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Applicable Outcomes: A Program Evaluation of the Investigations Math Program

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APPLICABLE OUTCOMES: A PROGRAM EVALUATION OF THE INVESTIGATIONS MATH PROGRAM

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Dedication

This work is dedicated to my family, who represent the inspiration for my drive and commitment. To my wife, Terri, who has stood by my side for twenty-three years prior to this educational journey, and has always supported my hopes and dreams as a selfless partner, thank you for being the support that made all of this possible. Thank you for being my sounding board, source of laughter, source of calm, and source of relief. Thank you for being there every step of the way. To my son Sekou, I wanted to be a model for you, and you have become a model for me with equal parts perseverance, love, and light. Know that this journey began with you 15 years ago and only this chapter ends for me as yours will soon begin. To my daughter Nala, you are the bright shiny star that keeps me focused and I appreciate your sharp mind, caring spirit, and maturity. To my mother, Jackie, thank you setting the example for growth mindset and showing me how to do everything at once. To the Hamer men, thank you all for always being a positive and motivational voice of support throughout our lives. You are all part of my journey and I love you all.

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Acknowledgments

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Abstract

This program evaluation study focused on the outcomes of a Math program for elementary level students. This mixed-methods study explored the relationship between the implementation of the *Investigations* Math program and teachers' perceptions of its impacts. The program theory that guided this study stated that teachers who were provided time and resources to examine best practice Math curricula and instructional methods would: adopt and implement a holistic Math program that updated the curriculum; create positive changes in teacher content and pedagogical knowledge; meet the needs of all students, at all proficiency levels; result in a consistent scope and sequence; and lead to improved student achievement. The findings did not fully support the program theory but did inform the school of study of the positive outcomes that the adoption of the *Investigations* program enhanced teachers' perceptions of: alignment of the curriculum with Common Core Standards for Mathematical Practice; their capabilities as leaders of the inquiry process within the classroom setting; facilitating a Math program with consistency in concepts, student experiences, and assessment; improved students' consistency of good thinking; and increased number sense, perseverance in solving problems, and use of appropriate tools to construct viable arguments. However, analysis of the ERB-CTP4 math achievement test scores revealed negligible changes in the overall mean student performance as a result of the implementation of the *Investigations* program. Weaknesses in the assessment materials of Investigations also required a supplemental curriculum to be adopted in parts.

APPLICABLE OUTCOMES: A PROGRAM EVALUATION OF THE INVESTIGATIONS MATH PROGRAM

CHAPTER 1

INTRODUCTION

Background

Van Der Sandt (2007) cites the examination of research by Koehler and Grouws (1992) on teaching from the perspective of four levels of complexity and representative models that reflected the changes and progress made in research on teaching. The highest level (Level 4) reflected current research, where research questions in teaching and learning are being approached from several perspectives, thereby, having a strong theoretical foundation (Koehler & Grouws, 1992). Koehler and Grouws' model suggests that outcomes of learning are based on a learner's own actions or behaviors, which are influenced by their beliefs about themselves as learners, their beliefs about the discipline of Mathematics, and what the teacher does or says within the classroom (1992). Wilkins (2008), whose theoretical model related teachers' content knowledge, attitudes, instructional beliefs and practices, found that teachers' beliefs had the strongest effect on their practice. Similar to the Koehler and Groews (1992) model, the Wilkins (2008) model supported the premise that teacher behavior is influenced by the teacher's content knowledge, how learners understand that specific content, the teacher's method of instruction, and the teachers' attitudes and beliefs about teaching and Mathematics.

Under former ESEA policies, schools strived to meet the adequate yearly progress goals in Mathematics achievement that are now defunct due to updated ESSA policies

(Chenoweth, 2016). Many schools attempted to maximize their efforts by turning to improved activity-based curricula (Gatti & Giordano, 2010). In the lower school program at the school of study, each classroom teacher had ownership of an individualized Math program, lacking continuity across the lower school classrooms. Not surprisingly, children were moving to the next grade having had different Math experiences. This was a challenge for numerous students who were prepared with different degrees of success for the next grade.

Program Overview

Critical inconsistencies in the basic Mathematical skills of kindergarten through fifth grade (K-5) students at the school of study were identified by the Pennsylvania Association of Independent Schools (PAIS), the regional accreditation body for the school of study. It was observed that the lower school (K-5) classes did not have a consistent scope and sequence for the Math program. Each classroom teacher covered the same basic topics, but the methodology and emphases were different. They did not use similar vocabulary, teach similar concepts, and were out of sync with their evaluation of student proficiency at the transition point from fifth grade to the middle school program in sixth grade. Meeting the needs of children who had been prepared differently was a challenge for the teachers who taught the next grade, the farther along a teacher was in the sequence of lower school grade levels, the more he or she had to differentiate instruction to meet the students' needs. There were also concerns that many teachers were tempted to focus their programs toward the more capable Math students because it tended to be their parents who were most vocal about whether the Math program was meeting their children's needs. Simultaneously, some children who were struggling were not having their needs met, and they were being recommended for Math tutoring.

A recommendation from the accreditation committee was made for the lower school to develop greater continuity in the Math program for the students from Kindergarten to fifth grade. The committee communicated that it was difficult for students to navigate the changes in content, ways of learning, strategies, and an emphasis on some curricular strands over others. The school responded to this critical need by (a) researching different Math programs, (b) visiting other schools to observe programs in practice, (c) piloting programs at different grade levels, and (d) hiring a Math consultant to assist in the transition to a uniform instructional platform. This process led to the selection of the *Investigations K-5 Math Program* for implementation in 2006.

Investigations in Number, Data, and Space, a kindergarten to fifth-grade curriculum, was developed by Technical Education Research Centers (TERC) under a grant from the National Science Foundation (Agodini & Harris, 2010). The program is based on a constructivist, student-centered approach that emphasizes the use of numerous problem-solving techniques, communicating about Mathematics verbally and through writing and drawing, as well as metacognition, or thinking about one's own reasoning (U.S. Department of Education, 2013). While poorly designed and implemented curricula can be confusing and frustrating to students and teachers, the No Child Left Behind Act required the publishers of *Investigations* to "conduct rigorous efficacy research to support their educational materials" (Gatti & Giordano, 2010, p. 1).

Context of the study. The program that was evaluated was the Math program for K-5 students attending lower school at an independent Quaker school in Philadelphia, PA. The school of study was accredited by both the PAIS and the Middle States Association of Colleges and Secondary Schools (MSACSS). The school served 865 students, kindergarten to 12th grade, that were comprised of 30% students of color and 6% Quaker students. There were 85 full-time faculty members, 25 part-time faculty members, and 19 assistant teachers/aides. The Lower School included 17 homeroom teachers and 17 assistant teachers/aides from this total.

The school was founded in 1845 and remained affiliated with the local Quaker Monthly Meeting. This rich Quaker history has been maintained in the school's mission to educate, not as training for a particular way of life, but as part of a lifelong process. The institution remained rooted in the Quaker tenets of simplicity, peace, integrity, community, equality, and stewardship. Students are guided and encouraged in their personal growth, the school is well resourced, and families are highly engaged with the school community. As is the Quaker practice, many institutional decisions were made through open dialogue and consensus among the community members involved.

In light of the PAIS accreditation team's recommendations, and the inadequacies of the curriculum, the school began the implementation process of the *Investigations* Math Curriculum for the lower school in 2006. The inconsistencies in the materials used and methods of instruction at each grade level were a primary concern. The lower school hoped to adopt a program that would bring consistency to the classrooms and provide a similar Math experience for all lower school students. The school aimed to help all children become active learners and flexible thinkers with a deep understanding of the Mathematics being investigated in the classrooms. The idea of creating in each classroom a Mathematical community in which children investigated problems not only for themselves but to share thinking with their peers was also a goal. The five-year rollout to transition the lower school division to the *Investigations* K-5 Math program, developed at TERC, and funded by the National Science Foundation, TERC, and Pearson Publishing, was completed in 2011.

As an independent, Quaker school, the school of study was not beholden to state testing mandates, nor was it required to publish the ERB CTP-4 standardized tests that it implemented as part of the assessment process to gauge student progress. In order to properly assess the effectiveness of curricular programs, periodic and meaningful program evaluation practices were necessary. Data from longitudinal studies were essential to examine the true achievement gains in the student population (Ding & Navarro, 2004) and surveys, or interviews, were practical methods to assess teachers' instructional experiences.

Description of the program. The *Investigations* K-5 Math program is a complete, flexible, rigorous, activity-based curriculum developed by TERC, and funded in part by the National Science Foundation (Gatti & Giordano, 2010). The program is built upon the tenet of active teaching. Active Mathematics teaching requires teachers to think deeply about the Mathematics content the students are learning and the instructional techniques they employ in order to meet diverse student needs and learning styles. Active Mathematics curricula like *Investigations* also encourages students to think creatively, develop and articulate their own problem-solving strategies, and work cooperatively with their classmates. The curriculum at each grade level is organized into units that offer from three to eight weeks of work covering the National Council of Teachers of Mathematics (NCTM) Mathematics standards. The *Investigations* K-5 Math program includes both ongoing and periodic assessment opportunities, as well as extended practice opportunities to help students become fluent with Mathematical skills and concepts.

Overview of the Evaluation Approach

In the 1960s, when the Great Society social programs were introduced by both Kennedy's and Johnson's administrations, the practice of evaluating teaching programs was originating (Karimnia & Kay, 2015). Educational programs are fundamentally about change and program evaluation is designed to determine whether change has occurred. Learners, teachers, administrators, other health professionals, and a variety of internal and external stakeholders participating in educational programs are invested because they are interested in change (Frye & Hemmer, 2012). While a program's focus on change is often focused on outcomes for the learners, everyone else involved with that program also participates in change. Therefore, effective program evaluation should focus, at least in part, on the questions: (1) Is change occurring? (2) What is the nature of the change? (3) Is the change deemed successful? This line of questioning directs the focus on program evaluation to look for both intended and unintended changes associated with the program (Frye & Hemmer, 2012).

Program evaluation model. Designed to assist administrators in making informed decisions, Context, Input, Process, and Product evaluation (CIPP) is a popular evaluation approach in educational settings (Mertens & Wilson, 2012; Zhang et al., 2011). The CIPP Evaluation Model was originally developed as a means to systematically provide timely evaluative information for use in decision-making (Stufflebeam, 1983). The CIPP evaluation model belongs in the improvement and accountability category, and is one of the most widely applied evaluation models (Zhang et al., 2011). This approach, developed in the late 1960s, seeks to improve and achieve accountability in educational programming through a "learning-by-doing" approach (Zhang et al., 2011, p. 62). Its core concepts are context, input, process, and product evaluation, with the intention of improving the program itself. An evaluation following the CIPP model may focus singularly on a context, input, process, or product evaluation, or may include a combination of these elements (Mertens & Wilson, 2012). As cited in Zhang et al. (2011), a survey by the American Society for Training and Development members concluded that Stufflebeam's CIPP model was preferred over other program evaluation models.

Context evaluation. The context evaluation stage of the CIPP Model creates the big picture indicating where both the program and the evaluation fit (Mertens & Wilson, 2012). This stage assists in decision-making related to planning, and enables the evaluator to identify the needs, assets, and resources of a community in order to provide programming that will be beneficial (Mertens & Wilson, 2012). Context evaluation also identifies the political climate of the environment that could influence the positive execution of the program (Mertens & Wilson, 2012). To achieve this, the evaluator compiles and assesses background information, and interviews program leaders and stakeholders. In addition, program goals are assessed, and data reporting on the program environment is collected. Data collection can use multiple formats. These include both formative and summative measures, such as analysis of extant documents and data, program profiling, case study interviews, and stakeholder interviews (Mertens & Wilson, 2012). Throughout this process, continual dialogue with the client maintains a focus on the needs of the stakeholders. This process is integral to the identity of this tool, which comes under the Use branch of evaluation (Mertens & Wilson, 2012).

Input evaluation. To complement context evaluation, input evaluation can be completed. In this phase, information is collected regarding the mission, goals, and plan of the program. Its purpose is to assess the program's strategy, merit and work plan against research, the responsiveness of the program to client needs, and alternative strategies offered in similar programs (Mertens & Wilson, 2012). The intent of this stage is to choose an appropriate strategy to implement to resolve the program problem (Zhang et al., 2011).

Process evaluation. In addition to context evaluation and input evaluation, reviewing program quality is a key element to CIPP. Process evaluation investigates the quality of the program's implementation. In this stage, program activities are monitored, documented and assessed by the evaluator (Mertens & Wilson, 2012). Primary objectives of this stage are to provide feedback regarding the extent to which planned activities are carried out, guide staff on how to modify and improve the program plan, and assess the degree to which participants can carry out their roles (Zhang et al., 2011).

Product evaluation. The final component to CIPP, product evaluation, assesses the positive and negative effect the program had on its target audience and documents both the intended and unintended outcomes (Mertens & Wilson, 2012). Both short-term and long-term outcomes are judged. During this stage, judgments of stakeholders and relevant experts are analyzed, viewing outcomes that impact the group, subgroups, and individual. Applying a combination of methodological techniques assures that all outcomes are noted and assists in verifying evaluation findings (Mertens & Wilson, 2012).

Purpose of the evaluation. This study of the *Investigations* K-5 Math program in an independent Philadelphia Quaker school sought to provide clarity on *Investigations* implementation and to inform faculty and school leaders as to the effectiveness of the program's outcomes. While all four components of the CIPP program evaluation design can be valuable, the purpose of this program evaluation was to measure the effectiveness of the *Investigations* K-5 Math program as it is currently implemented. The CIPP model supported this study, as it can be usefully adopted for retrospective evaluation of completed programs (Frye & Hemmer, 2012). This summative evaluation process was designed to support the lower school in its ability to determine whether the original short, medium, and long-term goals of the program were being met. The outcomes of the evaluation were to be shared with key lower school faculty: the head of lower school, the Math specialist for the lower school, the learning specialist/testing coordinator, and the lower school teachers.

Focus of the evaluation. This study focused on the final component of CIPP, product evaluation, as it assessed the positive and negative outcomes of the program. It accounted for both the intended and unintended outcomes and evaluate the program's effectiveness (Mertens & Wilson, 2012). It applied a concurrent mixed-methods approach where outcomes from the dialectical approach were noted and merged to verify evaluation findings (Mertens & Wilson, 2012). The product, or impact, evaluation component will benefit the school of study as it measures, interprets and judges the project outcomes and interprets their merit, worth, significance, and probity (Zhang et al., 2011).

Evaluation questions. When evaluation works effectively, it generates information to a wide range of audiences that can be used to make better decisions, develop greater appreciation and understanding, and gain insights for action (Preskill & Jones, 2009). The evaluation questions were directly related to the expected outcomes from the *Investigations* K-5 Math program. The first four questions related to teacher perceptions of the effectiveness of the implementation of the *Investigations* K-5 Math program. The fifth question related to the quantitative evaluation of student achievement data at the completion of the program.

The program evaluation research questions for this study are:

1) What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?
2) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about Mathematics content and pedagogical knowledge?
3) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program assisted the development of a consistent scope and sequence for the K-5 classrooms?
4) What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 program?

5) What are teachers' perceptions of the changes in student achievement resulting from implementation of the *Investigations* K-5 Math program?

Logic Model for the Product Evaluation of the Investigations Math Program

The *Investigations* K-5 Math program is applicable to all students enrolled in kindergarten through the fifth grade. The program was in effect as a complete sequence for students completing fifth grade each year since 2011. A logic model (Figure 1) distinctly shows what the long-term goals of the project were and which areas needed to be addressed to determine if the project was a success (Frechtling, 2007).

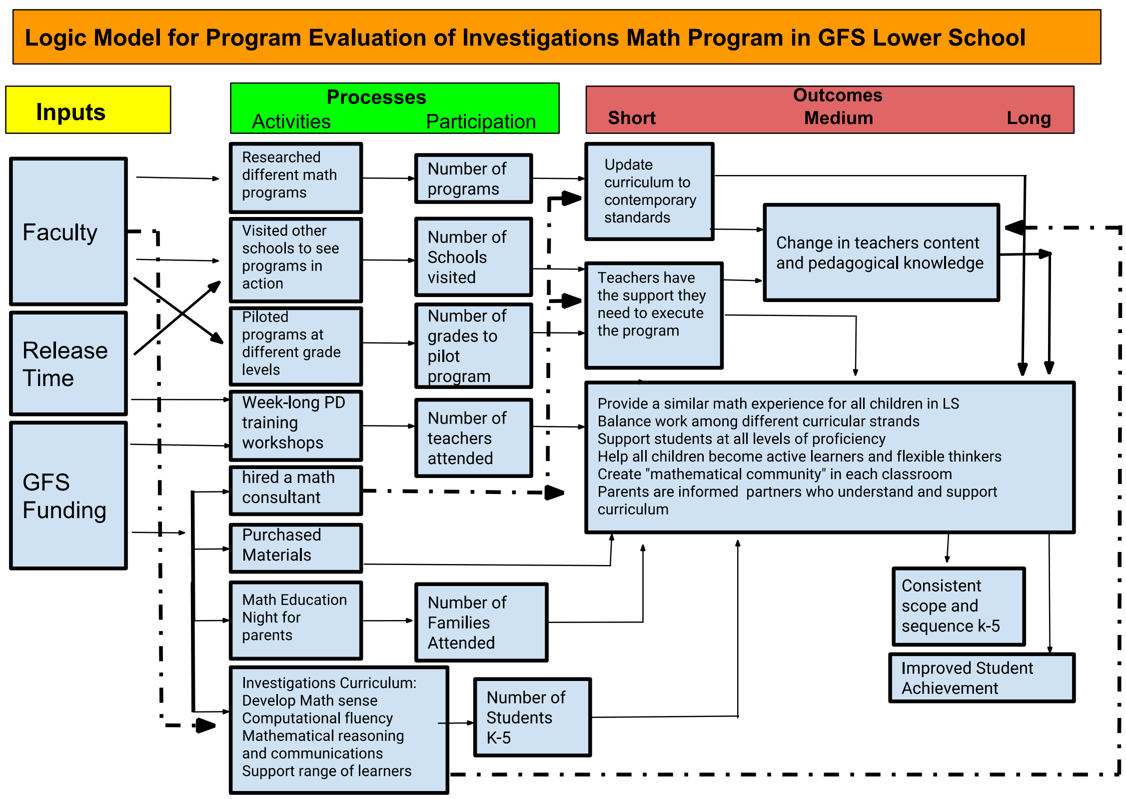

Figure 1. Logic model for program evaluation of *Investigations* K-5 Math program

The inputs that drive the processes, or outputs, are the faculty, release time, and the school's funding resources. The kindergarten through fifth grade teachers who delivered the Math curriculum to lower school students were supported by the lower school principal, the Math consultant, learning specialists, and teaching assistants.

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The processes, or outputs, that drive the outcomes encompassed research of different options for Math programs, school visits to programs in action and piloting of sample programs in current k-5 classrooms. The school of study funded professional development for all the K-5 teachers to attend training workshops for the Investigations program. This process included the hiring of a Math consultant, who supported the school's selection of the *Investigations* K-5 Math program and facilitated parent education nights to inform K-5 families of the programmatic changes.

As represented by the outcomes from the logic model (Figure 2), the intended outcomes from the implementation of the *Investigations* K-5 Math program begin with the short-term goals of giving teachers the support they need to execute a curriculum aligned to current Mathematics standards. The expected outcomes that initiate as short-term goals and span medium and long-term goals are to provide a similar Math experience for all children at all proficiency levels in the lower school. Also expected during this span of outcomes was the goal of creating Mathematical communities in each classroom where all students would become active learners and flexible thinkers. The

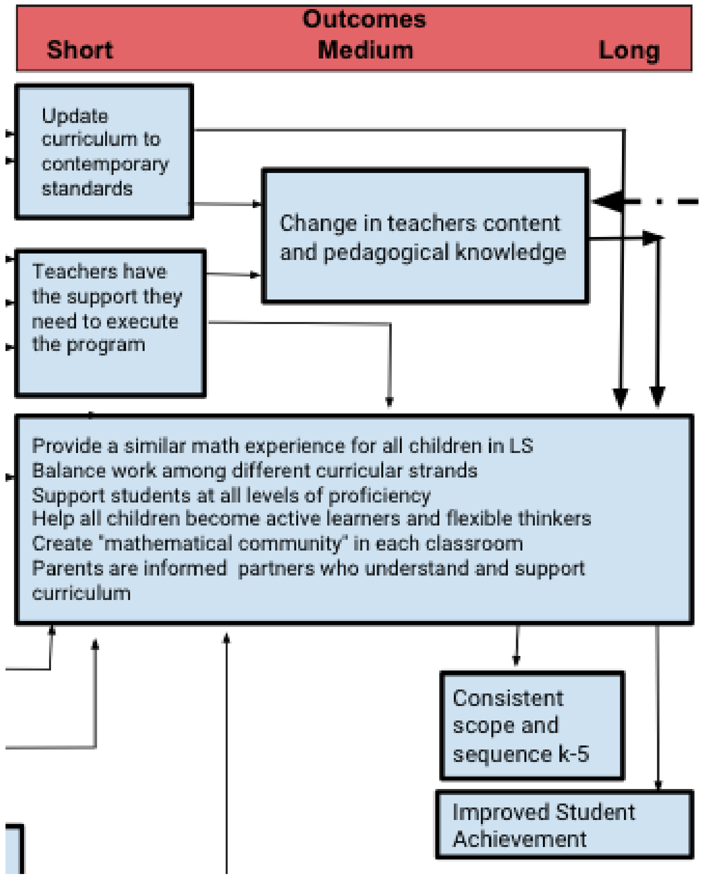

Figure 2. Outcomes for program evaluation of *Investigations* K-5 Math program (Zoomed insert of Figure 1.)

expected long-term outcomes from the *Investigations* program were a consistent K-5 scope and sequence and improved student achievement.

