Holding these positions placed me in a position to directly affect the instruction provided to kindergarten students, both in my classroom as well as the kindergarten population as a whole within the district. While academic rigor increased across the board, this study focused specifically on mathematics instruction, exploring the effects of using hands-on manipulatives in a small group setting on students' attitudes and engagement. Specifically, this study examined the following research questions.

Research Questions

1. What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematic?
2. What were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?

CHAPTER 2

THEORETICAL PERSPECTIVE AND LITERATURE REVIEW

"The best teachers are those who show you where to look, but don't tell you what to see."

-Alexandra Trenfor

While Chapter 1 provided the context for the study, Chapter 2 will provide support based on a literature review and a theoretical framework discussion. This chapter will include three sections. Section one will provide a basic introduction to the topic of developmentally appropriate practices. Section two will focus on the literature review and theoretical frameworks supporting the study, and section three will discuss manipulatives and small group instruction, with a clarification of terms.

An increasingly rigorous academic kindergarten program needs to be balanced by the use of developmentally appropriate practices (DAP) that are suitable for the cognitive development of five and six-year-old learners. The National Association for the Education of Young Children (NAEYC, 2009), stated that early childhood educators should "arrange firsthand, meaningful experiences that are intellectually and creatively stimulating, invite exploration and investigation, and engage children's active, sustained involvement. They do this by providing a rich variety of materials, challenges, and ideas that are worthy of children's attention" (p. 19). However, due to the increase in academic rigor over the past few years, fewer and fewer of these types of activities are being provided to kindergarten students. Activities that used to be commonplace in many kindergarten classrooms, such as dramatic play areas, puppet stages and hands-on centers, are being used less frequently, often being saved as a reward instead of a daily part of the learning process. “As academic seat-time in kindergarten to address literacy and numeracy standards and carry out the required assessments has increased, the result has been fewer opportunities for children to develop visual, spatial, and fine motor skills” (Kinzer, Gerharbt & Coca, 2015, p. 389). It is critical that young children receive age-appropriate instruction in a world of ever-increasing standards and academic rigor. Educators need to guard against outside pressure to engage students in activities that are not developmentally appropriate. These outside pressures could include high stakes testing and an increase in curricular requirements.

The literature review and theoretical perspectives discussed here will focus specifically on developmentally appropriate practices within the academic area of mathematics, specifically on how the DAP of hands-on manipulatives and small group instruction affects mathematics instruction in a full-day academic kindergarten program. A great deal of research and literature has been written exploring the most effective developmentally appropriate practices to use when teaching kindergarten students how to read. However, less time has been spent developing mathematics instruction (Sammons, 2010). There are also a lack of tools available to help predict students that may have future difficulties in math, compared to the tools available in language arts (Gersten, Jordan & Flojo, 2005). Finally, mathematics has been confined to “math time only” as opposed to being incorporated throughout the day in meaningful ways. Limited exposure leads students to believe that math is not as relevant or applicable as other areas of study. By failing to provide students with complex math content at an early age, educators could be limiting students’ future success regarding higher level mathematics success (Bailey, et al., 2015).

Theoretical Frameworks and Literature Review

Jean Piaget’s Theory of Cognitive Development provides a foundation of support for the use of manipulatives, specifically the preoperational and concrete operational stages of development. While Lev Vygotsky’s Zone of Proximal Development provides support for the use of small group instruction. At the conclusion of the discussion of Piaget and Vygotsky's educational philosophies, the ICAP Framework by Chi and Wylie (2014) will be presented. Piaget and Vygotsky’s theories complement the ICAP Framework, specifically the use of manipulatives and small group instruction, implemented to more actively engage the students’ during mathematics lessons. Increased engagement is the goal of the ICAP Framework. A detailed explanation of the framework and studies previously conducted using ICAP Framework will be discussed. This section will provide support for the current research, which involves identifying the effect of small group instruction and the use of manipulatives on student engagement and attitudes of kindergarten students in the area of mathematics.

Educational Philosophies

While the views of Piaget and Vygotsky may, at first glance, seem contradictory to one another, they both support developmentally appropriate practices from different perspectives. Combining the two theories may provide a more well-rounded program than focusing exclusively on one theory over the other. Frequently in the field of education, the pendulum swings from one side of an issue to the other, failing to find a common sense middle ground of support. A few examples of this pendulum swing come to mind, such as the debate between whole language versus phonics instruction or the debate between teacher-centered or student-centered instruction. As in life, finding a balance between two extremes is often the best route. "Integrating components of Piaget and Vygotsky can lead to a more balanced perspective that in turn can lead to more effective learning situations that can benefit all children, but especially those with mathematical learning difficulties" (Fusion, 2009, p. 345). Let us first explore Jean Piaget's Theory of Cognitive Development.

Piaget. Piaget's Theory of Cognitive Development focused specifically on young children and how they develop cognitively. As children learn, they are making a mental model of the world (McLeod, 2009, website). Piaget believed that children progressed through stages in a steady, gradual manner and that each stage laid the groundwork for the next stage to come (Ojose, 2008).

Piaget identified four levels of cognitive development (See Figure 1). The levels include the sensorimotor stage from birth to age 2, pre-operational stage from ages 2 to 7, concrete operational stage from age 7 to 11 and the formal operational stage from age 11 to adolescents and adulthood (McLeod, 2015; see Figure 1). Due to the age of the students involved in this study, an emphasis was placed on the pre-operational and concrete operational stages, as most kindergarten students fall somewhere within these two age groups. Based on Piaget's findings a child enters the pre-operational stage somewhere between the ages of 2-7. Due to age requirements put in place by the school district, children may not enter kindergarten unless they will turn five years of age by September 1st of the kindergarten school year. Anyone wishing to enroll a child before the age requirement must have the child tested by a psychologist to evaluate his/her readiness. This guideline places kindergarten students squarely in the preoperational stage when beginning kindergarten, and some students begin kindergarten over a year later (parents have the option to hold students back one year) at age 6. However, the assumption that students join kindergarten in the preoperational stage is based only on their chronological age, and not their actual cognitive development, which can have more variability.

During the preoperational stage, children should be working with physical objects to help develop critical thinking skills. "In this second stage, children should engage with problem-solving tasks that incorporate available materials such as blocks, sand, and water." (Ojose, 2008, p. 27). As children develop, they move from the preoperational stage to the concrete operational stage.

The concrete operational stage occurs roughly between the ages of seven and eleven. The concrete operational stage focuses on learning through concrete interactions with objects and experiences. Children should spend classroom time involved in activities that allow them to explore the world around them in a concrete fashion, not in an abstract way (Fuson, 2009). Ojose (2008) stated that during the concrete operational stage the use of hands-on activities “cannot be overemphasized” (p. 27). While Fortino, Gerretson, Button & Masters (2013) further state that children birth to eight years old should learn mainly through their senses and direct experiences.

By understanding a child's cognitive stage, a teacher is better able to structure classroom lessons and activities that are accessible to the child. Ojose (2008) stated, “All students in a class are not necessarily operating at the same level. Teachers could benefit from understanding the levels at which their students are functioning and should try to ascertain their students’ cognitive levels to adjust their teaching accordingly” (p.

29). Based on Piaget's Theory of Cognitive Development, teachers can make better-informed decisions about instruction for their students, especially in the area of mathematics (Fusion, 2009, Ojose, 2008). An implication for the classroom may involve increasing the number of concrete experiences for the students. One way to provide these concrete experiences is through the use of hands-on manipulatives during math instruction. Manipulatives allow the students to use their sense of touch as well as sight to help them learn new concepts.

Figure 1.

Piaget Cognitive Development Chart

PIAGET THEORY OF COGNITIVE DEVELOPMENT CHART		
Stages	**Age Range**	**Description**
Sensorimotor	From birth to 2 years	- Identifies object performance, the object still exists when out of sight - Recognition of ability to control object and acts intentionally
Preoperational	2 to 7 years	- Begins to use language - Egocentric thinking difficulty seeing things from other viewpoints - Classified objects by single feature i.e. color
Concrete Operational	7 to 11 years	- Logical thinking - Recognizes conservation of numbers, mass and weight - Classifies objects by several features and can place them in order
Formal Operational	11 years and onward	- Logical thinking about abstract propositions - Concerned with the hypothetical and the future - Create hypotheses and test

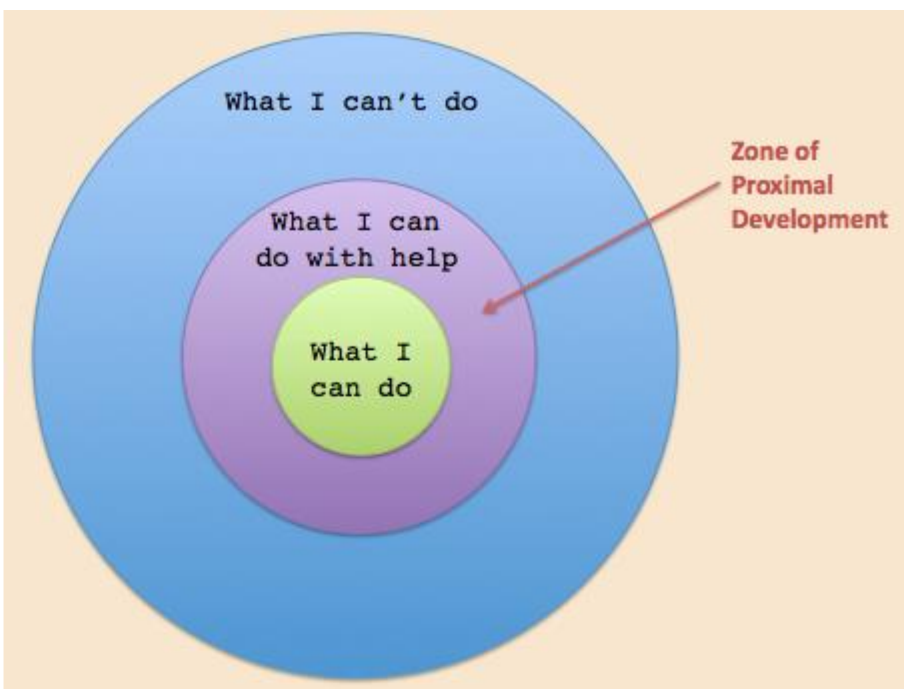
Source: http://www.studylecturenotes.com/basics-of-sociology/piaget-cognitive-development-theory-definition-stages

Vygotsky. Lev Vygotsky viewed learning from a different perspective. He was less concerned with the stages in which a child develops organically and focused more on how to help a child progress from one cognitive stage to the next. This growth can be fostered by what Vygotsky termed the Zone of Proximal Development (ZPD; see Figure

2). Fani & Ghaemi (2011) describe the Zone of Proximal Development as the difference between the learners actual IQ and the learners potential IQ (p. 1550). John-Steiner & Mahn (1996) explain it as "the distance between the actual development level as determined through independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (p. 198). They further propose that at the beginning of a learning activity, children, and learners in general, depend on more experienced peers/teachers to help guide them through the process (John-Steiner & Mahn, 1996, p. 192). If the lessons provided are too far beyond the child's cognitive level, he/she will not be equipped to assimilate the new information. On the other hand, if lessons are provided too far below the child's cognitive stage, he/she will not be challenged to grow cognitively.

Figure 2.

Zone of Proximal Development



Source: http://www.instructionaldesign.org/theories/social-development.html

The above definitions of ZPD support the use of small group instruction within a classroom setting. Through small group instruction, the teacher can work directly with students to help them attain an understanding that he/she would not have been able to achieve independently. This could be done in a large group setting, however it would be much more challenging. One teacher supporting twenty children at a variety of levels all at the same time is a daunting task. However, supporting three to six heterogeneously grouped learners at one time working on a similar task is more manageable. Starkey, Klein & Wakeley (2004) sum this concept up well. They state, "After Vygotsky, it is assumed that early mathematical knowledge develops primarily in social settings with mathematics content, concrete manipulatives, and scaffolding by a more competent agent, typically a parent or teacher" (p. 102).

Combining Piaget and Vygotsky. To capsulize the theories of both Piaget and Vygotsky, it could be said that Piaget believed that cognitive stages drive learning, while Vygotsky believed that learning drives cognitive development. For practical purposes as an educator, it becomes the old adage, which comes first the chicken or the egg? It is not critical to pick one theory over the other. Instead, they complement one another. By combining the two theories, a more well-rounded approach to teaching and learning can be established. Fusion (2014) advocated for this balanced approach between the two theories as well. A balanced approach would include "1) integration of both Piaget and Vygotsky's forms of knowing, 2) meaning making by connecting visual symbols as well as meaningful language, and 3) developing both fluency and understanding in learning" (Fusion, 2009, p. 347).

Now that the groundwork has been laid by Piaget and Vygotsky, the discussion will move to the theoretical framework created by Chi & Wylie (2014), the Interactive, Construction, Active, and Passive (ICAP) Framework. The ICAP Framework is a tool that can be implemented to put Piaget and Vygotsky's theories into practice within the classroom. Piaget's concrete stage of development fits well with both the active and constructive levels of the ICAP Framework. While Vygotsky's Zone of Proximal Development can be used to help students move up the engagement levels of the ICAP Framework. Each of these stages will be discussed more thoroughly in the upcoming section.

ICAP Framework by Chi and Wylie. Chi & Wylie's (2014) ICAP Framework attempted to maximize student learning by actively engaging the students during instruction. It is not a surprise to educators that children learn more when actively involved in the lesson or activity versus being that of a passive participant (Chi & Wylie, 2014). Before further discussion on the topic, clarification of the acronym ICAP is needed.

First, "I" stands for interactive, according to Chi & Wylie (2014), this was the gold standard for engagement. "Interactive mode of engagement achieves the greatest level of learning" (p. 220). Interactive behaviors must meet two criteria "a) both partners' utterances must be primarily constructive, and b) a sufficient degree of turn taking must occur" (p. 223). Both partners must be actively interacting with one another in regard to the learning. The interaction cannot be one-sided. It cannot be a regurgitation of something previously stated. Instead, it must include adding or developing the learning beyond just the recitation of facts. Second, the "C" in the ICAP framework stands for constructive, the learner was involved in adding something new to the thinking. They were not just restating what has already been said by others. Instead, they were synthesizing the information. The learner was going beyond what has already been stated to form opinions, inferences, and justifications. Examples of constructive learning could include drawing concept maps, asking questions, posing problems and comparing and contrasting information (Chi & Wylie, 2014, p. 222). Third, the "A" stands for active. Learners were outwardly doing something. One example may be physically moving manipulatives. However, it is important to note that this movement of manipulatives needed to be done in a thoughtful way with attention being focused on the activity not just mindless repetition (p. 222). And finally, the "P" stands for passive. Passive engagement was the lowest form of learning in the ICAP Framework. During passive engagement, the learner was not actively doing anything, no outward physical activity was noted. This may include quietly listening to an instructor or watching a movie (p. 221). Chi & Wylie (2014) equate the ICAP levels in the following way: passive = receiving, active = manipulating, constructive = generating, and interactive = dialoguing (p. 221).

The ICAP Framework identifies the different levels through “overt learning activities” (Chi, 2009, p. 75) that the students exhibited during the activity. Overt behavior is a key point in the framework. Educators are not able to see into a child’s thinking process, however, the teacher is able to observe overt behaviors during an activity. Chi (2009) classified overt behaviors into three categories of active, constructive, and interactive. Key terms for overt behaviors were identified for each level (See Table 2). Without tracking overt behaviors, the educator is unable to gain insight into the student's thinking. As a student moves up the complexity levels of the ICAP framework, he/she is more engaged in the learning activity. Chi (2009) stated,

> the claim here is that the set of activities designed as active is more likely to engage learners than being passive, the set of activities designed as constructive is more likely to enable the generation of new ideas than the set of activities designed as active, and the set of dialogue activities designed as interactive is more likely to encourage jointly produced substantive contributions than individual dialogue patterns (Chi, 2009, p. 84-85).

Table 2.
Overt Student Behaviors Categorized for ICAP Framework

Level of Behavior	Active	Constructive	Interactive
Terms Associated with Each Level	Looking at Searching for Pointing Underlining Copying Repeating Rotating	Explaining Justifying Constructing Reflecting Self-Monitoring Generating Hypothesis Elaborating Planning Predicting Outcomes Compare/Contrast	Revise Errors based on Feedback Respond to Scaffolding Argue, defend Confront Challenge Build onto another's thought Joint Dialogue

Source: Chi (2009)

The goal of the ICAP Framework was for students to reach the interactive level of learning, but each level provides important indicators of understanding and engagement. By using manipulatives in small group settings, it was hoped that students would reach more active, constructive and interactive levels of learning. Many of the interactive skills are higher level skills that are developed over time. Kindergarten students have not had a great deal of time to learn and develop these skills in an educational setting as kindergarten may be a child's first formal learning setting. Therefore, while interactive was the long term goal, all signs of active and constructive learning were encouraged. The main goal was to move away from a passive level of learning.

