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Cognitively Guided Instruction in Elementary Mathematics: Understanding Factors That Influence Classroom Implementation

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May 15, 2018

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Doctor of Education in

Bagwell College of Education

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To my soul mate and husband, Christopher, for your unyielding support and encouragement through this entire process. You inspire me to strive for greatness in every aspect of my life. I love you boundlessly and I am so appreciative of the valuable lessons I learn from you each day.

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Abstract

This study focused on the teaching technique known as cognitively guided instruction (CGI), through which teachers explore the individual learning styles of their students and use the information they gather to teach more complex concepts more effectively. The focus of this study was on 10 elementary mathematics teachers, with the goal of gaining a deeper understanding of the reasons they are making limited use of CGI techniques in their classrooms. The study used interviews and classroom observations of the 10 participants to identify the factors influencing their willingness or reluctance to apply CGI techniques to their instructional practices. The study gathered data regarding the factors that encouraged the use of CGI in participants' classrooms and regarding the factors that created their resistance to doing so or that caused a lack of confidence in CGI strategies.

Findings identified positive results from CGI techniques, with students showing learning levels beyond their grades and developing creative problem-solving techniques that were beneficial for the current curriculum and for future grade levels as well. Findings also identified the most significant deterrent for CGI use as being the time investment required to carry out the lessons or exercises in ways that incorporated CGI practices.

This study identified the value of CGI techniques and revealed the need to adapt and evolve teaching methods in line with the method. The study noted the challenges involved with CGI implementation, but showed that the positive results outweigh those issues. The study findings provide a compelling case for CGI as an approach that enhanced student problem solving, unlocks creative thinking, encourages more active student involvement in solving problems and provides collective encouragement and learning for students, teachers and administrators.

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Chapter 1: Introduction

The more traditional approach in the instruction of mathematics involves teacher-directed instruction where teachers assume the dominant role during instruction (Skarr et al., 2014). This more traditional approach is influenced by standardization of mathematics instruction, wherein teachers are expected to comply with national guidelines and meet the demands of high-stakes testing (Au, 2013). As a result of the more traditional method of teaching mathematics, elementary math students tend to depend more on memorization instead of reasoning, which can explain the students' failure to understand conceptual ideas (Swars, Smith, Smith, Hart, & Carothers, 2013).

Contrary to the more traditional approach of teacher-directed instruction where students are told what to do, mathematics instruction has evolved to an interactive learning process (Oksanen, Pehkonen, & Hannula, 2015). Evidenced-based research is often used as a rationale for using a particular instructional strategy (Ermeling, Hiebert, & Gallimore, 2015; Fallace, 2015). From this evidence-based body of research, child-centered instructional approaches have been popular in creating a learning environment where children are nurtured and encouraged to develop their own abilities (Fallace, 2015). According to Fallace (2015), child-centered instruction is a progressive approach to education, placing the importance of learning towards students instead of the teachers.

An example of child-centered instruction is cognitively guided instruction (CGI), which is based on the assumption that children have intuitive knowledge, serving as the foundation for more advanced knowledge on mathematics (Carpenter, Ansell, Franke, Fennema, & Weisbeck, 2015). CGI, which is rooted in social constructivism (Palincsar, 1998), is a relatively new instructional approach in mathematics that focuses on social interaction and differentiated instruction (Baker & Harter, 2015; Moscardini, 2015). The instructional approach was developed at the Wisconsin Center for Education Research in the late 1990's (Carpenter et al, 2015). A socially constructivist perspective emphasizes the importance of social interaction in the learning process (Baker & Harter, 2015; Palincsar, 1998). Using the CGI approach, teachers explore and analyze the cognitive strategies students use when solving mathematical problems in order to determine the appropriate teaching approach (Carpenter et al., 2015).

The accepted approach in teaching mathematics because traditional teacher-directed approaches remain the standard in many classrooms (Harbin & Newton, 2013; Moscardini, 2015). Even if teachers wanted to use more innovative strategies, they tend to resort to the approaches that they have always used in the past (Harbin & Newton, 2013). Nevertheless, according to Carpenter et al. (2015), students are more likely to succeed in learning mathematics if they are given the opportunity to invent their own problem-solving strategies and styles. CGI gives teachers the opportunity to explore first the individual learning styles of students and use that information to teach more complex concepts in mathematics (Carpenter et al., 2015).

To have a more balanced view of instructional approaches currently being used in schools, it is worth noting the controversy regarding the credibility of learning styles. Newton and Miah (2017) contend that there is no empirical evidence supporting the existence of different learning styles and that targeting these styles will not lead to improved outcomes. Hence, Newton and Miah argue that the use of learning styles as justification for individualized instructional approaches is primarily rooted in unsupported assumptions.

Despite the controversies regarding the validity of individual learning styles, CGI has been proposed as one of the instructional strategies that can address the need for differentiation in mathematics instruction (Baker & Harter, 2015; Moscardini, 2015). Differentiation is one of the main characteristics of CGI because the teaching approach depends on the individual learning needs of students when solving mathematic problems (Baker & Harter, 2015). The individual learning needs of students are considered when teachers use differentiated instruction in mathematics (Baker & Harter, 2015). Kirschner (2017) contended, however, that there is a lack of empirical evidence supporting the need for differentiated instruction.

Even though differentiation of instruction is a strength of CGI, it can also be challenging in terms of actual implementation (Baker & Harter, 2015). Teachers often do not make the effort to analyze the learning needs of students in terms of solving math problems so that individualized instruction can be developed (Moscardini, 2015). Despite this initial lack of effort, Moscardini (2015) found that when teachers become familiar with differentiated instruction through professional development, teachers acquire a deeper understanding of mathematics instruction. In contention against the usage of differentiated instruction, Kirschner (2017) cautioned that differences in learning preferences do not mean that teachers should refrain from the most efficient and effective method of teaching.