Program theory. From the full logic model (Figure 1), it is observable that the program theory posits:

1. The faculty research of different Math programs, the additional guidance of a Math consultant, and the adoption of the *Investigations* program would result in the short-term goal of updating the curriculum to contemporary standards.
2. The faculty visits to other schools to see programs in action, the piloting of the program at different grade levels, their work with the Math consultant and

participation in professional development training workshops, and their use of Investigations program materials would result in the short-term outcome of providing the support they needed to execute the program.

3. The utilization of the updated curriculum (*Investigations*), and the multiple support resources to execute the program, would result in the medium to long term outcome of positive change in teachers' content and pedagogical knowledge.
4. The combination of updated curriculum using the *Investigations* program, sufficient teacher support, and growth in teachers' knowledge would lead to the short , medium, and long-term outcomes of providing students across the K-5 grades with a similar Math experience, balancing the topics across curricular strands, differentiating to support students at all levels of proficiency, helping children to become active and flexible learners, and creating a Mathematical community in classroom that would be supported by informed parents as partners.
5. The combination of short and medium-term outcomes would result in the long-term outcomes of a consistent scope and sequence for the K-5 division and improved student achievement.

Definition of Terms

Context: Describes the important features of the environment in which the project or intervention is based (Frechtling, 2007).

Focus group interviews: A structure where group discussions on a particular topic are organized for research purposes (Creswell, 2014)

Impact evaluation: An evaluation that assesses a program's effects and the extent to which the program's goals were achieved (Mertens & Wilson, 2012).

Implementation: The act of carrying out or performing activities. Implementation can be characterized in terms of the extent to which it reflects what was intended in the plan (Frechtling, 2007).

Inputs: The resources that are brought to a project. Typically, resources are defined in terms of funding sources or in-kind contributions (Frechtling, 2007).

Logic model: A model that displays the sequence of actions in a program, describes what the program is and will do, and describes how investments will be linked to results (Mertens & Wilson, 2012).

Mixed-methods: A combination of qualitative and quantitative approaches in the study and/or data collection (Mertens & Wilson, 2012).

Outcomes: Changes that show movement toward achieving ultimate goals and objectives. Outcomes are desired accomplishments or changes (Frechtling, 2007).

Perception: A mode of apprehending reality and experience through the senses, thus enabling discernment of figure, form, language, behavior, and action (Given, 2008).

Processes (Outputs): The immediate results of an action; they are services, events, and products that document implementation of an activity. Processes (Outputs) are typically expressed in numbers or percentages (Frechtling, 2007).

Product evaluation: An evaluation that measures, interprets, and judges the achievements of a program in attaining its overall goals (Mertens & Wilson, 2012).

Program theory: A way of making explicit the assumptions underlying an intervention. It describes the causal linkages that are assumed to occur from project start to goal attainment and clearly defines the theory of change underlying a program or policy (Frechtling, 2007).

Qualitative evaluation: Approach to evaluation that is primarily descriptive and interpretive (Creswell, 2014).

Quantitative evaluation: Approach to evaluation involving the use of numerical measurement (Creswell, 2014).

Stakeholders: People who have a vested interest in the program, policy, or product being evaluated, and also have a stake in the evaluation (Mertens & Wilson, 2012).

Student achievement: engagement in educationally purposeful activities, satisfaction, acquisition of desired knowledge, skills and competencies, persistence, and attainment of educational outcomes (Kuh, Kinzie, Buckley, Bridges, & Hayek, 2006).

Time-Series Analysis: a variable that undergoes a repeated periodic observation that is used to characterize a pattern of behavior occurring in the natural environment over the measurement period (Linden, Adams, & Roberts, 2003).

CHAPTER 2

REVIEW OF RELATED LITERATURE

This study of the *Investigations* K-5 Math program at an independent, private Quaker school sought to provide clarity and to inform the school's faculty and school leaders as to the effectiveness of the program's outcomes. The conclusions from this study were meant to inform the administration's decisions to improve the execution of the program, or to seek alternative curricular options. This literature review begins by describing underlying concerns, depicting the context of the study, sharing evidence of the problem, providing an overview of program evaluations and delineating why it is useful to study the effects of a curricular program. The review then details the evaluation of elementary Math programs, and what previous research on evaluating Math programs tells us about their potential effects. The review then continues with a history and description of the *Investigations* K-5 curriculum, later delving into the efficacy of the program. A concluding segment follows, which defines the framework of teacher orientations to Math curriculum, an important understanding when evaluating the taught curriculum.

A Brief History of Program Evaluation in Education

While the roots of evaluation can be chartered as early as the 1800s, the initial phases of development that resulted in the current structure of program evaluation as a profession is traced to the 1960s (Mertens & Wilson, 2012). Lyndon Johnson's Great Society initiatives included Headstart programs and the Elementary and Secondary

Education Act (ESEA), which mandated evaluations as part of the programs (Mertens & Wilson, 2012). Using the agreed upon protocols from the Joint Committee on Standards and Evaluation, as described in Appendix A has expanded the reliability and uniformity of approach to program evaluations in a vast array of fields (Mertens & Wilson, 2012). Theorists in evaluation have constructed multiple approaches to guide the process of evaluations, which most often include the postpositivist, pragmatic, constructivist, and transformative paradigms (Mertens & Wilson, 2012).

Paradigms of program evaluation. The four paradigms represent a method of organizing the major influences that have affected the evolution of program evaluation. This evaluation falls under the pragmatic paradigm, which focuses primarily on data that is useful by stakeholders and advocates for the use of mixed methods. Pragmatic knowledge claims that the world is not an absolute unity, or singular reality apart from our perceptions (Atieno, 2009; Creswell, 2014). The history of the pragmatic paradigm began in the second half of the 19th century when pragmatists rejected the claim that the scientific method could discover "truth" (Ravitch & Carl, 2016). According to Mertens and Wilson (2012), the axiological assumption of contemporary pragmatists is that the value of something is a function of its consequences. This assumption supports the pragmatist notion that the value of an evaluation is how it's used and the outcomes of its use, rather than doing an evaluation for its own sake. The ontology of this paradigm is that truth is not the goal of evaluation as much as usefulness is, with respect to the problem. The epistemology of this paradigm is that pragmatists are free to study what is of interest and of value to them, and they can use the study in ways that are appropriate to generates positive outcomes (Greene & Caracelli, 1997; Mertens & Wilson, 2012). The methodology of the pragmatic paradigm is identified by the philosophical framework that guides some researchers to their choice of mixed methods. This research structure supports the assumption of the paradigm that the method should match the study's purpose (Ravitch & Carl, 2016).

A program evaluation may focus on the effectiveness of new processes, the expert review of documents, or guide future decisions that shift a program's direction. Program evaluation methods have changed since their inception, but the assertion remains the same. Evaluations are used to identify, classify, or apply the merit of a program and stakeholders are often involved in the process (Cain, 2002). Program evaluations employ all forms of research, inclusive of qualitative, quantitative, and mixed-method designs. Qualitative methods for this program evaluation were selected to measure the experiences of the elementary teachers who used the *Investigations* K-5 Math program and the usability of the program. The expertise-oriented program evaluation approach was selected for three reasons: primary teachers (a) are required to teach Math to all of the students within their class, (b) they selected the *Investigations* program and (c) could use their expertise with the program to evaluate the positive and negative elements of the program as highly qualified educators (Townsend, 2015). The conclusions of this line of reasoning led to the selection of a program evaluation as the methodology for this study.

Evaluation of elementary Math programs. The understanding that elementary school students in the United States demonstrate poor Math skills on national achievement assessments, specifically those students from lower socioeconomic backgrounds, and that accumulating evidence indicates an early and lasting difficulty with Mathematics is being experienced by many school children is indicated in numerous studies of Math curricular programs that have emerged in recent years (Agodini & Harris, 2010; Doabler, Fien, Nelson-Walker, & Baker, 2012).

Curricula funded by the National Science Foundation, including Investigations, were expected to show significant evidence of effectiveness in the areas of problem-solving, concepts, and applications, however, Slavin and Lake (2008) found little evidence of strong effects in these areas. They found that when referencing outcomes based on traditional measures such as state assessments and standardized tests, curriculum differences were less consequential than instructional practices. Slavin, Lake, and Groff (2010) assessed 13 studies of elementary Mathematics curricula, 40 middle and high school curricula, and found no evidence that different curricula produce different outcomes in terms of achievement. However, they did find strong evidence that using effective teaching strategies can make a real difference. The Doabler et al. (2012) study of three elementary Math curricula found that most textbooks were missing opportunities for explicit, systematic instruction, and none offered procedures for linking assessment results with instructional decision-making. The Bhatt and Koedel (2012) study of three elementary Math curricula found that major differences could exist between curricula that share the same pedagogical approach. Studies also indicate that teachers' self-efficacy is a key variable in student learning, changing the way that children work together, improving classroom management and motivation, and raising Mathematics outcomes for all students (Stronge, 2010). The impact of extensive professional development to help teachers use instructional strategies was found to have the strongest evidence of effectiveness (Slavin et al., 2010). With an effect size of d=1.00, superseded only by teacher feedback (effect size d=1.13) and students' prior cognitive ability (effect size d=1.04), “excellence in teaching is the single most powerful influence on achievement” (Hattie, 2003, p. 4).

A feasible strategy to address the low Math achievement of U.S. children is to improve the quality of foundational Math instruction delivered in elementary classrooms (Doabler et al., 2012). At the core of most Math programs are textbooks, which influence the ease of curriculum management in the classroom and assist teachers with guided opportunities to introduce students to critical Math content. Often, Math programs are offered in full service packages including textbooks, curricular pacing guides, manipulative tools, assessments, and training sessions for teachers. Documenting individual student achievement is a difficult task. Due to the concern that low elementary school performance would limit students’ future Mathematical capabilities, and their ability to function in an increasingly complex world, legislators constructed mandates for improved performance and accountability in schools (Ding & Navarro, 2004). Therefore, it is important to discern whether programs provide teachers with the foundational resources for teaching key Math concepts and skills to an inclusive spectrum of exceptional, proficient and struggling students (Doabler et al., 2012).

Concerns About Math Instruction

The most instructive elementary Math programs develop student knowledge through experiential, hands-on instruction that supports the development of number sense, is grounded in meaningful experiences, and solves real-world and contextualized Mathematics problems. Traditional Mathematics curriculum has historically focused on the acquisition of numerical skills such as number order, counting on, addition and subtraction facts, place value, and addition and subtraction algorithms while the constructivist Mathematics curriculum, which is grounded in Piaget's theory of child development, is focused on sense-making about number as a primary concern (Goodrow, 1998). The ongoing challenges of many classrooms to deliver effective Mathematics instruction is a national concern in the United States.

National achievement data in the United States show that elementary level students have relatively weak Math skills. The 2009 National Assessment of Educational Progress (NAEP) contends that only 39% of all fourth graders demonstrated proficiency in Math, and 18% rated below basic (National Center for Education Statistics, 2009). Six years later, the 2015 NAEP results showed minimal improvement with 40% of fourth graders demonstrating proficiency in Math (NAEP - 2015 Mathematics & Reading Assessments, n.d.). Critical inconsistencies in the basic Mathematical skills of kindergarten through fifth grade (K-5) students at the school of study were identified by PAIS, the regional accreditation body for the school of study. Dialogue among the teachers and school leadership led to the decision to select a uniform curriculum for the lower school classrooms.

Internal support of the constructivist philosophy at the school of study led to adoption of the *Investigations* K-5 Math program, which was approved and implemented across the K-5 classrooms. The roll out of the program, one grade level at a time, over a five-year period completed the curricular integration. After four more years in application, a total of nine years in use, the institution had not assessed the program’s effectiveness. The evaluation of the outcomes from this program at the school of study will deliver practical benefits to multiple stakeholders involved with the institution. Insights from the study will provide the necessary information to evaluate student progress, support teachers' instructional practices, and assist administrative leaders as they make curricular decisions regarding the elementary Math program.

Evidence of America's Mathematics education problem. Math education is essential and most jobs require at least some proficiency in the subject (Nahornick, 2016). A background in Math is needed to pursue technological development, to understand political and cultural issues, and simply in everyday life, so it seems evident that Mathematical proficiency matters (Nahornick, 2016). Contemporary research reveals that about 20% of students in community colleges' basic Math and pre-algebra programs lacked a sense of part-whole relationships with whole numbers (Steinke, 2015). Further, these concepts are needed to understand fraction and percent relationships, carries over to the relationship between details and the main idea in factual prose, in critical thinking in job situations, and on the current high school equivalency tests. The ability to compute, problem solve, and apply concepts and skills in Mathematics influences multiple decisions in our lives (Little, 2009). However, Mathematics is often challenging for students with, and without, disabilities to master. The long-term impact on students failing to develop Math skills is the direct effect on their potential earnings and future opportunities in a progressively science, technology, engineering and Mathematics (STEM) driven workforce. More than two-thirds of STEM workers have at least a college degree, compared to less than one-third of non-STEM workers (Langdon, McKittrick, Beede, Khan, & Doms, 2011). STEM degree holders also enjoy higher earnings, regardless of whether they work in STEM or non-STEM occupations.

Comparison studies, such as PISA and TIMMS, that are focused on student results have shown US students not performing as well in Math as students in many other developed countries (Hanushek & Woessmann, 2010; OECD, 2016; U.S. Department of Education, 2000). In 1983, the National Commission on Excellence in Education spent 18 months developing a research report, which concluded that schools in the United States were failing (No Child Left Behind [NCLB], 2002). They found that only a third of the country's population had the ability to solve multi-step Math problems. These findings ignited the government and other educational organizations to address these issues and improve the country's educational system. In 2001, with the passage of NCLB, the federal government required educators to use research-based programs to ensure students achieved 100% proficiency in reading and Mathematics by 2014 (NCLB, 2002). Numerous factors, including research that has documented the importance of early educational experiences on brain development, have given educators and policymakers greater insights to improve young children's learning (Daily, Burkhauser , & Halle, 2011). Daily et al. (2011) summarized the state and national initiatives that focused on Math and literacy readiness in early childhood and kindergarten programs:

> Readiness programs were supported in 2002, the Bush administration launched Good Start, Grow Smart, which urged states to develop voluntary early literacy and early Math guidelines for children between the ages of three and five and align them with their K–12 standards. The Obama administration has maintained a focus on early childhood by including $5 billion of new funding for Child Care, Head Start, Early Head Start, and programs for young children with special needs in the American Recovery and Reinvestment Act. (p. 21)

What is taught to students, and how it is taught, are important factors in a school's capability to make gains in student achievement, however, the widespread use of varying approaches to Math curriculum and instruction limits the generation of consistent evidence for system wide improvements (Agodini & Harris, 2010). During the fifteen years, from 2001 through 2015, the federally mandated policies of NCLB made improvements in the accountability of school systems and the achievement of students, but they also resulted in numerous negative outcomes for students, teachers, and school systems (Chenoweth, 2016). The ESEA law was rewritten and signed into law in 2015. The update to the ESEA-NCLB act, Every Student Succeeds Act, aims to correct many of the shortcomings of NCLB and maintains the requirements of states having standards but is more flexible relative to how a state chooses to manage the process (Chenoweth, 2016).

A Program History and Description of the Math Program - *Investigations*

The conceptual goals of Math education are multifaceted and include viewing Mathematics as a language of reasoning. As a particular kind of logical structure, students use Math to reason analytically about quantitative and spatial phenomena, make sense of things, and form judgments, inferences, and conclusions (Battista, 1999). When engaged in Mathematics, students learn to recognize and describe patterns by manipulating and reflecting on ideas to solve problems. The societal benefits of Math education stem from the capabilities of individuals to become articulate in employing the "abstract concepts and Mathematical perspectives that our culture has found most useful" in addition to the contributions that "future Mathematicians, engineers, and scientists make to the scientific/technical infrastructure of the country" (Battista, 1999, p. 425). These long-term outcomes are initiated in primary/elementary school classroom experiences.

In 1990, the Mathematics research and development group known as TERC (of Cambridge, Massachusetts) was funded by the National Science Foundation (NSF) to develop a complete K- 5 Mathematics curriculum (Kehle, Lambdin, Essex & McCormick, 2005). The goals of the *Investigations* K-5 curricular program mirror much of the conceptual goals of Math education by: supporting students to make sense of Mathematics and learn that they can be Mathematical thinkers, focusing on computational fluency with whole numbers as a major goal of the elementary grades, emphasizing reasoning about Mathematical ideas, communicating Mathematics content and pedagogy to teachers, and engaging the range of learners in understanding Mathematics (Investigations in number, data, and space, n.d.). In addition to the goals of the curriculum, the three guiding principles that are touchstones for the *Investigations* K-5 program are that: students possess Mathematical ideas; teachers remain engaged in professional development about Mathematics content, pedagogy, and student learning; and teachers integrate the students and content materials to create the curriculum as enacted in the classroom (Investigations in number, data, and space, n.d.). Willingham (2009) supported the perspective that students need to develop balanced Mathematical understandings as he shared his view that "procedural or factual knowledge without conceptual knowledge is shallow and is unlikely to transfer to new contexts, but conceptual knowledge without procedural or factual knowledge is ineffectual" (p. 14). The *Investigations* program instructs teachers to guide students to work on a smaller volume of in-depth problems and to select from a variety of materials, both concrete and technological, to find solutions as a regular daily practice. The increased conceptual knowledge assists students to move from bare competence with facts and procedures to the automaticity needed to be a good problem solver (Willingham, 2009). Teachers act as facilitators of student dialogue, assisting them to gain deeper understandings of Mathematical concepts, and to express their thoughts (U.S. Department of Education, 2013). Because the developers of the curriculum shared the belief that teachers are critical to the learning process, they designed the program to foster teacher learning (Remillard & Bryans, 2004). Examples of student work, research summaries and assessment samples were included in the program materials.

Each grade level is organized into units that may focus on a single subject, or may revolve around related subjects. For example, addition and subtraction or geometry and fractions could be part of a unit, which usually lasts within a timeframe of two to eight weeks. Each unit is designed around two or more investigations that provide multiple contexts in which students explore Mathematical challenges. Some investigations last only two or three days, while others may stretch for multiple weeks. Classroom activities can vary from day to day and are dependent on the type of investigation being studied. For example, an investigation lasting one week may consist of an introduction to the investigation by the teacher through a large group hands-on activity, followed by two or three days where students work in pairs or small groups to explore the concept in depth. The final class meeting during an investigation consists of the students and teacher discussing as a group what they learned during the investigation and the various methods they use to solve problems.

Efficacy of the *Investigations* K-5 curriculum. The *Investigations* K-5 Math program is based on constructivist theory, unlike most traditional Mathematics instruction and curricula that focus on the transmission, or absorption, view of teaching and learning (Clements & Battista, 1990). In traditional instruction, students passively "absorb" Mathematical structures invented by others and scribed in texts by authoritative adults, which depicts teaching as the transmitting of established facts, skills, strategies and concepts to students (Clements & Battista, 1990). The constructivist approach to Mathematics instruction defines learning as an active process. Cobb (as cited in Jaworski, 2002) suggested that constructivism challenges the notion that meanings reside in words, actions, and objects independently of an interpreter. Teachers and students are viewed as active partners who construct understandings and continually give contextually based meanings to each other's words and actions as they interface. Grady, Watkins, and Montalvo (2012) cite the following definition of constructivism from Glaserfeld:

> Constructivism is a theory of knowledge with roots in philosophy, psychology, and cybernetics. It asserts two main principles whose application has far-reaching consequences for the study of cognitive development and learning as well as for the practice of teaching, psychotherapy, and interpersonal management in general. The two principles are: (a) knowledge is not passively received but actively built up by the cognizing subject; and (b) the function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality. (p. 162)

A challenge in many constructivist settings, where the teacher is a “facilitator,” in contrast to most guided instruction settings, where the teacher is an “activator,” is the assumption that “knowledge is best acquired through experience based on the procedures of the discipline” (Hattie, 2009, p. 243). Some constructivists reject strategies, including memorizations, and fail to understand that it is advantageous to have automatic retrieval of knowledge (Quirk, 2013). This outlook can become an impediment to student progress if the teacher focuses on the process of Mathematics to the exclusion of teaching the skills of Mathematics (Hattie, 2009). Teachers should understand that constructivism is a way of knowing, not a teaching method. The instructional method of constructing conceptual knowledge, however, involves a consideration of the learner's viewpoint and an understanding that what they learn is socially constructed (Hattie, 2009). Goodrow's (1998) study of constructivist versus traditional Math methodologies examined (a) the development of number sense and number representation by children in traditional, transitional, and constructivist second-grade Mathematics classrooms and (b) how different teaching approaches influence the way children deal with computation exercises. The study found that children in constructivist classrooms, who had not learned rote, algorithmic procedures for addition and subtraction but, instead, relied on their own number sense, produced a larger percentage of correct responses through the use of diverse strategies and demonstrated a broader understanding of number relations and of the properties of the decimal system. In contrast, when students rely on procedural knowledge of the standard algorithm, their errors suggest an overgeneralization of rules (Resnick & Omanson, 1987). Conclusions from the Goodrow study support the view that children are more successful at computation when they rely on their own thinking about number sense rather than on taught procedures.

Achievement effects. The U.S. Department of Education study (Agodini, Harris, Thomas, Murphy, & Gallagher, 2010) presented the findings of a large-scale comparison study of four elementary school Math curricula in prominent use in classrooms: (1) Investigations in Number, Data, and Space (*Investigations*); (2) Saxon Math; (3) Math

Expressions; and (4) Scott Foresman-Addison Wesley Mathematics (SFAW). The study used randomized controlled trial techniques to compare the effect of each program on Math achievement of early elementary school students. The study found student-centered instruction and peer collaboration were significantly higher in *Investigations* classrooms than in classrooms using the other three curricula (Agodini et al., 2010). Student-centered instruction substitutes active learning for lectures, holding student responsible for their own learning through cooperative learning and assigning open-ended problems that require critical or creative thinking (Felder & Brent, 1996). The Agodini et al. (2010) study also found "that compared to teachers using the other curricula, *Investigations* teachers should pose more open-ended questions to students, repeat student answers in a neutral way, and probe students for reasoning or justification for their answers" (p. 97).