Supporting Studies. In studies previously conducted using the ICAP Framework, older more experienced learners have been the participants. Lam (2103) conducted research in a college level psychology course, while Wiggins, Eddy, Grunspan & Crowe (2017) focused on STEM courses at a college level, and Menekse, Stump, Krause & Chi

(2013) focused on students in engineering courses. The limited use of the ICAP Framework at the elementary level, specifically kindergarten, may be due to the relative newness of the theory, which was originally published in 2009 by Chi and later built upon by Chi & Wylie in 2014.

While limited ICAP studies have focused on younger children, positive results have been found in older populations. Wiggins et al. (2017) found that student outcomes in STEM classrooms increased when classes were taught in an interactive manner over that of a constructive manner (p. 12), supporting Chi and Wylie's (2014) claim that interactive lessons are the gold standard of engagement. Lam (2013) found that interaction was a key component in a large variety of tasks. She posited that the level of interaction between students influences that effectiveness of the task. Marzouk, Rakovic and Winne (2016), found the ICAP Framework could be used to help students self-monitor their learning. Each of the above stated studies found some level of support for the ICAP Framework. Many of them noted the need for further study of the ICAP framework and its practical application within the classroom.

Due to the limited use of the ICAP Framework with younger students, support is provided below for the use of hands-on manipulatives and small groups that can be incorporated into the ICAP Framework for use in a kindergarten classroom setting and study. Providing evidence that both the use of manipulatives and small group instruction are developmentally appropriate forms of instruction in a kindergarten classroom.

Manipulatives in Small Group Instruction

Two terms, manipulatives and small group instruction, need to be clarified before moving forward. Both terms are widely used in a variety of different situations. Due to this vast range of uses, it is necessary to define and briefly discuss each term and how it was applied in this study.

First, let us focus on the term manipulatives. Manipulatives have been defined as “an object that can be handled by an individual in a sensory manner during which conscious and unconscious mathematical thinking is fostered” (Swan & Marshall, 2010, p. 14). For the purpose of this study, manipulatives were defined as any material that could be physically manipulated by the students to help gain a deeper understanding of the mathematical concept that was being presented during the lesson. Hands-on mathematics manipulatives may include items specifically created to use in conjunction with mathematics instruction such as base ten blocks, pattern blocks and unifix cubes (See Figure 3). However, manipulatives could include common items that are intended for purposes other than mathematics use, such as counters, beans or dominos. For our purposes, this study did not include calculators or digital manipulatives that can be found on iPads or other commonly used electronic devices. Matton, Bates, Shifflet, Latham & Ennis (nd), found both traditional and digital manipulatives to be equally effective when used to teach computational skills. However, it has been decided not to include these items in this study as students are unable to move the items physically and some abstract thinking is required, as well as the limited availability of these items in some classrooms and homes.

Figure 3.

Mathematical Manipulatives

Unifix Cubes Pattern Blocks Base Ten Blocks

(Source: Images found on Google Pictures)

Manipulatives may be used in a variety of subject areas, such as language arts, science, and social studies. Examples of these types of manipulatives might include letter tiles to be used in language arts and magnifying glasses in the area of science. However, this study focused specifically on manipulatives used in mathematics instruction.

The second term to be defined is small group instruction. Although, research has found that the exact number of students included in a small group is not as critical as the instruction provided, group size is still worth discussing (Enu, Danso & Awortwe, 2015). Small group size can vary based on class size, needs of students, and age of the students involved. Older students tend to be more independent than younger children, allowing for a larger number of students to be included in a small group. For the sake of clarity, henceforth small groups will consist of groups of three to six students working in conjunction with one teacher as supported by Enu et al. (2015). This range allows for adequate social interaction between the teacher and students as well as between peers within the group. Groups smaller than three students limit the ability to interact with peers. While groups of more than six students create management challenges in regards to behavior and use of manipulatives. Groups larger than six students also allow some students to become nonparticipants. Students can become silent observers instead of active participants. “It seems prudent to keep groups as small as possible to promote positive interdependence, yet as large as necessary to provide sufficient diversity of opinions and backgrounds as well as resources to get the work done” (Enu et al., 2015, p. 119).

Although manipulatives and small group instruction are two separate techniques, they can be directly connected within the classroom; manipulatives used by the students while working within a small group environment. Due to this connectivity, the two techniques were interlocked throughout this study. Both techniques are DAP if used in conjunction with one another but they are not necessarily DAP if used in isolation. Think of the following classroom examples: during a whole group math lesson, the teacher provides pattern blocks for the students to use. However, due to the large group size, the teacher is unable to make sure that each child is using the manipulatives correctly. Due to lack of supervision, instead of using the pattern blocks as designated for the lesson, the children begin using them in a way which leads to off-task disruptive behaviors. In this situation, the manipulatives are not being utilized in an efficient manner as the students are not mature enough to use them appropriately in such a large group setting. Similarly, if the teacher uses small group instruction for a mathematics lesson without manipulatives, the teacher is simply lecturing to a small group of students for 30 minutes about a topic instead of a large group. Even though the students are in a small group, they are not receiving the appropriate type of instruction.

However, by combining the two techniques, manipulatives and small group instruction, the teacher can provide the students with developmentally appropriate instruction. The students become actively engaged through the use of manipulatives. Engagement leads to a deeper understanding of the math objective. In a small group setting, the teacher can scaffold and monitor the learning in a way that would not be possible during whole group instruction. The NAEYC supports the instructional strategy of small group instruction as it encouraged educators "to adjust the complexity and challenge of activities to suit children's level of skill and knowledge, teachers increase the challenge as children gain competence and understanding" (p. 19). To provide structure for the DAP of manipulatives and small group instruction in the area of mathematics, the theoretical framework established by Chi and Wylie's (2014) Interactive, Constructive, Active and Passive (ICAP) Framework was used. An explanation of the ICAP theoretical framework was previously provided as well as foundational support from theorists Piaget and Vygotsky.

Manipulatives. The following studies provide support for the use of manipulatives in the classroom as supported by the ICAP framework of learning that encourages the use of active, constructive, and interactive learning. Carbonneau, Marley & Selig (2012) conducted a meta-analysis of 55 previously completed studies that compared instruction using manipulatives in mathematics to that of mathematics instruction without the use of manipulatives in grades ranging from kindergarten to college level. Ninety-four articles were initially identified, but only 55 met the rigorous criteria established by the authors. Studies were required to meet four conditions before being included in the analysis. The four components included “1) studies compared instruction using manipulatives in mathematics instruction to those not using manipulatives, 2) some type of instruction needed to be provided during which time the students would use manipulatives to learn, 3) the studies had to define the term manipulative clearly, and 4) a significant amount of quantitative data needed to be provided” (Carbonneau, Marley & Selig, 2012, p. 383). The findings indicated that students who received mathematics instruction with the use of manipulatives had a small to medium sized improvement over those who received math instruction based on abstract symbols alone (p. 396). However, it should be noted that manipulatives were not found to increase growth in isolation. Instead, gains were seen when the use of manipulatives was combined with guidance during the learning process (Carbonneau, Marley & Selig, 2012, p. 396). This points to the effectiveness of incorporating both manipulatives and small group instruction.

Holmes (2013) found similar findings in a meta-analysis of 21 previously conducted studies on the use of manipulative in PK-12 learning environments (p. 3). For studies to be included in the analysis, they needed to meet the following four criteria. “1) Publication dates between 1989-2012, 2) must be written in English, 3) studies must employ a randomized or quasi-experimental design, and 4) investigate an innovation or intervention that used manipulatives, either physical or digital, during school-based mathematics instruction” (Holmes, 2013, p. 3). Holmes (2013) stated, “Although clearly not a mathematic achievement panacea, results from this review provide evidence that student achievement in grades PK-12 can be improved through the use of mathematics manipulatives” (p. 4). Both of the studies mentioned above allude to the fact that while manipulatives are helpful in increasing students' mathematical knowledge they, alone, are not sufficient to make large gains. For this reason, this study combined manipulative use with small group instruction. This combination is a more effective and efficient way to increase students' mathematical performance.

Small Groups. Evidence can be found to support the use of small group instruction within the classroom, specifically in regards to mathematics instruction. Enu et al. (2015) focused specifically on the question of whether or not group size had any effect on students' mathematics achievement in a small group setting (p. 119). To answer this question, two pre and post-tests were administered to a total of 97 primary aged students, 47 of those students were included in the experimental group that received small group instruction, while the 50 students involved in the control group received whole group instruction. The findings indicated that small group learning improved the performance of students (p. 122).

Sharan, Ackerman & Hertz-Lazarowitz (2017) looked specifically at how small group interactions helped students develop problem-solving skills. They defined small groups as students working together to problem solve, seek and interpret knowledge (p. 125). Data was gathered over a three week period from ten elementary classrooms, five classes using small group instruction and the remaining five using a traditional whole group instruction. After analyzing the data, it was found that the students who engaged in small group instruction made greater gains in higher order thinking skill than their counterparts who received the same information through whole group instruction (Sharan et al., 2017, p. 128). However, they did not find the same improvement in lower level thinking skills. In that area, both groups scored similarly.

Finally, Margolin and Regev (2011), gathered multiple sources of data for the length of a school year at cooperating elementary schools for a case study in an attempt to ascertain how mathematics discourse in a constructivist environment differs to that of a traditional setting (p. 3). Through the research, they were able to identify five different strategies that improve the quality of mathematics discourse in the classroom. One of these five strategies focused specifically on challenging students within their Zone of Proximal Development to develop a deeper understanding of math concepts (Margolin & Regev, 2011, p. 12). This information supports Vygotsky's Zone of Proximal Development which can be utilized in ICAP Framework. Teacher/student interactions would be used in active, constructive and interactive levels of the ICAP Framework. While the teacher is interacting with the students at any one of these ICAP levels, he/she can scaffold the learning to meet the needs of the individual learner. The remaining four strategies stated in the study could also be employed through student teacher interaction at a student's Zone of Proximal Development. The remaining four skills consist of using accurate mathematical language, discussing students misconceptions about a topic, demonstrating concepts with visuals, and establishing a routine of questioning, explaining, and discussing topics (Margolin & Regev, 2011, p. 12).

Both Enu et al. (2015) and Margolin and Regev (2011) conducted research into how small groups effect mathematics instruction. In both studies, it was found that while small group configurations were a means in which to provide instruction, the instruction itself was an important component as well. This has a significant implication in regards to the use of small group instruction and manipulatives. Quality instruction needs to be provided, and student engagement is one piece of quality instruction. Students will be more engaged as they move up the ladder of ICAP Framework levels. One way to increase the ICAP Framework level is to provide instruction in a smaller group setting that allows the students to be more actively engaged while using manipulatives to construct knowledge and interacting with peers to build upon that knowledge. As stand-alone methods, neither the use of manipulatives nor small group instruction was the most efficient way to develop mathematical understanding. Instead, it was the combination of the two that was hoped to provide the greatest results when used in conjunction with the ICAP Framework.

CHAPTER 3

METHODS

"Play is the highest form of research." -Albert Einstein

Research Approach

For this study, mixed methods action research was conducted. Mixed methods studies combine both qualitative and quantitative data to provide a clear, in-depth picture of the context and data. The two types of data, qualitative and quantitative, are integrated in a meaningful way in an attempt to answer the study's research questions (Ivankova, 2015, p. 5). Mixed methods research is a "practitioner-based" form of research, meaning that the researcher is not primarily trained in research methods, instead the researcher has his/her primary training in another field (Mertler, 2017, p. 3). In the case of this study, the researcher's primary training was in the area of elementary education. The purpose of this study was to answer the following research questions that pertain to a real-world problem in the researcher's local context.

1. What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?
2. What were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?

Setting

The study was conducted in a rural school district in Pennsylvania. The district was broken down into two elementary schools grades K-3, one intermediate school grades 4-6, one middle school grades 7-8 and one high school grades 9-12. The entire district serviced roughly 4,000 students in all. Slightly over 41% of the students received free and reduced lunch. The study was implemented in one of the elementary schools, which will be referred to as East Elementary School (EES), a pseudonym. EES consisted of roughly 460 students in grades kindergarten through third. Each grade level had six self-contained classrooms in which one teacher provides instruction in all academic areas except specials classes which consist of art, music, library, technology and physical education. The innovation was conducted in one kindergarten classroom at EES.

The teaching staff at EES was a stable population with few new teachers being added to the staff on a regular basis. Within the last six years, only one new classroom teacher had been hired. She was hired to fill a vacancy of a retiring teacher. The principal had remained the same for the past 15 years. Only within the past two years, had a new assistant principal been added to the staff to assist with administrative tasks. A large majority of the teachers held a Master's Degree in education. All teachers were teaching within their specific certifications. There were no teachers filling positions with emergency certifications. The intervention was conducted only within my classroom, where I had taught for 13 years. I led the intervention and collected the data within the classroom with all students, but only those students whose parents agreed to participate were included in the data analysis for this dissertation.

Participants

Kindergarten students at EES were involved in a full-day academic program that ran from 8:30 am until 3:30 pm Monday through Friday. Within the last twelve years, no children at EES were enrolled in first grade without first completing a kindergarten program either through a local school district or private kindergarten program. On average, 115 to 130 kindergarten students were enrolled each year at EES. Depending on the year, kindergarten class size ranges from 18 to 25 students.

Kindergarten students were placed into a classroom based on assessments conducted during kindergarten registration, which occurred in the spring of the previous year. Every attempt was made to create heterogeneously grouped classes based on the registration assessment scores. During registration, students complete three tasks which were assessed to calculate a combined overall score. The tests included letter identification, number identification, and a listening/participation activity. The individual scores were combined to get an overall score. When students were assigned to individual classrooms, the overall score was used to evenly distribute the students between the classrooms. This was done to avoid having a classroom with a disproportionate number of high or low functioning students, the goal was to have a well-balanced class with a wide variety of learners included in each class. An equal number of girls and boys were also included in each class, if possible. However, due to birth rates, this was not always possible.

The students range in age from five to six-years-old at the beginning of the school year. All students must turn five by September 1 of that school year. If a parent desired to have early admittance for a child at the age of four, the parents needed to have a psychological evaluation and an IQ test completed. This was rarely done. Within the last five years, only three students had been admitted early.

The majority of the students attending EES were Caucasian (83%). EES had a limited minority population, consisting of Hispanic and Bosnian students. Diversity in academic background and experiences were seen in entering kindergarten students.

Eleven student entered kindergarten having previously attended some type of preschool program, while five students did not attend preschool. For an additional five students preschool attendance was unknown and one student was repeating kindergarten. The study employed a convenience sampling as only the students placed in my classroom at the start of the year received the innovation.

Participant Specifics. The study was conducted during the 2019-2020 school year. Twenty-four students were assigned to the classroom that received the innovation. The study was explained and discussed with parents at Open House that was held in August. At that time, parents were given a parental consent form to have their child included in the study. The parental consent for was provided to parents in English. Twenty-two parents granted approval for their children to participate in the study by returning a signed consent form. It was assumed that two parents did not provide consent based on the fact that they did not return the parental consent form. The two children who did not have a signed consent form received the innovation as part of the class but no data or video was collected for these two children.

Of the twenty-two students included in the study, eleven were female and 11 were male. At the time the Student Attitude Survey was conducted, in mid-February, nine students were five years of age and thirteen students were six years of age. Demographically, one student was identified with Oppositional Defiant Disorder (ODD), two were diagnosed with Autism Spectrum Disorder (ASD), five students received speech and language services, and two students were identified with Attention Deficit Hyperactivity Disorder (ADHD). Of the two students identified with ADHD, one of those students was on medication for the entire length of the study. The other student diagnosed as ADHA began taking medication mid-way through the study, specifically at the end of December. All of the above mentioned demographics fell within the realm of the normal for a kindergarten class within this context. The class was demographically similar to the other five kindergarten classrooms within the building in all aspects with the exception of the two students diagnosed with Autism Spectrum Disorder. The classroom involved in the study was designated as the room in which students with an Autism diagnosis were placed if it has been decided that they would be in a general education classroom versus a self-contained Autism Support Classroom. This designation was made due to the classroom teacher's experience and training with students diagnosed with Autism Spectrum Disorder, and was in place for the past seven years.