With the use of differentiated techniques such as cognitively guided-instruction, school leaders can influence the behaviors of teachers and other subordinates (Aldulaimi & Sailan, 2012; Drago-Severson, 2012; Goddard, Goddard, Kim, & Miller, 2015; Kaniuka, 2012; Park & Jeong, 2013). According to Garza, Drysdale, Gurr, Jacobson, and Merchant (2014), effective leadership of principals can lead to the sustained success of schools, particularly in reaching organizational goals. Principals who are considered instructional leaders are able to foster collective efficacy among teachers, underscoring the ability of school leaders to influence the use of CGI (Goddard et al., 2015). The experiences of teachers during school reforms and organizational change are characterized by different emotions and perceptions, which may include self-doubts, lack of confidence, and resistance toward change (Kaniuka, 2012). The beliefs and attitudes of teachers can influence their instructional practices, which means what teachers use in class is based on their own personal beliefs (Archambault, Janosz, & Chouinard, 2012; Polly et al., 2013). However, the beliefs and perceptions of teachers do not always align with their actual instructional practices in their classrooms, reflecting the possible challenges in the adoption and implementation of innovative teaching methods (Archambault et al., 2012; Harbin & Newton, 2013; Polly et al., 2013). Several personal, institutional, and policy-related factors may affect the willingness or reluctance of teachers to implement school reforms related to innovative instructional practices in mathematics (Harbin & Newton, 2013; Polly et al., 2013; Tam, 2015).

Thus, this study focused on CGI as an instructional strategy in mathematics. The rest of the chapter includes the following key topics: (a) problem statement, (b) purpose of the study, (c) research questions, (d) conceptual framework, (e) nature of the study, (f) definitions, (g) assumptions, (h) scope and delimitations, (i) limitations, and (j) significance. The chapter concludes with a summary of the key information central to the research problem.

Problem Statement

CGI is a relatively novel strategy in teaching mathematics to elementary students (Baker & Harter, 2015; Moscardini, 2015). Rooted in socially constructivist instructional strategies, CGI focuses on the differentiated learning and teaching. in order to provide differentiated assistance in learning mathematics (Carpenter et al., 2015). The implementation of CGI in elementary classrooms remains limited despite the benefits associated with the technique (Moscardini, 2015) because many teachers still use traditional strategies based on standardized practices. The gaps in the literature that were identified are the limited understanding of addressing individual learning needs through differentiated instruction, the challenges of appropriate instruction in mathematics, and the factors that influence the implementation of CGI in elementary mathematics (Kirschner, 2017; Polly et al., 2013).

CGI can address a solution for the many drawbacks provoked by the increased standardization in mathematics instruction by giving teachers the opportunity to differentiate instruction based on the individual learning needs of their students (Polly et al., 2013). Differentiation can be challenging for teachers because of the efforts needed to analyze the learning needs of students and teach based on those individual cognitive styles (Baker & Harter, 2015; Moscardini, 2015). The problem is that teachers tend to resort to instructional strategies that they have traditionally used in the past; failing to use more innovative strategies such as CGI (Harbin & Newton, 2013; Moscardini, 2015). This study addresses this gap by exploring the reasons why mathematics teachers are or are not using CGI in teaching math. The results of the study provide an improved understanding of the different factors that influence the willingness and resistance of teachers to adopt and implement CGI in mathematics.

Purpose of the Study

The purpose of the study was to gain a deeper understanding of the reasons why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The study also aimed to assist leaders in identifying factors that could facilitate the adoption of CGI in teaching mathematics in elementary. The study will hopefully provide guidance from transferability in factors that facilitate the adoption of socially constructive instructional practices. The results of the current study expanded the literature on CGI by acquiring a deeper understanding of teacher decision making processes in regards to CGI.

Research Questions

Based on the purpose of this study, the corresponding research question was: What factors influence the willingness or resistance of elementary mathematics teachers regarding the use of CGI?

Significance

The significance of the study resides in the identification and the elaboration of the different factors that prevent and support change from traditional approaches to CGI in mathematics. The results of the current study could expand the literature on the facilitators and barriers that influence mathematics teachers from using CGI. The results of the study also serve as the foundation for future studies in terms of expanding the framework of understanding regarding the different factors that influence the willingness or resistance of elementary math teachers regarding the use of CGI in their classroom instructional practices. Rooted in the concept of naturalistic generalizations, the particulars of the results of the qualitative study may be transferable to other similar situations or contexts (Stake, 1995). Additionally, the study improves the understanding of the facilitating factors that can encourage teachers to adopt CGI in teaching mathematics. The findings can be instrumental in discovering the different factors that prevent the widespread use of CGI in elementary mathematics.

Conceptual Framework

The approach to building the conceptual framework was based on the view that all of the elements of the research processes are linked in order to form a coherent foundation. According to Ravitch and Riggan (2017), a conceptual framework "both shapes the design and direction of your study and guides its development" (p. 4). In addition, they view conceptual frameworks as "a way of linking all of the elements of the research process" (p. 5). In a broader sense, a conceptual framework of a study provides insights into the ideas and beliefs of a researcher about the phenomenon being explored and examined.

Ravitch and Riggan (2017) also viewed a conceptual framework in terms of reason and rigor. Reason entails the justification of the relevance of the research topic, whereas rigor entails the alignment of the different components of the study that support the research topic. Based on this view of reason and rigor, the study's conceptual framework includes the theoretical framework, research design, personal connection, and problem statements in order to support the topical research that was selected. The study is a topical research because CGI is a new approach that celebrates differentiation and individuality. The implementation of CGI is a complex topic because of various relevant issues based on the practices of mathematics instruction; teacher beliefs and attitudes that are influenced by resistance to change, personal factors, institutional factors, and policy-related factors; and effective leadership.

To support this topical research, several components of the conceptual framework are identified in order to demonstrate alignment and rigor. The theoretical framework is guided by the sociocultural theory and the change theory. The selection of sociocultural theory was appropriate for the current study because of the recognition of the importance of environment in the thinking process of an individual (Vygotsky, 1978). The selection of change theory was appropriate for the current study because of the recognition that there are factors that encourage and prevent change. The research design is a case study using interviews and classroom observations as the data sources. The problem that served as the focus of the conceptual framework was the limited understanding of the factors that influence the implementation of CGI in elementary mathematics (Moscardini, 2015). The personal connection of the researcher is the need to find the best ways to serve students as their educator. Figure 1 shows a graphic representation of the conceptual framework (Jorrín Abellán, 2016).