The Agodini and Harris (2010) study of four curricula: *Investigations; Saxon Math; Math Expressions; and Scott Foresman-Addison Wesley Mathematics* recruited and randomly assigned the four programs to first-grade classrooms across 39 schools from four districts, in four geographically dispersed states, in three regions of the country, with each district implementing all four curricula. The results of study showed that the average Math achievement for *Math Expressions* and *Saxon* students was 0.30 SD higher than *Investigations* students and 0.24 SD higher than SFAW students.

As a teacher-as-facilitator program, the *Investigations* K-5 curriculum requires teachers to lead the students toward collaborative dialogue. This goal necessitates that teachers will develop effective lines of questioning to drive students' understandings and ownership of content. Both of these findings can be attributed to the constructivist methodology of the *Investigations* curriculum, which requires teachers to guide, not direct students through the inquiry process. According to the efficacy study of the *Investigations* program by Gatti and Giordano (2010), where Math achievement was measured by the Group Mathematics Assessment and Diagnostic Evaluation (GMADE), the program assisted students in realizing positive educational attitudes and achievement outcomes. The *Investigations* student groups showed mixed performance of minimally outperforming comparison groups at the second-grade level and "dramatic and educationally significant increases at both the early and late elementary grades" (Gatti & Giordano, 2010, p. 23), with late elementary *Investigation*s students completing 5th grade testing five months ahead of their counterparts in the comparison group. While Investigations ranked as the least impactful curriculum of the four compared in the Agodini and Harris (2010) study when measuring effectiveness of first-grade Math achievement, and showed significant increases in Math achievement at multiple levels in the Gatti and Giordano (2010) study, it was also recognized by Agodini and Harris as having the most student centered and constructivist approach of the four programs and identified by Gatti and Giordano for teacher and student approval of its activities, materials and ability to make Math more appealing and fun for students.

Theoretical Framework of Teacher Orientations Toward Math Curriculum

Teacher behavior is influenced by the teacher's content knowledge, how learners understand that specific content, the teacher's method of instruction, and the teacher's attitudes and beliefs about teaching and Mathematics (Van Der Sandt, 2007). Also informed by what Doyle (1993) has named teachers' curriculum processes, is the method by which teachers construct or enact curriculum. Studies of teachers' curricular methods include scrutiny of how teachers utilize resources like curriculum guides, and how there is an assumption that teachers inherently understand the intent and meaning of the resources. Remillard and Bryans (2004) view the enacted curriculum as a co-construction between teachers and students as they participate in the daily instructional routines. Their findings revealed that the most significant learning occurred during the process of enacted learning, due to the cognitive stretch that occurs for teachers and student together during those moments. It is in these circumstances, when teachers "examine unfamiliar Mathematical tasks and interpret student work on them while teaching" (Remillard & Bryans, 2004, p. 355), that teachers' ideas about pedagogy are challenged and changed. Researchers have found that a teacher's level of content knowledge and pedagogical beliefs determine how they structure their lessons. As teachers' process similar information from textbooks, and activities differently, there is an assumption that teachers use suggestions in the curriculum differently as well, a situation referred to as "opportunities for learning" by Remillard and Bryans (2004, p. 355).

A negative impact on student achievement develops when there is a lack of instructional level alignment (LeMire, Melby, Haskins, & Williams, 2012). In cases where teachers fail to accommodate academically diverse students, the students experience inequitable learning opportunities. Instructional level alignment, where instruction is given at a level that is beneficial to the student, is reliant on specific aspects of the cognitive domain (Lemire et al., 2012). While effective instruction leads to growth in a student's knowledge, comprehension, and critical thinking, poor instruction may lead to a sense that the student is not valued and that success is not possible in the educational setting. Hackenberg (2010) shared that the lack of a student's ability to reach a valuing state could result in substantial negative consequences where there is potential for a student to affectively shut down. The affective domain has received less attention than the cognitive domain, primarily due to the widespread application of the levels of Bloom's cognitive domain of educational taxonomy (Lemire et al., 2012). However, a student's affective response to instruction can play a major role if their interest level is high enough. Subban (2006) found that students continue to see cognitive stimulation if they enjoyed a task at an early age, which also helps marginalized students to engage in the classroom. Engaging students actively in the content, and the learning process helps all students to see patterns developing, and to see learning as a positive experience. As noted by Kennedy and Smolinsky (2016), the experiences of African American boys who were successful in Mathematics reflected several key factors: recognition of abilities, support systems and a positive Mathematical and academic identity.

Summary

The challenge of achieving Math proficiency in elementary classrooms persists despite technological developments, curricular innovations, and increased accountability of school systems. Teacher self-efficacy and improved quality of foundational Math instruction is the most plausible method to address low Math achievement (Stronge, 2010; Doabler et al., 2012). A teacher facilitated, student-centered, constructivist approach to instruction increases students' depth of understanding and their ability to express Mathematical concepts (U.S. Department of Education, 2013). This instructional approach increases students' breadth of understanding of number relationships and their intuitive abilities to create diverse problem-solving strategies. Teachers with greater content knowledge, and self-efficacy, demonstrate greater competence at supporting constructivist instructional methods. This level of competent instruction supports students' affective domain, which engages marginalized, mainstream, and advanced students alike and helps them to view learning as a positive experience (Subban, 2006). Large-scale studies of major elementary curricula shared mixed reviews of the impact on student achievement of student-centered and collaborative programs, such as *Investigations*. The Gatti and Giordano (2010) efficacy studies of *Investigations* supported the Math achievement outcomes and positive educational attitudes of students who used the program while the Agodini and Harris (2010) study showed limited impact on Math achievement. Insights from studies in the literature support the premise that experiential, hands-on instruction that develops number sense is the most instructive methodology for elementary Math programs. Curriculum and instruction practices that are grounded in meaningful experiences, and provide solutions to real world applications are the most beneficial Math programs for elementary students.

CHAPTER 3

METHODS

Overview to the Program Evaluation

At the most basic level, evaluation involves making value judgments about available information (Cook, 2010). Therefore, an educational program evaluation typically uses data and information resources to decide the merit or worth of an educational program, especially if it focused on outcomes as is this study. Educational program evaluation is more formally defined as the “systematic collection and analysis of information related to the design and implementation and outcomes of a program for the purpose of monitoring and improving the quality and effectiveness of the program” (ACGME, 2013 p. 8). The choices of specific measurement tools typically used to gather information for evaluations are guided by many factors, including the primary evaluation questions that define the program’s successes or failures. A strong evaluation process maintains accountability while supporting the educator’s ability to learn useful information about their program (Goldie, 2006). For many years evaluation models did not support such an inclusive scope of needs, but contemporary program evaluation standards have been designed to “guide the evaluation of educational training programs, projects, and materials in a variety of settings” (Mertens & Wilson, 2012, p. 23).

This study focused on the final component of CIPP, product evaluation, as it assessed the positive and negative outcomes of the *Investigations* program at the school of study. It applied a mixed-methods methodology to assure both qualitative and quantitative outcomes are noted to assist in verifying evaluation findings (Mertens & Wilson, 2012). The product, or impact, evaluation component benefits the school of study as it interprets the merit, worth, significance, and probity of the outcomes (Zhang et al., 2011).

Evaluation questions. When evaluations work effectively, they generate information to a wide range of audiences that can be used to make better decisions, develop greater appreciation and understanding, and gain insights for action (Preskill & Jones, 2009). The questions for this study were directly related to the expected outcomes from the evaluation of the *Investigations* K-5 Math program. The first four questions related to teacher perceptions of the effectiveness of the implementation of the *Investigations* K-5 Math program. The fifth question related to both teacher perceptions and the quantitative evaluation of changes in student achievement during the course of implementation of the program.

The program evaluation research questions for this study were:

1) What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?
2) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their Mathematics content and pedagogical knowledge?
3) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program assisted the development of a consistent scope and sequence for the K-5 classrooms?

4) What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 program?
5) What are teachers' perceptions of the changes in student achievement resulting from implementation of the *Investigations* K-5 Math program?

Participants

The participants in the focus group interviews for the study were 16 of the 17 current Kindergarten through 5th grade teachers at the school of study. The lone non-participant was not available to meet during either focus group interview session. As the curricular topics and the students' developmental needs transition greatly between early childhood and late elementary, the span of participant grade levels supported a maximum variation sampling strategy (Mertens & Wilson, 2012). This group ranged in their depth of experience teaching the curriculum (Figure 3), inclusive of a combination of

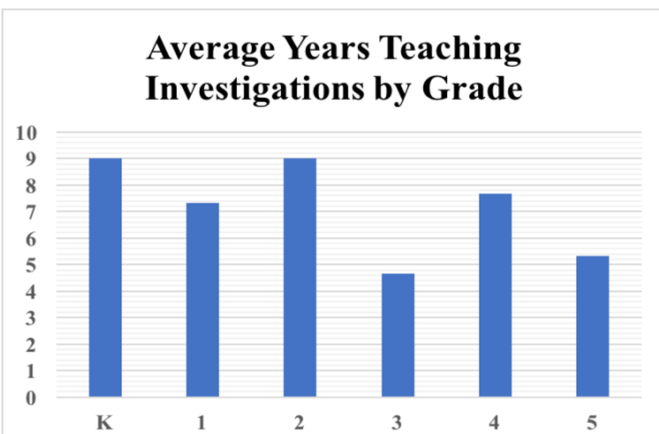

Figure 3. Average number of years teaching the *Investigations* program by grade level.

Teachers who taught Math at the school of study prior to the implementation of the *Investigations* K-5 Math program and those who began instruction after the implementation of the program was adopted. This inclusive strategy revealed the nuanced professional backgrounds and experiential differences among teachers across the different grade level contexts.

Table 1

Profiles of Focus Group Interview Participants

Participant	Years Teaching	Years Teaching at School	Years Teaching Invest.	Grade levels of Teaching experience	Academic Background
1	20	4	4	1,3,4,6	BA Art MA Education
2	31	30	5	1,4,5	BS Education MA Education
3	10	10	9	K, 1	BA Art
4	38	27	9	2, 3	BA
5	20	20	9	3	BS Theater MA El. Education MS Ed Leadership
6	12	10	9	1, 2	BS MS Social Work MA Education
7	11	5	5	5	BS Architecture MA El. Education
8	7	3	3	1,3,4	MA El. Education
9	10	2	2	3	BA English MA El. Education
10	6	2	2	4,5	BS Urban Studies MS El. Education
11	16	10	7	4,5	BA History M. Ed MS general
12	8	5	5	4, 5	MA Education Cert. Special Ed
13	37	34	8	4	BA Archeology M.Ed Elem Educ
14	34	27	8	2	BA Anthropology MA Religion
15	24	24	9	K	BA Pol. Science MA Education
16	21	17	9	K	BA Lat. America MA T.E.S.L.

Note. BA=Bachelor of Arts; BS=Bachelor of Science; MA=Master of Arts; MS=Master of Science; M.Ed=Master of Education; T.E.S.L.=Teaching of English as a second language

The study was supported by the Lower School Division Head, the Director of

Curriculum, and the Learning Specialists. The K-5 teachers were invited to participate in the study to support the school's desire for the program to be effectively evaluated.

Data Sources

Qualitative data: Focus group interviews. The first measure utilized two sets of focus group interviews, a structure where group discussions on a particular topic are organized for research purposes (Gill, Stewart, Treasure, & Chadwick, 2008). All 17 of the Lower School Math teachers were invited to participate in the study, and they all agreed. As one teacher was unavailable for the focus group, the remaining 16 teachers were divided into the two focus interview groups consisting of eight participants each. The goal of this method was to promote self-disclosure among the participants, where the group dynamic and open-ended inquiry could create a dialogue that takes on a life of its own (Rennekamp & Nall, 2000). This method effectively probed group participants for more in-depth information on their perceptions, insights, attitudes, experiences, and beliefs (Centers for Disease Control and Prevention, 2008). Quotes that represented the sense of the focus group responses during the interviews were included in the findings.

The Focus Group Protocol (Appendix B was field tested prior to implementation utilizing a review panel of administrators (Table 2) who possessed knowledge of focus group protocols, an intimate knowledge of the *Investigations* program and its adoption, and an understanding of research design. Two of the three panelists were involved in the process of researching the various Math programs that resulted in the selection and use of *Investigations*. The third panelist assisted the first two panelists in the process of supporting the teachers throughout the implementation of the *Investigations* curriculum as it was introduced annually to a new grade level team. The review panel listed below

(Table 2) agreed to pilot test the Focus Group Protocol in support of the study. Utilizing the think aloud interview method (Fonteyn, Kuipers, & Grobe,1993; Pilot Testing Data Collection Instruments, n.d.), the panelists talked through their thinking processes as they tried to answer each interview question.

Table 2

Review Panel for Focus Group Interview Protocol

Name	Role	Years involved with *Investigations* Program	Academic Background
Sue Scirica	Learning Specialist	10 years	BA English MS Psychology PhD School Psychology
Page Fahrig-Pendse	Director of Curriculum and Instruction	6 years	BA History MS Elem. Education EdD Teaching, Learning, and Curriculum
Sharon Askew	Lower School Math Coordinator	10 years	BS Mathematics

The purpose of this methodology was to ensure that the participants in the sample group not only understood the interview questions, but understood them in the same way. During this review process, the panelists also shared the key ideas that were raised from the line of questioning to be considered during the coding process of the focus group transcripts (Appendix C). The triangulation of the review panelists' insights through dialogic engagement supported the soundness of the focus group protocol through confirmability, interpretive validity, and evaluative validity (Ravitch & Carl, 2016). A review panelist also agreed to code the interview transcripts utilizing Focus Group

Interview Themes for Coding (Table 3) and *the* “key ideas to look for” (Appendix C), providing interrater reliability as an additional validity strategy. Multiple coding is one method that allows researchers to address the issue of subjectivity of interpretation at the coding and analysis level (Ravitch & Carl, 2016).

The questioning route for the focus group interviews aligned with the established evaluation questions, supporting the impact evaluation of the CIPP model and the pragmatic paradigm (Gill et al., 2008; Mertens & Wilson, 2012). In an effective questioning route, the specific order in which the questions are asked, has an informal beginning, flows cogently and intuitively from one question to another, and moves from more general questioning to the specific (Rennekamp & Nall, 2000). The time required to exhaust the discussion for each question was estimated in order to effectively manage the focus group discussion. Rennekamp and Nall (2000) describe a typical sequence of five general types of questions for focus interviews:

1) Opening questions- Easily answered questions that help participants to talk and feel comfortable.
2) Introductory questions- Help to focus the group’s conversation on the topic at hand.
3) Transition questions- Ask the participants to add depth beyond the introductory questions, linking them to the key questions to follow.
4) Key questions- Ask the participants to focus on the major areas of concern
5) Ending questions- Bring closure to the interview session

To support the logical flow of dialogue, the questioning route for this study's focus group interview sessions was executed as follows:

1) How long have you been using the *Investigations* curriculum? (Opening question)
2) Think back to when you first used the program. What were your first impressions? (Introductory question)
3) What is your perception of how well the use of *Investigations* K-5 Math program has updated the curricular program to support the school's standards of practice for Math? (Transitional question)
4) What has been the impact of *Investigations* K-5 Math program on your content and pedagogical knowledge? (Key question)
5) What are your perceptions regarding the extent to which the use of *Investigations* K-5 Math program has supported the development of a consistent scope and sequence for the K-5 division? (Key question)
6) What is your perception of changes in student achievement during the course of the implementation of the *Investigations* K-5 Math program? (Key question)
7) What unintended outcomes (positive and negative) resulted from the use of the *Investigations* K-5 program? (Key question)
8) Is there anything else we should have talked about but did not? (Closing question)

As shown in Table 3 and Table 4, information from the focus groups was collected to evaluate teacher perceptions of the following:

(1) Improvement in instructional practices

(2) Positive effect on increasing computational fluency and reasoning about Mathematical ideas

(3) Communication of Mathematics content and pedagogy to teachers

(4) Engaging the range of learners in understanding Mathematics

(5) Accuracy, feasibility, and utility of the program as set forth in The Joint Committee Program Evaluation Standards for evaluating educational programs.

These results were designed to inform personnel at the school of study and to support their decisions of whether or not the program should be modified moving forward.

Table 3

Focus Group Interview Themes for Coding

A. How would you rate *Investigations* K-5 Math program in the following areas?

1. Effectiveness of Instructional Strategies
2. Ease of implementing the program
3. Effectiveness of balancing curricular strands
4. Effectiveness in supporting students at all levels of proficiency
5. Effectiveness in increasing lesson coherence
6. Readability and usability of printed materials
7. Effectiveness of teaching Mathematical processes
8. Support provided by the program materials
9. Supports collaboration between and across grade levels

B. How well does *Investigations* support your instructional skills in teaching students?

1. To make sense of problems and persevere in solving them?
2. To reason abstractly and quantitatively?
3. To construct viable arguments and critique the reasoning of others?
4. To model with Mathematics?
5. To use appropriate tools strategically?
6. To attend to precision?
7. To look for and make use of structure?
8. To look for and express regularity in repeating reasoning?

Table 4

Table of Specifications: Alignment of Research Questions, Program Objectives, Focus Group Themes for Coding, and Standards for Educational Evaluation

Research Questions	Program Objectives	Coding Themes	Evaluation Standards
(1) What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?	(1) Improvement in instructional practices (2) Positive effect on increasing computational fluency and reasoning about Mathematical ideas (3) Communication of Mathematics content and pedagogy to teachers (4) Engaging the range of learners in understanding Mathematics (5) Accuracy, feasibility, and utility of the program	A.)3-9 B.)1-8	Utility Accuracy, Feasibility
(2) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their Mathematics content and pedagogical knowledge?	(1) Improvement in instructional practices (3) Communication of Mathematics content and pedagogy to teachers	A.)1-2,7 B.)1-8	Utility Accuracy
(3) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program assisted the development of a consistent scope and sequence for the K-5 classrooms?	(1) Improvement in instructional practices (3) Communication of Mathematics content and pedagogy to teachers (4) Engaging the range of learners in understanding Mathematics (5) Accuracy, feasibility, and utility of the program	A.)3, 5-9 B.)1-8	Utility Accuracy, Feasibility
(4) What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 Math program?	(1) Improvement in instructional practices (2) Positive effect on increasing computational fluency and reasoning about Mathematical ideas (3) Communication of Mathematics content and pedagogy to teachers (4) Engaging the range of learners in understanding Mathematics (5) Accuracy, feasibility, and utility of the program	A.)1-9 B.)1-8	Utility Accuracy, Feasibility
(5) What are teachers' perceptions of changes in student achievement resulting from implementation of the *Investigations* K-5 Math program?	(2) Positive effect on increasing computational fluency and reasoning about Mathematical ideas (4) Engaging the range of learners in understanding Mathematics (5) Accuracy, feasibility, and utility of the program	A.)4, 7 B.)1-8	Utility Accuracy, Feasibility

Quantitative data: Student achievement test scores. For the second measure, the archived achievement test data were acquired from the full grade-level sets of former 5th grade students spanning four of the five years leading up to the intervention and concluding with four of the five years post-intervention at the school of study. The data set included all former students who completed the fifth-grade program in the lower school during the eight years inclusive of 2007, 2008, 2010, 2011, and 2103-2016. The school of study utilized the Educational Record Bureau (ERB) CTP-4 comprehensive testing programs to test all fifth-grade students in Math and literacy achievement each spring. As shown in Table 5, the content categories of the ERB CTP-4 Level 5 achievement test aligned with the curricular units of the fifth-grade *Investigations* Math program. The alignment between the test assessment parameters and the curricular program was essential to accurately measure changes in student achievement. Biggs (2003) suggests this element is a challenge for teachers when they assess students' learning outcomes as "faulty assumptions and practices about assessment do more damage by misaligning teaching than any other single factor" (p. 2). Biggs' (2003) notion of constructive alignment, where the components of the teaching system are closely affiliated to the learning activities assumed in the intended outcomes, are supported in this case by the alignment between the curriculum, the achievement test, and the standards of practice for Math adopted by the school of study. The strong alignment between the ERB content categories and *Investigations* unit summaries supported the use of the ERB CTP-4 achievement test as a valid instrument to measure changes in student achievement at the conclusion of the fifth-grade level *Investigations* curriculum.

Table 5

Corresponding Investigations Grade 5 Units for ERB CTP4-Level 5 Content Categories

ERB CTP4 Content Categories	***Investigations* Grade 5 Unit Summaries**
Numbers and Number Relationships	What's That Portion? Fractions and Percentages • Students study the relationship among fractions and between fractions and percentages. • They use a variety of contexts and models, including area, number lines, and rotation, to further understand the meaning of fractions.
Number Systems and Number Theory	Thousands of Miles, Thousands of Seats: Addition, Subtraction, and the Number System • Students study place value in large numbers • Students finalize their study of subtraction by refining and gaining fluency in solving subtraction problems. • Using a context of the capacities of stadiums and arenas, they solve addition and subtraction problems involving four- and five-digit numbers.
Geometry and Spatial Sense	Prisms and Pyramids: 3-D Geometry and Measurement • Students investigate concepts of volume by finding the volume of prisms, pyramids, cylinders, and cones.
Measurement	Measuring Polygons: 2-D Geometry and Measurement • Students create polygons using "power polygon" pieces and discuss, apply, and evaluate definitions of these polygons. • They focus on properties of quadrilaterals and similarity of 2-D shapes. • Measurement work includes finding measures of angles using known angles and finding perimeter and area of rectangles.
Statistics	How Long Can You Stand on One Foot? Data Analysis and Probability • Students describe major features of a set of data, represented in a line plot or bar graph, and quantify the description by using medians or fractional parts of the data. • Students draw conclusions about how two groups compare based on summarizing the data for each group.
Probability	How Long Can You Stand on One Foot? Data Analysis and Probability • Students also look at the probability of various events. • Students also consider the notion of fairness in the context of probability by playing fair and unfair games, that is, games in which players do or do not have equal chances of winning.
Pre-Algebra	Growth Patterns: Patterns, Functions, and Change • Students investigate situations in which two quantities change in relation to each other. • Students describe data about functional relationships, and understand how the changes and totals are related. • They also compare two linear functions with different rates of change.
Math Communication	Not Applicable for School of Study

Note. Adapted from Standards for Mathematical Practice. (n.d.). Retrieved from http://www.corestandards.org/Math/Practice/

Data Collection

This program evaluation study used a convergent, parallel mixed-methods strategy, where both the quantitative and qualitative data were gathered during the same data collection phase (Creswell, 2014). Creswell notes that the combination of open-ended data and closed-ended data provides some broader perspectives as a result of using the different methods as opposed to using a single method. This method "builds off the historic concept of the multimethod, multitrait idea from Campbell and Fiske (1959), who felt that a psychological trait could best be understood by gathering different forms of data" (Creswell, 2014, p. 219). The convergent parallel mixed methods design for this study included qualitative focus group interviews, in addition to the data analysis of achievement test scores.