Role of Researcher

I held a dual role during the study as both the classroom teacher and researcher. In the role of the teacher, I was responsible for planning and implementing the instruction provided to the students based on the District curriculum. As the researcher, I gathered both qualitative and quantitative data in an attempt to answer the research questions set forth in the study. A dual role presented both pros and cons for the study.

Positive characteristics of the dual role of researcher/teacher include an in-depth understanding of the curriculum and students, as well as, frequent opportunities to gather data. The dual role allowed extra flexibility when structuring and implementing the innovation. As long as the District curriculum was followed, I had the ability to present the information in whatever manner I saw as most beneficial to my students. Another critical benefit to the dual role became evident when obtaining parental consent. Parents appeared to be more willing to allow their child to participate in a study that was conducted by a familiar figure, their child's teacher, than an outside researcher who was unfamiliar to them. Only two of the twenty-four parents did not fill out a signed parental consent form for their child. The decline was implied as no paperwork was returned. It was believed that one unreturned paper was due to a language barrier, the parents spoke little English. It was unknown why the second parent failed to return the paperwork.

Drawbacks to the dual role were also considered. Being both the researcher and the teacher was challenging due to increased demands on time, resources, and organization. If I held only one of these positions, I would have been able to focus all of my time on just one area versus dividing my time between the two. The next two drawbacks tie into bias. First, I needed to be aware of my own biases. As a teacher, I have opinions on how I think mathematics should be taught. I had to make sure not to allow my opinions to cloud the data that was collected. I needed to be open to what the data was showing. Second, I needed to be careful not to express my biases to the children, either directly or indirectly. Kindergarten students are eager to please their teacher. I did not want my wording, facial expressions, or actions to sway the children's opinions about mathematics. This was especially important during the data collection phase of the study, specifically the Student Attitude Survey.

Procedures

Approval. Three different forms of approval were obtained before data collection began. First, the site manager, in this study the building principal, provided written consent for the study to take place at the school. The principal was informed regarding the purpose of the study, the research questions, the participants, the data collection methods being used, and any other pertinent information (See Appendix D). Second, approval was obtained from Arizona State University's Institutional Review Board (IRB). Third, consent was gained from the parents of the students involved in the study. In order to make sure that the parents were informed about the goals and process, the study was discussed at Open House prior to the start of the school year. At that time, parents had the opportunity to sign a written consent letter. However, if they had further questions about the study, more time was allotted to meet with individual parents as needed. However, there were no parents that requested further discussion regarding the study. One week prior to the start of data collection, any letters of consent not returned were viewed as declined consent. Any student of a parent who did not give consent still received the innovation. However, no data was gathered or included for that student other than for educational purposes within the classroom that fit within the realm of the teacher's role as classroom teacher. Students with declined parental consent were not videotaped during lessons (See Appendix E).

Innovation

The innovation focused on the effects of using hands-on manipulatives during small group instruction in mathematics on the engagement level and attitudes of kindergarten students. The innovation involved the actual structure of the daily mathematics lesson. In the past, mathematics instruction involved a whole group lesson followed by math centers. Math center being a time when the students were able to rotate to different activities for a brief amount of time while the teacher monitored behavior. The whole group lesson was largely teacher-led. The teacher provided and presented the information to students, who were mostly passive participants of the lesson. Attempts were made to engage the students but only on a basic level. The teacher would ask surface level recall types of questions, possibly modeling an idea with visuals but not truly engaging the students in the process. While this structure allowed the teacher to cover large amounts of material in a fairly short amount of time, the students were not active participants, and the teacher was unable to ascertain each child's level of understanding due to the large whole group setting.

The innovation for the study involved a change in the lesson structure, moving from whole group instruction in mathematics to small group instruction with a focus on the use of hands-on manipulatives. Lessons were taught in a small group setting in which the students were expected to be active participants in the lesson. While in the small group setting, hands-on manipulatives were used on a daily basis by each student. Chi & Wylie's (2014) ICAP Framework was used to structure the lessons. As an experienced teacher within the school, I observed that whole group lessons resulted in students being mainly at the passive level of the ICAP Framework. For this study, all small group lessons, the teacher behavior was targeted to be at least at the active level or higher during small group mathematics instruction. "Active" was the minimum requirement for the lessons, every attempt was made to move the lessons to either construction or interactive, if possible.

In order to categorize lessons into the ICAP Framework, a table of teacher behaviors was generated to allow for consistent classification of lessons. The behaviors listed were used to classify lessons at each level of the Framework (See Table 3). The teacher rubric further ensured that high quality instruction was being presented in conjunction with the use of manipulatives in a small group setting. The rubric encouraged the use of high quality teaching through the use of academic language and questioning by the teacher while interacting with the students. All three components; manipulatives, small group instruction, and high quality instruction, worked together to attempt to move students up the ICAP Framework.

Table 3.

ICAP Framework Examples of Teacher Overt Behaviors during Mathematics Lessons

Level of Behavior	Passive	Active	Constructive	Interactive
Teacher Behaviors Associated with Each Level	Majority of the lesson spent talking "at" the whole group No manipulative provided to students Questioning done in a rapid fire method with little time allowed for student responses between questions Teacher is physically separate from students (possible in front of room or board) Does not engage with individual students Few student questions are answered Little to no input is asked of the students	Providing directions/activities for the students to follow Manipulatives are provided but only used in a way directed by the teacher Basic recall and lower level thinking questions asked of students Teacher physical closer to students but still directing the action Interacting with students but mainly to provide direction Providing a model of how the students do the activity	Providing goal of lesson without providing students with the answers Single manipulative provided for lesson, some instruction on how to use manipulative but allows time for student exploration Guiding questions asked (ex What would happen if? Or Could you try..?) Teacher lead member of small group but allows time and opportunity for peer interactions Engaging students but primary focus is to prompt student thinking Encouraging explanation of students thinking process Encouraging hypothesis making and predictions	Minimal role in group instead encourages and facilitates interactions between students Multiple manipulatives provided with ample time for exploration Probing questions (Tell me more. Or Explain your thinking) Integrated in lesson more as a fellow learner and less as a teacher Set stage for learning buy allows students to guide activity/lesson Help students engage in joint dialogue

As stated above, the Chi & Wylie (2014) ICAP Framework was used to structure the math lessons. In Chi & Wylie's (2014) work, as well as the work of other researchers using ICAP Framework, the participants of the studies were older and more mature than those involved in this study; most participants were college-level learners. At this point, I was unable to identify any studies that attempt to use the ICAP Framework with children as young as kindergarten. This may be due to the relative newness of the framework, which was published in 2014. Due to the lack of previous study with this level of student, clarification of what each level looks like at a kindergarten level was needed. The table below provides examples of what each level might look like in a kindergarten classroom. However, as this was a new application of the ICAP Framework, the list is not exhaustive and should be considered a work in progress (See Table 4).

Table 4.

ICAP Framework Examples of Student Overt Behaviors at a Kindergarten Level

Level of Behavior	Passive	Active	Constructive	Interactive
Terms Associated with Each Level	Looking randomly around the room Not making eye contact Not interacting with others Not using manipulatives Being non-responsive Randomly moving around the room	Looking at the teacher/materials/visuals Searching for a specific manipulative Pointing at a manipulative or number Holding up a requested item Copying the teacher/other students action Repeating a direction/word/phrase used in the lesson Rotating/moving manipulatives	Explaining his/her thinking or what he/she is doing with the manipulative Justifying why he/she did something a certain way "I did this because…" Constructing something based on the lesson idea Reflecting orally about what he/she liked or learned during the lesson Self-Monitoring whether or not he/she got the correct answer Generating Hypothesis- making a prediction about what will happen and why Elaborating- explaining something in further detail. Ex. I added the blue square to the pattern to make it longer. Planning-Orally explaining how he/she will do something	Revise Errors based on Feedback-Ex. "Billy did it this way and it work. I am going to try the same thing." Respond to Scaffolding- "The teacher said this. I am going to do that, then do this next." Argue, defend- explain why he/she did something in a certain way Confront-Ex "You said to do this but I did this and it worked." Challenge- Ex. " I think I can build a bigger number than you." Build onto another's thought Joint Dialogue- between peer or teacher around the topic of lesson

The innovation began in September of the 2018-2019 school year and concluded in February of the same school year. Time was allowed at the start of the year for the students to become acclimated to school procedures and routines prior to data collection. The innovation started in the second week of the school year, but data collection did not begin until mid-September. The innovation was conducted on a daily basis during the allotted math instructional time which lasts in duration from sixty to eighty minutes per day, with one videotaped lesson occurring each week. Data was gathered from the videotaped lessons. Data was collected from September until February. A total of twenty videotaped lessons were included in the study. The topics of the lesson followed the District curriculum based on the Everyday Math Series by McGraw Hill. Lessons were completed in the sequential order as proscribed in the Everyday Math teacher's manual. More information regarding the specifics of the series can be found at https://www.mheducation.com/prek-12/program/microsites/MKTSP-TRA15M0.html.

Instruments and Data Collection

Four types of data were collected in the study and are discussed in further detail below.

Videotaping Procedures. Small group mathematic lessons including the use of hands-on manipulatives were videotaped one time per week. Groups consisted of heterogeneously grouped students. Students were chosen randomly using the Class DoJo apps grouping feature. This app randomly grouped all students into small groups based on the requested number of students per group. For specifics on the app, visit https://www.classdojo.com. For the study, groups of six were created. The number of students in each group ranged between three and six students, the exact number varied based on the daily attendance. If a student was absent on the day he/she was to be included in a videotaped group, the group met as dictated by the app with the absent individual not being present. Therefore, some groupings included a range of four, five, or six students. Groups were not reformulated due to absences. Each day the class was divided into four groups. Each week the first randomly generated group was videotaped. The remaining three groups received the same innovation and lesson but were not videotaped. The teacher activated the iPad video function before starting the lesson and turned off the iPad at the completion of the lesson. Both the teacher and students were recorded during the lesson for future data collection. Students without parental consent were seated off camera. At a later date, the videos were viewed for data collection purposes. Time-on-task, transcriptions, and engagement levels of both the teacher and students were recorded. Information was tracked on the time-on-task sheet and the premade engagement level sheets. Each tape was viewed a minimum of three time, once to gather time-on-task data, once to identify engagement levels, and at least once for transcription. More viewings occurred as needed.

Time-on-Task Observation. A time-on-task observation provided the data needed to answer research question 1, "What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?" Time-on-task was measured by tracking overt student behaviors. A momentary time sampling was used, gathering data at 30 second intervals. At each 30 second interval, the student's overt behavior was recorded. The top seven indicators on the tracking sheet coincided with on-task behaviors, while the bottom eight indicators coincided with off-task behaviors. A percentage was then gained for each student. After individual time-on-task scores were tabulated, the scores were averaged together to find a group time-on-task score. The data was gathered from the video recordings made during the small group mathematics lessons each week (See Appendix G). A group time-on-task score was tabulated in an attempt to identify the success of the innovation for use with the entire class, not its success for individual students. For this reason, the time-on-task measure of the whole group was used instead of that of the individual student. The rationale for the use of a group average versus individual averages further included the formations of the groups themselves. Each group was randomly chosen on a daily basis. Due to this random selection, students were working with different students every day. Interactions between different combinations of students could have effected an individual student's time-on-task score, either negatively or positively. For the above stated reasons, the group average was used in the study.

Engagement Level Analysis. The ICAP Framework was used to identify students' specific level of engagement on recorded videos during mathematics lessons as well as teacher behaviors. During each lesson, student actions were coded according to Table 4, as a marker of student engagement in the lesson. Table 3 was used to classify teacher behaviors. All lessons included in the study needed to rate at least an "active" level on the scale of teacher behaviors (See Table 3).

Transcriptions. Once again using the video recording, data was gathered in the form of transcribed lessons. The transcriptions were used to further answer the question of engagement and to elaborate on the Student Attitude Survey. While the time-on-task measure provided quantitative data, the transcriptions provided qualitative data that was used to further support the data gathered during the time-on-task measure to more fully explain what happened during the lesson. Specific examples were used to provide insight into the numbers provided by the quantitative date. Transcriptions were further used to identify ICAP Framework levels for lessons based on the overt behaviors of the students. They were further used to support information gathered from the Student Attitude Survey.

Student Attitude Survey. The Student Attitude Survey was conducted at the end of the data collection period. The Student Attitude Survey was based on a Likert-type scale. However, due to the age and reading ability of the participants, modifications were made. The survey was administered in a whole group setting so that the teacher could read aloud the survey to the students. Students were seated in “secret detective spots.” Secret detective spots were locations spaced out around the room that prevent students from looking at one another’s papers. This allowed students to make their own judgements about each statement without feeling pressure from others to answer in a certain way. The survey was conducted in a whole group setting so that students do not feel pressure to fill in the “right answer” because the teacher was watching them too closely.

In order to help the students provide answers in the correct location while completing the survey, pictures were added by each question to make for easy identification by students, For example, the teacher said, “Put your finger on the picture of the boat. We are going to answer this question now.” On each question, the student was asked to fill in a smiley face corresponding to how he/she felt about each statement. A detailed description of what each face represented was provided on the survey. The student were directed to color in the face that matched how he/she felt about each statement (See Appendix F for the actual survey). The survey was used to answer research question 2, “What were kindergarten students’ attitudes regarding small group instruction and the use of hands-on manipulatives?”

Time-on-task, engagement level, and transcription were collected simultaneously, while the Student Attitude Survey data was collected shortly before the completion of the study. Data gathered for time-on-task, engagement level, and transcription were collected via video recordings of weekly lessons. The decision was made to use video recording due to the researcher’s role as both the teacher and researcher. In this dual role, it would be challenging to collect accurate data in real time. During the lesson, the focus must be on the teaching of the students, not the data collection. Therefore, the video recordings allowed the teacher to go back at a later time and take on the role of the researcher and gather the needed data. The video recordings also allowed for repeated viewings, this was critical because different information for the time-on-task observation, transcription, and engagement levels were gathered from the same tapes.

Data Collection. The data was gathered from September (9/26/18) of the school year until the February (2/19/19). Video recordings were made on the researchers personal iPad held by a tripod. To remove the novelty factor of being videotaped, the iPad and tripod were incorporated into the classroom from the first day of school. Every few days the iPad was moved to a different location in the classroom. This allowed students to become familiar and comfortable with the iPad, so that they become desensitized to it. This desensitization was important in order to gain authentic data, the recordings were meant to capture true behaviors during a lesson, not students “acting” for the camera. It was also important for students who may be shy to get used to having a camera in the room so that a true portrayal of their behavior could be captured.

Data Analysis

Once the data was gathered, it was analyzed to answer the study's research questions. Research Question #1, "What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?" and Research Question #2, "What were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?" The table provided below shows exactly which types of data were used to answer each of the research questions (See Table 5).

Table 5

Data Collection Method and Research Question Correlation

Data Collection Tool	Time-on-task Observation	Engagement Level	Transcripts	Student Attitude Survey
Type of Data	QUAN	QUAN	QUAL	QUAN
Research Question #1-What level of engagement do kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?	X	X	X	
Research Question #2-What are kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?			X	X

Time-on-task analysis provided solid quantitative data to answer the first research question involving student engagement. The Student Attitude Survey data, transcriptions, and engagement level were used to support and elaborate these findings. Therefore, the time-on-task and engagement level measures were analyzed first. Based on a discussion with the local school psychologist, a specific level of acceptable time-on-task was set at 80%. Further evidence was found to support the 80% time-on-task rate in the Imeraj et al (2013) study, regarding classroom time-on-task behavior. The study found that students diagnosed with ADHD were on average focused in a classroom setting 75% of the time, and typically developing students were on-task 88% of the time (p. 488). Setting this study's time-on-task behavior of 80% within that range, allowing for both typically developing students and those with ADHD the opportunity to be successful during the innovation. Godwin et al (2016) found students in a regular education classroom to be off-task 10-50% of the time (p. 129), again falling within the 80% range. A time-on-task percentage was calculated for each student in the videotaped lessons. Then the percentages for each student was averaged to find a group percentage. This was done for each lesson. Twenty lessons were taped. A percentage for each lesson was graphed over the course of the study. Engagement levels using the ICAP Framework were also tracked for each lesson, for both the teacher and student overt behaviors.

Data analysis was conducted next. In order to analyze the quantitative data gathered from the student questionnaire, SPSS version 25 statistics package was utilized. Specifically data was examined to identify student views on whole group versus small group lessons, willingness to participate in different settings, and self-efficacy regarding mathematics in general. Frequencies were analyzed for each question and a 2 tailed t-test was conducted. The qualitative data gathered through the transcriptions was analyzed using thematic analysis. Once the videos were recorded, transcriptions and observations were documented through multiple viewings. The transcriptions were then open coded. After open coding was complete, themes were identified. Four themes were identified, student-student interaction, teacher-student interactions, positive comments regarding the lesson, and negative comments regarding the lesson. Each of the four themes were assigned a specific color on the transcripts. The frequency of each type of comment was tallied for each lesson. The findings were compiled on a table. These themes are discussed in relation to the quantitative findings, providing concrete examples whenever possible.