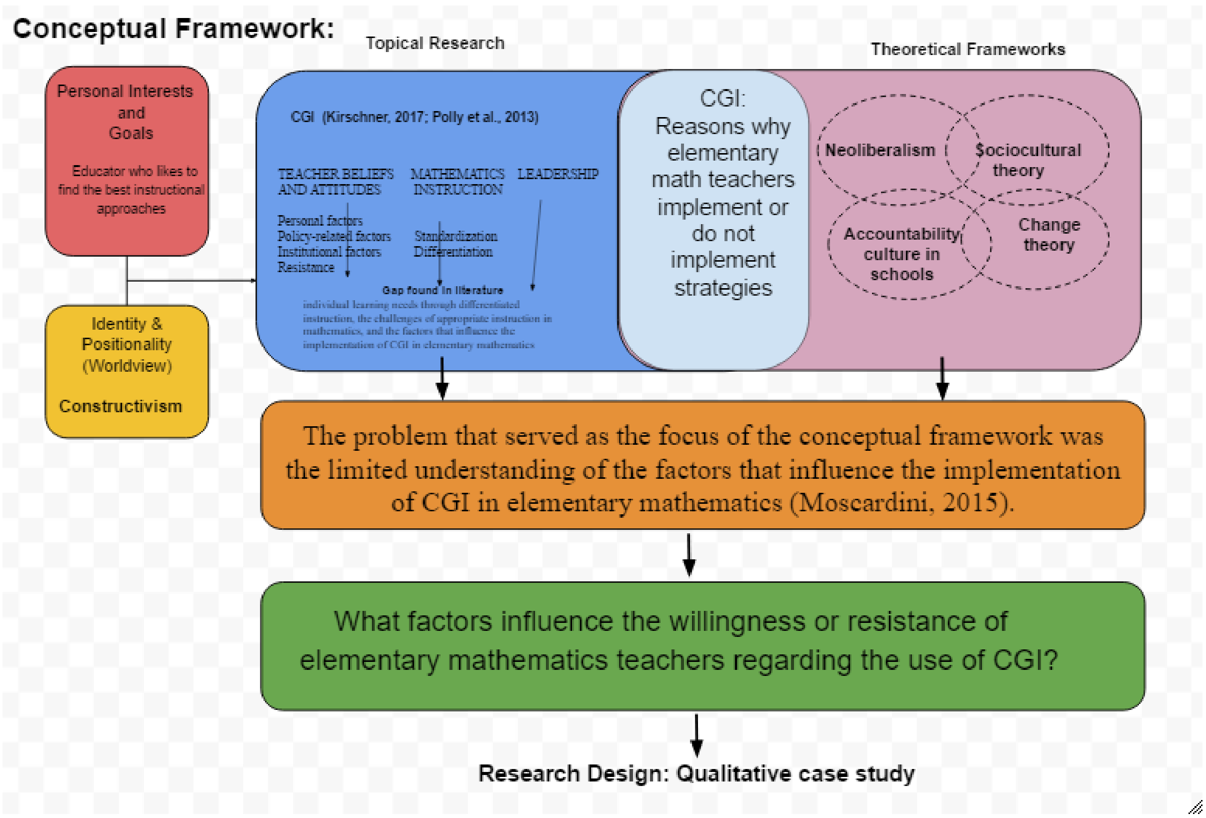

Figure 1. Conceptual framework.

The problem that served as the focus of the conceptual framework was the limited understanding of the factors that influence the implementation of CGI in elementary mathematics (Moscardini, 2015). To address this problem, the purpose of the study was to explore why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The results of the study provide an improved understanding of the different factors that influence the willingness and resistance of teachers to adopt and implement CGI in mathematics.

Based on the nature of the topic and the worldview adopted by the researcher, a qualitative case study research tradition was selected for this study. Stake's (1995) case study involved the examination of a phenomenon in-depth within real-life context without manipulating certain key processes or variables. The participants for the current study were 10 elementary mathematics teachers who were undergoing CGI interventions in a school district in the southeastern part of the United States at the time of data collection. The unit of the case was at the individual level, focusing on the individual experiences of teachers regarding the use of CGI in their classroom instructional practices in a single school. The school was given the pseudonym of Woodbury Elementary for this study. Data sources came from individual semi-structured interviews and classroom observations. Data collected from the interviews and classroom observations was analyzed using Mayring's (2003) qualitative content analysis. The strategies used to enhance the quality of the case study were based on credibility, dependability, transferability, and confirmability of the results (Shenton, 2004).

The theoretical frameworks that served as the foundation of the conceptual framework were Vygotsky's (1967) sociocultural theory and Lewin's (1947) change theory. These theories also enabled the researcher to engage, integrate, and argue the findings from this study from an existing formal framework of knowledge (Ravitch & Riggan, 2017). These theories and model provided theoretical and conceptual bases to the understanding of the different factors that contributed to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics in elementary. Each of these perspectives will be discussed, supported by the findings from the literature review.

Definitions

The following key terms were defined:

Cognitively guided instruction. Cognitively guided instruction (CGI) is defined as a strategy where teachers use the intuitive knowledge of children as foundation for teaching more advanced knowledge (Carpenter et al., 2015).

Differentiated instruction. Differentiated instruction is defined as a teaching approach wherein the individual learning needs of students are considered and encouraged (Baker & Harter, 2015).

Instructional strategy. Instructional strategy refers to what teachers do in order to teach their students (Choi, Klein, & Hershberger, 2015).

Socially constructivist strategies. Socially constructivist strategies are instructional methods that emphasize the importance of social interaction in the learning of children (Baker & Harter, 2015).

Summary

CGI is one of the instructional strategies that can enhance the achievement of elementary grade students in mathematics (Polly et al., 2013). Through differentiated instruction and individualized teaching based on cognitive style, teachers can support the learning of students of mathematics more effectively (Baker & Harter, 2015; Moscardini, 2015). The research problem was that there was limited information about the implementation of CGI in elementary mathematics, particularly from the perspectives of mathematics teachers. The aim of this study was to explore the different factors that influenced the willingness or resistance of elementary math teachers regarding the use of CGI based on instructional practices in math, their beliefs and attitudes, and school leadership. The research gaps that were identified in the literature include the limited understanding of addressing individual learning needs through differentiated instruction, the challenges of appropriate instruction in mathematics, and the factors that influence the implementation of CGI in elementary mathematics (Kirschner, 2017; Polly et al., 2013).

The components of the conceptual framework supporting this were based on Vygotsky's (1967) sociocultural theory and Lewin's (1947) change theory, providing a foundation to the understanding of the different factors that contribute to teachers' willingness or resistance in implementing CGI in elementary mathematics. A qualitative research approach was appropriate in generating in-depth data needed to answer the research questions comprehensively and full of relevant details. Case study was selected as the appropriate research design because researchers can examine a phenomenon in-depth within real-life context without manipulating certain key processes or variables (Stake, 1995). This study was significant because the results can lead to improved understanding factors that influences teachers' decisions regarding the use or lack thereof CGI.