The focus group interviews consisted of a cohort of 16 participants. As the recommended protocol for focus group sample size is six to nine people per group, this study consisted of two discrete focus group interview sessions (Mertens & Wilson, 2012). Each session consisted of a semi-structured, hour-long inquiry session where the group of teachers responded to open-ended questions. This approach allowed participants to tell their personal stories in a descriptive fashion that could result in unanticipated findings (USAID Center for Development Information and Evaluation, 1996).

The results from the focus group interviews yielded descriptive qualitative data on teachers' observations, experiences, and perceptions concerning the use of the *Investigations* K-5 program. The quantitative measure, an analysis of ERB CTP-4 student achievement test scores, served as the secondary data source to provide support for data collected via the focus group interviews. The extant achievement test score data were acquired from the archives of the Learning Support offices at the school of study. The results from both data collection methods were analyzed after the data collection phase.

Dependability and credibility. The criteria for determining trustworthiness of qualitative inquiry shifted during the 1980s when Guba and Lincoln developed criteria to secure rigor of qualitative study, reframing the terms for achieving rigor, reliability, validity, and generalizability with dependability, credibility, and transferability (as cited in Morse, 2015). While the idea of uniform measurement in qualitative studies is less pertinent than in quantitative inquiry, it is the evaluator's duty to maintain a system of documentation to record changes and the supporting reasons during the study. Multiple strategies were implemented to enhance the credibility of the qualitative data collection during this study.

Prolonged and substantial engagement, where significant time was spent on data collection within the setting, allowed time for trust to be established with participants (Mertens & Wilson, 2012; Morse, 2015). Peer debriefing, which utilized the expert review panel (Table 2), allowed for the study to be discussed at different stages of the research progression. This process, which supported conceptualization of the theory and enhanced the reflective nature of peer dialogue, supported the development of the internal validity of the study (Morse, 2015; Ravitch & Carl, 2016). Participants were given copies of the findings and the opportunity to share additional comments via optional formal group meetings, individual conferences, and digital communication. Member checking, which allowed the focus group participants to review the data from their transcribed interviews for data correction and additional insights, helped to clarify the evaluator's accuracy of transcriptions and overall work quality (Mertens & Wilson, 2012).

Data Analysis

Using the convergent parallel mixed methods strategy, the two data sources were analyzed independently and then brought together (Creswell, 2014). The focus group interviews served as the primary collection method of the qualitative data. The test achievement scores served as the primary quantitative data. Using extant student achievement data, both pre-implementation and post-implementation of the *Investigations* K-5 Math program, the Math achievement trends from the ERB CTP-4 Math assessments were evaluated using the process of short interrupted time-series analysis (Bloom, 1999). In this side-by-side comparison, I first reported the qualitative findings and then evaluated whether they were supported by the quantitative findings.

Qualitative measures. The first measure of the results was an analysis of the focus group interview data to discern teacher perspectives relative to the program goals that were stated prior to implementation of the *Investigations* K-5 Math curriculum (see Table 2). The focus group data were based solely on perceptions of teachers at this school of study and at the point in time of the interviews. It will not be constructed for external use or to predict teacher perspectives beyond the school of study.

Rennekamp and Nall (2000) support the analysis of focus group data through three overarching steps. Through indexing, the reading of transcript notes and assignment of codes or “labels” to each piece of relevant information, the codes linked together common viewpoints in the text that related to key questions of the study. Through management, the extracts of text that were allocated the same code were collected together. Through interpretation, summary statements were developed from the extracted texts to form key themes of the study. Through the process of reading the focus group summaries, reading each transcript, and analyzing each question individually, the trends and patterns were documented (USAID Center for Development Information and Evaluation, 1996). There was consideration for the meaning of the words participants used, the contexts in which comments were made, the shifts in opinions during the discussion, the responses that were based on personal experiences, and the major ideas from the findings. The summary of the findings, including selected quotes that represented the sense of the focus groups' commentary, was shared with the participants, as a continuation of the validity strategy, to insure the ongoing formative analysis of the group's feedback. The coded themes from the focus group responses and feedback channels were descriptively analyzed to aggregate the data set (USAID Center for Development Information and Evaluation, 1996).

Quantitative measures. The second measure was a quantitative analysis of Math achievement test scores to determine a pattern of progress or regression in student performance during the implementation of the *Investigations* program. The analytical method used was a time-series analysis, defined simply as a variable that undergoes a periodic observation or measurement (Linden et al., 2003). While any variable that is measured over time may be influenced by prior observations, time series models take advantage of these correlations as the foundation for predicting future behavior (Linden et al., 2003). It is this factor of time-series analysis that differentiates it from traditional statistical tests that measure change, such as regression analysis. Interrupted time-series analysis is a method that is used to "estimate the impact of programs, designed to increase the academic achievement of students in primary and secondary school" (Bloom, 1999, p. 4).

There are three fundamental phases to develop a time-series model: (1) use a sufficient number of observations to graph the data and recognize any patterns in the series that may assist the evaluator to identify the appropriate time-series model, (2) properly fit the data within the correct model, (3) evaluate the model by comparing baseline (pre-launch) data with the post-launch, intervention data (Linden et al., 2003). This study will use a baseline mean model, which is applicable with as few as three years of baseline test data, where each year's cohort of students represents "a sample of students from a conceptual population that could have been used to measure the effectiveness of the school that year" (Bloom, 2003, p. 9).

A major concern of using interrupted time-series for educational research is the potential lack of adequate data, however, this challenge is substantially overcome through the use of average annual test scores (Bloom, 1999). While measuring the mean annual test scores can disguise the gap between students with the strongest and weakest backgrounds, measuring a program's effect on the standard deviation of the students' test scores helps to assess the equity implications of an educational program (Bloom 1999). This study also analyzed the standard deviation trends between the pre-program and post-program implementation achievement test scores to determine the trends in the spread of student performance. Due to numerous variables including fidelity of implementation, lack of teachers using measurable instruments, etc. over the nine-year span of program implementation, there were questions of validity regarding the differences in achievement test results being attributed solely to the implementation of the *Investigations* program. As Table 4 shows, coding themes from the focus group interviews provided data that was analyzed with descriptive statistics to evaluate trends of the quantitative data.

Table 6

Analysis Methods for Evaluation Questions

Evaluation Questions	Data Sources	Data Analysis
1) What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?	Focus Group responses Standards for Mathematical Practice (adapted from NCTM)	Descriptive statistics Qualitative analysis and interpretation of teachers' Focus Group responses
2) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their content and pedagogical knowledge?	Focus Group responses	Descriptive statistics. Qualitative analysis and interpretation of teachers' Focus Group responses.
3) What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program developed a consistent scope and sequence for the K-5 classrooms?	Focus Group responses	Descriptive statistics. Qualitative analysis and interpretation of teachers' Focus Group responses.
4) What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 program?	Focus Group responses	Qualitative analysis and interpretation of teachers' Focus Group responses.
5) What are teachers' perceptions of changes in student achievement resulting from implementation of the *Investigations* K-5 Math program?	Focus Group responses ERB CTB4- Standardized achievement test scores	Descriptive statistics. Time Series analysis of standardized test scores.

Assumptions, Delimitations, Limitations

Assumptions. The assumptions that influence this study include the belief that lower school teachers possess the pedagogical knowledge and experience levels to implement and assess the skills and growth of their students. This study assumes validity of the alignment between ERB CTP-4 content categories and the curricular units of the *Investigations* program. The study assumes fidelity of implementation to be consistent during the implementation phases and continued use of the *Investigations* program. This study also assumes that the culture of the lower school classroom teachers would be supportive of the evaluation process to support effective classroom practices.

Delimitations. The delimitations that influence this study include the choice of using a focus group interview format due to time constraints and limited access to the participants in order to complete individual interviews. As the evaluation is reviewing an established program, a choice was made not to use survey data due to the inability to gain valid and reliable pre-implementation data. The choice of acting as an internal evaluator, specifically as a school administrator, may also have an impact on the responses of the subjects to the interview questions.

Limitations. A major limitation of qualitative approaches is that the findings cannot be extrapolated to broader populations with the same amount of certainty that quantitative analyses can be extrapolated (Atieno, 2009). The findings of program evaluations are not tested to discover whether they are statistically significant as the goal is not to generalize findings beyond the individuals or sites under study (Creswell, 2014). There were numerous limiting factors that impacted this study.

The process of focus group interviews and coding for themes was limited by both time constraints and the competing nature of a group interview. While the occurrence of themes during the dialogue were noted, a lack of comments on behalf of participants did not establish a lack of support toward themes on behalf of those participants, but it created a limited view of their opinions. A limitation specific to this evaluation study was also reflected in the range of the teachers' years of experience instructing the *Investigations* K-5 Math curriculum. Teachers with limited exposure may have less informed perspectives to evaluate and communicate the outcomes expected from the program. The study delineated between these groups of teachers through their interview feedback. The information provided by interview participants was filtered through their individual perceptions, and not all participants were equally articulate and perceptive. Additionally, interviewer biases can undermine the validity and reliability of the information and recommendations generated in group interviews. The most persistent bias in group interview processes is confirmation bias, which arises from selectively focusing on information and ideas that confirm the preconceived notions and hypotheses of the interviewers (Kumar, 1987).

Ethical Considerations

As the evaluator, my role was "to establish social relations with stakeholders and monitor those relations" (Mertens & Wilson, 2012, p. 45) throughout the study. My professional role as the middle school principal was external to the program, however, as a principal that supervises in another division within the same educational organization, the context of my role relative to the participants may have been viewed as one of authority. Evaluations that adhere to the JSCEE Standards (Appendix A) address the possible dimensions of quality in program evaluation (Yarbrough, Shulha, Hopson, & Caruthers, 2011). Utility standards are focused on the value of the evaluation processes to the stakeholder. Feasibility standards function as a measure of evaluation effectiveness and efficiency. The propriety standards delineate legality and fairness in addressing stakeholder needs. Accuracy standards support the honest representations, findings and judgments about evaluation quality. The evaluation accountability standards support credible documentation and a meta-evaluative outlook towards improvement of the evaluation process. My study adhered to the Program Evaluation Standards by conducting meta-evaluation during the design stage and throughout the life of the evaluation process to insure the worth of the evaluation outcomes, maintain the ability to adapt the evaluation process as needed, and to increase the confidence of the stakeholders (Mertens & Wilson, 2012; Yarbrough et al., 2011). This methodology also minimized bias, as the meta-evaluation processes included a review question set to help ensure the objectivity of the program evaluation plan. Once the dissertation proposal was approved, I submitted the research proposal to the College of William & Mary Institutional Review Board (IRB). The IRB approved the dissertation research proposal and I then met with the appropriate administrators from the school of study to gain approval to conduct the research.

CHAPTER 4

FINDINGS

The purpose of this mixed-methods study of the *Investigations* K-5 Math program at an independent Philadelphia Quaker school was to examine the program's outcomes, to provide clarity on the implementation of *Investigations* program, and to inform faculty and school leaders of the effectiveness of the program's results. The study was supported by the program theory that if teachers were provided time and resources to examine best practice Math curriculum and instruction, they would adopt and implement a holistic Math program that met the needs of all students at all proficiency levels, and increase their content and pedagogical knowledge, which would result the long-term outcomes of a consistent scope and sequence for the K-5 division and improved student achievement. However, as this study wasn't an experimental study of the *Investigations* program, changes in student achievement were not attributable to the use of *Investigations*.

Multiple data sources were examined via semi-structured focus group interviews and analysis of student achievement test data. While the focus group interviews were held in two sessions, the descriptive data, coding, and quotes were taken from the two groups as whole, representing input from all 16 participants. The associated figures that depict the focus group coding themes represent the number of participants that were identified as explicitly mentioning the various coded themes for each question across the combined 16 interview participants (n=16). The frequency of coded themes represents the number of participants that commented explicitly about the designated themes. A challenge in the findings were that a lack of explicit, coded commentary did not inherently translate to the sense of the focus group discussion.

Multiple coders of the interview transcripts, incorporating coding conclusions from an expert review panelist (Appendix D), provided “the capacity to furnish alternative interpretations and thereby act as the devil’s advocate” (Barbour, 2001, p. 1116) to the interviewer’s coding outcomes. This chapter details the findings obtained from both avenues of data collection by presenting descriptive statistics of the occurrences of coding themes from the focus group interview transcripts, summaries of the focus group interview responses, supporting quotes directly from the interview transcripts that represent and illustrate the sense of the combined focus groups’ discussions, and quantitative analysis of extant data from students’ achievement test scores.

First Impressions of Investigations

Teachers’ first impressions of the *Investigations* curriculum were varied, with a combination of optimism and skepticism as the program was being reviewed. The program was viewed as very different from the way teachers had previously approached Math instruction in the Lower School division. Unlike the spiraling curricular structure of the Everyday Math program that had been in use, some teachers appreciated the notion that they “could spend more days delving into a topic” before moving on. There was the sense among focus group participants that the appearance of the Math texts supported a shift in the pedagogical approach to Math instruction, as one teacher noted:

> I noticed in the layout of the pages there was a lot more room on pages than some other Math books. There were a lot of problems that were very open for the kids

to show how they solved problems in whatever way they did. So, it seemed like the process was more important than the quantity.

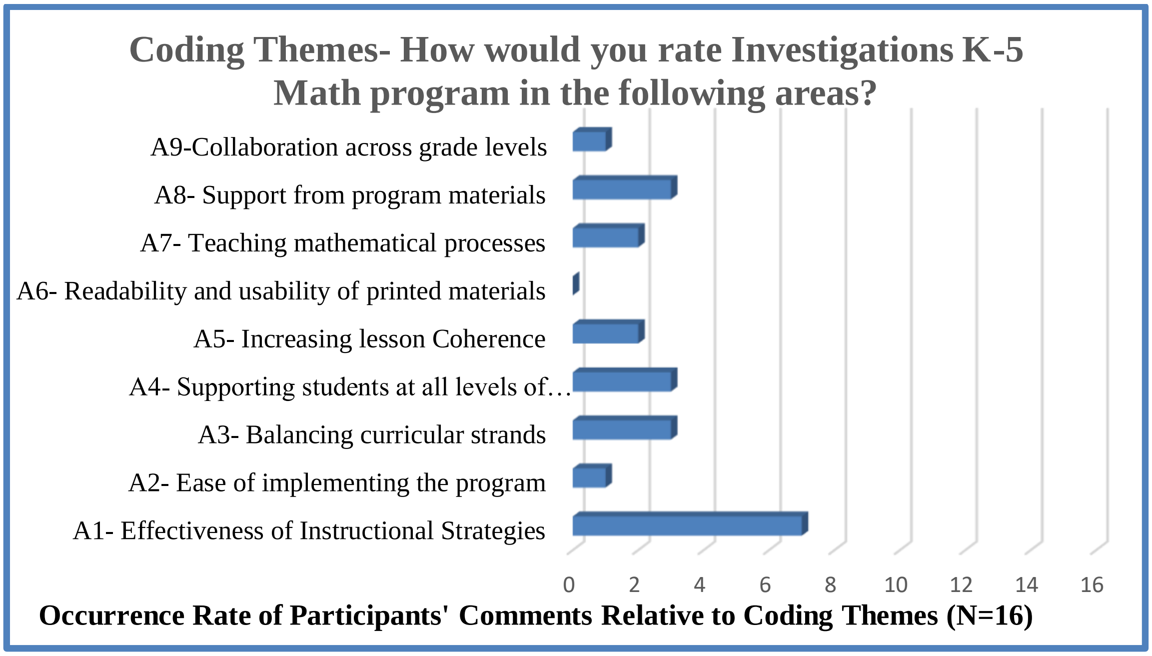

Figure 4. Frequency of coding themes A1-A9 for first impressions of *Investigations* K-5 Math program

As depicted in the occurrences of themes in Figure 4, the support from program materials (n=3), balancing curricular strands (n=3), supporting students at all levels (n=3) were mentioned by a few participants while effectiveness of instructional strategies (n=7) was highlighted the most in teacher commentary. Teachers realized quickly that a lot of preparation was necessary, as the early editions required manipulatives and for teachers to set up systems of materials for long-term use. A teacher who was involved in the initial transition stated:

> And so, it was a matter of trying to set up the system so I could use it over and over. There were a lot of manipulatives. And then for the children that first year it was ok but by the second year I had children who had special needs and issues. And so, some of the manipulatives and the organization and the use of them had

to adapt. They haven't had the previous experience with that kind of Math and that work. I was teaching a lot of routines and establishing a structure, or workshop structure, which felt a little challenging.

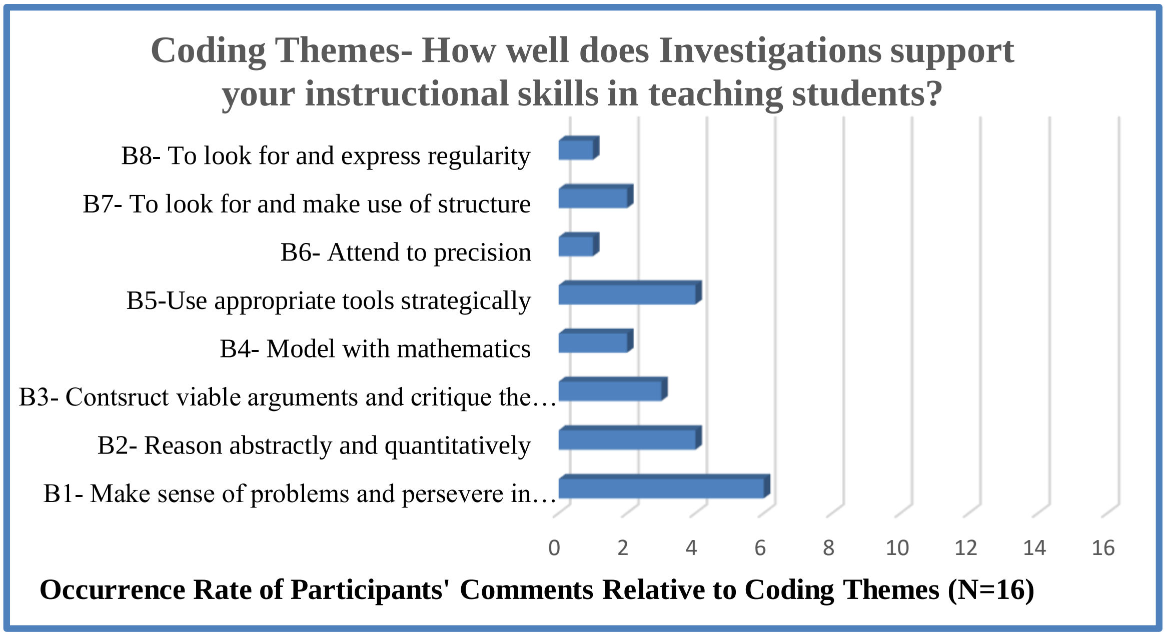

Figure 5. Frequency of coding themes B1-B8 for first impressions of *Investigations* K-5 Math program

Though there was difficulty with the transition to the new curricular program, teachers were also excited to try the *Investigations* program because of the constructivist perspective of learning and the kinds of lessons that were incorporated. As depicted in the occurrences of themes in Figure 5, constructing viable arguments (n=3), strategic use of appropriate tools (n=4), reasoning abstractly and quantitatively (n=4), and making sense of problems and perseverance (n=6) were emphasized the most in teacher commentary. Teachers also worked with their grade-level teams because there was a lot to decipher and talk about. One of the early challenges was that the amount of time that *Investigations* appeared to require wasn't realistically available from the perspective of numerous teachers. This belief caused some teachers to adapt some of the *Investigation*s units to a format that was more accessible for the students. Focus group participants shared the sense that that this initial challenge required a shift in mindset. One stated:

> I have often enjoyed working with assistant teachers who want to teach. And I found this was a harder one to share with an assistant because of the amount of preparation and conversation. I felt that it made me do more whole class teaching than I really liked. I really liked to work with smaller groups of children and then bring the kids together so I found that sometimes I wasn't differentiating enough because I wasn't able to take advantage of the other teacher in the room.

Teachers were dedicated to the process of implementation, including additional hours of preparation, running off copies, or cutting up materials and creating ways to differentiate allocation of sets of materials among teachers. Some teachers liked this curricular model because prior to the use of *Investigations*, each teacher designed their own program. Teachers liked “being part of a school that had their act together” and each grade “supported what the kids were going to be doing in the next grade.”

Evaluation question 1: What are teachers’ perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school’s desired standards of practice for Math?