The recordings were further used to classify each lesson based on the ICAP Framework. In order to do this, Table 3 was used. The table identified overt teacher behaviors that could be seen in each type of lesson. This table allowed for consistent classification of lessons on the ICAP Framework. The recordings were used to record overt student behaviors in order to classify the lesson's level of engagement on the ICAP Framework.

Validity

Validity was taken into account when structuring the study. Three procedures were put in place to increase the validity of the study. First, triangulation was utilized. Triangulation occurs when multiple types of data are used to answer the research questions (Creswell, 2015). In this study, both qualitative and quantitative data were used. Data was gathered from transcripts, Student Attitude Survey, engagement levels of both the students and teacher, and time-on-task measures. These various types of data were used to corroborate the study's findings. Second, long-term observations occurred. By spending a great deal of time in the data collection context, a better understanding of the situation occurred. This was one benefit of being both the researcher and teacher. I was regularly and deeply immersed in the situation, which provides a deep and complete understanding of the situation. Twenty lessons collected over a twenty-week period were included in the data. Third, peer examination was used to validate the study and data.

Peer examination allowed peers within the local context to view the study. Based on their expertise in the field they were able to provide insight into the process and data collected. This technique is similar to member checking, when one or more participants review the study to check for accuracy (Creswell, 2015). However, due to the age of the participants in the study, member checking was not a viable option.

One further concern for validity should be stated, specifically concerning the Student Attitude Survey. A limitation to the Student Attitude Survey involved the participants' age and maturity level. While the students successfully followed the teacher's directions and completed the survey, it cannot be proven that the students fully understood the task at hand. It is unlikely that the students had previously completed a survey, due to their young chronological age, or understood the purpose of a survey. This may have led to them filling in the "faces" based on which one they like best instead of matching the face to the corresponding feeling. It is unclear whether or not the students understood the complexity of the task. However, as the participants of the survey were the individuals actually receiving the innovation, it was important to hear their thoughts and feelings on the innovation.

CHAPTER 4

DATA ANALYSIS AND RESULTS

"Education is a natural process carried out by the child and is not acquired by listening to words but by experiences in the environment."

-Dr. Maria Montessori

The following chapter focuses specifically on the data gathered during the implementation of the innovation; including both quantitative and qualitative data in this mixed methods study. Using both forms of data allowed for a more in-depth ability to answer the research questions. The quantitative data included time-on-task during academic instruction, labeling engagement levels using the ICAP Framework rubric for both teacher behaviors and student behaviors, and the results from the Student Attitude Survey, while the qualitative data included the transcription data gathered during each lesson. The two guiding research questions were:

1. What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?
2. What were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?

The time-on-task measure and ICAP engagement levels were used to answer the first research question, while the Student Attitude Survey was used to answer the second. The transcripts were used to help contextualize and provide additional support for both research questions.

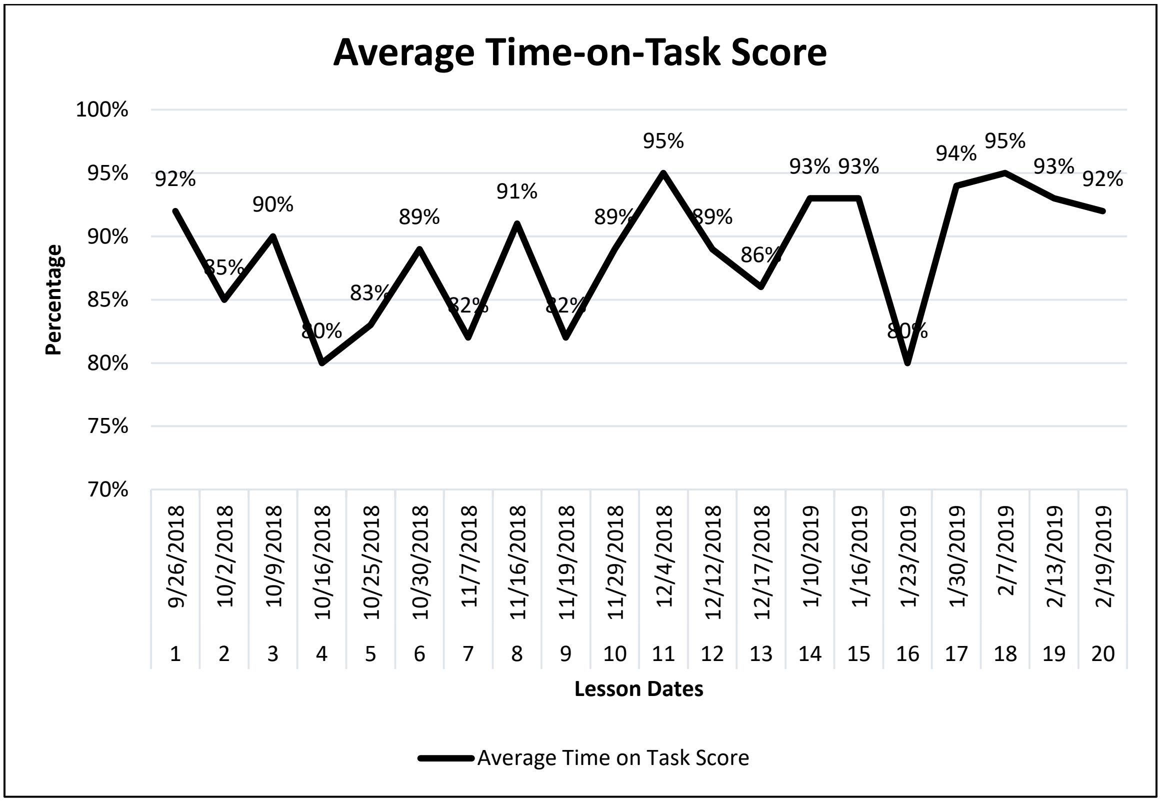
For the first research question on engagement, the time-on-task measure provided the primary data. ICAP Framework levels, of both students and the teacher were then coded, and transcription data was used as further contextual information to more fully respond to the question. To analyze the student survey data, SPSS version 25 was used to calculate frequencies for each survey item, as well as to identify statistical significance between items. The remainder of the chapter provides specific data for each data collection tool, first focusing on the quantitative data before moving to a discussion of the qualitative data.

Quantitative Data

Time-on-Task Measure. A multi-step process was used to calculate the students' time-on-task during instruction. First, each student's time-on-task was calculated using the basic mathematical computation to find the average (average= total sum of all numbers/number of items in the set). The time-on-task measure was broken down into 30-second intervals. At each 30 second mark, information was recorded regarding the student's most frequent observable behavior during that 30-second interval. The first seven descriptors indicated on-task behavior, while the last eight indicators were classified as off-task behaviors (See Appendix G). Time-on-task was measured twenty times for each group member during each lesson for ten minutes (See Appendix H for specific individual student time on task averages). After the average for each student was calculated, a group time-on-task score was then calculated using the same mathematical equation for average, but across all students in the same group. The acceptable level of engagement was set prior to data collection at 80%, meaning for the innovation to be considered successful, the group average for the lesson needed to equal or exceed 80% time-on-task behavior by students. As can be seen in Figure 4, all lessons included in the study met or exceeded the 80% requirement. The lowest percentage was 80%, recorded in lessons four and sixteen. The highest time-on-task percentage was recorded for lessons eleven and eighteen, at 95% time-on-task behavior (See Figure 4).

Figure 4.

Average Time-on-Task Score



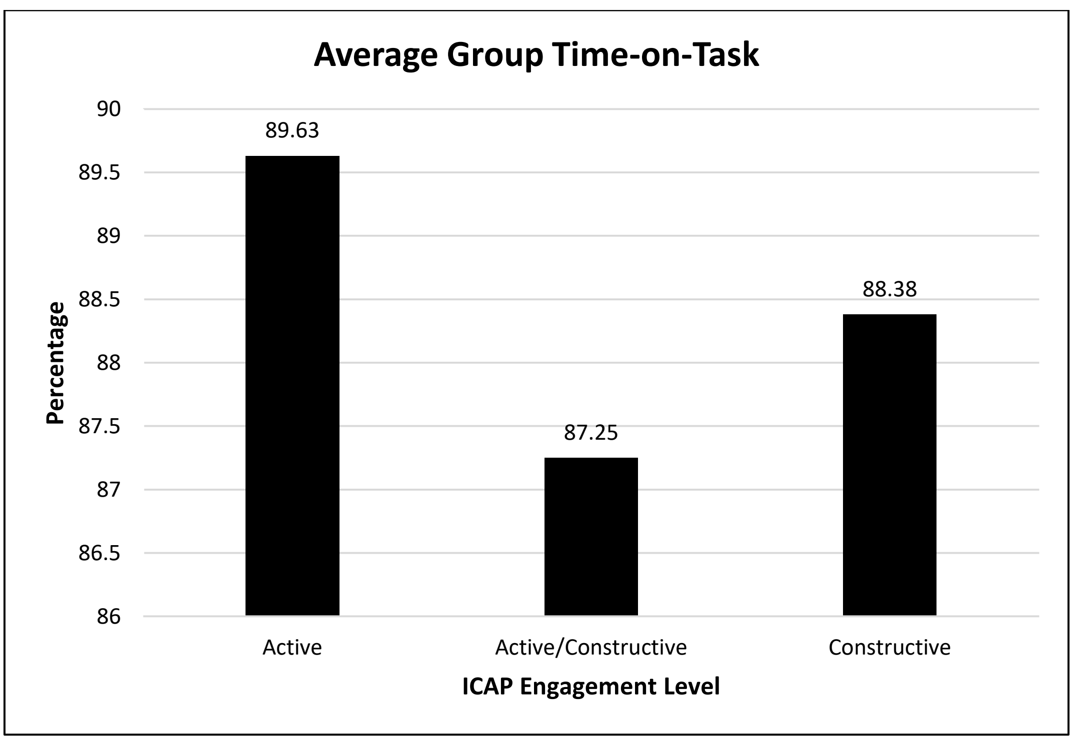
Note: The average (on the above table) was taken from one group during each recorded session. Each session contained a random grouping of students that changed for every lesson.

As stated previously, all lessons were at the active level of engagement or higher using the ICAP Framework. Lesson were coded based on the teacher ICAP Framework Rubric. After viewing the lesson recordings, specific teacher behaviors were identified and circled on the rubric, the overall rubric was then analyzed to classify the lesson into one of the four ICAP Framework categories. No lessons during the data collection period were found to be at the passive level of engagement based on the teacher ICAP rubric. Therefore, data is only shown for active, active/constructive, and constructive lessons. Active/constructive lessons being lessons that scored an equal number of indicators on both the active and constructive columns of the teacher ICAP Framework rubric (See Table 3). None of the lessons used during data collection reached the interactive level of the ICAP Framework; therefore, no information on interactive lessons was included.

Based on the teacher ICAP Framework rubric, lessons categorized as active had the highest group time-on-task percentage with 89.63%. Constructive lessons had an 88.38% of group time-on-task behavior, while the active/constructive lessons had a combined group time-on-task percentage of 87.25% (See Figure 5). All three of the engagement levels exceeded the 80% group time-on-task level set at the onset of the study.

Figure 5.

Average Group Time-on-Task



Engagement Level

ICAP Framework (Teacher). In order to consistently determine the level of each lesson, the teacher's overt behaviors were observed and recorded on a premade rubric (See Table 3). Based on the ICAP Framework of engagement teacher rubric all lessons in the study reached at least the active level of engagement, none of the lessons qualified as passive. It was found that out of the twenty lessons included in the study, 40% of the lessons fell into the active category of engagement, 20% fell into a combination active/constructive level, 40% of the lessons were classified as constructive, 0% of lessons were passive, and 0% of lessons fell into the interactive range (See Figure 6). Lessons were considered active/constructive if there were an equal amount of indicators marked on the rubric for more than one of the engagement categories. For example, in lesson five, three teacher behaviors fell into the active category of engagement while three teacher behaviors fell into the constructive category, indicating an even split between engagement levels. Therefore, lesson five was considered an active/constructive lesson.

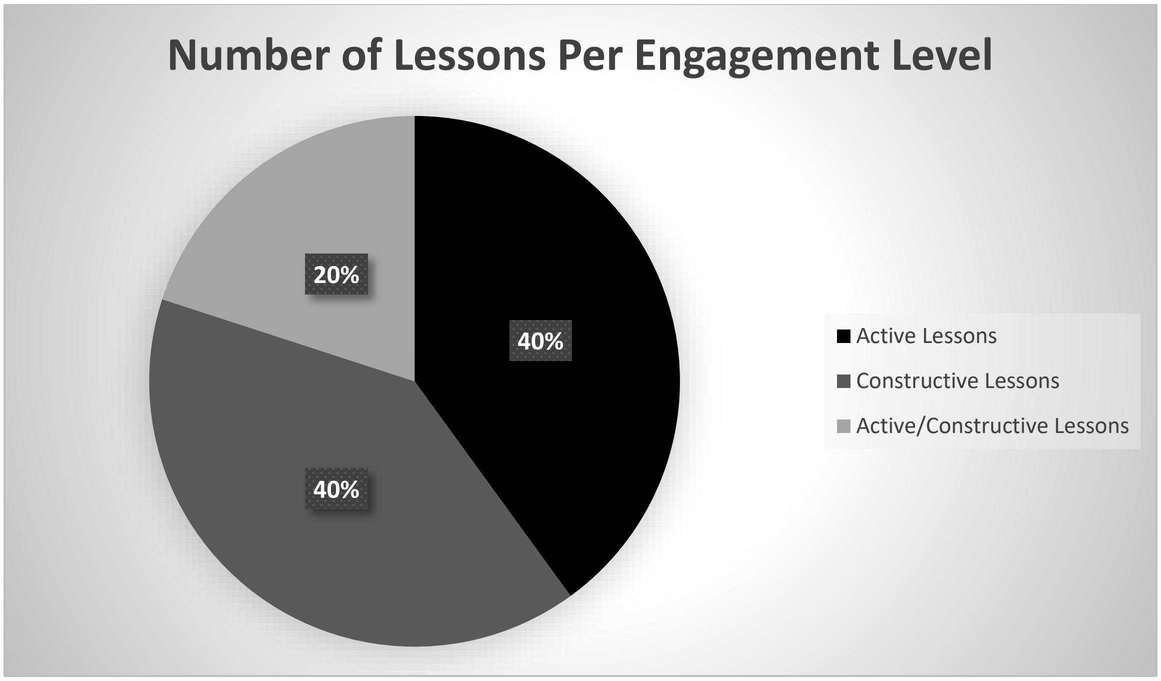


Figure 6.

Number of Lessons per Engagement Level

None of the lessons using the teacher ICAP Framework rubric fell into the passive category. Passive lessons are those lesson in which the teacher is the main focus of the lesson, and the students are passive observers. Only two occurrences of passive overt teacher behaviors were found on any of the teacher rubrics. Occurring on one indicator in lesson four and on one indicator in lesson eleven, both of these occurrences involving the same teacher behavior classification. The classification stated that the teacher spent a "majority of the lesson talking 'at' the group."

It should further be noted that none of the twenty lessons fell into the interactive level of engagement. Out of all twenty lessons, only one indicator on the teacher rubric was found to have met the requirement for an interactive lesson. This occurred in lesson six, regarding the indicator that stated, "Multiple manipulatives provided with ample time for exploration."

ICAP Framework (Student). To further understand engagement, data was collected during each lesson regarding individual student engagement levels. A rubric containing overt student behaviors was used. It contained the same four ICAP Framework categories: interactive, constructive, active, and passive, as the teacher rubric; however, this rubric explicitly focused on student behaviors (See Table 4). The data showed that in seven lessons, all students within the group fell firmly into the active category of engagement, while in eight lessons, the students had an active-active/constructive-constructive combination of scores. In four lessons, students had a combination of active and passive scores. Only one indicated a combination of active, passive, and constructive scores (See Table 6).