Chapter 2: Literature Review

CGI is one of the innovative instructional strategies that can enhance the academic achievement and engagement of elementary grade students in mathematics (Baker & Harter, 2015; Moscardini, 2015; Polly et al., 2103). Through differentiated instruction and individualized teaching based on the unique cognitive styles of individual children, teachers can support the learning of students of mathematics more effectively (Baker & Harter, 2015; Moscardini, 2015). Through the implementation of CGI, teachers explore and analyze the cognitive style of students when solving mathematics problems in order to determine the appropriate teaching approach for a particular child (Baker & Harter, 2015; Carpenter et al., 2015; Moscardini, 2015; Polly et al., 2103).

The use of CGI in classrooms is not currently widespread in teaching mathematics because traditional teacher-directed approaches continues to be the standard (Harbin & Newton, 2013; Moscardini, 2015). The research problem addressed in the current study is the lack of information about the factors that influence the implementation of CGI in elementary mathematics, particularly based on the unique perspectives of mathematics teachers. The aim of this study was to explore the different factors that influence the willingness or resistance of elementary mathematics teachers regarding the use of CGI in their classroom instructional practices.

The literature search strategy used in this study involved searching for relevant and reliable sources such as published academic books and peer-reviewed journal articles in online databases. The online databases that were used to search for topical literature to support the conceptual framework included the following: EBSCOhost Online Research Databases, ERIC: Educational Resource Information Center, Google Scholar, Lesson Planet, Project Muse, PubGet, and SpringerLink. The key words and terms that were used to search for relevant literature included the following: *CGI, socially constructivist instruction, social constructivism, constructivism, child-centered instruction, teacher-directed instruction, mathematics teachers, challenges of mathematics teachers, educational leadership, instructional leadership, effective leadership, school reforms, school leadership, role of principals during school reforms, resistance to change, beliefs of mathematics teachers, attitudes of mathematics teachers, teacher resistance, differentiated instruction, differentiation, mathematics instruction, and innovative teaching strategies in mathematics*. Most of the research studies included were within the 2014-2018 time frame to ensure the most recent findings. The results of the literature review served as the foundation of the information and discussion presented in this chapter.

To enhance the quality and relevance of information that is included in the review, a large majority of the literature presented in this study was published between 2012 and 2016. Older peer-reviewed journal articles were also included if limited literature existed on a particular topic or when referencing the origins of a theory or a seminal study in CGI. The presentation of the literature review involved the combination of integrative reporting and in-depth focus on a particular study that is critical to the research topic. The literature review conducted was instrumental in the identification of the gap in knowledge, which served as the anchor for the problem, purpose, and research questions of the current study.

The purpose of this literature review was to examine what previous researchers have found regarding the topical research and the theoretical frameworks – in this case, the use of socially constructivist strategies in teaching mathematics at the elementary level. The literature review also examines the existing literature regarding the theoretical supports framing the research topic. In order to have a better understanding of the research problem, the topics included in the review of the literature were the following: (a) issues/deficiencies in mathematics instruction, (b) mathematical reaching practices at the elementary level, (c) CGI in mathematics, (d) teacher beliefs and attitudes, and (e) the role of effective leadership on teacher development, change, and teacher resistance. The sociocultural theory and change theory were also discussed as part of the theoretical frameworks. The literature review chapter will end with a conclusion, which includes the identification of the gap in knowledge in CGI, its significance in in the literature and how this gap will be addressed in the proposed study.

Issues/Deficiencies in Mathematics Instruction

Standardization continues to be the mainstream approach and framework in which mathematics instruction is based, which underscores the current culture of accountability in most educational systems (Gallimore & Ermeling, 2012). However, according to Ermeling et al. (2015), standardization is a significant barrier in effective mathematics teaching and instructional changes. Emerling et al. (2015) identified three main reasons why standardization is not effective and can lead to problems in instruction: (a) the focus is on activity and not achievement, (b) they have the possibility of uncoupling learning goals from instructional methods, and (c) they encourage one-approach-fits-all settings.

When teachers are forced to standardize their instruction (Ermeling et al., 2015; Fallace, 2015), the pedagogical insights gained by teachers in their instructional experiences in the classrooms can sometimes be ignored. The new information and insights that teachers gain from the classroom and years of experience are not transformed into classroom instruction when standardization is always used (Ermeling & Graff-Ermeling, 2014;

Ermeling et al., 2015). The concept of standardization is also incongruent with the purpose of research, which is to continue finding ways to improve instruction.

Teachers need to have the opportunity to evaluate their own experiences in order to continuously improve the quality and effectiveness of their instruction (Ermeling & Graff-Ermeling, 2014). Ermeling et al. (2015) contended that instructional practices in mathematics improved if the goal was advancement and not on simply replicating adopting standardized practices that are usually superficial in terms actual relevance in many classrooms today. Proponents of standardization assume that what works in one setting will also work in another setting (Emerling et al., 2015), which is often not the case.

With the increased importance in following pedagogy-based standards in teaching mathematics, innovative instructional practices in elementary mathematics can become complex and difficult to implement for educators (Blazar, 2015). Mathematics teachers are continuously exploring different instructional strategies that can improve the achievement of elementary school students (Polly et al., 2013; Sharma, 2015). Finding effective strategies for teaching complex subjects such as mathematics to children at a very young age remains a pertinent issue among educators and within the mathematics research literature (Blazar, 2015).

Child-centered instruction approaches tend to be more associated with higher positive achievement in mathematics among students compared to the more traditional approach of teacher-directed instruction (Fallace, 20015; Lerkkanen et al., 2016). According to Fallace (2015), child-centered instruction is a progressive approach to education, placing the importance of learning towards students instead of the teachers. Child-centered instruction is instrumental in creating a learning environment where children are nurtured and encouraged to develop their own abilities (Fallace, 2015). In contrast to child-centered instruction, teacher-directed instruction usually fails to account for the differences in the learning processes of different students (Lerkkanen et al., 2016). Highlighting the importance of differentiation, child-centered approaches focus on the individual strengths and weaknesses of each student during classroom instruction (Lerkkanen et al., 2016). Differentiated instruction emphasizes the importance of considering and encouraging the individual learning needs of students (Baker & Harter, 2015).