Some teachers were initially confused by this line of inquiry because they were trying to figure out if the question was about alignment with the Common Core State Standards or the Common Core Standards for Mathematical Practice. This confusion led to most of the discussion being focused on reaching clarity on that topic, and as depicted in Figure 6, there was limited explicitly coded commentary from participants on this issue. As the school of study is not mandated to address the Common Core standards, some teachers rarely paid attention to them. However, there was a sense from the focus group participants that the school's standards of practice for Math modeled the NCTM and Common Core Standards for Mathematical Practice., and were woven throughout everything that they do. One teacher shared:

> I think the nine practices about perseverance and using models and finding patterns. Those things are woven throughout everything we do. And it may not always explicitly say that but I think our philosophy of Math education really aligns with those nine-Math practices.

The sense of the focus group participants was one of agreement that the philosophy of Math education throughout the division aligned to those standards.

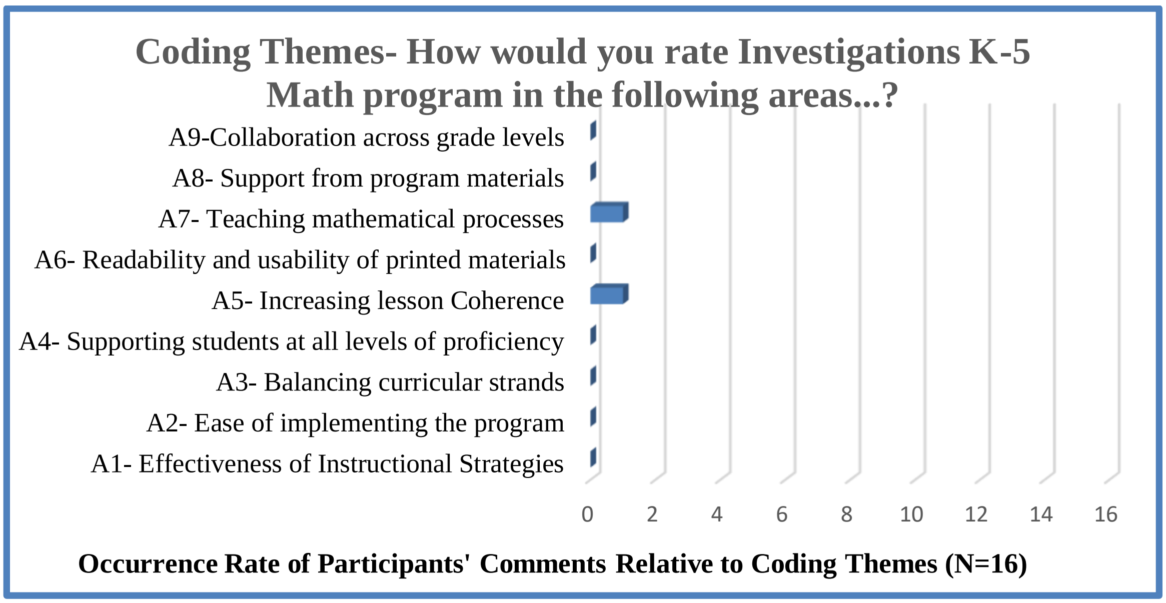

Figure 6. Frequency of coding themes A1-A9 for Evaluation Question 1: What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?

The Lower school’s reaccreditation process, in years prior to adopting *Investigations*, is what prompted much of the dialogue around the lack of continuity in the Lower School division’s Math program. Teachers did not share a scope and sequence across grade, nor did they share a common vocabulary. They did not use the same language and weren't necessarily teaching the same skills within the same grade-levels. The adoption of the *Investigations* program delivered those attributes and teachers supported the transition. They began to feel that “we had a sense of where we had come from and where we were going,” so they maintained a purist approach that initially didn’t add anything to the *Investigations* curriculum. Although there was limited dialogue explicitly coded for Figure 6, there was a sense from the focus group participants that not previously having a consistent Math program, *Investigations* provided a good foundation and that, by default, it updated the school’s Math curriculum as it was constructed to be in alignment with the Common Core Standards for Math Practice.

Evaluation question 2: What are teachers’ perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their content and pedagogical knowledge?

Teachers reflected on their instructional practices prior to implementation of *Investigations* with respect to the overarching Mathematical goals for the different grades. A participant shared that, as a division, teachers had “eclectic kind of ways of doing things and you would take the best of whatever little activities or lessons that you could come up with and then use them kind of at your own discretion.” It was also shared that formerly, students were taught procedures but they really didn’t understand what they were doing. Teachers observed that students could work procedurally with numbers and they could crunch them and get answers, but students weren't seeing, or understanding, what was actually happening behind the numbers. The sense of the focus group dialogue was that a clear shift occurred as *Investigations* was introduced. One participant stated:

> *Investigations* totally changed that in terms of how I taught because we purposefully didn't teach those algorithms and the kids really had to really find other ways and we gave them many models of other options for how to work through problems. But we didn't explicitly teach using those algorithms and we still don't. And that, I think, that way of not giving them the formulas and procedures really forced them to have to make sense of what's really going on behind the numbers.

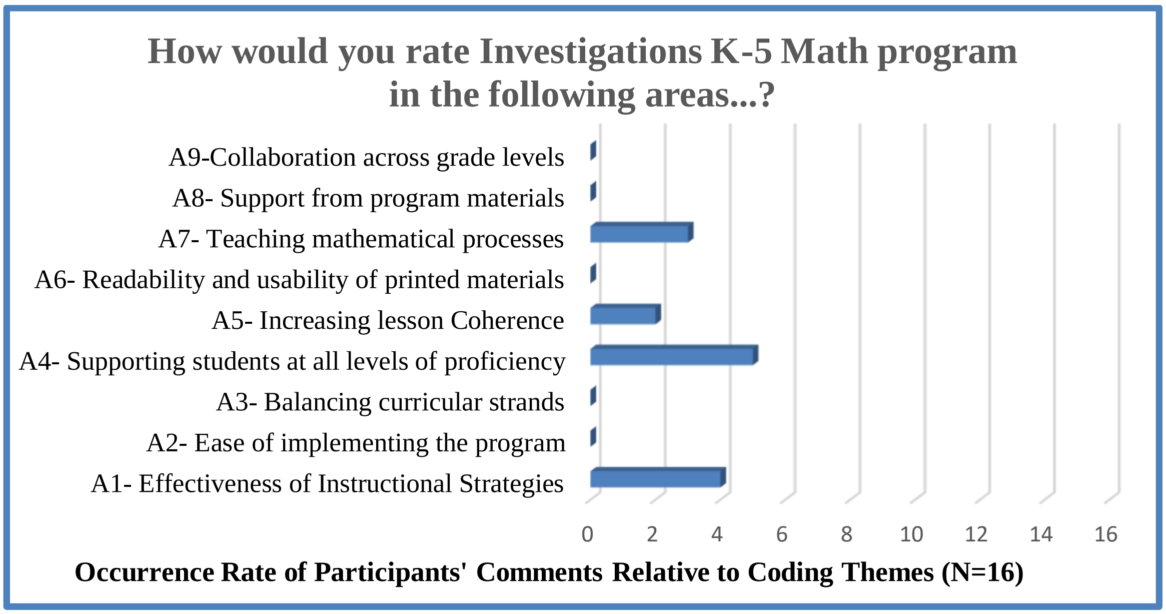

Figure 7. Frequency of coding themes A1-A9 for Evaluation Question 2: What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their content and pedagogical knowledge?

As depicted in the occurrences of themes in Figure 7, increasing lesson coherence (n=2), teaching Mathematical processes (n=3), and effectiveness of instructional strategies (n=4) were addressed while supporting students at all levels (n=5) was emphasized the most in the focus group commentary. Teachers shared that use of *Investigations* helped students to gain a number sense that they weren't really teaching before. This shift was represented in the occurrences of comments related to effectiveness of instructional strategies (n=4) and supporting students at all proficiency levels (n=5). Some teachers shared that when they started working with the curriculum they wished that they had been taught Math in this way because they considered themselves not to be Math oriented, or not really liking Math. The sense of the focus group participants was that the implementation of the program changed the perception of Math for them. A teacher stated:

> I love being able to think about all these ways, it's so much more playful, it's so much more interesting and so much more intuitive for kids. So, I think that it has helped me sort of personally love Math more, you know, and made it probably, in that way, also made it sort of more fun and easier for me to teach really like what makes a seven. And you know student could count one two three four five six seven but what's in a seven. So, it teaches them to see. So, some of the games like a seven could be like five and a two when you're laying out the little tiles. So, I think we began to really teach kids numbers sense.

Teachers stated that the format of *Investigations*, where they teach a lesson, the children work in partner groups, usually have activities, and then come back and share their strategies of the learning very much aligned with the reading and writing workshop model, which affirmed that the architecture of the lessons for them. One teacher commented that while the students were trying problems, she talked and raised questions with the table partners of the students about what they were doing, and what their thinking was. When assessing for student thinking, she would bring students together, being strategic about which children were asked to share or not. The sense of the focus group participants was that they felt the structure of *Investigations* was challenging, but it really elevated their practice and established a standardized way to plan and carry out explicit instruction about certain learning goals. A participant shared:

> I felt in my own thinking about it that I was learning a lot and that felt most challenged by the conferring part. Like what are the questions or what are the ways to push children who are struggling and push children who, you know, you need to differentiate.

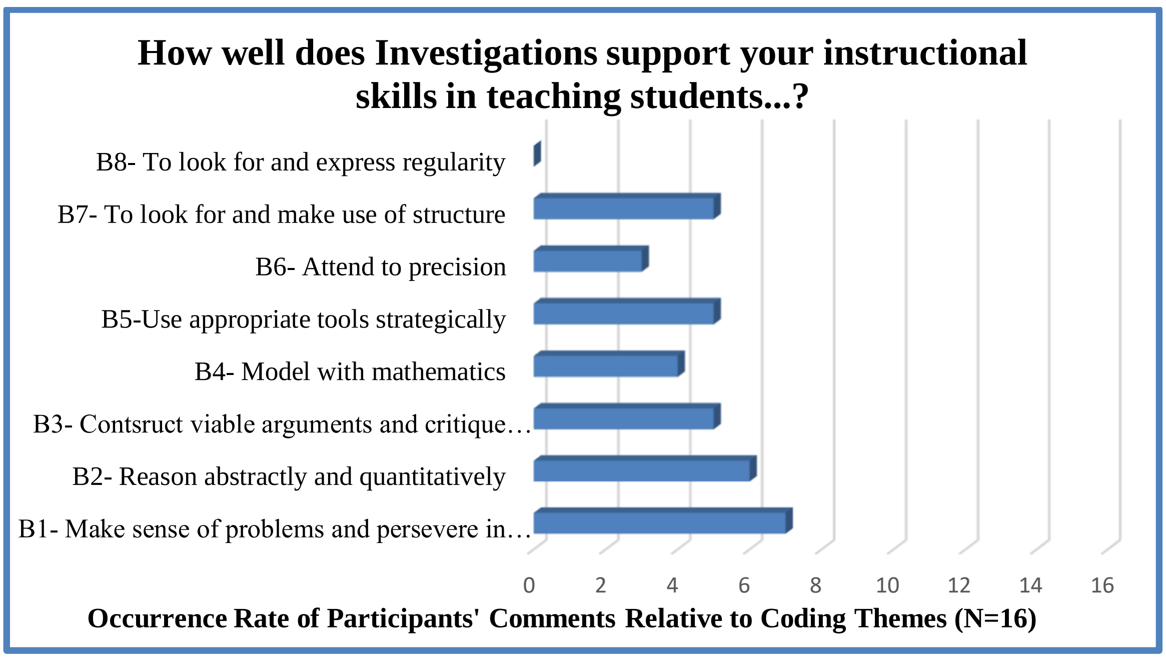

Figure 8. Frequency of coding themes B1-B8 for Evaluation Question 2: What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their content and pedagogical knowledge?

As depicted in the occurrences of themes in Figure 8, the focus group participants heavily participated in dialogue around the issue of their development as practitioners. The themes of instructional skills to help students making sense of problems and perseverance (n=7), reason abstractly and quantitatively (n=6), constructing viable arguments (n=5), strategic use of appropriate tools (n=5), look for and make use of structure (n=5), model with Mathematics (n=4), and attend to precision (n=3) demonstrated broad engagement by focus group participants.

While students may have viewed a problem, and associated it with simpler Math concepts, teachers felt that *Investigations* materials helped to teach students that solving a simple problem could be the same model that's used for really complex ideas like multiplying and dividing fractions, where teaching algorithms may appear to be magic tricks. Teachers often had students whose parents had taught them algorithms already, or they had learned it at other schools, and they're really good at using them. Those students consistently exclaimed, “oh my god it's not magic, I know why it works now.” Teachers felt that it really helped some students to think like Mathematicians. They would develop the language to talk about Math and explore problems in a more open and flexible way.

Teachers also commented on one area of the curriculum that was a limiting factor. They were challenged by parents who wanted extensions for their children, and who felt that their children needed more academic challenges and wanted them to be pushed more. There were places where teachers felt that they put a lot of effort into working with struggling students but the extensions that were offered in the *Investigations* curriculum weren't enough for that exceptionally fast-moving group of children. While they felt *Investigations* definitely prepared students to think the way they needed to think for really challenging problems, teachers also felt that they needed to add extensions from other resources because the extensions in *Investigations* were not adequate for the strongest learners. The sense of the focus group participants was a common identification of the differences they observed between students that developed their Math sense under the *Investigations* model in contrast to students who entered their classrooms new to the curriculum. A teacher shared the dynamic that regularly occurred in the classroom setting:

> Every year, we have like one or two new students who come in who've been in a different Math curriculum for a long time. And I have kids who've been using *Investigations* for a long time in the same room and I think it really shows you the strengths of *Investigations* because there are kids who come in who were, you know, top of their class in Math or very zippy with the algorithms but they can't explain why they work and they don't have the persistence to push through challenging problems.

Teachers broadly felt that for certain units *Investigations* alone didn’t facilitate the kind of depth they desired. They found that they had to do other little changes like change the way things were formatted on the page. Even though they wanted the students to really prove and explain their learning, some of the textbook layouts implied that students should just put an answer on the paper. The sense of the focus group participants was that at times, the language that was used in the *Investigations* text didn't necessarily convey what was intended for students. A teacher shared:

> I also have a problem in fifth-grade where the students are not really supposed to be explaining through words as much their Math thinking. They're supposed to

> use equations but it'll still say explain how you know instead of like prove your thinking or show your work. And so, I have two kids who just keep on working and working and working to show me this paragraph that they've written where it would have been much faster and showing way more Mathematical understanding to list sort of an equation form or do a drawing.

Evaluation question 3: What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program developed a consistent scope and sequence for the K-5 classrooms?

Teachers uniformly understood and supported the fact that the lower school division aimed to find a Math program that promoted consistency in concepts, experiences, and assessment. They sought a common language, making sure that they weren't missing big ideas, or that teachers weren't favoring certain topics over others. The sense of the focus group participants was that teachers across the division had to relearn their methodology. As one teacher mentioned:

> So, that in itself is I think really helpful. And I also I just think opening up- it's good for the kids to see how other kids solve problems. It's good for adults to see that. And I think we've also found the flaws in it too. And the things that maybe are too repetitive or there aren't enough of this certain kind of thing. But I think the core is like the idea that Math is problem-solving and that there is not just one way to solve the problem and I think you can apply that across all the topics and then you have a kind of common language that kids will sort of respond to.

Teachers valued the development that when they asked children to explain their thinking as they arrived in a grade, and those students had previous years of experience in that practice, it was not jarring to them. It helped to overcome the inclination of students not wanting to explain their thinking because it was too much work. They felt that consistency in Math assessment was vastly improved year-over-year through the use of *Investigations*.

The sense of the focus group participants was mixed with regard to aspects of the scope and sequence. A teacher shared that it was beneficial to have a curricular "spine" that still "allowed for individual teacher voice in acknowledging and adjust the sequence for the kid who always finishes fast." It was shared that at one point during the implementation there was a common core update at the fifth-grade level which incorporated a lot of changes and teachers of the grade decided to make some of their own. A teacher shared:

> We felt that the standard algorithm for subtraction which was introduced in the fifth-grade, which we felt was much too late and they didn't end up having to use it in division before it was actually taught, which was really bizarre. And so, were like saying well maybe just do it in fourth grade which is when we used to do it before we had *Investigations*.

The sense of the focus group participants was one of positive intrigue for teachers when they discussed the insistence of students at all levels explaining their reasoning, in writing as well as orally, as it meant that students really had to know the Mathematical processes. As a teacher stated:

> Sometimes we'll get little drawings of somebody with a picture of a face with a thought bubble and I'm thinking that the answer is 47 and that's their way of explaining through writing what the answer is but it doesn't exactly explain it but

> I think expecting them to explain it is also really important. And I think building that on through by the time they hit fifth-grade they must be very used to being asked to explain.

The sense of the focus group participants was that the *Investigations* program helped teachers across all grade levels to make a shift toward having students prove their thinking. It was shared that when students had to prove that a calculation was right and convince someone else rather than just share an answer, it helped them to know the point of the concept or skill.

However, the sense of the focus group participants was also that *Investigations* didn't offer enough practice problems. If students were working on addition or subtraction skills for a lesson, the workbooks often offered only three or four problems and teachers felt that they needed more repetition for students to sufficiently demonstrate competency with a skill. There was an understanding that the assessment needs varied year-to-year as there were some students for whom those three or four problems were all they could do in the prescribed amount of time. There had also been years where students rapidly moved through a unit. This inconsistency of *Investigations* to support the higher-level students led to incorporation of the supplemental program, *Context for Learning*, to provide additional Math challenges as needed.

Context for learning supplemental curriculum. Teachers shared that there were areas where there were gaps, less effective units, and the need for differentiation for students that required greater challenges from the *Investigations* program. They felt that *Investigations* already existed in a form where there seemed to be more content than could realistically be taught in a year, but there were also gaps that needed to be addressed. Teachers began supplementing and blending the *Investigations* curriculum with *Context for Learning* units. Over time, the use of *Context* units had also caused some challenges in staying true to the full *Investigations* program. A teacher shared:

> At this point, we have added so much and it's really hard to know what to cover because if we're using a *Context* unit for fractions then how much of the *Investigations* fraction work do we need to do… I feel like we have some bits and pieces but I also think that we're coming back to who we are. We are very strong teachers and we need a little bit of our own voice and we've got a whole range of students and they need a little bit of something too.

Teachers also shared that the *Investigations* program had a good lesson architecture and it felt like a strong match with the reading and writing workshop program that was used in the lower school division. Teachers felt that *Investigations* was a natural complement because they shared such strong lesson structures, but they also recognized where *Investigations* broke down. They mentioned that the reason why reading and writing workshop was so compelling was due to the ability for broad differentiation within the program. The reading program easily allowed for students to be leveled and if a student demonstrated in all ways that they were ready to move on a level, they would then be changed to whatever degree needed. The writing program also did that in a naturally progressive way. They felt that in the *Investigations* program there was not as much consideration of differentiation to the higher levels of students' capabilities. Teachers struggled as they considered how they could meet each student at the right level in their Math classes in the same way that they did for reading and writing.

They also shared that the *Context* units still felt very new and so the placement of where those units belonged instead of certain *Investigations* units felt like something that was still being trialed. Teachers discerned what made sense to leave out, where it made sense to incorporate a *Context* unit fully, and where it was appropriate to not visit *Investigations* at all in a unit. There was an imbalance regarding what was practiced a lot and what wasn't practiced very much. A teacher shared:

> There are some parts of second-grade that go on and on and on ad nauseam with word problems, with adding and subtracting. Everybody gets really sick of them. The numbers I would say through second-grade at least, and I'm not sure about third-grade, are very high. And so, the kids who come in with really good skills, in second-grade *Investigations*, I think they go basically to hundred and *Context* has really pushed that to a thousand.

The use of *Context* units brought additional benefits to the lower school division. Some teachers dealt with predictably unhappy parents who were dissatisfied with the level of accommodations that were made for students who were strong Mathematicians coming into a grade because they weren't challenged by certain *Investigations* units. That's one of the concerns that using the *Context* units addressed and teachers observed a sharp decline in parental complaints since they were incorporated.

Evaluation question 4: What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 program?

Focus group participants reflected on the experiences during the implementation and follow up years and identified some of the unintended positive and negative outcomes from the use of *Investigations* program (Table 7).

Table 7

Unintended Outcomes (Positive and Negative) from Implementation of Investigations Shared by Focus Group Interview Participants

Unintended Positive Outcomes	Unintended Negative Outcomes
Teachers better understood the core of a classroom in terms of skill levels.	Teachers felt there was an excess of repetition of problems in some texts
Greater variety in the complexity and presentation of the problems in the textbook	Parent backlash regarding the appearance of problems in the text looking simple and feeling that students were less challenged.
Teachers were better able to anticipate where they could dig deeper and push students further in the curriculum	Extensions were needed for students at higher competency levels which resulted in adoption of Context for Learning units.
Children who hadn't considered themselves strong, or liking Math, seemed to access the program more readily	Resource workbooks for parent at-home use didn't align well with classroom curriculum and was hard to navigate.
	Investigation materials didn't always communicate well. Appeared in its designs to be textbook trying to be a non-textbook for more appeal.

Some positive outcomes were shared out. A teacher identified a positive outcome as the "consistency of good thinking and a better understanding of number systems basics." It was noted that parent engagement increased as the curriculum was introduced to a new grade level each year of the rollout. A teacher shared:

> Also educating some parents at the Math night, and we've had Math mornings where the parents and kids actually get to play the Math games together. Parents go "oh yeah I didn't actually think out the problem that way." I think that kind of helped move it forward

One unintended benefit that was observed in the first-grade classrooms was the way children who hadn't considered themselves strong, or liking Math, seemed to access the *Investigations* program more readily. It appeared that the introduction of the fresh, new curriculum, and a different approach, helped children who felt they weren't strong working with numbers to flourish. A first-grade teacher observed that the students increasingly showed an affinity for geometry, or for graphing, which resulted in greater numbers of children identifying as Mathematicians. The sense of the focus group participants was that over time they had come to understand the core of a classroom in terms of skill levels, and felt it was a good sign for teachers to have well defined curricular goals for particular grade levels.