Table 6

Results from Student ICAP Framework Rubric

Results from Student ICAP Framework Rubric	
Number of Lessons	ICAP Framework Category based on Rubric
7	Active only
8	Active, Active/Constructive, Constructive
Combination	
4	Active and Passive Combination
1	Active, Passive, Constructive Combination

Student Attitude Survey. In order to analyze the Student Attitude Survey, frequencies for each question on the survey were calculated. Questions one through fourteen had twenty-two valid responses with no missing or invalid responses. Question fifteen had twenty-one valid responses and one missing response. All complete data was analyzed to answer the study research question. There were not enough participants to evaluate the survey with a factor analysis, so each item was evaluated independently. The survey was broken into four parts. Part one consisted of two questions that gathered demographic information regarding students' age and gender, and are reported in the participants section of the methods.

Part two of the Student Attitude Survey consisted of five questions that focused on the students' feelings pertaining to math. The survey showed that 72.7% of students either liked or really liked math. It further showed that 72.7% of students thought that math was important or really important, and 77.3% thought that they were learning new things in math class. While a large percentage of students, 86.3%, thought that they were good or really good at math, a smaller percentage (59.1%) reported liking or really liking the idea of spending more time on math each day (See Table 7).

Table 7
Part 2-Feelings about Math

Part 2- Feelings about Math

Questions	4-Really Liked	3-Liked	2-Okay	1-Did Not Like
How do you feel during math class?	31.8	40.9	22.7	4.5
Do you think that you are good at math?	63.6	22.7	13.6	0
Do you think that math is important?	50.0	22.7	13.6	13.6
Do you think that you are learning new things in math?	45.5	31.8	9.1	13.6
How would you feel if we spent more time on math each day?	31.8	27.3	18.2	22.7

The third part of the survey focused on the students' feelings about specific parts of math class. Five questions were used to gather this information. A large majority of students (81.9%) either liked or really liked using manipulatives during math class. A similar number of students liked or really liked working with a partner during math (81.8%). The survey further showed that an equal number of students liked or really liked working in small groups as did working with just the teacher during math class, 68.2% each, while slightly more students liked or really liked whole group math lessons, 72.7%. (See Table 8).

Table 8
Part 3- Feelings about Parts of Math Class

Part 3- Feelings about Parts of Math Class				
Questions	**4-Really Liked**	**3-Liked**	**2-Okay**	**1-Did Not Like**
How do you feel when you get to use materials that you can hold in your hands, like pattern blocks and unifix cubes?	45.5	36.4	9.1	9.1
How do you feel when you get to work in a small group with the teacher and 3 other friends during math?	27.3	40.9	22.7	9.1
How do you feel when you do a math lesson with the whole class?	54.5	18.2	9.1	18.2
How do you feel when you work with just the teacher during math?	50.0	18.2	22.7	9.1
How do you feel when you work with a partner during math?	50.0	31.8	18.2	0.0

The final part of the Student Attitude Survey focused on participation in specific activities during math class. Once again, five questions comprised this section of the survey. Two questions on this section of the survey received identical scores from respondents. In both cases, 81.8% of students indicated that they liked or really liked being called on by the teacher during a math lesson, and they liked or really liked it when others listened to their questions. However, 63.6% liked or really liked raising their hands in a small group setting while only 54.5% liked to raise their hand during a whole group setting. This indicated a significant difference of 9.1% in students who liked or really liked to raise their hands in a small group setting to that of a whole group setting. Finally, 61.9% of students liked or really liked to talk to a friend about math (See Table 9).

Table 9
Part 4- Participation in Activities

Part 4- Participation in Activities				
Questions	**4-Really Liked**	**3-Liked**	**2-Okay**	**1-Did Not Like**
How do you feel when you raise your hand during small group lessons?	40.9	22.7	9.1	27.3
How do you feel when you raise your hand during lessons when everyone is together?	40.9	13.6	22.7	22.7
How do you feel when you are called on by the teacher?	68.2	13.6	13.6	4.5
How do you feel when other people listen to your questions?	59.1	22.7	9.1	9.1
How do you feel when you get to talk to a friend about math?	28.6	33.3	33.3	4.8

In order to compare students' attitudes regarding math in different structures within the class, a series of paired samples tests were conducted comparing students' impressions of whole class, small group, individual, or peer work, specifically (questions 7 through 10 on the Student Attitude Survey). Each item was compared to all of the others, and there were no significant differences in students' ratings of the different types of instruction, except between small group and peer work during math instruction. Students rated liking peer work significantly more (M=3.32), SD=.780) than small group instruction (M=2.86, SD=.941; t(21)=2.11, p=.047).

Qualitative Data

Transcription Data. Each of the twenty lessons were transcribed to gather further data on engagement and student attitudes towards math. Transcription were based on video recordings of each lesson; it was not done in real time. Transcriptions involved dialogue during the twenty recorded lesson. There were no interviews or leading questions asked, only naturally occurring conversations during a math lesson using the innovation. The transcriptions were then coded into four categories. These categories were: positive statements regarding math, negative statements regarding math, student-to-student interactions, and student-to-teacher interactions.

Student-to-teacher interactions were evident in all twenty lessons. Student-to-teacher interactions were classified as a verbal dialogue regarding the math topic between the teacher and one individual student, not the teacher interacting with the entire small group. This type of interaction involved students and teacher asking questions to one another or discussions revolving around clarifying thinking on the topic. One example of a student-to-teacher interaction was found in lesson five.

> "Look at your two items. Hold up the one that is longer. So between the two things which is longer? Who can prove to me which is longer?" (teacher)
> "This is longer" (student)
> "But prove it" (teacher)
> "This is so short. This is long" (student)
> "See how she compared them" (teacher)

During lesson ten, the students were making patterns, AB patterns, ABB patterns, ABC patterns, during this time, another example of a student-to-teacher interaction occurred.

> "What if we did the whole alphabet?" (student)
> "If we did the whole alphabet (student's name) how many different colors would we need? Do you know how many letters are in the whole alphabet?" (teacher)
> "No, I don't" (student)
> "Look and see if you can figure it out. Look at the alphabet up there" (teacher)
> "22?" (student)
> "Actually there are 26. You would need 26 different colors" (teacher)

Student-to-student interactions were also identified in the transcripts. Student-to-student interactions were found in seventeen of the twenty lessons. No student-to-student interactions were evident in lessons five, six, and thirteen. Student-to-student interactions mainly involved students sharing ideas and work with one another. An example of idea sharing can be found in lesson one's transcript,

> "Wait, I know! We can use these ones and a square" (child 1).
> "Yeah, okay" (child 2).

A second example of the student-to-student interaction can be seen in lesson eight,

> "(Student's Name) try a triangle. Try a triangle" (child 1).
> "I will" (child 2).
> "No, that won't work" (child 3).

Furthermore, a third example of the student-to-student interaction can be seen in lesson ten, while students were attempting to make ABC patterns using pattern block shapes.

> "ABC" (child 1)
> "You would be like yellow, black, red" (child 2)
> "You would have to pick a different one" (child 3)
> "Okay guys, why doesn't each one of us pick a color" (child 1)
> "Okay" (child 3)

Transcriptions were further analyzed for positive and negative comments regarding math by the students. Teacher comments were not analyzed, as the teacher's attitude regarding math was outside of the domain of this study. It was assumed that the teacher would act professionally at all times; therefore, all comments regarding math would be positive, as it would be unprofessional to speak negatively about a subject that is being taught to students. Since no direct questions were asked of the students during lessons as to their feelings regarding math the positive comments were more general. For example, in lesson one, a student commented, "That's easy," and in lesson fourteen, "I can do it!" Numerous comments expressed excitement about activities, such as "Bam, did it" (lesson 14), "This looks like fun" (lesson 15), and "This is cool" (lesson 17). Simple comments such as "Wow" were found in lessons two, eleven, and twenty. Thirteen out of twenty lesson contained at least one positive comment made by students in relation to the lesson. These comments indicate a positive feeling towards the math activities being conducted during the lessons.

Transcripts were further analyzed for negative comments regarding math or the math activities conducted during the lessons. No explicit direct negative comments were found. Only two comments were found that could be construed as negative; however, it could be argued that these were just statements of fact, not negative comments. In both lessons eight and twelve, a student commented, "This is hard" during the activity. Only two out of twenty lesson contained possible negative comments in relation to the lesson. (See Appendix J for specific frequency details)

Summary

Regarding the first research question, what level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics, the time-on-task data showed that students exhibited a high level of engagement during small group hands-on mathematics instruction. Engagement levels were 80% or higher for lessons falling into the active or higher range using the ICAP Framework using the teacher rubric. The 80% level of successful engagement met the criteria outlined in this study to indicate that the innovation of small group hands-on instruction was successful. The level of successful engagement was further supported by the student ICAP rubric. Based on the rubric, 92% of students were engaged at the active level or higher during the lessons, specifically, 68% active level, 17 % active/constructive level, and 7% constructive level. Only one rating of passive was indicated and there were zero interactive classifications.

The second research question, what were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons, was answered using the Student Attitude Survey and transcripts from lessons. Students mentioned enjoying the activities, feeling like they could be successful in lessons, and took an active role in their work. The Student Attitude Survey similarly showed that students liked mathematics instruction, in general, and felt successful in their work. They reported liking peer-to-peer work more than small group instruction, however. Overall, the data indicated that the innovation of small group instruction with the use of hands-on manipulatives in mathematics to be successful.

CHAPTER 5

DISCUSSION

"Children learn as they play. Most importantly in play children learn how to learn."
-Fred Donaldson

From the inception of this study, the goal was to learn more about how developmentally appropriate practices in kindergarten impacted student engagement and attitudes, specifically in the area of mathematics. An innovation was designed and implemented in a self-contained full-day kindergarten classroom. The innovation itself involved altering the structure of mathematics lessons, moving from a mainly whole group lesson approach to small group lessons that incorporated the use of hands-on manipulatives. Both qualitative and quantitative data were gathered over a six month period to answer the study's two research questions.

1. What level of engagement did kindergarten students display during the use of hands-on manipulatives during small group instruction in mathematics?
2. What were kindergarten students' attitudes regarding the use of hands-on manipulatives during small group instruction during mathematics lessons?

Research question one focused on engagement levels of students during small group hands-on mathematics lessons. Time-on-task data was gathered to answer the question. It was found that all twenty lessons included in the study, had an 80% or higher time-on-task group average, which met the goal level of 80% set at the onset of the study. Average group time-on-task percentages ranged from 80-95%. With the average group time-on-task being highest for lessons that were considered active using Chi & Wylie's (2014) ICAP Framework, with a combined average of 89.63%.

Time-on-task is an important factor in a student's learning. Multiple studies have supported the need for student engagement in kindergarten students' mathematical growth and achievement (Robinson & Mueller, 2014) as well as successful learning (Goldwin, Almeda,& Petroccia, 2013). Other studies have suggested the need for movement in the learning process (Snyder, Dinkel, Schaffer, Hiveley, & Colpitts, 2017). Thus, it was not unexpected that students were highly engaged in small group lessons with manipulatives they were able to physically move throughout the lesson.

The lessons were structured in a way that encouraged the use of manipulatives. During each lesson, the teacher provided manipulatives for the students to use to help develop the mathematical concept being presented. The teacher made sure that there were enough manipulative available so that all students had their own materials, or at the very most, only two students were required to share materials. This allowed the students to spend the majority of the lesson working with manipulatives. The availability of manipulatives may have also contributed to the on-task behavior demonstrated by the students.

Piaget

Piaget believed that learners should incorporate materials to help with problem-solving and that hands-on activities were of the utmost importance for young learners (Ojose, 2008). Ojose (2008) further summarized Piaget's thoughts by stating, "As students use the materials, they acquire experiences that help lay the foundation for more advanced mathematical thinking" (p 28). Piaget's Theory of Cognitive development directly supported the use of hands-on manipulatives. Based on Piaget's research, he identified students between the ages of 2-7 years old to be in the pre-operational stage of cognitive development. The pre-operational stage is the time in which students are making a mental model of the world (McLeod, 2009). At this stage, children should be learning and exploring the world around them in concrete physical ways (Fuson, Ojose). This type of hands-on learning was the basis for the innovation in this study. Each lesson in the study was structured to allow students to physically manipulate objects in an attempt to build a deeper understanding of the mathematical concepts being presented in the lesson.

The study further looked into students' feelings regarding the use of hands-on manipulatives. In the second section of the Student Attitude Survey, students were asked to rate their feelings regarding the use of manipulatives. In response, 81.9% of students "liked" or "really liked" using hands-on manipulatives such as unifix cubes and pattern blocks during math lessons. This enjoyment may have contributed to increased engagement during lessons.

The combination of empirical support for Piaget's Theory of Cognitive Development and the students' feelings regarding the use of manipulatives during mathematics, as indicated on the Student Attitude Survey, provided a strong foundation for the innovations continued implementation in order to engage students during mathematics instruction. While Piaget was used as support for the use of hands-on manipulatives, Lev Vygotsky's theory regarding the Zone of Proximal Development was put forth as support for the innovation's structure of small group instruction.

Vygotsky

Vygotsky's Zone of Proximal Development further supported the innovation within this study, specifically the implementation of small group instruction. The Zone of Proximal Development refers to, as Fani & Ghaemi (2011) stated, the difference between a learner's actual IQ and the learner potential IQ. Zone of Proximal Development further refers to the student's ability to move from their current level of understanding to that of a higher level with the guidance and support of an adult or more experienced peer who is able to provide scaffolding to the learning. Scaffolding allows students to grow further in their learning than they could do independently. The use of scaffolding and adapting instruction to the Zone of Proximal Development come into play when students can interact with the teacher regarding mathematical concepts. This interaction is not always possible in a whole group setting.

Increased time-on-task behavior during small group instruction may have been due to the increased interactions between the teacher and student, as well as increased interaction with peers. In this study, only four to six students were in a group with the teacher. This allowed for a 1:6 per teacher/student ratio versus the 1:24 teacher/student ratio that would have occurred during whole group lessons. A smaller teacher/student ratio allowed for more interactions to occur between the teacher and individual students. It is unreasonable to think that a teacher could interact with all 24 students individually during a whole group lesson. However, it is not unrealistic for the teacher to interact with four to six students individually during a small group lesson timeframe. For this study, groups of four to six students were possible, based on class size and availability of multiple centers for rotation. However, the size of groups in future implementations may vary due to overall class size and space options. Enu, Danso, and Awortwe (2015) found that the exact size of the groups did not matter, instead groups should be "small enough to promote positive interdependence, yet as large as necessary to provide sufficient diversity of opinions and background as well as resources to get the work done" (p. 119). By working in small groups, the teacher was more able to differentiate instruction and meet the varying needs of students (Desoete & Stock, 2013). No longer were lessons being presented above or below a student's academic level. Instead, the teacher was able to meet the student at his/her Zone of Proximal Development and tailor the students' work to their own level (Margolin & Regev, 2011).

Kindergarten small group math instruction has been shown to be developmentally appropriate for kindergarten programs in the past, and have led to consistent, high-quality instruction (Elicker & Mathur, 1997). This is likely because of the ability to adapt instruction to students' levels. Doabler & Fien (2013) found that early math instruction should be intense and challenging enough to meet the needs of all students. This is not always possible in the larger class grouping, but with student-specific adaptations that can be made in the small group setting, students are more likely to be challenged in their math tasks.

In this study, student-to-teacher interactions were coded using the lesson transcripts. Student-to-teacher interactions were identified in all twenty lessons, indicating a high level of interaction between the two groups. It can be inferred through these interactions,that the teacher was attempting to scaffold the learning for each student. To further support student-teacher interactions, the Student Attitude Survey showed that 68.2% of students liked or really liked working with the teacher and a small group of other students. These factors together point to a positive student performance, as well as perception of small group mathematics instruction.

While research question one focused on engagement, research question number two focused on students' attitudes regarding mathematics, specifically looking at the students' feelings about math, feelings about parts of math class, and feelings about participation in mathematics activities. The data in this area was less clear cut than the data regarding engagement, as the participants in this study were kindergarten students, so unable to give extensive information about their attitudes. However, the information they did provide was still promising. The Student Attitude Survey suggested that a majority of students held positive feelings about math class in general, as well as in each of the specific areas. The indicators "liked" or "really liked" on the survey received scores of 59.1% to 86.3% in the first section regarding feelings about math. The second section, feelings about specific parts of math class, had scores ranging from 68.2% to 81.8% for the "liked" and "really liked" indicators. In the final section regarding participation in mathematics lessons, 54.5% to 81.8% "liked" or "really liked" participating in mathematics in a variety of ways. The lowest percentage can be seen regarding students' feelings about raising their hand in a whole group setting. Only 54.5% of students "liked" or "really liked" raising their hand in a whole group setting, while 63.6% "liked" or "really liked" raising their hand in a small group setting. This suggests that more students were willing to participate and engage in math lessons in small groups than they were in a large group setting and support the use of this innovation.