Mathematical Teaching Practices at the Elementary Level

The more traditional approach in the instruction of mathematics involves teacher-directed instruction where teachers assume the dominant role during classroom instruction (Skarr et al., 2014). Directed instruction typically involves giving classroom lectures and demonstrating to students how to solve mathematical problems and equations (Skarr et al., 2014). In directed instruction, teachers show students the necessary steps or procedures to solve various mathematics problems (Skarr et al., 2014). This more traditional approach to teaching mathematics assumes that different children can learn mathematics concepts using the same method.

When mathematics is taught in a standard teacher-directed method, elementary mathematics students tend to depend more on memorization instead of reasoning and problem solving (Swars et al., 2013). The reliance on rote memorization can explain the students' failure to understand conceptual ideas in mathematics (Swars et al., 2013). Purnomo, Kowiyah, and Assiti (2014) noted that memorization in mathematics can lead to negative student outcomes such as making errors, not knowing how to interpret mathematics concepts, and lack of sensitivity and ability to perform problem solving.

According to Blazar (2015), inquiry-oriented instruction is more positively related to student learning outcomes in elementary contexts – in particular, which extends to low stakes mathematics tests and concept-based teaching (Blazar, 2015). Inquiry-based instructional approaches tend to be more engaging to students compared to a more teacher-directed instructional approach (McKeown, Abrams, Slattum, & Kirk, 2016). Teachers who have a content-area expertise in elementary mathematics is also associated with higher student learning outcomes compared to teachers with more generalized specializations (Blazar, 2015).

Standardization in mathematics instruction is practiced in order to comply with national guidelines and meet the demands of passing high-stakes testing (Au, 2013). Standards-based pedagogy in mathematics is based on the principles set by the National Council for Teachers of Mathematics (McGee, Wang, & Polly, 2013). These general principles and standards include equity, curriculum, teaching, learning, assessment, and technology (National Council for Teachers of Mathematics, 2000). Higher frequency in the use of standard-based instruction in mathematics is associated with higher levels of student achievement in mathematics (Ottmar, Rimm-Kaufman, Larsen, & Berry, 2015). However, Blazar (2015) noted that effective mathematics teachers were usually instructors who were involved in ambitious and innovative instructional strategies, greater engagement with students, and have a more confident grasp of classroom management.

Successful instruction in mathematics tends to be a combination of effective instructional practices and positive student participation (Ing et al., 2015; Ottmar et al., 2015). Ottmar et al. (2015) found that teachers who were able to cultivate a supportive classroom environment built on social and emotional trust between teachers and students could result in improved student learning in mathematics. Students are more likely to experience enhanced learning in mathematics when they are able to express their own ideas while being engaged in other people's ideas in class (Ing et al., 2015).

Morgan, Farkas, and Maczuga (2015) examined which instructional strategies in mathematics were most effective to elementary students. The study was a population-based longitudinal design involving Grade 1 elementary students who were grouped into either: (a) have difficulties in mathematics and (b) have no difficulties in mathematics. The results of the analysis indicated that only teacher-directed instruction was effective in influencing positive achievement for both elementary students with mathematics difficulties and without mathematics difficulties. For classes with high number of students who were experiencing difficulties in mathematics, teachers tended to use instructional strategies involving manipulatives/calculators and movement/music.

Even though less used in mainstream classrooms in mathematics, there is some empirical support for the effectiveness of using manipulatives and music in mathematics instruction (An, Capraro, & Tillman, 2013; Carbonneau, Marley, & Selig, 2013). For instance, An et al. (2013) found that using music in mathematics instruction was effective in terms of influencing positive learning outcomes in the mathematics abilities of elementary students. Some of the mathematics abilities that were enhanced as a result of integrating music in mathematics instruction were the ability to solve mathematics problems, demonstrate reasoning skills, and have the proficiency to use mathematics symbols, notations, equations, and inequalities (An et al., 2013).

In terms of manipulatives, Carbonneau et al. (2013) conducted a meta-analytic study to examine the efficacy of teaching mathematics using concrete manipulatives. The meta-analytic study was based on 55 studies, involving 7,237 students from kindergarten to college students. The results of the data analysis indicated that using concrete manipulatives was statistically more effective compared to using abstract mathematic symbols in terms of student learning. However, Carbonneau et al. (2013) also found that instructional characteristics moderated the relationship between the use of concrete manipulatives and student learning. The limitation of this study was that the sample used by the researchers did not only include elementary students, but a wide range of grade levels from kindergarten to college.

Even though not yet widely used, socially constructivist approaches in the instruction of mathematics have been utilized by a few educators (Baker & Harter, 2015; Sharma, 2015). A social constructivist approach to instruction involves the recognition that knowledge is constructed based on social interactions and relationships (Palincsar, 1998). Moreover, this particular perspective in mathematics education emphasizes the importance of social interaction in the learning of children of mathematics concepts to solve mathematics problems as opposed to memorization and rote drills that were traditionally used in mathematics instruction (Baker & Harter, 2015; Palincsar, 1998).

CGI in Mathematics

CGI has been proposed as one of the instructional strategies that can address the need for differentiation in mathematics instruction, ranging from teaching geometric concepts to problem solving of equations (Baker & Harter, 2015; Moscardini, 2015; Patsiomitou, 2014). CGI is an instructional strategy wherein teachers use the intuitive knowledge of children as foundation for teaching more advanced knowledge (Carpenter et al., 2015). In mathematics, CGI is based on the assumption that children have intuitive knowledge of mathematics, which should serve as the foundation for the further development of more formal and advanced knowledge (Baker & Harter, 2015; Moscardini, 2015; Patsiomitou, 2014; Carpenter et al., 2015).

Using the CGI method, teachers explore and analyze the cognitive strategies of students when solving mathematics problems in order to determine the appropriate teaching approach (Carpenter et al., 2015). The assumptions in using CGI are that students have complex cognitive thinking abilities, are nonconforming, autonomous, and can engage in low levels of structure when learning (Fan & Zhang, 2014). In CGI, teachers determine the appropriate instructional method for a particular child by listening to and learning from their student (Kazemi, Gibbons, Lomax, & Franke, 2016). This method of child-centered instruction highlights the individualized nature of a cognitively guided strategy (Carpenter et al., 2015; Kazemi et al., 2016).