The unintended negative outcomes were also shared. The sense of the focus group participants was the recognition of a lot of repetition across the *Investigations* texts and that some of the problems were not very challenging for some students. Teachers noted the variety and differences across *Investigations* units. The nine upper elementary teachers of grades 3-5 moved in a slightly different direction to try to build more substance for those who were doing Math at a higher level of thinking by utilizing the *Context for Learning* Math units. Strategically placing two or three *Context* units at each grade level throughout the year responded to the need to meet the wider range of student capabilities, particularly the ones on the higher end. The sense of the focus group participants was that they were on trial the first few years of implementation, where teachers felt like they were always proving to parents that the program was working for the students. A teacher shared:

> I felt a part of that was also that it's just really different than the way parents were taught. And so, I don't think that they really understood the good Math that was happening. So, I think part of, you know, adding more richness and more challenging stuff helped but I also think just communicating what we were teaching in class more effectively helped a lot.

Additional negative outcomes were due to problems with the Investigations resource materials for parents. Teachers shared that some of the workbooks didn't align well with the classroom curriculum, and some teachers felt that the textbooks didn't always communicate concepts clearly due to a design that made it look like a non-textbook.

Evaluation question 5: What are teachers' perceptions of changes in student achievement resulting from implementation of the *Investigations* K-5 Math program?

Teachers initially responded to this prompt by considering a consensus definition of achievement. During the initial implementation of the *Investigations* program, they recognized that certain students were computational whizzes in the sense of speed and efficiency. But they stressed that efficiency wasn't as crucial until about the fourth grade. A teacher shared:

> So, I think the first group of kids, and maybe it's still, who came out of the lower school and *Investigations* I think was a little disturbing, as I understand to the middle school teachers, because there seemed to be something that was in place

previously, or at least kids had been exposed to, that wasn't there anymore. We thought they were better thinkers but they didn't look it on a timed test or whatever. They didn't look as strong.

The sense of the focus group was that the situation had improved since the initial group of students were introduced to the program. There was a recognition of the facility of later student cohorts that used the strategies more efficiently, with more consistency and reliability than the groups from the first year or two of instruction. A teacher stated:

> There were much more visual strategies that relied on the number line, and jumps on the number line, which I think is a great model for introducing certain concepts and then by fifth grade they need those to get kind of solidified so it's a little bit more efficient. And I think at this point they have.

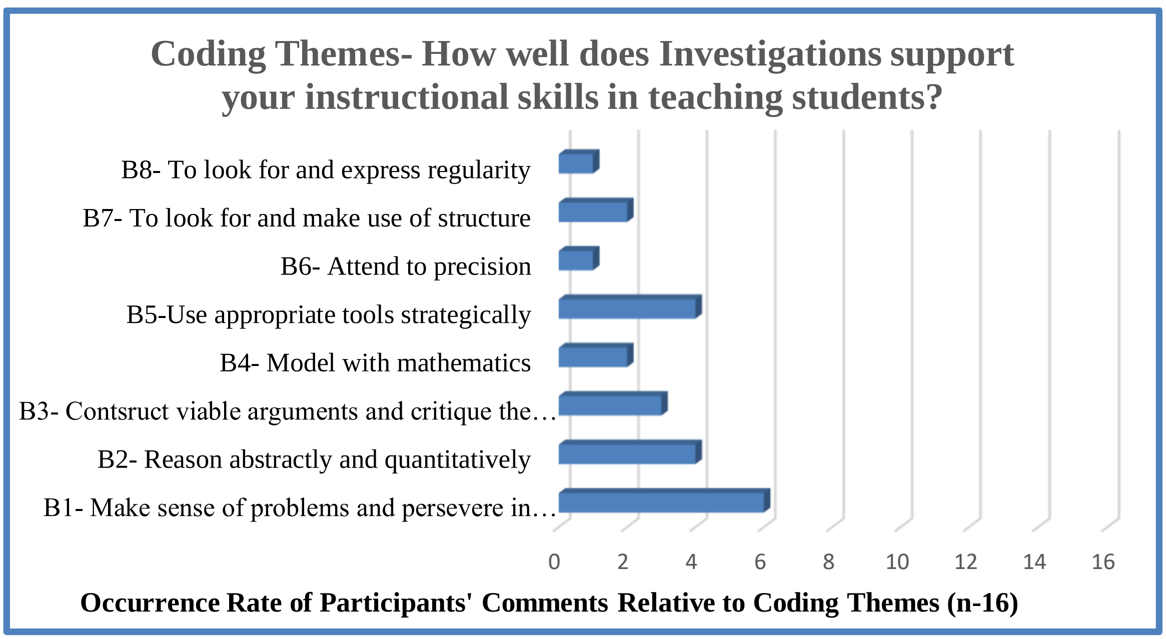

Figure 9. Frequency of coding themes B1-B9 for Evaluation Question 5: What are teachers' perceptions of changes in student achievement resulting from the implementation of the *Investigations* K-5 Math program?

As depicted in the occurrences of coding themes in Figure 9, the focus group participants explicitly mentioned all the coding themes during the dialogue of their perceptions of changes in student achievement. The participation was not as deep for any particular issue except for making sense making sense of problems and perseverance (n=6). However, the breadth of commentary was well rounded and depicted the connection teachers made in their perception of instructional skills impacting student achievement. Almost all of the coding themes were addressed by multiple focus group participants, leaving only two of the following themes mentioned singularly: themes of instructional skills to help students reason abstractly and quantitatively (n=4), constructing viable arguments (n=3), model with Mathematics (n=2), use appropriate tools strategically (n=4), strategic use of appropriate tools (n=5), look for and make use of structure (n=5), model with Mathematics (n=4), and attend to precision (n=1), look for and make use of structure (n=2), and to look for and express regularity (n=1). demonstrated broad engagement by focus group participants.

A teacher shared that there were definitely still a few kids that might not consider themselves Mathematicians, or were more confident in language arts. However, it was also shared and supported by the groups that they hadn’t observed an incident when a student didn't get something right and appeared absolutely crushed by it. A teacher shared:

> The attitude towards math is more just, ok, let me just figure out a different way. I feel like in that sense I would consider that a huge achievement. I don't know what it was like before obviously but from past teaching experience at other

> schools, I feel like that's a really strong difference I see just the like that to really strong difference I see, just the attitude towards math in the kids.

The sense of the focus group participants was that students' general attitudes toward challenges in Math grew in resiliency, as they were inclined to figure out new or different approaches to problem-solving. The coding theme of student making sense of problems and having perseverance (B1; n=5) from Figure 9 supported this premise.

Teachers shared that the first few cohorts of students that had completed *Investigations* and transitioned to the middle school generated conflict between lower and middle school teachers due to questions about the students' capabilities. There was a noticeable impact on the transitioning students due to the adoption on Investigations, while the middle school hadn't adapted to those changes. They were unclear of the students' knowledge base as they entered the 6th grade and needed clarity on the skills they needed to teach. A teacher shared:

> And so, we don't teach long division we teach a version of what we call the big house which just uses the same sort of structure, but it's more flexible than a long division algorithm. And so, I think they (Middle School teachers) had the idea that there are these kids coming in and they don't even know what division is; they don't know anything.

Over time, the lower school teachers felt there was greater recognition of the transitioning students as really good problem solvers and much stronger Math students overall. Coming out of their experience with the *Investigations* curriculum, the teachers perceived the students presented as more confident, more consistently flexible thinkers. A teacher shared:

If you are assessing actually their math thinking separately from sort of specific skills and saying OK well what strategies do they. I think it creates a slightly different picture. But I think from what I've heard from middle school that they're stronger overall and I think it has been good for the lower kids. I think definitely. I think they kids who are on the lower end overall have like a better identity as mathematicians.

The sense of the focus group participants was the notion that if students' Math thinking was assessed separately from specific skills, and recognized for the strategies they used, it created a slightly different picture. They felt that the students on the lower performance end had a more positive identity as Mathematicians.

Analysis of standardized test assessments. The archived ERB achievement test data below (Table 8) was acquired from the full grade-level sets of former 5th grade students.

Table 8

Summary of ERB-CTP4 Math Achievement Test Scores

Annual Testing Groups	***No. of Students***	***Sum***	***Average***	***Variance***	***S.D.***
2007	54	18082	334.85	687.34	26.22
2008	55	18440	335.27	265.87	16.31
2010	58	19549	337.05	719.84	26.83
2011	45	15062	334.71	535.03	23.13
2013	59	19635	332.80	368.20	19.19
2014	56	18833	336.30	314.76	17.74
2015	56	18911	337.70	277.16	16.65
2016	58	19483	335.91	368.75	19.20

The data in Table 8 spanned four of the five baseline years leading up to the intervention (2007, 2008, 2010, 2011) and concluding with four of the five follow-up years post-intervention (2013-2016) at the school of study. Data were not available for the years 2009 and 2012 and those years are omitted from the analysis. Using the baseline mean model (Figure 10 for short interrupted time-series analysis, the baseline mean test score for the pre-intervention period was generated by averaging the mean test scores for the years 2007, 2008, 2010, and 2011. The baseline mean score is represented by the horizontal line of black dots across the center of the chart in Figure 10. The baseline mean score was projected forward to generate a visual comparison of the baseline mean score in contrast to the post-intervention mean test score data (Bloom, 1999). For this set of ERB-CTB4 test scores, the mean baseline test score was represented by the horizontal line at 335.47 for years 2007, 2008, 2010, and 2011. The projection of this horizontal line through the follow up period years of 2013-2016 depicts the contrast between each year of baseline scores and each year of follow-up mean test scores.

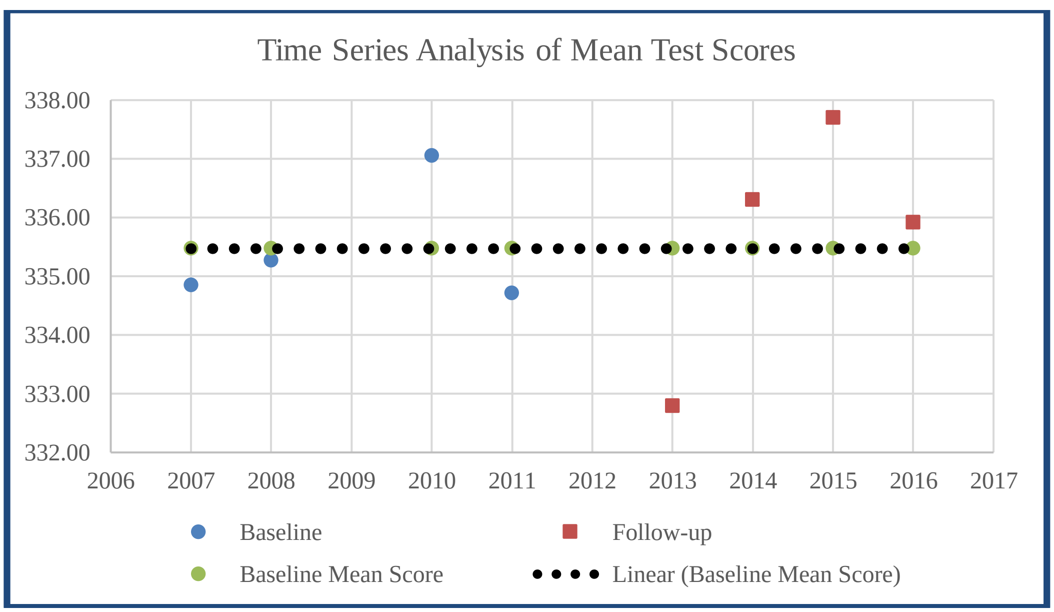

Figure 10. Time Series Analysis (Baseline Mean model) of ERB-CTP4 Test Scores

The time series analysis revealed a baseline mean test score of 335.47, which was contrasted against the follow-up mean test score of 335.68. A deeper look at the two stages in Figure 10 can reveal multiple interpretations. The basic finding is that the negligible difference between the baseline mean score and follow-up mean score alludes to no difference in scores. An alternate view of scores reveals the 2010 baseline score was substantially higher than the baseline mean score and the 2013 follow up score was substantially lower than the baseline mean score. If the two years were taken as outliers, the trend of higher mean scores post implementation of *Investigations* could be viewed as more substantial. In fact, after the implementation year, the next three years of testing yielded higher mean scores. At this point, however, that data are inclusive and the basic finding is that Investigations is no better or worse than the previous program regarding the trend of Math achievement test scores.

Figure 11 depicts the standard deviation trends between the pre-intervention and post-program implementation achievement test scores to determine

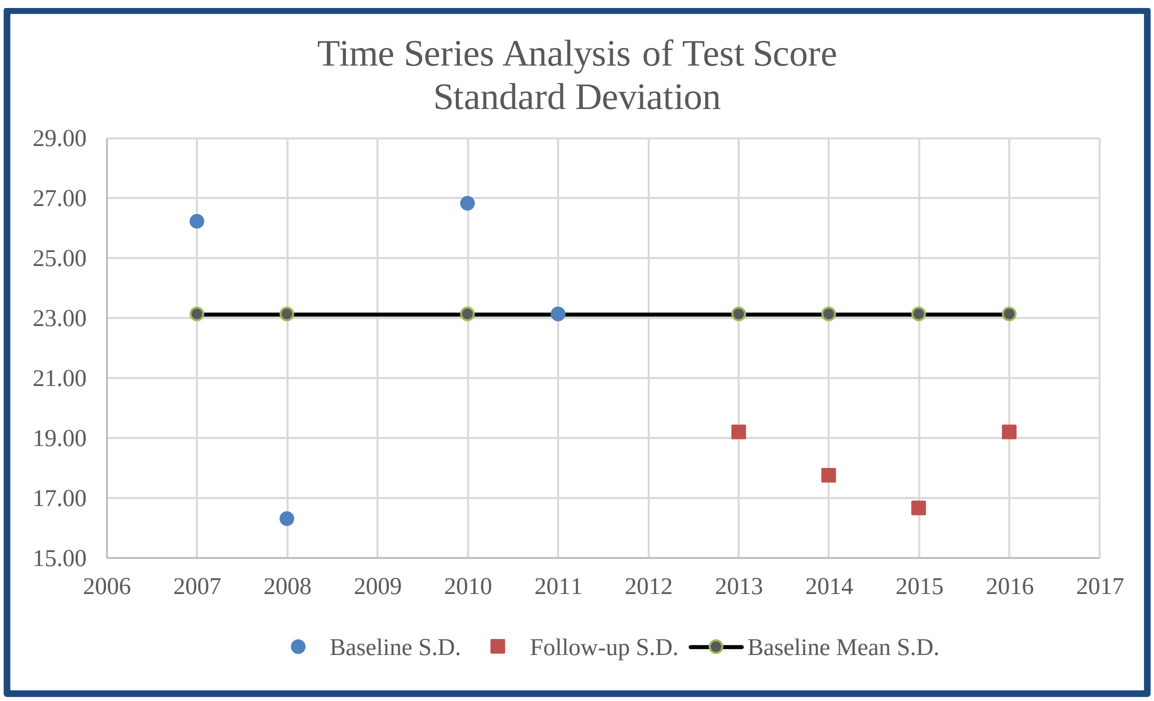

Figure 11. Time Series Analysis (Baseline Mean model) of Standard Deviation of ERB-CTP4 Test Scores

the spread of student performance. The baseline mean score is represented by the solid black horizontal line across the center of the chart in Figure 11. The time series analysis of the standard deviation of mean test scores revealed the baseline mean standard deviation of 23.12 in contrast to the standard deviation of 18.20 for follow-up mean test scores. This analysis showed a trend of standard deviation for the follow-up years consistently below the baseline mean standard deviation value. The basic finding is that variability in students' scores was greater pre-intervention than post intervention, but it does not provide any evidence of changes in student achievement.

Summary of Findings

The findings of this study present a broad overview of the benefits and challenges of the implementation of the *Investigations* Math program. Themes that arose from teachers' first impressions of the program (Figure 4) were that it would bring necessary consistency in the use of materials, lesson coherence, instructional strategies, and teaching of foundational Math processes across the division. Teachers worked diligently and expansively to adopt the new instructional practices as the transition to *Investigation*s began. The introduction of *Investigations* inherently updated the curriculum with a conformity that was aligned with NCTM and Common Core Standards for Mathematical Practice. Though the teachers were not obligated by state mandate to follow the standards, the school of study chose to model its standards of practice for Mathematics in congruence with the Common Core Standards for Mathematical Practice.

Through its structural design for kindergarten through fifth-grade classrooms, *Investigations* solved the challenges of curricular alignment. Teachers' content and pedagogical knowledge was positively impacted by the transition to the new curriculum. The themes of increased effectiveness in the instructional strategies, lesson coherence, and differentiation were cited in faculty comments (Figure 7). Teachers felt that the process of transitioning to the new program enhanced their own capabilities as Mathematicians and as leaders of the inquiry process within the classroom setting. They felt strongly that their instructional skills were improved (Figure 8) in the areas of teaching students to reason abstractly and quantitatively, and supporting students' abilities to make sense of problems and persevere in solving them (Figure 8). As the intent of the curricular transition was to develop a consistent scope and sequence, focus group participants felt that was achieved through the school's adoption of the program. During the initial adoption years, the themes of comprehensive program materials, increased ability for differentiation, and ease of program implementation were prevalent in teacher reflections. After the initial years, there was a recognition that the program was limited in the volume of practice problems and its ability to differentiate for more advanced students. Teachers adopted units from the Context for Learning curricular program to increase the volume of practice and as a supplement for more advanced students.

The unintended positive outcomes from the program's adoption included the improved ability of teachers to assess the students in their classrooms in terms of skill levels, greater variety in the complexity and presentation of textbook problems, teachers were better able to anticipate where they could dig deeper and push students further, recognition of where the depth of curricular topics was lacking or overused. Unintended negative outcomes were also identified, including the appearance of a lack of complexity in some *Investigations* units, which created opposition from some of the parent community members who did not fully understand the new approach to instruction. Teachers also identified an excess of repetition of problems in some texts and extensions were needed beyond the Investigations curriculum for students with higher Math competencies. The themes of supportive program materials, effectiveness in differentiation, and effectiveness of instructional strategies were most frequent in teacher comments.

The implementation of the *Investigations* program prompted teachers to consider their perceptions of student achievement. The shift from students who demonstrated procedural efficiency to those that showed reasoning, problem-solving skills and resiliency was a growth area for the teachers in the division. Teachers perceived the upward trend in students' overall strength as Mathematicians was due to demonstrated improvement in reasoning abstractly and quantitatively, making sense of problems, perseverance in solving problems, using appropriate tools, and constructing viable arguments (Figure 9). Teachers favored the Investigations curricular approach, which minimized the focus on speed and emphasized students' Math thinking apart from specific skills. They also recognized some weaknesses in the assessment materials of Investigations and adopted Context for Learning assessments, as needed, to supplement the *Investigations* program. Analysis of the ERB-CTP4 achievement test scores (Figure 14) revealed negligible changes in the overall mean student performance before and after implementation of the *Investigations* program. However, analysis of the standard deviation of the test scores (Figure 15) revealed a consistently lower spread of student performance after the implementation of the *Investigations* program.

CHAPTER 5

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

National achievement data from the 2009 National Assessment of Educational Progress (NAEP) showed that elementary level students in the United States have relatively weak Math skills (National Center for Education Statistics, 2009). The poor Math performance of elementary school students was substantiated in numerous studies of Math curricular programs that had emerged in recent years (Agodini & Harris, 2010; Doabler et al., 2012). With an effect size of d=1.00, excellent teaching is superseded only by teacher feedback (effect size d=1.13) and students' prior cognitive ability (effect size d=1.04), as the most impactful influence on achievement (Hattie, 2003). Doabler et al. (2012) supported the improvement of foundational Math instruction as a feasible strategy to address the low Math achievement of children across the United States.

The *Investigations* K-5 Math program was adopted and implemented in a Philadelphia independent Quaker school that intended to contemporize the curriculum, support teachers' growth in their content and pedagogical knowledge, and improve student achievement. The *Investigations* program identified the goals of supporting students to make sense of Math, emphasizing reasoning about Math ideas, focusing on computational fluency, learning that they could be Mathematical thinkers, communicating Mathematics content and pedagogy to teachers, and engaging the range of learners in the classroom. The purpose of this mixed-method study was to investigate the effectiveness of the program's outcomes. The findings of this study presented a broad overview of the benefits and challenges of the implementation of the *Investigations* Math program. The theory that underlined this study was that if teachers were provided the time and resources to examine best practice Math curriculum and instruction, they would then develop and implement a holistic Math program that met the needs of all students at all proficiency levels, which would result in improved student achievement (Figure 1). To develop a comprehensive evaluation, extant student achievement test data were used and semi-structured focus group interviews were conducted to evaluate the findings and better understand the impact the adoption of the *Investigations* program on students and faculty at the school of study. In support of the program theory, the findings presented in Chapter 4 focused on teachers' perceptions of the outcomes from the implementation of the *Investigations* program. Chapter 5 provides a discussion of how the results supported, or opposed, the program theory and recommendations for future research.

Discussion of Findings

The findings of this study presented a broad overview of the benefits and challenges of the implementation of the *Investigations* Math program. The introduction of *Investigations* inherently updated the curriculum for the lower school divisions at the school of study with a conformity that was aligned with NCTM and Common Core Standards for Mathematical Practice. From the teachers' initial outlook of the curriculum (Figure 4), they felt that it would improve the quality of instruction through its consistency in the use of materials, lesson coherence, instructional strategies, and easing of curriculum management in the classroom (Doabler et al., 2012). Teachers' curriculum processes, the construction of curriculum and how it is enacted, in the classroom can have a significant impact on its effectiveness (Doyle, 1993). Teachers at the school of study worked diligently to co-construct the “enacted” curriculum with students through their daily lessons, benefitting from the cognitive stretch that was ongoing (Remillard & Bryans, 2004). Though the teachers were not obligated by state mandate to follow the standards, the school of study chose to model its standards of practice for Mathematics in alignment with the Common Core Standards for Mathematical Practice.