The students' willingness to participate more frequently in a small group setting versus whole group might have had to do with their enjoyment of the activities. Howard, Perry & Tracy (1997) found that students enjoyed working with manipulatives. Throughout this study, students expressed their enjoyment with comments like "Wow" and "Look at this" during instruction. This enjoyment may have led them to be more open to discussing what they were doing and why. During small group time, students were able to express themselves in a way that was just not possible in a whole group setting. Students were able to share their thought process and knowledge with fellow peers and the teacher (Johns, 2015). Johns found that kindergarten students expressed their math understanding in a variety of ways, such as through actions, conversations and questions (p. 1021). The teacher encouraged these interactions during the study by asking students to share thoughts with a partner or with the small group. Because of the small group size, each child was able to share, and appeared to enjoy the experience. They even noted on the Student Attitude Survey that they liked sharing with a partner most over small group or whole group instruction.

Two unexpected findings were identified in the data. First, the data showed that more students liked or really liked working with a partner (81.8%) versus working in small groups (68.2%). While students stated that they enjoyed working with partners, the study did not investigate the students' time-on-task during partner work. Students may enjoy working with a partner, but there was no data collected to determine if they were actually engaged in and completing the assigned tasks during partner work. Future study would be needed to examine a comparison of the effect of time-on-task behavior in small groups versus partner work. The second unexpected finding involved data indicating that students liked or really liked working in a whole group setting (72.7%) more than working in small groups (68.2%). This was in contrast to reporting that they felt more comfortable raising their hands in the small group setting versus whole group setting. Again, this concept fell outside of the scope of the study. Time-on-task data was not gathered in a whole group setting. So, while students felt positive about working in small groups (68.2%), they expressed even more positive feelings towards whole group work (72.7%) and partner work (81.8%). However, due to the lack of data collected in these two areas, whole group work, and partner work, it cannot be determined if the students were more or less on-task during these activities.

Overall, the data from this study positively supports the use of small group mathematics instruction with the use of hands-on manipulatives. This was an indication that the innovation was successful in fostering student engagement during math lessons, as well as creating positive feelings towards mathematics in general.

ICAP Framework

Chi & Wylie's ICAP Framework played a critical role in the development and success of the innovation, as well as the validity of the data collected. The ICAP Framework allowed instruction to be organized with consistent classification within the study. The four levels of engagement in the ICAP Framework were passive, active, constructive, and interactive. The study attempted to engage students more fully in mathematics lessons; for that reason, all lessons included in the study were designed to be at the active level of engagement or above. The data showed that 40% of lessons in the study were considered active level, 20% were classified as an active/constructive combination, and 40% were considered constructive based on the teacher ICAP rubric.

It should be noted that no lessons reached the interactive level. The interactive level was likely not attained due to the limited language development and conversational skills of the students. In order for a lesson to be considered interactive, students needed to be able to hold a joint dialogue pertaining to the topic, challenge others thinking, confront, argue and defend their position on a mathematics topic. These are advanced skills which are not easily found in kindergarten students due to their limited exposure to academic language and advanced conversational skills. While not unattainable, it would be rare to have a mathematics lesson in kindergarten that would meet the needed criteria for an interactive level of engagement. As active lessons were the most engaging for kindergarten students, when developing lessons, the teacher should attempt to structure lesson in the active and constructive levels, targeting those specific identifiers on the ICAP teacher rubric. It was further difficult to reach this level of interaction using heterogeneous grouping. A few of the study's participants displayed some interactive traits. However, due to the heterogeneous grouping, they were not necessarily paired with other students at a similar level; instead, they were randomly grouped with students of varying ability. Two-way interaction is needed by two or more students to reach a higher level of engagement. This two-way interaction was not possible with students not yet working at an interactive level. As no studies using the ICAP Framework have been identified in the research working with such young students, further study into this topic may be useful to better understand the potential within the kindergarten classroom to reach each of the ICAP levels.

Limitations

While every attempt was made at the inception of the study as well as throughout the planning and implementation process to account for and mediate limitations, some limitations occurred that were outside of the realm of control. The limitations of the study are discussed below.

The first limitation of the study was the small sample size. One classroom, consisting of twenty-two students, was included in the study. While the intent of this study was not generalization to all kindergarten classrooms, the small sample size did not allow for certain analysis, such as a factor analysis to evaluate constructs in the Student Attitude Survey.

Another limitation of the study was related to the duration of the study. Data was collected for twenty weeks. The twenty-week period was implemented to fit into the traditional nine-month school year. At the start of the school year, time was allowed for the students to become acclimated to the school setting and expectations. Time was also planned into the recording period to account for school holidays and breaks, while still allowing the twenty lessons to be recorded prior to the end of the school year. It was decided that all data collection needed to be completed prior to the third and final trimester of the academic year, as this was a substantial testing time based on the school calendar. All benchmarks and end of the year testing occurred in the third trimester. For this reason, data for the study was not collected in the third trimester.

A third limitation was the dual role of the researcher. Researcher bias involves the potential for researcher's beliefs to influence the study (Ivankova, 2015). The mere fact that, as the classroom teacher, I chose to focus on small group instruction with the use of hands-on manipulatives implied that I valued these things. While unintentional, this bias may have been passed along to the students through my tone or actions during the course of the study. This bias may have affected the way the participants viewed the activities.

The final limitation involved the Hawthorne Effect. The Hawthorne Effect states that the participants may change their behavior because they know they are being observed (Spencer, 2017). The participants in this study knew that they were being observed in a two-fold manner. First, the participants knew that the lessons were being videotaped, as they saw the start and stop of each recording on the iPad. However, it appeared that this was less impactful than the fact that the student knew that I, as the teacher, was sitting roughly two feet away from them watching their movements and interacting with them throughout the lesson. The participants' behavior could have been drastically different if they were working in a small group with hands-on manipulatives without direct teacher supervision.

Future Recommendations

Implications for Future Practice. Small group instruction with the use of hands-on manipulatives holds potential for future classroom practice. Most importantly is the continued use of the innovation with future classes. The data supports the innovation as a successful way to provide mathematics instruction to kindergarten-aged students. To facilitate the innovation's implementation, the following steps should be taken (a) increase access to and variety of hands-on materials, (b) update lesson plan format to include materials, active ICAP level teacher behavior, and grouping of students, (c) systematic rotation system for math time based on small group instruction, and (d) continued monitoring of student and teacher behaviors using the ICAP Framework rubric. Each one of these points will be discussed in further detail below.

The innovation partially centered on the use of hands-on manipulatives. Even an experienced teacher with a well-established classroom may find the need to supplement his/her current materials. While hands-on mathematical materials may be used for multiple purposes, a large variety of materials would allow for diversity and the ability to better meet the standards in the mathematics curriculum. Materials might include everyday items, such as bean or buttons, that could be repurposed for math lessons or items explicitly created for a mathematical purpose, such as pattern blocks or unifix cubes. Keeping in mind that in the course of the school year, roughly 180 mathematics lessons will be taught. The increase of manipulatives will need to be considered when setting up a classroom for flow, storage, and efficiency. Additional money or resources may need to be cultivated for the purchase of these items.

Secondly, an updated lesson plan format will be needed to track, organize, and plan for small group instruction during mathematics. While the teacher was meeting with small groups presenting the main lesson for the day, the remainder of the class was engaged in a different educational activity. This involved detailed planning to ensure that all students are engaged in learning while the teacher’s focus is on the small group instruction. During the course of the study, a four-group rotation was used to allow the teacher to meet with groups of between four to six students. The four-group rotation included: teacher group using hands-on manipulatives, iPads using mathematical apps, math game required by the District's math series, and a math center time that included a hands-on review of the previous day's lesson. The number of groups needed may vary based on class size. While the teacher's group and review group changed daily, the iPad group and game remained the same throughout the week. This required a great deal of planning and material preparation. By updating the lesson plan format to meet the needs of the teacher for small group instruction, the task of planning and preparation may be more easily accomplished.

The third implication involves the rotation and grouping of students. The use of an app, such as Class DoJo's random grouping function, helped create heterogeneous groups daily. However, some type of tracking system would be helpful to track students who missed lessons due to time out of the classroom. Students miss time in the classroom for a variety of reasons: illness, intervention groups, individualized testing, and unexpected interruptions. The teacher needs to have a way to identify students who missed the small group teacher lesson so that they can be caught up at a later time.

Lastly, an updated working rubric to interpret the ICAP Framework teacher and student behaviors at this early age group is needed. As previously stated, literature on the ICAP Framework at the kindergarten level has not been found. Due to this, the teacher and student ICAP Framework rubrics in this study were adapted from rubrics used for more advanced students. The rubrics were not meant to be seen as an exhaustive list of all possible behaviors. By continually adding descriptors to the rubrics, the document will continue to grow and change. The continual use of these rubrics has the potential to help teachers recognize how to provide active levels of engagement during mathematics instruction.

Implications for Future Research. Throughout the course of the study, further avenues of research were identified. Discussed below are four future courses of research (a) further developing the ICAP Framework at a kindergarten or early elementary level, (b) researching how small group instruction with the use of hands-on manipulatives effects engagement and attitude in different content areas, such as reading, writing, spelling, science, and social studies, (c) delving into the effects of homogeneous grouping of students versus heterogeneous grouping during small group instruction in mathematics, and (d) identify a variety of strategies that would encourage engagement by kindergarten students at the active level of the ICAP Framework.

The ICAP Framework was an invaluable tool during this study to allow for consistent labeling and classification of lessons. However, much of the ICAP Framework information was modified to meet the needs of young learners. During the literature review phase of the study, ICAP Framework studies could only be found pertaining to older, more experienced students. This implies that more research is needed to broaden the application of the ICAP Framework into younger learners. The research and this study showed benefits to using the ICAP Framework model of engagement. Further research could increase its use and real-world application with elementary-aged students.

Secondly, further research could be conducted into whether or not small group instruction with the use of hands-on manipulatives is an effective way to increase engagement and attitudes in different subject areas, such as reading, writing, spelling, science, and social studies. Science seems to lend itself to a more hands-on approach. However, some creative problem solving may be needed to identify ways to incorporate hands-on instruction in reading beyond a superficial level. Reading is a multifaceted skill.

Therefore, it may need to be broken down into smaller increments for further study. Attempting to group all reading skills together in one study may be too large of an undertaking. Future studies could be structured similarly to the current study, tracking time-on-task behaviors, classifying lessons using the ICAP Framework, and gathering students' opinions via a Student Attitude Survey.

A third avenue of research could focus on the actual grouping of students for small group instruction. For this study, the students were grouped randomly into heterogeneous groups. This type of grouping may have affected the level of engagement attainable during the small group lessons. The question arose, what would happen if a group of higher-achieving/functioning students were grouped together? Would they have been able to participate in the conversational interactions that are necessary to reach the constructive or interactive level of engagement on the ICAP Framework? While an interesting question, the current study purposefully chose not to group students by ability. The rationale behind this decision was the concern that if students were grouped by ability, the lower-achieving students might not have received the same rigorous instruction as the higher functioning students. While not intentional, the teacher may not have exposed the lower-achieving group to the same vocabulary or questioning as the higher performing group. However, a future study could be structured to explore the benefits of homogenous versus heterogeneous grouping.

The final research implication to be discussed involves further exploration of strategies that can be employed by the teacher to help kindergarten students work at the active level of engagement on the ICAP Framework more frequently and consistently. This study found that kindergarten students were actively engaged in small group hands-on mathematics lessons at an on-task level of 80% or higher, and most highly engaged when lessons were presented at the “active” level. However, very few lessons had instances of students working at a constructive level, and there were no instances found of kindergarteners working at the highest level of engagement, the interactive leve1. The study focused on reaching the active level of engagement through small group instruction with the use of hands-on manipulatives. However, other strategies and techniques may be available that would further promote active levels of engagement.

Conclusion

Rigorous academic kindergarten programs are most likely here to stay. It is unlikely that the educational system will turn back the clock to a less rigorous time of learning. For this reason, classroom teachers need to be aware of how best to educate their students to meet these rigorous standards while still providing instruction in developmentally appropriate ways. The danger of providing developmentally inappropriate instruction to students is increased stress, which could harm a child’s ability and willingness to learn. Based on the data gathered during this study, small group instructions with the use of hands-on manipulatives in mathematics is one way to instruct kindergarten students successfully. Students were found to be highly engaged in the learning, and express positive attitudes towards the subject, the activities, and themselves. This is a promising first step in finding the right balance between rigorous instruction and developmentally appropriate (and fun!) activities for young kindergarten students.

REFERENCES

Bailey, D. H., Nguyen, T., Marcus Jenkins, J., Domina, T., Clements, D. H., Sarama, J., . . . Spitler, M. (spring 2015). Fadeout in an early mathematics intervention: same old schools or underlying skills? *SREE Conference*, 1-B4.

Bermudian Spring School District. Retrieved from www.bermudian.org

Bodrova, E. (2017). Make-believe play versus academic skills: a Vygotskian approach to today's dilemma of early childhood education. *European Early Childhood Education Research Journal*. doi:10.1080/13502930802291777

Carbonneau, K. J., Marley, S. C., & Selig, J. P. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology,105*(2), 380-400. doi:10.1037/a0031084

Chi, M. T. (2009). Active-Constructive-Interactive: A conceptual framework for differentiating learning activities. *Topics in Cognitive Science*,73-105. doi:10.1111/j.1756-8765.2008.01005.x

Chi, M., & Wylie, R. (2014). The ICAP framework: linking cognitive engagement to active learning outcomes. *Educational Psychology,49*(4), 219-243. doi:10.1080/00461520.2014.965823

Creswell, J. (2015). *Educational Research:planning, conducting, and evaluating quantitative and qualitative research*(5th ed.). New York, NY: Pearson.

Conewago Valley School District. Retrieved from www.conewago.k12.pa.us

Desoete, A., & Stock, P. (2013). Mathematics instruction: Do classrooms matter? *Learning Disabilities: A Contemporary Journal,11*(2), 17-26.

Doabler, C., & Fien, H. (2013). Explicit mathematics instruction: What teachers can do for teaching students with mathematics difficulties. *Intervention in School and Clinic,48*(5), 276-285. doi:10.1177/1053451212473151

Elicker, J., & Mathur, S. (1997). What do they do all day? Comprehensive evaluation of a full-day kindergarten. *Early Childhood Research Quarterly,12*, 459-480.

Enu, J., Danso, P., & Awortwe, P. (2015). Effects of group size on students mathematics achievement in small group settings. *Journal of Education and Practice,6*(1), 119-122.

Fani, T., & Ghaemi, F. (2011). Implications of Vygotsky's zone of proximal development (ZPD) in teacher education: ZPTD and self scaffolding. *Procedia-Social and Behavioral Science*,*29*, 1549-1554. doi:10.1016/j.sbspro.2011.11.396

Fairfield Area School District. Retrieved from www.fairfieldpaschools.org

Fortino, C., Gerretson, H., Button, L., & Masters, V. (2013). Growing up WILD: teaching environmental education in early childhood. *International Journal of Early Childhood Environmental Education*,*2*(1), 156-171.

Fuson, K. C. (2009). Avoiding misinterpretations of Piaget and Vygotsky: mathematical teaching without learning, learning without teaching, or helpful learning-path teaching? *Cognitive Development*,*24*, 343-361. doi:10.1016/j.cogdev.2009.09.009

Garrett, R., & Hong, G. (2016). Impacts of grouping and time on the math learning of language minority kindergartners. *Educational Evaluation and Policy Analysis*,*38*(2), 222-244. doi:10.3102/0162373715611484

Gersten, R., Jordan, N. C., & Flojo, J. R. (2005). Early identification and interventions for students with mathematics difficulties. *Journal of Learning Disabilities*,*38*(4), 293-304.

Gettysburg Area School District. Retrieved from www.gettysburg.k12.pa.us

Godwin, K., Almeda, V., & Petroccia, M. (2013). Classroom activities and off-task behavior in elementary school children. Retrieved June/July, 2019, from https://escholarship.org/uc/item/8mx9h5hq

Godwin, K., Almeda, V., Setlman, H., Kai, S., Skerbetz, M., Baker, R., & Fisher, A. (2016). Off-task behavior in elementary school children. *Learning and Instruction*, *44*, 128-143. doi:10.1016/j.learinstruc.2016.04.003

Holmes, A. B. (2013). Effects of manipulative use on PK-12 mathematics achievement: a meta-analysis. *SREE Conference*, 1-B6.

Howard, P., Perry, B., & Tracey, D. (1997). Mathematics and Manipulatives: Comparing primary and secondary mathematics teachers' views. *Annual Meeting of the Australian Association for Research in Education*,4-10.