Differentiation is one of the main characteristics of CGI because the said teaching approach depends on the individual learning needs of students when solving mathematic problems (Baker & Harter, 2015). According to Carpenter et al. (2015), students were more likely to succeed in learning mathematics if they were given the opportunity to invent their own problem-solving strategies and styles. CGI gives teachers the opportunity to explore first the individual learning needs of students and use that information to teach more complex concepts in mathematics (Carpenter et al., 2015).

In terms of the effectiveness of CGI, research generally showed that strategies rooted in CGI are significantly better when compared to traditional mathematics instruction (Baker & Harter, 2015; Jitendra, Star, Dupuis, & Rodriguez, 2013). Based on a sample of 1,163 seventh-grade students in 42 classrooms, Jitendra et al. (2013) found that schema-based instruction wherein students were given the chance to self-monitor with some assistance for problem-solving was significantly better compared to standard mathematics instruction. The comparison between the groups was based on the scores of the participants in a pre-test and post-test mathematics problem-solving exam. In a qualitative study conducted by Baker and Harter (2015), the researchers found that the effectiveness of CGI in mathematics could be attributed to “student-centered pacing, alternative forms of assessment and teacher scaffolding” (p. 27).

Challenges in Implementing Cognitively Guided Instruction

Despite the empirical evidence supporting the effectiveness of CGI in mathematics (Baker & Harter, 2015; Jitendra et al., 2013), the approach is not yet commonly used in many classrooms (Harbin & Newton, 2013; Moscardini, 2015). Even if teachers wanted to use innovative strategies in teaching mathematics, there is a tendency to resort to the approaches that they have always used in the past (Harbin & Newton, 2013). Teachers often do not make the necessary effort to analyze the learning needs of students in terms of solving mathematics problems so that individualized instruction can be developed (Moscardini, 2015). However, Moscardini (2015) also found that when teachers became familiar with CGI through professional development, teachers acquired a deeper understanding of mathematics instruction.

Another barrier in the implementation of CGI is the difficulty in operationalizing differentiation (Delisle, 2015). Even though differentiation of instruction is a strength of CGI, differentiation can also be challenging in terms of actual implementation in classrooms (Baker & Harter, 2015). According to Delisle (2015), differentiation is impractical and almost impossible to implement in every classroom. The weaknesses of differentiation that contribute to the strategy's infeasibility are: (a) focusing on knowledge that students already know, (b) demonstration of knowledge in multiple methods, and (c) addition of complexity to the instruction and learning process (Delisle, 2015).

Echoing the arguments of Delsile (2015) about the complexity of implementing CGI because of differentiation, Turner et al. (2016) conducted a qualitative study exploring how different teachers interpreted and assessed the mathematical learning base of a student. The results of the data analysis revealed that several teachers made different connections and interpretations about a child's knowledge base in mathematics based on their individual interaction and observation. The variety in the connections made by the different teachers highlighted both the strength and weakness of differentiated instruction such as CGI (Baker & Harter, 2015; Delisle, 2015).

In conclusion, CGI can address the problem of instructional standardization and lack of differentiation in mathematics instruction by giving teachers the opportunity to tailor instruction based on the individual learning needs of their students (Polly et al., 2013). The problem is that teachers tend to resort to instructional strategies that they have traditionally used in the past (Harbin & Newton, 2013; Moscardini, 2015). Given the amount of time and effort needed, differentiation of instruction is a particular challenge for the widespread implementation of CGI (Baker & Harter, 2015; Delisle, 2015). The limitation of the studies reviewed in this section is that the researchers did not examine the different factors that influence the willingness and resistance of teachers to adopt and implement CGI strategies in elementary mathematics.

Teacher Beliefs and Attitudes

Scholars have not come to a consensus on the impact on teacher beliefs and student achievement. One view is that the beliefs of teachers can shape their perceptions and feelings about learning and teaching mathematics (Oksanen et al., 2015). The beliefs and attitudes of teachers can influence their instructional practices, which means what teachers use in class is based on their own personal beliefs (Archambault et al., 2012; Bobis, Way, Anderson, & Martin, 2016; Oksanen et al., 2015; Polly et al., 2013; Purnomo, Suryadi, & Darwis, 2016). The beliefs of teachers regarding the efficacy or useful of a particular approach can influence their decision to implement a non-traditional approach to instruction (Jääskelä, Häkkinen, & Rasku-Puttonen, 2017; Trust, 2017). Regardless of the findings from evidence-based research about the effectiveness of a particular instructional method, different teachers have different perceptions about its utility in class (Jääskelä et al., 2017).

Teachers have a variety of beliefs regarding teaching based on their own values and principles (Jääskelä et al., 2017). Teachers' beliefs about the utility of a particular instructional strategy depend on their own beliefs about the subject being taught (Utterberg, Lundin, & Lindström, 2017). For instance Utterberg et al. (2017) found that teachers' decision to adopt digital tools in teaching mathematics depended on their own beliefs about the most appropriate method in teaching mathematics.

In addition to self-empowerment and personal motivation, teachers are more likely to adopt innovative teaching practices when there is a self-belief that they are capable of influencing change (Trust, 2017). Hull, Booker, and Näslund-Hadley (2016) found that openness to the experience is a predictor of teacher self-efficacy, suggesting that exploration is often necessary in the development of self-efficacy. When teachers have sufficient levels of self-efficacy about their ability to implement a particular instructional method, these educators will have more positive perceptions about their use of this instructional method (Troia & Graham, 2016). Higher self-efficacy leads to higher probability of the implementation of a new instructional method (Hull et al., 2016).

Another view is that despite the relationship between beliefs and practices of teachers, Polly et al. (2013) found that there was no direct relationship between teacher beliefs and student achievement. This suggested that teacher beliefs and practices may not always be consistent with each other or that other mediating factors may play a role in the relationship between teachers beliefs and student achievement (Harbin & Newton, 2013; Purnomo et al., 2016). Bobis et al. (2016) found that the relationship between teacher beliefs and student achievement were mediated by factors such as efficacy, confidence in teaching, and perceptions about student engagement.

Supporting the controversy regarding the disconnection between instructional practices and beliefs of teachers, there are no definitive research studies on which is more significant in predicting positive school outcomes (Archambault et al., 2012; Polly et al., 2013; Purnomo et al., 2016). Archambault et al. (2012) found that the beliefs of teachers could predict the mathematics achievement and engagement of students. Upadyaya and Eccles (2014) also found that the beliefs of teachers regarding the achievement of their students could predict the development of interest of children in mathematics. However, Polly et al (2013) found that the actual instructional practices of teachers in class were more significant than their beliefs in terms of influencing the achievement of students (Polly et al., 2013).