The sense of focus group participants was that due to the growth in their content and pedagogical knowledge, they were positively impacted by the transition to the *Investigations* curriculum. Faculty cited the themes of increased effectiveness with instructional strategies, lesson coherence, and differentiation in their comments (Figure 7). Teachers felt that the process of transitioning to the *Investigations* program enhanced their capabilities as Mathematicians and as leaders of the inquiry process within the classroom setting. As teacher behavior is influenced by their content knowledge, the process of learning how to implement the new curriculum can increase their competency, and consequently, their attitudes and beliefs about teaching Mathematics (Van Der Sandt, 2007). Teachers felt that they gained flexibility in their lessons and felt confident that the increase in personal development strategies and grade-level collaboration enhanced their instructional skills.

However, there was also a sense among the group that some limiting factors inhibited the facilitation of the curriculum. One challenging factor was the limited ability for teachers to differentiate upward for students. The extensions provide by Investigations weren’t satisfactory to accommodate the faster paced students. This challenge eventually led to the adoption of the Context for Learning curricular units as a supplemental resource. Teachers also found that for certain units, Investigations didn't have the depth of study they wanted, which led to some teachers to making adaptations to the formatting and layout of pages. The sense of the focus group participants was that, on occasion, the texts didn't properly communicate what they had intended for students.

Through its structural design for kindergarten through fifth-grade level students, *Investigations* delivered Math program with consistency in concepts, student experiences, and assessment. Limiting the use of varying approaches to a Math curriculum and instructional practices may enhance the potential for division-wide improvements (Agodini & Harris, 2010). The intent of the curricular transition was to develop a consistent scope and sequence and the sense from the focus group participants was that the goal was achieved through the adoption of the *Investigations* program. It is an asset to effectively differentiate instruction for teachers to have an established program that provides them with the foundational resources to teach core Math concepts and to impart the skills necessary for an inclusive spectrum of student competency levels (Doabler et. al., 2012). A teacher that focuses on the process of Mathematics without teaching the foundational skills can impede student progress (Hattie, 2009). A balanced approach toward Mathematical understandings that incorporate conceptual knowledge and procedural knowledge allows students to develop the depth to apply their understandings in new and different contexts (Willingham, 2009). After the first few years using *Investigations*, teachers recognized that the program was limited in the volume of practice problems which prompted an appeal for additional external resources. Teachers adopted units from the *Context for Learning* curricular program to differentiate for more advanced students and to increase the amount of practice exercises.

The positive outcomes from the adoption of the Investigations were perceived by focus group participants to be consistency of good thinking; increased number sense from students; teachers' improved ability to assess the students in their classrooms in terms of skill levels; updated and consistent curricular goals; and increased depth of curricular topics. Acknowledgement of the program's shortcomings was equally empowering and allowed for the teachers to take ownership and problem-solve in a collaborative fashion. That collaborative nature supported the teachers' ability to educate parents that had voiced opposition to the methodology of the *Investigations* program.

The implementation of the *Investigations* program prompted teachers to consider their conceptions of student achievement and how they could positively impact it. The perceptions of positive student achievement were heavily rooted in their observations of student behavior. Over time they observed students using the curricular strategies more efficiently, increasing in perseverance through hands-on and constructivist practices, and an increase of students that appeared to enjoy their experiences in Math classes. Teachers recognized the students' increasingly engaging behaviors with respect to the Math program while also assessing their development relative to the skills promoted by the Investigations program.

Analysis of the ERB-CTP4 achievement test scores (Figure 10) revealed negligible changes in the overall mean achievement scores prior to the implementation versus post-implementation of the *Investigations* program. Essentially there was no difference in achievement scores between the former curriculum and Investigations. Analysis of the standard deviation of the test scores (Figure 11) revealed a consistently lower variability of student performance during the follow up years after the implementation of the *Investigations* program. This outcome could support the trend of "reductions in the gap between students at the top and students at the bottom of the achievement distribution" (Bloom, 1999, p. 12). However, it could also reflect the challenges that teachers had in supporting students in the higher ability range, essentially limiting their growth and assessment outcomes. Without confirmability for either of those two scenarios, it can only be stated is that the variability of test scores decreased during the follow up years.

As this was not an experimental study of *Investigations*, changes in student achievement could not be attributed to the use of the Investigation program. However, "good quality instruction positively and directly affects student achievement" (Stronge, 2010, p. 45). While Slavin et al. (2010) found no evidence that different Math curricula produced different outcomes in student achievement, they also found strong evidence that effective teaching strategies made a real difference. The outcomes of this study are inconclusive with respect to the Slavine et al. findings that extensive professional development to help teachers use instructional strategies had the strongest evidence of effectiveness.

The instructional direction for lower school mathematics at the school of study moved toward a clarified constructivist approach, confirming a focus on sense-making about numbers as a principal interest (Goodrow, 1998). As discovered in the outcomes from the Agodini (2010) study, students can benefit from the increased instructional focus on student-centered instruction and peer collaboration. Supporting the themes that centered on the effectiveness of instructional strategies, balanced curricular strands, and increased differentiation, teachers can develop greater facility with the practices of open-ended instruction and cooperative learning that inform the active learning of student centered instruction (Felder & Brent, 1996). Teacher's perceptions of improvement in students' overall strength as Mathematicians correlate to goals of consistency of instructional practice focused on number sense, and open-ended problem-solving, limiting students' reliance on standard algorithms (Resnick & Omanson, 1987; Slavin & Lake, 2008). Teachers instructional practices can contribute to students' improvement in reasoning abstractly and quantitatively, making sense of problems, perseverance in solving problems, using appropriate tools, and constructing viable arguments (Figure 11). Participants favored the way *Investigations* focused on students' Math thinking apart from specific skills, moving away from a focus on speed and efficiency. The recognized weaknesses in assessment allowed them to look for additional options, which resulted in the adoption of *Context for Learning* assessments to supplement the *Investigations* program.

Implications for Policy and Practice

Achieving Math proficiency in elementary classrooms remains a challenge in America, despite technological developments, curricular innovations, and increased accountability of school systems. Increasing the quality of foundational Math instruction is the most probable method to improve low Math achievement (Doabler et al., 2012; Stronge, 2010). The adoption of *Investigations* created numerous, positive impacts for the school of study and shifted the framework of teacher orientation with respect to the math curriculum (Van Der Sandt, 2007). The process of preparing to teach with a new methodology created a learning community where teachers increased their content understanding and instructional confidence. To insure alignment across the division, the cross-grade and between grade meetings created partnerships and sharing of practices that was beneficial for teacher and students.

Table 9

Links between Findings for Evaluation Questions and Recommendations

Findings for Evaluation Questions (EQ)	Related Recommendations
EQ1. The introduction of *Investigations* inherently updated the curriculum with a conformity that was aligned with NCTM and Common Core Standards for Mathematical Practice.	Consistently review updates and revisions to curricular, institutional, state, and national standards for Mathematical practice.
EQ2. Teachers felt that the process of transitioning to the new program enhanced their own capabilities as Mathematicians and as leaders of the inquiry process within the classroom setting.	Continue working on classroom practices, developing and adopting materials and strategies for differentiation. .
EQ3. Through its structural design for kindergarten through fifth-grade level students, *Investigations* delivered a Math program with consistency in concepts, student experiences, and assessment.	Continue ongoing dialogue between horizontal grade-level teams and vertical cross-grade teams to maintain consistency in methodology and assessment practices.
EQ4. The benefits were identified as consistency of good thinking and increased number sense, while challenges were recognized as a lack of complexity at times and challenges to differentiate up for advanced students.	Continue to identify unexpected positive and negative outcomes from the "enacted curriculum" and the impact on students and families.
EQ5. Teachers' perceptions of math achievement were rooted in positive, observable constructivist student behaviors. However, there were negligible changes in math achievement scores between the adoption of Investigations and the previous math program.	Develop specific curricular strategies to increase students' Math achievement scores.

Recommendations for the School of Study

Consistently review updates and revisions to curricular, institutional, state, and national standards for Mathematical practice. The primary goal of the transition to the *Investigations* curriculum was to align, in both content and pedagogy, the Math curriculum across the division (Figure 1). That initial goal having been accomplished, the faculty moved to the phase of maintenance of curricular structure and program fidelity. As an independent school that has adopted a program that was fully aligned to the content and practice standards of the Common Core State Standards (CCSS), it is incumbent for teachers and school leaders to remain aware of adaptations and changes in the Math standards, and revisions to the *Investigations* program moving forward. It is recommended that teachers document changes in content (including supplemental materials) and instructional strategies on an annual basis.

Continue working on classroom practices, developing and adopting materials for differentiation to enhance their content knowledge and instructional practices. A significant impetus, and short-term goal (Figure 2), for the adoption of the curriculum was to insure the K-5 classroom Math programs were properly aligned both horizontally and vertically with a uniform culture and approach to instruction. As teaching and learning take place in a whole system, where the components of an inadequate system aren't integrated to support high-level learning and the teaching and assessment of a sound system are attuned to do so, students in properly regulated environments are encouraged to use higher order learning processes (Biggs, 2003). As "excellence in teaching is the single most powerful influence on achievement" (Hattie, 2003, p. 4), teachers at the school of study should continue working on classroom practices to fine tune and continually adjust the curriculum as needed. As the need to differentiate for the high ability student was noted multiple times as a challenge of the curriculum, obtaining resources to address the issue should be a goal until such time as the *Investigations* program includes the facility for differentiation at the levels that student from the school of study require.

Continue ongoing dialogue between horizontal grade-level teams and vertical cross-grade teams to maintain consistency in methodology and assessment practices. A key motivation, and medium to long-term goal (Figure 2) in the process of implementing the *Investigations* program, was to positively impact teachers' content and pedagogical knowledge. Just as teachers cited their increased confidence and improved Mathematical aptitude throughout the process of adopting and preparing to teach the *Investigations* program, they also focused on the continued dialogue with colleagues about instructional practices as an essential, beneficial factor. Remillard and Bryans (2004) shared congruent findings where teachers benefited from regular opportunities to explore program materials together and to have conversations about their use across different classrooms. As numerous teachers reflected heavily on the early educator workshops and training during their initial exposure to the *Investigations* methodology, a key factor to maintain program fidelity was professional development for faculty new to the division. This an especially important practice as natural turnover occurs each school year.

Continue to identify unexpected positive and negative outcomes from the enacted curriculum and the impact on students and families. As teachers become increasingly facile with the *Investigations* program within their classrooms, dialogue should continue to be fostered between them to discern where outlier occurrences of difficulty, ease, or lack of student engagement appear during instruction and assessment of students. The enacted curriculum, the co-construction of the cognitive stretches that occur regularly between students and teachers daily, has a significant role in the effectiveness of instruction (Doyle, 1993; Remillard & Bryans, 2004). Additionally, the manifestation of the student experience is often represented by the voice of the parent community, so continued parent communication and explanation of the curricular approach may be an essential vehicle for clarity within the community.

Develop specific curricular strategies to increase student achievement scores. A short, medium and long-term goal of the adoption of *Investigations* was to develop students that were active learners and flexible thinkers (Figure 2). Teachers consistently shared the perception that students improved in their ability to reason, make sense of problems, and persevere. The school of study will need to determine if increasing the achievement scores is a goal worth pursuing beyond the perceived positive classroom practices and environment that have been established during the implementation of the *Investigations* program. Those practice have their merit as constructivist practices, however, they have not translated into gains in ERB math achievement scores. There was no measureable differences between mean achievement scores after the adoption of Investigations in contrast to the former math program.

Summary of Recommendations

The set of recommendations provided are directly related to the findings for the evaluations questions if this study. School leaders and teachers at the school of study should regularly review updates to the *Investigations* curriculum, in addition to revisions to the state or national standards for Math practice. A systematic approach to curriculum review and oversight may limit the gaps and stagnation that could occur in teachers' pedagogical practices. To support this ongoing systematic oversight, teachers should continue developing their instructional practices, with a focus on strategies for differentiation. The insights that can develop from group reflection can act as the foundation for teachers to maintain and enhance their content knowledge and instructional practices. Ensuring that the dialogue occurs across grade-level teams and between cross-grade teams creates a system that maintains consistency in methodology and assessment practices throughout the division. The active nature of the communication dynamic throughout the division supports the ability of teachers to identify the unexpected positive and negative outcomes from the enacted curriculum and the impact on students and families. Teachers should maintain the programmatic shift in instructional approach from the focus on developing computational skills to that of creating problem solvers and deep thinkers. Teacher perceptions supported the belief that students benefited most from relevant learning activities, not rote topic content.

Recommendations for Future Research

The scope of this study was restricted to the analysis of lower school (K-5) teachers and students at the school of study. Recommendations for future research would include expanding the study to follow the lower school students through their first year of middle school Mathematics, including an assessment of their performance on the sixth-grade level ERB Mathematics tests. Additionally, as the ERB-CTP4 standardized testing is available as early as first grade, a longitudinal study of student performance beginning in the first grade, and continuing annually through fifth grade, would allow for a more thorough examination of curricular effectiveness. As this study focused on teacher perceptions, a more in-depth study of student perceptions and performance could assist the determination of the impact of the *Investigations* instructional and curricular approach.

Conclusions

This study provided a thorough understanding of teachers' perceptions of the relationship between the adoption of the *Investigations* K-5 Math program and the expected changes in the instructional Math practices and student achievement in support of the program theory. The program theory that supported this study stated that teachers who were provided time and resources to examine best practice Math curricula and instructional methods would: adopt and implement a holistic Math program that updated the curriculum, create positive changes in teacher content and pedagogical knowledge, meet the needs of all students, at all proficiency levels, result in a consistent scope and sequence, and lead to improved student achievement.

The findings did not fully support the program theory. It did inform the school of study of the positive outcomes that the adoption of the *Investigations* program enhanced teachers' perceptions of: the alignment of the curriculum with Common Core Standards for Mathematical Practice; their capabilities as leaders of the inquiry process within the classroom setting; facilitating a Math program with consistency in concepts, student experiences, and assessment; improved students' consistency of good thinking and increased number sense.

However, analysis of the ERB-CTP4 math achievement test scores revealed negligible changes in the overall mean student performance as a result of the implementation of the *Investigations* program. Essentially, student achievement was comparable in outcomes to that of the prior curriculum. Additionally, weaknesses in the assessment materials of Investigations, and a lack of ability to differentiate up for high ability students, also required a supplemental curriculum to be adopted for extensions Recommendations provided to school of study for the findings that did not support the program theory included: school leaders regularly reviewing curriculum; development of resources for differentiation; continued grade-level and cross-grade dialogue; developing specific strategies to increase math achievement scores. Teacher perceptions supported the belief that students benefited most from relevant learning activities and they should maintain the programmatic shift in instructional approach from the focus on developing computational skills to that of creating problem solvers and deep thinkers.

APPENDIX A

JCSEE Program Evaluation Standards

Utility Standards

The utility standards are intended to increase the extent to which program stakeholders find evaluation processes and products valuable in meeting their needs.

- **U1 Evaluator Credibility** Evaluations should be conducted by qualified people who establish and maintain credibility in the evaluation context.
- **U2 Attention to Stakeholders** Evaluations should devote attention to the full range of individuals and groups invested in the program and affected by its evaluation.
- **U3 Negotiated Purposes** Evaluation purposes should be identified and continually negotiated based on the needs of stakeholders.
- **U4 Explicit Values** Evaluations should clarify and specify the individual and cultural values underpinning purposes, processes, and judgments.
- **U5 Relevant Information** Evaluation information should serve the identified and emergent needs of stakeholders.
- **U6 Meaningful Processes and Products** Evaluations should construct activities, descriptions, and judgments in ways that encourage participants to rediscover, reinterpret, or revise their understandings and behaviors.
- **U7 Timely and Appropriate Communicating and Reporting** Evaluations should attend to the continuing information needs of their multiple audiences.
- **U8 Concern for Consequences and Influence** Evaluations should promote responsible and adaptive use while guarding against unintended negative consequences and misuse.

Feasibility Standards

The feasibility standards are intended to increase evaluation effectiveness and efficiency.

- **F1 Project Management** Evaluations should use effective project management strategies.
- **F2 Practical Procedures** Evaluation procedures should be practical and responsive to the way the program operates.
- **F3 Contextual Viability** Evaluations should recognize, monitor, and balance the cultural and
political interests and needs of individuals and groups.
- **F4 Resource Use** Evaluations should use resources effectively and efficiently.

Propriety Standards

The propriety standards support what is proper, fair, legal, right and just in evaluations.

- **P1 Responsive and Inclusive Orientation** Evaluations should be responsive to stakeholders and their communities.
- **P2 Formal Agreements** Evaluation agreements should be negotiated to make obligations explicit and take into account the needs, expectations, and cultural contexts of clients and other stakeholders.
- **P3 Human Rights and Respect** Evaluations should be designed and conducted to protect human and legal rights and maintain the dignity of participants and other stakeholders.
- **P4 Clarity and Fairness** Evaluations should be understandable and fair in addressing stakeholder needs and purposes.
- **P5 Transparency and Disclosure** Evaluations should provide complete descriptions of findings, limitations, and conclusions to all stakeholders, unless doing so would violate legal and propriety obligations.
- **P6 Conflicts of Interests** Evaluations should openly and honestly identify and address real or perceived conflicts of interests that may compromise the evaluation.
- **P7 Fiscal Responsibility** Evaluations should account for all expended resources and comply with sound fiscal procedures and processes.

Accuracy Standards

The accuracy standards are intended to increase the dependability and truthfulness of evaluation representations, propositions, and findings, especially those that support interpretations and judgments about quality.

- **A1 Justified Conclusions and Decisions** Evaluation conclusions and decisions should be explicitly justified in the cultures and contexts where they have consequences.
- **A2 Valid Information** Evaluation information should serve the intended purposes and support valid interpretations.
- **A3 Reliable Information** Evaluation procedures should yield sufficiently dependable and consistent information for the intended uses.
- **A4 Explicit Program and Context Descriptions** Evaluations should document programs and their contexts with appropriate detail and scope for the evaluation purposes.
- **A5 Information Management** Evaluations should employ systematic information collection, review, verification, and storage methods.
- **A6 Sound Designs and Analyses** Evaluations should employ technically adequate designs and analyses that are appropriate for the evaluation purposes.

- **A7 Explicit Evaluation Reasoning** Evaluation reasoning leading from information and analyses to findings, interpretations, conclusions, and judgments should be clearly and completely documented.
- **A8 Communication and Reporting** Evaluation communications should have adequate scope and guard against misconceptions, biases, distortions, and errors.

Evaluation Accountability Standards

The evaluation accountability standards encourage adequate documentation of evaluations and a metaevaluative perspective focused on improvement and accountability for evaluation processes and products.

- **E1 Evaluation Documentation** Evaluations should fully document their negotiated purposes and implemented designs, procedures, data, and outcomes.
- **E2 Internal Metaevaluation** Evaluators should use these and other applicable standards to examine the accountability of the evaluation design, procedures employed, information collected, and outcomes.
- **E3 External Metaevaluation** Program evaluation sponsors, clients, evaluators, and other stakeholders should encourage the conduct of external metaevaluations using these and other applicable standards.

APPENDIX B

Focus Group Protocol

Thank you for taking the time today to speak with me about the *Investigations* K-5 Math program. Today, I would like to ask you questions about your work and observations using the *Investigations* K-5 program. Your responses will become part of my doctoral research on program outcomes. Our conversation today should take no more than one hour. I am audio-recording our session for transcription and analysis. Please note that I have completed training regarding the research of human subjects, that all of your responses will remain confidential, and identifying information will be redacted in the transcript. You may withdraw from this interview at any time without penalty.

Before we begin, I'd like you to maintain several group norms:

- Respect everyone's point of view. There are no right or wrong answers.
- Please do not identify other people by name. You may refer to them instead as "a student" or "a principal" or "a teacher."
- Due to the audio recording, I need only one person at a time to speak.
- In order to maintain our group confidentiality, please do not share or discuss specific ideas or information shared in this session with others.

Interview Questions:

1) How long have you been using the *Investigations* curriculum?
2) Think back to when you first used the program. What were your first impressions?
3) What is your perception of how well the use of *Investigations* K-5 Math program has updated the curricular program to support the school's standards of practice for Math?
4) What has been the impact of *Investigations* K-5 Math program on your content and pedagogical knowledge?
5) What are your perceptions regarding the extent that use of *Investigations* K-5 Math program has supported the development of a consistent scope and sequence for the K-5 division?
6) What is your perception of the change in student achievement during the course of the implementation of the *Investigations* K-5 Math program?
7) What unintended outcomes (positive and negative) resulted from the use of the *Investigations* K-5 program?
8) Is there anything else we should have talked about but didn't?

THIS PROJECT WAS FOUND TO COMPLY WITH APPROPRIATE ETHICAL STANDARDS AND WAS EXEMPTED FROM THE NEED FOR FORMAL REVIEW BY THE COLLEGE OF WILLIAM AND MARY PROTECTION OF HUMAN SUBJECTS COMMITTEE (Phone 757-221-3966) ON 2017-07-18 AND EXPIRES ON 2018-07-18.

APPENDIX C

Focus Group Protocol Review Panel: Outcomes for Coding

<u>Focus Group Interview Questions:</u>

1) How long have you been using the *Investigations* curriculum?

2) Think back to when you first used the program. What were your first impressions?