Imeraj, L., Antrop, I., Sonuga-Barke, E., Deboutte, D., Deschepper, E., Bal, S., & Roeyers, H. (2103). The impact of instructional context on classroom on-task behavior: a matched comparison of children with ADHD and non-ADHD classmates. *Journal of School Psychology, 51*, 487-498. doi: 10.1016/j.jsp.2013.05.004

Ivankova, N. V. (2015). *Mixed methods applications in action research*. Los Angeles, CA: SAGE.

Jackson, L. A. (2009). Observing children's stress behaviors in a kindergarten classroom. *Early Childhood Research & Practice,11*(1). Retrieved January 25, 2017, from http://ecrp.uiuc.edu/v11n1/jackson.html

Johns, K. (2015). How do kindergarteners express their mathematical understanding? *Universal Journal of Educational Research*, 3(12), 1015-1023. doi:10.13189/ujer.2015.0312110

John-Steiner, V., & Mahn, H. (1996). Sociocultural approaches to learning and development: a Vygotskian framework. *Educational Psychologist,13*(3/4), 191-206.

Kinzer, C., Gerhardt, K., & Coca, N. (2016). Building a case for blocks as kindergarten mathematics learning tools. *Early Childhood Education,44*, 389-402. doi:10.1007/s10643-015-0717-2.

Lam, R. (2013). Maximizing learning from collaborative activities. *Proceedings of the Annual Meeting of Cognitive Science Society,35*, 2814-2819.

Littlestown Area School District. Retrieved from www.lasd.k12.pa.us

Lynch, M. (2015). More play, please: the perspective of kindergarten teachers on play in the classroom. *American Journal of Play,7*(3), 347-370.

Margolin, I., & Regev, H. (2011). From whole class to small group instruction: learners developing mathematical concepts. *Issues in the Undergraduate Mathematic Preparation School Teacher,2*(Feb), 1-13. Retrieved from www.k-12prep.math.ttu.edu.

Marzouk, Z., Rakovic, M., & Winne, P. (2016). Generating learning analytics to improve learners' metacognitive skills using nStudy trace data and the ICAP framework. *Simon Fraser University*,1-6.

Mattoon, C., Bates, A., Shifflet, R., Latham, N., & Ennis, S. (2015). Examining computational skills in prekindergarteners: the effects of traditional and digital manipulatives in a prekindergarten classroom. *Early Childhood Research & Practice,17*(1), 1-9.

McLeod, S. (2009). Jean Piaget. *Simple Psychology*. Retrieved March 17, 2017, from www.simplepsychology.org/piaget.html

Menekse, M., Stump, G. S., Krause, S., & Chi, M. T. (2013). Differentiated overt learning activities for effective instruction in engineering classrooms. *The Research Journal for Engineering Education,102*(3), 346-374. doi:10.1002/jee.20021.

Mertler, C. A. (2017). *Action research: Improving schools and empowering educators*(5th ed.). Los Angeles, CA: SAGE.

National Association for the Education of Young Children and National Council of Teachers of Mathematics (NAEYC and NCTM) (2002). Position statement. *Early childhood mathematics: Promoting good beginnings*. Retrieved from http://www.naeyc.org/about/positions/psmath.asp

National Center for Educational Statistics. Retrieved from https://nces.ed.gov

National Institute for Early Education Research. Retrieved from http://nieer.org

Ojose, B. (2008). Applying Piaget's theory of cognitive development to mathematics instruction. *The Mathematics Educator,18*(1), 26-30.

Pennsylvania Department of Education. SAS website. Retrieved from www. www.pdesas.org

Polly, D., Margerison, A., & Piel, J. A. (2014). Kindergarten teachers' orientations to teacher-centered and student-centered pedagogies and their influence on their students' understanding of addition. *Journal of Research in Childhood Education,28*(1), 1-17. doi:10.1080/02568543.2013.822949

Robinson, K., & Mueller, A. S. (2014). Behavioral Engagement in Learning and Math Achievement over Kindergarten: A Contextual Analysis. *American Journal of Education,120*(3), 325-349. doi:10.1086/675530

Sackett Catalogue of Bias Collaboration, Spencer EA, Mahtani K, Hawthorne bias. In: Catalogue of Bias 2017: https://catalogofbias.org/biases/hawthorne-effect/

Sammons, L. (2010). *Guided math: a framework for mathematics instruction*. Huntington Beach, CA: Shell Education.

Scott-Little, C., Lesko, J., Martella, J., & Milburn, P. (2007). Early learning standards: results from a national survey to document trends in state-level policies and practices. *Early Childhood Research & Practice,9*(1). Retrieved January 25, 2017, from http://ecrp.illinois.edu/v9n1/little.html

Sharan, S., Ackerman, Z., & Hertz-Lazarowitz, R. (1980). Academic achievement of elementary school children in small group versus whole class instruction. *The Journal of Experimental Education,48*(2), 125-129. Retrieved March 18, 2017.

Smith, T.G. Rogers, N. Alsalam, M. Perie, R. Mahoney, and V. Martin. (1994). The condition of education, 1994. Washington, DC: National Center for Educational Statistics.

Snyder, K., Dinkel, D., Schaffer, C., Hiveley, S., & Colpitts, A. (2017). Purposeful movement: The integration of physical activity into a mathematics unit. *International Journal of Research in Education and Science,3*(1), 75-87.

Starkey, P., Klein, A., & Wakeley, A. (2004). Enhancing young children's mathematical knowledge through a pre-kindergarten mathematics intervention. *Early Childhood Research Quarterly,19*, 99-120. doi:10.1016/j.ecresq.2004.01.002

Swan, P., & Marshall, L. (2010). Revisiting mathematics manipulative materials. *Australian Primary Mathematics Classroom,15*(2), 13-19.

Wiggins, B. L., Eddy, S. L., Grunspan, D. Z., & Crowe, A. J. (2017). The ICAP active learning framework predicts the learning gains observed in intensely active classroom experiences. *AERA Open,3*(2), 1-14. doi:10.1177/2332858417708567

Upper Adams Area School District. Retrieved from www.upperadams.org

APPENDIX A

STATE REQUIREMENTS FOR KINDERGARTEN

APPENDIX A

STATE REQUIREMENTS FOR KINDERGARTEN

Types of state and district requirements for kindergarten entrance and attendance, by state: 2014

State	Compulsory school age	Kindergarten entrance age	State requires district to offer full-day kindergarten program	State requires district to offer half-day kindergarten program	State requires kindergarten attendance
United States[2]	†	†	12	34	16
Alabama	6	5 on or before 9/01	Yes	No	No
Alaska	7	5 on or before 9/01	No	No	No
Arizona	6	5 before 9/01	No	Yes	No
Arkansas	5	5 on or before 8/01	Yes	No	Yes
California	6	5 on or before 9/01	No	Yes	No
Colorado	6 on or before 8/01	5 on or before 10/1	No	Yes	No
Connecticut	5	5 on or before 1/01	No	Yes	Yes
Delaware	5	5 on or before 8/31	Yes	No	Yes
District of Columbia	5	5 on or before 9/30	Yes	No	Yes
Florida	6	5 on or before 9/01	No	Yes	No

Georgia	6	5 by 9/01	No	Yes	No
Hawaii	6 by 1/01	5 on or before 7/31	No	Yes	No
Idaho	7 by first day of school	5 on or before 9/01	No	No	No
Illinois	6 on or before 9/01	5 on or before 9/01	No	Yes	No
Indiana	7	5 on 8/01	No	Yes	No
Iowa	6 by 9/15	5 on or before 9/15	No	Yes	No
Kansas	7	5 on or before 8/31	No	Yes	No
Kentucky	6 by 10/01	5 by 10/01	No	Yes	No
Louisiana	7	5 on or before 9/30	Yes	No	Yes
Maine	7	5 on or before 10/15	No	Yes	No
Maryland	5	5 on or before 9/01	Yes	No	Yes
Massachusetts	6	Local education agency (LEA) option	No	Yes	No
Michigan	6 by 12/01	5 by 10/01	No	Yes	No
Minnesota	7	5 on or before 9/01	No	Yes	No
Mississippi	6 by 9/01	5 on or before 9/01	Yes	No	No
Missouri	7	5 before 8/01	No	Yes	No

Montana	7	5 on or before 9/10	No	Yes	No
Nebraska	6 by 1/01	5 on or before 7/31	No	Yes	No
Nevada	7	5 on or before 9/30	No	Yes	Yes
New Hampshire	6	LEA option	No	Yes	No
New Jersey	6	LEA option	No	No	No
New Mexico	5 by 9/01	5 before 9/01	No	Yes	Yes
New York	6	LEA option	No	No	No
North Carolina	7	5 on or before 8/31	Yes	No	No
North Dakota	7	5 before 8/01	No	Yes	No
Ohio	6	LEA option	No	Yes	Yes
Oklahoma	5	5 on or before 9/01	Yes	No	Yes
Oregon	7	5 on or before 9/01	No	Yes	No
Pennsylvania	8	LEA option	No	No	No
Rhode Island	6	5 on or before 9/01	No	Yes	Yes
South Carolina	5	5 on or before 9/01	Yes	No	Yes
South Dakota	6	5 on or before 9/01	No	Yes	Yes
Tennessee	6	5 on or before 8/15	Yes	No	Yes

Texas	6	5 on or before 9/01	No	Yes	No
Utah	6	5 before 9/02	No	Yes	No
Vermont	6	LEA option	No	Yes	No
Virginia	5	5 on or before 9/30	No	Yes	Yes
Washington	8	5 by 8/31	No	Yes	No
West Virginia	6	5 by 9/01	Yes	No	Yes
Wisconsin	6	5 on or before 9/01	No	Yes	No
Wyoming	7	5 on or before 9/15	No	Yes	No

https://nces.ed.gov/programs/statereform/tab5_3.asp

APPENDIX B

ORIGINAL FULL-DAY KINDERGARTEN BROCHURE-EES SCHOOL

APPENDIX B

ORIGINAL FULL-DAY KINDERGARTEN BROCHURE-EES SCHOOL

What should my child wear/bring to Kindergarten?

- Comfortable clothes that will allow your child to use the bathroom independently
- Comfortable shoes – open toed shoes and sandals are not safe on the playground
- Coats that are easy to open and close with your child's name on the inside
- A book bag large enough to fit a 9 x 12 folder – NO wheels or briefcase styles

What can I do to help my child develop the skills taught in Kindergarten?

- Talk to your child and discuss the events of the school day
- Read to your child every day
  - Read books, nursery rhymes, poems, newspapers, and magazines
  - Let your child see you read for information and pleasure; They will imitate what they see

- Play games that involve identifying letters, numbers, shapes, or colors
- Communicate with your child's teacher
  - Parents and teachers are partners
  - Together, parents and teachers can establish excellence in education

[redacted]

Elementary School Hours: 8:30-3:15

Mission Statement

The [redacted] promotes individual and collaborative excellence enabling students to become competent, confident, and creative builders of the future.

Full Day Kindergarten

[redacted]

Why Full Day Kindergarten?

The Federal *Every Student Succeeds (ESSA)* Act and Pennsylvania state learning standards require that all children reach specific academic levels in various grade levels. Consequently, academic expectations for kindergartners entering first grade are higher today than ever before. Our goal is to help all children experience success in what should be the most rewarding and enjoyable first year of their school experience. Full day kindergarten gives children the gift of time:

Time to allow students to develop at an age appropriate pace.

Time to develop reading, writing, oral language, math, science and social studies skills and increase students' achievement in reaching end of year academic goals.

Time to participate in art, physical education, library, music, and keyboarding.

Time for hands-on, whole group, small group, cooperative and individual instruction.

Time for forming relationships and practicing social skills.

Time to promote self-confidence and the willingness to take risks.

Time to gain confidence academically, socially, and emotionally in the first year of school ultimately promoting a positive attitude about learning that the students will carry with them throughout their school years.

What is the curriculum?

Reading Workshop
- McGraw Hill ® reading series
- Whole group & small group instruction
- Phonemic awareness skills
- Oral language activities
- Self-selected reading

Writing Workshop
- Kid Writing ®
- Shared writing
- Interactive writing

Math Workshop
- Everyday Math ®
- Hands-on manipulatives

Content Workshop
- Science
- Social Studies
- Technology

Specials
- Art
- Physical Education
- Library
- Music
- Keyboarding

How can I get involved?

•Volunteer – your help is welcome in the classroom

•PTO – is responsible for sponsoring and coordinating many great school events

How can I prepare my child for Kindergarten?

You are your child's first teacher. Your child is getting ready to take the first big step away from home into the wonderful world of kindergarten! Below are some helpful tips that you may wish to consider as you prepare your child for this new adventure.

Social Skills
- Talk about using manners when speaking
- Practice taking turns
- Learn the importance of cleaning up after yourself
- Be consistent with discipline and expectations

Personal Care Skills
- Be sure your child can handle bathroom needs independently
- Be sure that your child can put their coat on independently
- Practice tying shoes
- Practice washing hands correctly

Readiness Skills
- Look for familiar letters in signs, books, or magazines
- Read to your child
- Practice counting
- Identify colors and shapes
- Identify some letters and numbers
- Practice writing his/her name using a capital letter for the first letter and lowercase for the rest. Example: Allison, not ALLISON

Let your child know that it is okay to be nervous about starting kindergarten. If your child seems anxious, encourage them to express any fears or concerns. Contact their teacher if the anxiety continues.

APPENDIX C

CURRENT FULL-DAY KINDERGARTEN BROCHURE- EES SCHOOL

APPENDIX C

CURRENT FULL-DAY KINDERGARTEN BROCHURE- EES SCHOOL

What should my child wear/bring to Kindergarten?

- Comfortable clothes that will allow your child to use the bathroom independently.
- Comfortable shoes – open toed shoes and sandals are not safe on the playground.
- Coats that are easy to open and close with your child's name on the inside.
- A book bag large enough to fit a 9 x 12 folder (NO wheels or briefcase styles)

What can I do to help my child develop the skills taught in Kindergarten?

- Talk to your child. Discuss the events of the school day.
- Read to your child every day. Read books, nursery rhymes, poems, newspapers, and magazines. Let your child see you reading for information and pleasure; They will imitate what they see.
- Play games that involve identifying letters, numbers, shapes, or colors.

Communicate with your child's teacher. Parents and teachers are partners! Together, parents and teachers can establish excellence in education!

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

Elementary School Hours:
8:45-3:15

Mission Statement

The [redacted] promotes individual and collaborative excellence enabling students to become competent, confident, and creative builders of the future.

FULL DAY KINDERGARTEN

[redacted]

[redacted]

How can I prepare my child for Kindergarten?

You are your child's first teacher. Your child is getting ready to take the first big step away from home into the wonderful world of kindergarten!

Below are some helpful tips that you may wish to consider as you prepare your child for this new adventure.

Social Skills

- Talk about using manners when speaking.
- Practice taking turns.
- Learn the importance of cleaning up after yourself.
- Be consistent with discipline and expectations.

Personal Care Skills

- Be sure your child can handle bathroom needs independently.
- Be sure that your child can put their coat on independently.
- Practice tying shoes.
- Practice washing hands correctly.

Readiness Skills

- Look for familiar letters in signs, books, or magazines.
- Read to your child.
- Practice counting.
- Identify colors and shapes.
- Identify some letters and numbers.
- Practice writing his/her name using a capital letter for the first letter and lowercase for the rest.

What is the curriculum?

Reading Workshop
- Houghton Mifflin reading series
- Whole group & small group instruction
- Phonemic awareness skills
- Oral language activities
- Self-selected reading

Writing Workshop
- Kid Writing
- Shared writing
- Interactive writing

Math Workshop
- Everyday Math

Content Workshop
- Science
- Social Studies
- Technology

Specials
- Art
- Physical Education
- Library

How can I get involved?

- Volunteer – your help is welcome in the classroom!
- PTO – come to the PTO meetings! The PTO is responsible for sponsoring and coordinating many great school events!

Let your child know that it is okay to be nervous about starting kindergarten. If your child seems anxious, encourage him/her to express any fears or concerns. Contact the teacher if the anxiety continues.

APPENDIX D

SITE APPROVAL LETTER

APPENDIX D

SITE APPROVAL LETTER

(Date)

I, ____, principal, understand and give my permission to Jessica Miller, ASU doctoral student, to conducted a mixed methods action research study at ____. I understand that she will be gathering four forms of data, time-on-task observations, field note observations, engagement level, and a student attitude survey. She has explained the purpose of the study to me, as well as the methods and procedures involved in the study. Parent Consent will be gained prior to any data collection.