Research on the relationship between teacher beliefs and instructional practices is mixed, with some showing significant correlation (Polly et al., 2016; Zakaria & Maat, 2012) and others showing minimal to no correlation (Harbin & Newton, 2013; Purnomo et al., 2016). According to Purnomo et al. (2016), the beliefs of teachers was one of the contributing factors forming the gap between theory and practice intended to improve instruction in mathematics. Zakaria and Maat (2012) found that the beliefs of mathematics teachers were consistent with their instructional practices.

Examining the beliefs and attitudes of teachers can provide important insights into their classroom practices (Polly et al., 2013; Purnomo et al., 2016). Purnomo et al. (2016) conducted a qualitative case study using questionnaires, video observations, and interviews to explore the relationship between the beliefs of pre-service teachers and their instructional practices. The results of the data analysis revealed that the instructional practices of pre-service teachers did not necessarily reflect their beliefs; however, their beliefs about the nature of mathematics as a subject was the most dominant factor that shaped their instructional practice.

To examine the disparity between teacher beliefs and practices in mathematics instruction at the elementary level, Harbin and Newton (2013) conducted a qualitative case study using data collection tools such as observations, interviews, and reflections. The study's sample consisted of elementary level teachers, who were purposefully selected. The results of the analysis revealed that there was small relationship between the beliefs of mathematics teachers and their actual classroom practices. For example, teachers may have beliefs about how students should learn mathematics, but their instructional practices did not necessarily reflect innovative strategies associated with standardized practices in mathematics. Harbin and Newton (2013) noted that teachers were more likely to use instructional strategies that they learned as students.

As highlighted by the literature reviewed, teacher beliefs and attitudes can be important in transforming theories about effective teaching into classroom instructional practices (Harbin & Newton, 2013; Polly et al., 2013; Purnomo et al., 2016). In the following sub-sections, several key topics relevant to the understanding of teacher beliefs and attitudes are discussed. The discussion will focus on the following key topics: (a) resistance to change, (b) personal factors of teachers, (c) institutional factors, and (d) policy-related factors.

Resistance to Change

Despite the many educational reforms that have been enacted to improve instruction, there are only minimal changes in classroom instruction (Cuban, 2013). Teacher resistance can be one of the factors that explain why structural innovations are time-consuming and not always well accepted (Boohene & Williams, 2012; Park & Jeong, 2013; Terhart, 2013). Rooted from the neoliberal culture of accountability, many teachers have to teach their student to pass high-stakes test, leading teachers to resort to standardized instruction (Au, 2013; Milner et al., 2012).

Similar to other organizational behaviors, educators can also experience resistance to change, in which school reforms are met with reticence and reluctance in terms of implementation (Park & Jeong, 2013). Teachers’ resistance to school reform changes can have a significant impact in the overall effectiveness of educational institutions (Quinn, 2012; Terhart, 2013). Resistance within an organization can lead to failures in the implementation of change as a result of opposition from members (Boohene & Williams, 2012; Quinn, 2012; Terhart, 2013).

Even though resistance to change is typically viewed negatively (Boohene & Williams, 2012; Quinn, 2012; Terhart, 2013), Schechter and Ganon-Shilon (2015) contended that resistance can also be a positive phenomenon. Specifically, resistance to change in terms of questioning and doubts can also serve as a positive component of school reforms (Schechter & Ganon-Shilon, 2015). Resistance to change can be an opportunity for constructive reforms, helping leaders and policymakers to foster continued growth of schools (Schechter & Ganon-Shilon, 2015).

Teachers who resist change can greatly influence the school atmosphere and culture in both negative and positive ways (Quinn, 2012). For instance, when teachers ignore, misuse, or misrepresent feedback gained from data-based assessment, improving teaching practices may not be achieved (Terhart, 2013). Teachers' resistance to change tends to be higher when reforms are initiated by the government compared to reforms that are initiated internally (Park & Jeong, 2013). Teachers may be more receptive to change if they believe that modifications need to occur based on their own experience in class (Harbin & Newton, 2013). According to Yoon (2016), teachers were more likely to have a positive attitude towards change if principals were able to provide and show data that support the need for reforms.

Oksanen et al. (2015) conducted a study examining how schools leaders have successfully implemented a school reform in terms of gaining the cooperation of teachers. The sample consisted of Finnish teachers who were tasked to move away from teacher-directed instruction into a more social-constructed method. The researchers found that the availability of manual and teaching guide published by the National Board of Education of Finland helped in the successful implementation of reforms by teachers. Training was also made available to help teachers acquire the necessary skills to implement the new mathematics curriculum. Written materials were also made available to help teachers modify their instructional practices, suggesting that institutional support is important during school reforms.

During a school reform initiative, teachers often experience different emotions ranging from self-doubt to advocacy (Kaniuka, 2012). According to Huillet, Adler, and Berger (2011), teachers often resisted instructional changes when there was a perception of lack of expertise in the new method. Certain personal, institutional, and policy-related factors may either alleviate or exacerbate the challenging experience of implementing school reforms (Mansfield & Volet, 2014; McKeown et al., 2016; Moscardini, 2015; Ottmar et al., 2015). Each of these factors will be discussed to have a better understanding of the issues that can influence the willingness or resistance of teachers toward change.

Personal Factors

Personal factors such as time constraints, low self-efficacy, lack of confidence, past experience, and perceived inadequacy in content knowledge can affect the instructional practices or behaviors of teachers (Bobis et al., 2016; Ellett, Demir, & Monsaas, 2015; Holzberger, Philipp, & Kunter, 2014; McKeown et al., 2016; Ottmar et al., 2015; Yoon, 2016). Given that these different personal factors can influence the behaviors and attitudes of teachers in terms of their instructional practices, they may also play significant roles in times of school reforms and change (Bobis et al., 2016; McKeown et al., 2016). These different personal factors are briefly discussed in this section to have a better understanding of how teachers’ beliefs and attitudes can affect school reforms and new instructional practices.

When faced with the opportunity to apply a new approach to teaching, teachers often engage in internal dialogue regarding their advantages and disadvantages (Retna, 2016). Even if there is evidence that a particular new approach to teaching can be effective and beneficial to students, teachers often consider the pragmatic aspects of its implementation (Mulholland & O'Connor, 2016). If there is a perception that the disadvantages outweigh the advantages, these new instructional approaches are likely to remain aspirational (Mulholland & O'Connor, 2016).