What is your thinking process as you try to answer this question?	Key Ideas to look for	Codes (Table 4)
Program would need a new level of teacher support	Training in Concepts of *Investigations*	A1, A7
Why did we do this curriculum anyway?	Training in new Classroom Management	A2, A7
This is nebulous- Not ready to do this on my own	Assessment	A4, A5, A7, A9
This is so different from how I teach	Ongoing Collaboration	A9
We don't have enough time for this curriculum	Ability to differentiate	A4
Glad to be implementing with colleagues	Challenging Students	A4
Glad to be working with a Math coordinator	Teacher preparedness	A2, A3, A9
	Student Experience	A4

3) What is your perception of how well the use of *Investigations* K-5 Math program has updated the curricular program to support the school's standards of practice for Math?

What is your thinking process as you try to answer this question?	Key Ideas to look for	Codes (Table 4)
Created a consistent program and philosophy of teaching	Consistency across Grades	A1, A5, A9
Created a standard of practice for the school-	Building through K-5	A1, A5, A9
Students sharing more about their understanding	Building concepts & number sense	B1, B2
Students gaining flexibility in strategies	Collaboration	A1, A3, A4, A5, A7
Hard to differentiate for "strong" Math students	Differentiation	A4
Cohesiveness of content and pedagogy Parent communication /perception	NCTM Standards	A1, A3, A7

4) What has been the impact of *Investigations* K-5 Math program on your content and pedagogical knowledge?

What is your thinking process as you try to answer this question?	**Key Ideas to look for**	**Codes (Table 4)**
"How do I teach Math"- build this knowledge	Flexibility with lessons	A1, A2, A4, A7, B1-B8
Growth in knowledge of teaching and topics	Growth in teacher knowledge	A1, A3, A4, A7, B1-B8
Collaboration to look at how to help students communicate understandings	Collaboration	A1, A3, A4, A5, A7, B1-B3, B8
More focus on algebraic thinking	More Algebraic thinking	B1, B2
Better strategies for personal development	Personal Development Strategies	A1, A8
More coaching for differentiation	Coaching for Differentiation	A1, A2, A4, A7

5) What are your perceptions regarding the extent that use of *Investigations* K-5 Math program has supported the development of a consistent scope and sequence for the K-5 division?

What is your thinking process as you try to answer this question?	**Key Ideas to look for**	**Codes**
Do Classroom experiences look alike?	Consistency in Concepts	A3, A5,
Program instead of individual teachers	Consistency in Experiences	A1-A8
Consistent review of scope and sequence	Consistency in Assessment	A1, A3, A5, A7, A8,

6) What is your perception of the change in student achievement during the course of the implementation of the *Investigations* K-5 Math program?

What is your thinking process as you try to answer this question?	Key Ideas to look for	Codes
How do teachers look at Math students?	Understanding	B1-B8
Students are stronger in sharing understanding	Memory of Prior Learning	B1-B8
Students not memorizing Math facts and algorithms	Application to New Situations	B1-B8
Students resistant to adopt strategies that might be more efficient	Enjoyment in Math	B1-B8
Ability to challenge high achievers	Differentiation	A2, A4

7) What unintended outcomes (positive and negative) resulted from the use of the *Investigations* K-5 program?

What is your thinking process as you try to answer this question?	Key Ideas to look for	Codes
Has it been harder to differentiate for the range of students? "Are high flyers challenged?" questions	Differentiation- easier and harder	A2, A4,
Workshops for teacher collaboration	Collaboration	A9
Parent resistance	Workshops	A6, A8
Changes in teachers, parents, students, perceptions of what a strong Math student is	Variety of Collaboration, Understanding	A9, B1-B8
Students problem-solving skills are stronger	Understanding	B1-B8

8) Is there anything else we should have talked about but didn't?

What is your thinking process as you try to answer this question?	Key Ideas to look for	Codes
ERB Scores continue to hold well- Can we say students are stronger Math students yet?	Assessment, Deeper Concepts	A1, A4, A7, B1-B8

APPENDIX D

Focus Group Coding Outcomes from Review Panelist

Evaluation question 1: What are teachers' perceptions regarding the extent that the implementation of the *Investigations* K-5 Math program updated the curricular program to the school's desired standards of practice for Math?
The coding from the expert review panelist supported the findings in its recognition of the "key ideas to look for" (Appendix C): Building through K-5 (A1, A5,A9) and Consistency across Grades (A1, A5,A9) as prominent focus group themes.

Evaluation question 2: What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program impacted how they feel about their content and pedagogical knowledge?
The coding from the expert review panelist supported the findings in its recognition of the "key ideas to look for" (Appendix C): growth in teacher knowledge (A1, A3, A4, A7, B1-B8), personal development (A1, A8), flexibility with lessons (A1, A4, B1-B8), and more algebraic thinking (B1, B2) as prominent focus group themes.

Evaluation question 3: What are teachers' perceptions regarding the extent to which implementation of the *Investigations* K-5 Math program developed a consistent scope and sequence for the K-5 classrooms?
The coding from the expert review panelist supported the findings in its recognition of the "key ideas to look for" (Appendix C): Consistency in Concepts (A3, A5) and Consistency in Concepts (A1-A8) as prominent focus group themes.

Evaluation question 4: What are teachers' perceptions regarding unintended outcomes (positive or negative) that have resulted from the implementation of the *Investigations* K-5 program?
The coding from the expert review panelist supported the findings in its recognition of the "key ideas to look for" (Appendix C): Understanding (B1-B8), Differentiation (A2, A4) and Collaboration (A9, B1-B8) as prominent focus group themes.

Evaluation question 5: What are teachers' perceptions of changes in student achievement as a result of implementation of the *Investigations* K-5 Math program?
The coding from the expert review panelist supported the findings in its recognition of the "key ideas to look for" (Appendix C): Application to New Situations (B1-B8), Enjoyment in Math (B1-B8), Memory of Prior Learning (B1-B8), Understanding (B1-B8), Differentiation (A2, A4) as prominent focus group themes.

APPENDIX E

Timeline

Phase	Activities	Anticipated Completion Dates
Phase 1- Dissertation Proposal	Complete précis (EPPL 781with topic approval from dissertation chair)	December 2016
	Draft chapters 1 & 3 (EPPL 782 with preliminary review by dissertation chair)	January-February 2017
	Complete proposal (chapters 1-3 with guidance from dissertation chair)	March 2017
	Defend proposal with dissertation committee (make modifications as required)	July 2017
Phase II- Preliminary Steps to Conducting Study	Request approval from W&M IRB (if required)	July 2017
	Secure permission from school district/other educational organization to conduct research study (if required)	July 2017
	Conduct pilot survey and revise instrumentation (if needed)	July 2017
Phase III- Conduct Study	Execute study as approved by dissertation committee	July- September 2017
	Collect, tabulate, and analyze data or findings	July-September 2017
	Write Chapters 4 and 5 (unless alternative format is approved by committee	October-December 2017
	Communicate with dissertation chair throughout	Ongoing
Phase IV- Dissertation Defense	Schedule defense date when approved by dissertation chair	October 2017
	Submit final dissertation to committee when approved by chair	November 2017
	Prepare for dissertation defense (e.g., PowerPoint presentation)	November 2017
	Defend dissertation (make modifications as required)	January- 2018
	Complete remaining steps for graduation: • Version approved by committee submitted to EPPL dissertation editor by chair • Make all required changes to dissertation • Submit final approved dissertation electronically • Complete all graduation forms and other requirements	January-February 2018

APPENDIX F

Literature Survey Talley Matrix

Reference	Year	Key Concept or Descriptor	Main Ideas	Data Quality
Chenoweth, K. (2016). ESSA offers changes that can continue learning gains. *Phi Delta Kappan, 97*(8), 38-42. doi:10.1177/0031721716647017	2016	Education Policy	The obligation of states to articulate what they expect students to learn; the expectation that schools have an obligation to help all their students meet or exceed standards; the requirement that states assess regularly to measure whether schools are teaching the standards; and the requirement that information about schools, including assessment results, be made available to educators, students, parents, and communities.	Yes
Teacher education around the world. (1998). *Journal of Mathematics Teacher Education, 1*(3), 341-348.	1998	Education Policy	The article provides information on various creative programs and models for educating Mathematics teachers in Italy. The Primary School programs were reformed in 1985. It states that the basic components of Mathematics at the compulsory level are arithmetic and geometry. The fundamental distinction between the teachers of lower and upper secondary schools is in their basic education in Mathematics and this plays a deciding factor in the recruitment of Mathematics teachers. Secondary teachers are not required to have a specific education in pedagogical issues. The author affirms that the education of Mathematics teachers is almost overlapping with the education of a professional Mathematician.	Yes
Clements, D. H., & Battista, M. T. (1990). Constructivist learning and teaching. *Arithmetic Teacher, 38*(1), 34.	1990	Education Theory	Discusses the constructivist approach to teaching Mathematics. Defines constructivism and its major goals.	Yes
Felder, R. M., & Brent, R. (1996). Navigating the bumpy road to student-centered instruction. *College Teaching, 44*(2), 43.	1996	Education Theory	Discusses various aspects of the student-centered approach to college teaching. Problems encountered during implementation of the approach; Faculty concerns.	Yes
Battista, M. T. (1999). The Mathematical miseducation of America's youth. (cover story). *Phi Delta Kappan, 80*(6), 424.	1999	Instructional Assessment	Discusses the best manner in which to assess the quality of Mathematics teaching. Need to understand the essence of Mathematics and how students understand Mathematical ideas; Criticism of the reform movement in Math education	Yes
LeMire, S. D., Melby, M. L., Haskins, A. M., & Williams, T. (2012). The devalued student: Misalignment of current Mathematics knowledge and level of	2012	Instructional Assessment	Within this study, we investigated the association between 10th-grade students' Mathematics performance and their feelings of instructional misalignment between their current Mathematics knowledge and educator support. Data from the 2002 Education Longitudinal Study, which included a national sample of 750 public and private high schools in the United States, was used for the investigation. Our findings indicate	Yes

instruction. *Mathematics Educator, 22*(1), 63-83.			that student perceptions of both instructional alignment and educator support are associated with Mathematics performance.	
Little, M. E. (2009). Teaching Mathematics: Issues and solutions. *Teaching Exceptional Children Plus, 6*(1), 1-15.	2009	Instructional Assessment	The ability to compute, problem solve, and apply concepts and skills in Mathematics influences multiple decisions in our lives. The National Research Council (1989) reported that Mathematics is especially evident in our technology-rich society, where number sense and problem-solving skills have increased the importance and demands of advanced levels of proficiency.	Yes
Remillard, J. T., & Bryans, M. B. (2004). Teachers' orientations toward Mathematics curriculum materials: Implications for teacher learning. *Journal for Research in Mathematics Education, 35*(5), 352-388.	2004	Instructional Assessment	This study was prompted by the current availability of newly designed Mathematics curriculum materials for elementary teachers. Seeking to understand the role that reform-oriented curricula might play in supporting teacher learning, we studied the ways in which 8 teachers in the same school used one such curriculum, Investigations in Number, Data, and Space (TERC, 1998). Findings revealed that teachers had orientations toward using curriculum materials that influenced the way they used them regardless of whether they agree with the Mathematical vision within the materials.	Yes
Steinke, D. A. (2015). Evaluating number sense in workforce students. *MPAEA Journal of Adult Education, 44*(1), 1-8.	2015	Instructional Assessment	Earlier institution-sponsored research revealed that about 20% of students in community college basic Math and pre-algebra programs lacked a sense of part-whole relationships with whole numbers. This concept, needed to understand fraction and percent relationships, carries over as a grasp of the relationship between details and the main idea in factual prose, in critical thinking in job situations, and on the current high school equivalency tests.	Yes
Van Der. Sandt, S. (2007). Research framework on Mathematics teacher behaviour: Koehler and Grouws' framework revisited. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(4), 343-350.	2007	Instructional Assessment	This article investigates some of the factors influencing teachers' behaviour namely knowledge, attitude and views and beliefs. A research framework on teacher behaviour is presented, in an effort to expand the theoretical understanding of the factors influencing teacher behaviour and to guide future teacher education.	Yes
Cain, J. S. (2002). An evaluation of the connected Mathematics project. *Journal of Educational Research, 95*(4), 224.	2002	Math Program Evaluation	A formative, internal evaluation was conducted on the Connected Mathematics Project (CMP), a middle school reform Mathematics curriculum used in Lafayette Parish, Louisiana. An analysis of the Iowa Test of Basic Skills and the Louisiana Education Assessment Program Mathematics data indicate that the program is working: The CMP schools significantly outperformed the non-CMP schools on both standardized tests.	Yes
Ding, C., & Navarro, V. (2004). An examination of student Mathematics learning in elementary and	2004	Math Program Evaluation	Educators and policy-makers have engaged in heated debates as to the effects of such standardized testing practices on actual student achievement. The current study documents	Yes

middle schools: A longitudinal look from the us. *Studies in Educational Evaluation, 30*(3), 237-253. doi:10.1016/j.stueduc.2004.09.004			longitudinal Math achievement growth based on 716 students in a single U.S. school district. The data for this study are student Math scores on SAT 9 achievement tests.	
Doabler, C. T., Fien, H., Nelson-Walker, N., & Baker, S. K. (2012). Evaluating three elementary Mathematics programs for presence of eight research-based instructional design principles. *Learning Disability Quarterly, 35*(4), 200-211. doi:10.1177/0731948712438557	2012	Math Program Evaluation	The review builds on earlier research that evaluated the curricular features of core Math programs to improve the performances of students with or at risk for Mathematics difficulties. In this review, three elementary Math programs, at Grades 2 and 4, were evaluated for the presence of eight instructional principles.	Yes
Kennedy, E., & Smolinsky, L. (2016). Math circles: A tool for promoting engagement among middle school minority males. *Eurasia Journal of Mathematics, Science & Technology Education, 12*(4), 717-732. doi:10.12973/eurasia.2016.1223a	2016	Math Program Evaluation	This article presents results of a case study of a Math circle designed for low income, minority students from an inner city middle school. The study focused on the impact of participation in the Math circle on students and the design features of the experience that were most effective at promoting engagement and positive reactions from students.	Yes
Agodini, R., & Harris, B. (2010). An experimental evaluation of four elementary school Math curricula. *Journal of Research on Educational Effectiveness, 3*(3), 199-253. doi:10.1080/19345741003770693	2010	Math Program Evaluation	Evaluation of Four Math Programs, Including Investigations. The results show that average spring first-grade Math achievement of Math Expressions and Saxon students was 0.30 SD higher than Investigations students and 0.24 SD higher than SFAW students.	Yes
Karimnia, A., & Kay, E. (2015). An evaluation of the undergraduate TEFL program in Iran: A multi-case study. *International Journal of Instruction, 8*(2), 83-98.	2015	Program Evaluation	The purpose of this study is to assess the quality of Islamic Azad University TEFL program at B.A. (undergraduate) level in Iran. To do so, five IAU branches were selected through cluster sampling. Using Stufflebeam's (2002) CIPP model, the data were gathered through a researcher-made questionnaire. This model incorporates four main segments including the evaluations of context, input, process and product.	Yes
Zhang, G., Zeller, N., Griffith, R., Metcalf, D., Williams, J., Shea, C., & Misulis, K. (2011). Using the context, input, process, and product evaluation model (CIPP) as a comprehensive framework to guide the planning, implementation, and	2011	Program Evaluation	In this article, Stufflebeam's Context, Input, Process, and Product (CIPP) evaluation model is recommended as a framework to systematically guide the conception, design, implementation, and assessment of service-learning projects, and provide feedback and judgment of the project's effectiveness for continuous improvement. This article (1) explores the CIPP evaluation model's theoretical roots and applications, (2) delineates its four components, (3) analyzes each	Yes

assessment of service-learning programs. *Journal of Higher Education Outreach & Engagement, 15*(4), 57-84.			component's role in a service-learning project's success, and (4) discusses how the model effectively addresses Service-Learning Standards for Quality Practice.	
Frye, A. W., & Hemmer, P. A. (2012). Program evaluation models and related theories: AMEE guide no. 67. Medical Teacher, 34(5), e288-e299. doi:10.3109/0142159X.2012.668637	2012	Program Evaluation	This Guide reviews theories of science that have influenced the development of common educational evaluation models. Educators can be more confident when choosing an appropriate evaluation model if they first consider the model's theoretical basis against their program's complexity and their own evaluation needs. Reductionism, system theory, and (most recently) complexity theory have inspired the development of models commonly applied in evaluation studies today.	Yes
Grady, M., Watkins, S., & Montalvo, G. (2012). The effect of constructivist Mathematics on achievement in rural schools. *Rural Educator, 33*(3), 38-47.	2012	Instructional Assessment	International assessment data indicate American students are not competing with their counterparts in other countries. The Mathematics curriculum and pedagogy are not preparing students to compete in a global economy. This study compared student achievement using sixth grade Mathematics results from the Illinois Standards Achievement Test.	Yes
Active Mathematics teaching. (1983). *Education Digest, 49*(2), 69-70.	1983			Yes

APPENDIX G

Checklist for Focus Group Interviews

Advance Notice
_______ Contact participants by phone two weeks (or more) before the session.
_______ Send each participant a letter confirming time, date, and place.
_______ Give the participants a reminder phone call prior to the session.
Questions
_______ Questions should flow in a logical sequence.
_______ Key questions should focus on the critical issues.
_______ Limit the use of "why" questions.
_______ Use "think-back" questions as needed.
Logistics
_______ The room should be satisfactory (size, tables, comfort, sound, etc.).
_______ Arrive early.
_______ Check background noise so it doesn't interfere with tape recording.
_______ Have name tents for participants.
_______ Place a remote microphone on the table.
_______ Place the tape recorder off the table near the assistant moderator's chair.
_______ Bring extra tapes, batteries, and extension cords.
_______ Plan topics for small-talk conversation.
_______ Seat experts and talkative participants next to the moderator.
_______ Seat shy and quiet participants directly across from moderator.
_______ Serve food.
_______ Bring enough copies of handouts and/or visual aids.
Moderator Skills
_______ Practice introduction without referring to notes.
_______ Practice questions. Know the key questions. Be aware of timing.
_______ Be well rested and alert.
_______ Listen. Are participants answering the question?
_______ Use probe, pause, or follow-up questions as needed.
_______ Avoid verbal comments that signal approval.
_______ Avoid giving personal opinions.
Immediately After the Session
_______ Check to see if the tape recorder captured the comments.
_______ Debrief with the research team.
_______ Prepare a brief written summary

Note. Krueger, Richard A. and Mary Anne Casey (2000). Focus Groups: A Practical Guide for Applied Research. 3rd Edition. Thousand Oaks, CA: Sage Publications.

APPENDIX H

Participant Informed Consent Form

I,_________________________________ , agree to participate in a research study involving lower school teachers who are instructors of the *Investigations* K-5 Math program. The purpose of this study is to inform the effectiveness of meeting the learning outcomes and to gain teachers' perspectives on the knowledge and skills acquired as a result of the program.

As a participant, I understand that my participation in the study is purposeful and voluntary. Participants were selected to represent key individuals currently teaching the *Investigations* curriculum. I understand that approximately 17 teachers will be selected to participate in this study.

I understand that I will be expected to participate in one (1) semi-structured, focus group interview related to my knowledge and implementation of *Investigations* K-5 Program, my classroom instructional practices and/or my involvement in the assessment of student development.

I understand that the interviewer has been trained in the research of human subjects, my responses will be confidential, and that my name will not be associated with any results of this study. I understand that the data will be collected using an audio recording device and then transcribed for analysis. Information from the audio recording and transcription will be safeguarded so my identity will never be disclosed. My true identity will not be associated with the research findings.

I understand that there is no known risk or discomfort directly involved with this research and that I am free to withdraw my consent and discontinue participation at any time. I agree that should I choose to withdraw my consent and discontinue participation in the study that I will notify the researcher listed below, in writing. A decision not to participate in the study or to withdraw from the study will not affect my relationship with the researcher, the College of William and Mary generally or the School of Education, specifically.

If I have any questions or problems that may arise as a result of my participation in the study, I understand that I should contact Sean Hamer, the researcher at 617-388-7326 or smhamer@email.wm.edu, Dr. Michael DiPaola, dissertation chair at 757- 221-2344 or mfdipa@wm.edu, or Dr. Tom Ward, chair of EDIRC, at 757-221-2358 or EDIRC-L@wm.edu.

My signature below signifies that I am at least 18 years of age, that I have received a copy of this consent form, and that I consent to participate in this research study.

______________________________________ __________________________
Signature of Participant Date

______________________________________ __________________________
Signature of Researcher Date

THIS PROJECT WAS FOUND TO COMPLY WITH APPROPRIATE ETHICAL STANDARDS AND WAS EXEMPTED FROM THE NEED FOR FORMAL REVIEW BY THE COLLEGE OF WILLIAM AND MARY PROTECTION OF HUMAN SUBJECTS COMMITTEE (Phone 757-221-3966) ON 2017-07-18 AND EXPIRES ON 2018-07-18.

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Columbia University-Teachers College, New York, NY 2009
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University of Massachusetts, Boston MA 2003
B.A. Human Services - Concentration in Training & Development - Minor in Chemistry

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WORK EXPERIENCE

Head of Middle School
GERMANTOWN FRIENDS SCHOOL, Philadelphia, PA 2015-Pres.
FRIENDS ACADEMY, North Dartmouth, MA 2012- 2015

- Directed the academic, athletic and social and emotional growth of students in Grades 6 – 8
- Supervised and evaluated the curricular and professional development of divisional faculty members
- Developed the school's technology transition to GAFE (Google Applications for Education) Platform
- Planned and facilitated Middle School Service-Learning Program and local community partnerships
- Established Student Advisory program, revised Parent Conferences and Parent Education Series
- Counseled families and facilitated Secondary Schools Admissions process

COMMUNITY COLLEGE OF PHILADELPHIA, Philadelphia, PA 2015-Pres
Adjunct Instructor

- Courses taught: MTH 118 Algebra 1; MTH 117 Elementary Algebra

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