(Signature)

____

(Contact Information)

____

APPENDIX E

PARENTAL CONSENT LETTER

APPENDIX E

PARENTAL CONSENT LETTER

Hands-On Learning

PARENTAL LETTER OF PERMISSION

Dear Parent:

I am a student in the Doctoral Program at Arizona State University working under the direction of Dr. Erin Rotheram-Fuller. I am conducting a research study to examine the effects of hands-on learning in small groups on kindergarten students' engagement and attitude.

I am inviting your child's participation in an in class survey about hands-on learning. Your child's participation in this survey is voluntary. If you choose not to have your child participate, there will be no penalty. Likewise, if your child chooses not to participate in the survey, there will be no penalty. You are able to remove your child from the study at any time. The results of the survey may be published, but your child's name will not be used. This survey is a way for me to get to know your child's feelings about hands-on learning.

I am also inviting your child's participation in videotaped lessons conducted during small group math lessons including the use of manipulatives. Your child's participation in the videotaping is voluntary. If you choose not to have your child participate, there will be no penalty Likewise, if your child chooses not to participate in the interview, there will be no penalty. The results of the lessons may be published, but your child's name will not be used.

Although there may be no direct benefit to your child, the possible benefit of your child's participation is an opportunity to share what he/she has learned and how he/she feels about hands-on learning. There are no foreseeable risks or discomforts to your child's participation.

Responses will be kept confidential and will not be labeled with students' names. I am the only person who will view the videotaped lessons. The results of this study may be used in reports, presentations, or publication but your child's name and image will not be known/used.

If you have any questions concerning the research study or your child's participation in the survey or interview please contact me at (717) 818-9983.

Sincerely,
Jessica Miller

By signing below, you are giving consent for your child __________________ to participate in the above study.

_____________________ __________________________ _____________
Signature Printed Name Date

If you have any questions about you or your child's rights as a participant in this research, or if you feel you or your child have been placed at risk, you can contact Dr. Erin Rotheram-Fuller at Arizona State University or the Chair of the Human Subject Institutional Review Board, through the Office of Research Integrity and Assurance at (480) 965-6788.

APPENDIX F

STUDENT ATTITUDE SURVEY

APPENDIX F

STUDENT ATTITUDE SURVEY

Student Mathematics Attitude Survey

Directions to Proctor: The entire questionnaire will be read aloud to the students. For consistency, please only say what is in bold text, this will ensure that all of the students are hearing the same information. If a child asks a question, please answer it to the best of your ability while still keeping as close to the original bolded text as possible. Keep in mind the students may need extra help to stay in the correct row when answer the questions. It is acceptable to point to the correct row for a student if needed. Small pictures are at the beginning of each row to help the students follow along more easily. For each row say, **"Put your finger on the ---. This is the question that we are answering now."**

Read the following introduction aloud to the students.

Boys and Girls,

Today I will be asking you to answer some questions about math class and what we do during our math lessons. I will use your answers to help find out what you like or do not like about math so that I can build better lessons for us in the future. I will read to you 11 questions. It will only take about 5-10 minutes to complete this activity.

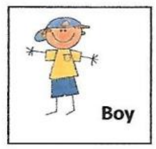
First, I will help you find the correct row. Then I will read you the question. After I read the question, you will color in the face that best shows how you feel about each question. There is no right or wrong answer, just be honest and tell me what you think.

We are now ready to start. Pick out one crayon to use to color in your answers.

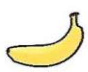
Part 1-All About You (Demographic Information)

(Put your finger on the apple. In this row, color that box that shows if you are a boy or girl.)

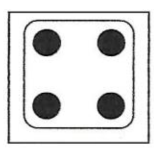
I am a



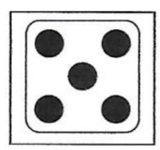
(Put your finger on the banana. In this row, color the box that shows how old you are. The choices are 4, 5, or 6. Count the dots in each box to help you find the number that you want.)



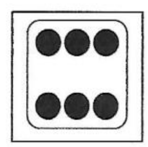
How old are you?



4

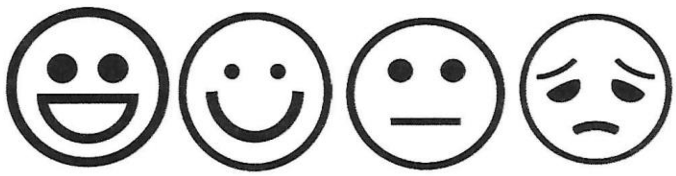


5



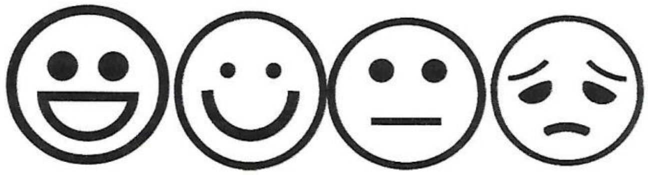
6

Look at the faces below. The faces show different feelings. The big smile means that you really like something, the regular smile means that you like something, the straight mouth means you think something is okay, the frown means you don't like something. (Act out the faces if needed to help the children understand the differences between faces.) **In the following questions, I want you to color the face that shows how you feel about the question.**

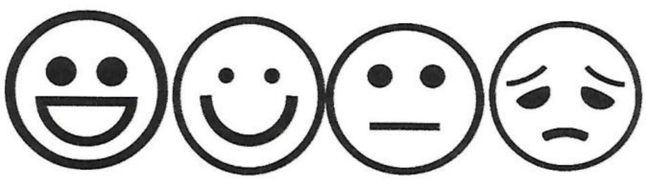


Part 2- Feelings about Math

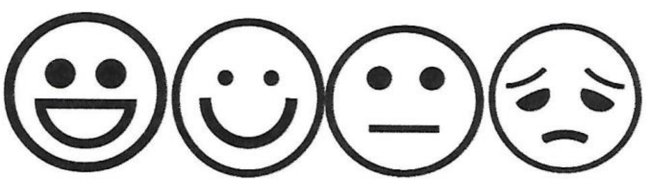
How do you feel during math class?



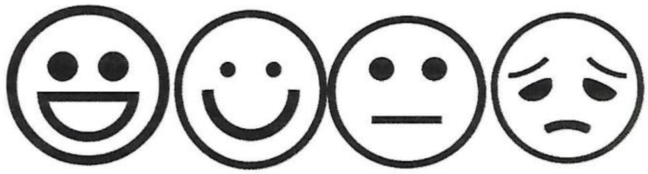
Do you think that you are good at math?



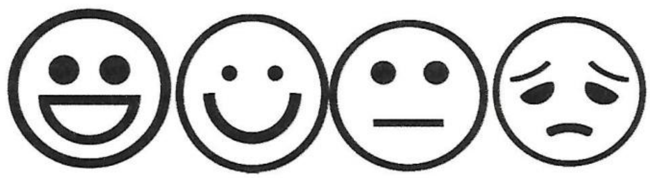
Do you think that math is important?



Do you think that you are learning new things in math?

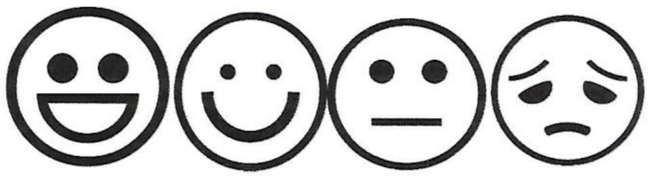


How would you feel if we spent more time on math each day?

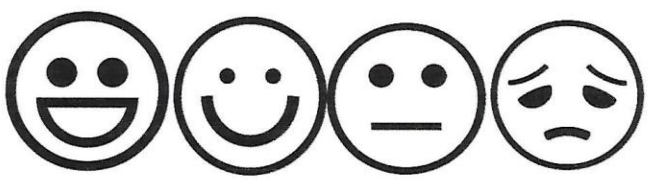


Part 3-Feeling about Parts of Math Class

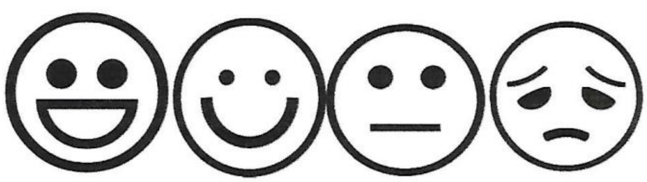
 **How do you feel when you get to use materials that you can hold in your hands, things like pattern blocks and unifix cubes?**



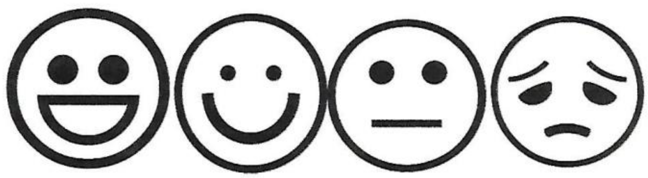
 **How do you feel when you get to work in a small group with the teacher and 3 other friends during math?**



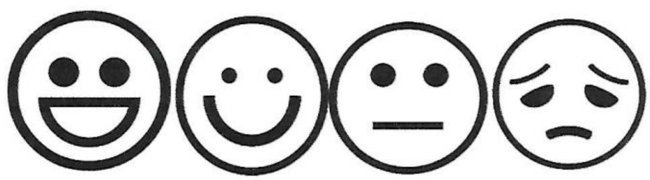
 **How do you feel when you do a math lesson with the whole class?**



How do you feel when you work with just the teacher during math?

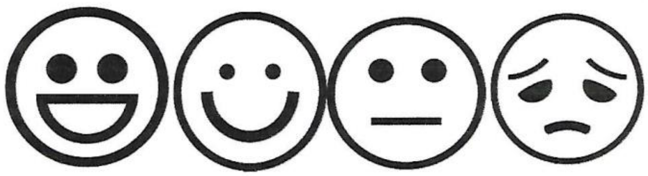


How do you feel when you work with a partner during math?

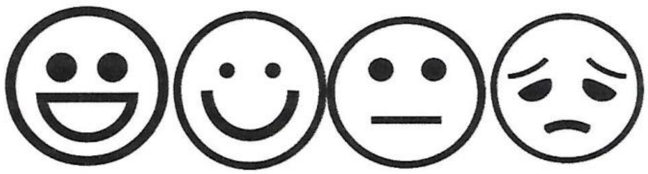


Part 4- Participation in Activities

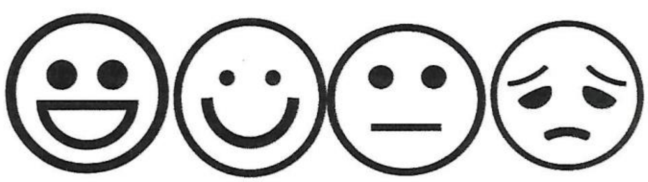

How do you feel when you raise your hand during small group lessons?



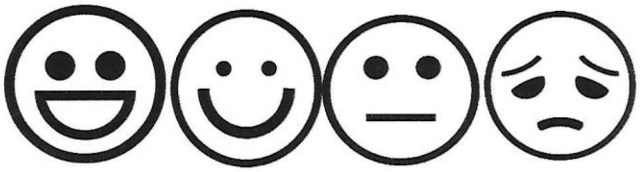

How do you feel when you raise your hand during lessons when everyone is together?



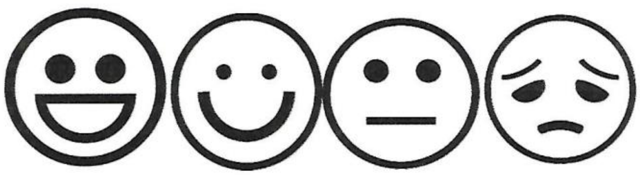

How do you feel when you are called on by the teacher?



How do you feel when other people listen to your question?



How do you feel when you get to talk to a friend about math?



Thank you for answering the questions! If you have any questions about this activity you may ask Mrs. Miller.

APPENDIX G

TIME-ON-TASK TOOL

APPENDIX G

TIME-ON-TASK TOOL

Time on Task Observation

Student ______________________ Teacher______________ Date/Time______________

Observed by______________________

+ = on task   - = off task

30 sec. Intervals	:30	1:00	1:30	2:00	2:30	3:00	3:30	4:00	4:30	5:00	5:30	6:00	6:30	7:00	7:30	8:00	8:30	9:00	9:30	10:00	Total
Instruction I-Interactive C-Constructive A-Active P-Passive																					
STUDENT #1																					
Interacting with materials																					
Interacting with peers on topic																					
Interacting with teacher on topic																					
Raising hand																					
Asked question about topic																					
Made observation/comment about topic																					
Looking at the teacher/materials																					
Not interacting with materials																					
Using materials in a random fashion or way not appropriate for lesson																					
Disengaged from task																					
Talking out unrelated to topic																					
Out of seat																					
Looking around																					
Behavior redirect																					
Fidgeting																					

Comments:

APPENDIX H

INDIVIDUAL TIME-ON-TASK SCORES AND ICAP LEVLES

APPENDIX H

INDIVIDUAL TIME-ON-TASK SCORES AND ICAP LEVLES

Lesson	ICAP Framework Engagement Level Based on teacher	Group Time-on-Task Percentage	Individual Student Time-on-Task Scores and Corresponding ICAP Framework Engagement Level	
1	A	92	100	A
			70	A
			95	A
			100	A
			95	A
2	C	85	84	A
			89	A
			95	A
			89	A
			67	A
3	A	90	85	A
			100	A/C
			85	A/C
			95	A/C
			84	A/C
4	A	80	89	A
			74	P/A
			67	P/A
			89	P/A
			79	A
5	A/C	83	82	A
			89	A
			63	A
			90	A
			91	A
6	C	89	92	A
			95	A/C
			85	C
			90	C
			83	A/C
			89	C
7	A/C	82	80	A
			85	A
			75	A
			89	A
8	C	91	100	C
			89	A
			70	A
			100	C

			94	A/C
9	A	82	79	A
			85	A
			85	A
			74	P/A
			84	A
			83	A
10	A/C	89	95	A
			95	A/C
			95	A
			65	A
			95	A/C
11	A	95	95	A
			85	P/A
			95	A
			100	A
			100	A
12	C	89	80	A
			95	A
			85	A/C
			95	A
13	C	86	92	A/C
			68	P/A
			95	A/C
			85	P/A
			90	A/C
			97	A/C
14	C	93	95	A/C
			100	A
			80	A/C
			95	A
			95	A
15	A	93	87	A
			95	A
			100	A
			95	A
			80	A
			100	A
16	C	80	90	A
			85	A
			95	A
			50	P
17	C	94	100	C
			100	C
			75	A
			100	A
18	A/C	95	100	A
			95	A
			90	A/C
			95	A

19	A	93	85 100 95 90 95	A A A A A
20	A	92	95 95 100 90 95 74	A A A A A A
Total Lesson 40% 20 20%	Active= 8 A/C= 4 Constructive= 8	Overall percentage of all lessons 88.65%	Average of all individual time on task 88.65%	Active= A/C= C= 40%

APPENDIX I

ARIZONA STATE UNIVERSITY IRB APPROVAL

EXEMPTION
GRANTED

Erin Rotheram-Fuller

Division of Educational Leadership and Innovation - Tempe

-

Erin.Rotheram-Fuller@asu.edu

Dear Erin Rotheram-Fuller:

On 8/9/2018 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Involve Me! Using Developmentally Appropriate Practices to Support a Rigorous Kindergarten Program: The Effects on Engagement and Attitude
Investigator:	Erin Rotheram-Fuller
IRB ID:	STUDY00008598
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Site Permission Letter 8.6.18.pdf, Category: Consent Form; • Jessica Miller IRB Protocal Involve Me.docx, Category: IRB Protocol; • CITI completion report 1.pdf, Category: Other (to reflect anything not captured above); • Jessica Miller IRB Parental Consent Letter Draft 2.pdf, Category: Consent Form; • CITI completion report 2.pdf, Category: Other (to reflect anything not captured above); • Student Attitude Survey PDF.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions);

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (1) Educational settings on 8/9/2018.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB

Administrator

cc: Jessica

Miller

Jessica Miller

APPENDIX J

POSITIVE AND NEGATIVE COMMENT FREQUENCIES

APPENDIX J

POSITIVE AND NEGATIVE COMMENT FREQUENCIES

Lesson	Number of Positive Comments	Number of Negative Comments
1	2	0
2	0	0
3	2	0
4	0	0
5	0	0
6	0	0
7	1	0
8	0	1
9	1	0
10	5	0
11	1	0
12	6	1
13	1	0
14	6	0
15	1	0
16	0	0
17	2	0
18	5	0
19	0	0
20	2	0