Time constraints are often a major barrier for teachers in the implementation of a new instructional program or technique (Eriksson, Romar, & Dyson, 2017; Goh, Hannon, Webster, & Podlog, 2017: Mulholland & O'Connor, 2016; Retna, 2016). The implementation of a new teaching strategy or approach is particularly time consuming for teachers, underscoring the commitment that is often necessary when pursuing such a decision (Eriksson et al., 2017). According to Goh et al. (2017), an overcrowded schedule is a significant barrier that can prevent many teachers from integrating various programs that are intended to improve instruction. As a result, the implementation of an effective instructional approach supported by evidence-based research remains aspirational for many teachers (Mulholland & O'Connor, 2016).

Self-efficacy or confidence in one’s ability to be successful in one’s actions is one factor that can influence the level of readiness of teachers for organizational change (Ellett et al., 2015 Nolan & Molla 2017). Nolan and Molla (2017) contended that confidence is an important component of the professionalism of teachers, giving these practitioners the capital to engage in different opportunities that can enhance their effectiveness. According to Retna (2016), the perceived difficulty in implementing a new instructional method or technique can be a major challenge for many teachers even if there is a perception that such innovation can be useful and beneficial.

Holzberger et al. (2014) conducted a quantitative study examining whether the self-efficacy of mathematics teachers predict their instructional behaviors. The sample consisted of 155 mathematics teachers and 3,483 grade 10 students. The results of the analysis revealed that the self-efficacy of teachers predicted their instructional practices. The findings of the study suggest that changes in teachers' instructional practices brought about by school reforms may also be determined by their level of self-efficacy.

The lack of confidence of teachers may be influenced by inadequate professional development, preservice background, or training (Retna, 2016). Teacher confidence can be enhanced through exposure to mentoring opportunities (Nolan & Molla 2017). For instance, teachers who have been exposed to mentoring have shown to have concern for the social development of their students (Uibu, Salo, Ugaste, & Rasku-Puttonen, 2017). Through these efforts, the confidence of teachers may be enhanced, which can lead to a higher level of professional capital which is important in engaging in non-traditional instructional approaches (Nolan & Molla 2017).

One of the important factors that teachers may consider when deciding to implement an innovative instructional strategy is to determine if the new method would be compatible with different learning needs and can benefit different groups of students (Gulikers, Runhaar, & Mulder, 2017; Schechter, Kazakoff, Bundschuh, Prescott, & Macaruso, 2017). For instance, teachers are more likely to continue implementing an innovative instructional method if assessments show that such methods are effective in improving the academic achievement of students (Gulikers et al., 2017). Teachers are more likely to be consistent with their implementation of an instructional innovation if students are engaged (Schechter et al., 2017).

Perceived inadequacy in content knowledge can also affect the instructional practices or behaviors of teachers (Bobis et al., 2016; Huillet et al., 2011; Yoon, 2016). Teachers are more likely to have a positive attitude about a particular instructional method or approach if they see themselves as competent in that area (Yoon, 2016). Teachers are less likely to adopt a new instructional approach if there is a perception that their expertise and knowledge are not adequate (Huillet et al., 2011). Teachers are more likely to develop a more favorable attitude toward a new instructional approach once a deeper understanding or expertise is achieved (Moscardini, 2015).

Institutional Factors

Institutional factors such as the availability of school support can influence the instructional practices and behaviors of teachers (Holzberger et al., 2014; McKeown et al., 2016; Oksanen et al., 2015; Zimmerman, Knight, Favre, & Ikhlef, 2017). Some examples of institutional support include training, professional development, written guides or manuals, and leadership (Oksanen et al., 2015). Institutional support can be particularly important during changes and school reforms (Vaino, Holbrook, & Rannikmäe, 2013).

Sufficient training is an important factor that may influence the willingness of teachers to adopt new instructional methods (Brody & Hadar, 2017; Sedova, Sedlacek, & Svaricek, 2016; Zimmerman et al., 2017). Teachers are sometimes forced to teach instructional methods that they have not yet achieved an acceptable level of mastery or expertise (Nixon, Luft, & Ross, 2017). The feedback gained from the facilitators of a professional development can be particularly helpful for teachers to acquire the necessary skills and knowledge to implement a particular instructional innovation (Brody & Hadar, 2017). Sufficient training is particularly helpful during the transition from educational reforms (Zimmerman et al., 2017).

Sedova et al. (2016) conducted an action research study by constructing a teacher development program intended to help educators transform student classroom talk through professional development training. The participants were eight secondary teachers in the Czech Republic who were part of a one-year professional development program. Data were collected through video recordings, which allowed the researchers to measure the changes in classroom talk and discourse before and after the implementation of the professional development. The results of the data analysis revealed that there was a change in classroom discourse increase in student talk with reasoning, suggesting that training was effective in making teachers more likely to adopt and succeed in a new teaching method (Sedova et al., 2016).

Similar to the study goals of Sedova et al. (2016), Zimmerman et al. (2017) examined the effect of professional development training on the ability of teachers in Qatar to develop their behaviors and efficacy brought about by educational reforms in the country. Teacher behaviors and efficacy were quantitatively measured before and after the implementation of the professional development. The results of the regression analysis indicated that the professional development training was effective in facilitating improvements in teacher behaviors and efficacy when compared to the control group. The implication of this finding highlights the importance of sufficient training in helping teachers implement new teaching methods or strategies, particularly when such innovative approaches are mandated through educational reforms.

Additionally, communication with students, colleagues, and administrators can encourage teachers to adopt non-traditional teaching approaches, which may be related to a culture of innovation and change (Brody & Hadar, 2017). Interaction with different groups of people, not just with professionals, gives teachers the ability and information to improve themselves as educators (Brody & Hadar, 2017). Interaction with different stakeholders can give teachers adequate insights to assess whether an innovative instructional strategy can be both pragmatic and beneficial in their classroom (Brody & Hadar, 2017).

According to Ottmar et al. (2015), deficiencies in the personal abilities of teachers to teach effectively in mathematics can be minimized or removed when institutional support is available. Conversely, lack of institutional support for teachers can lead to poor success in the implementation of a school reform (Ottmar et al., 2015). Modification in the beliefs and attitudes of teachers can be facilitated through different institutional factors ranging from strategies such as attending professional development, participating in structured group activities, and engaging in collaborative action research (Mansfield & Volet, 2014; McKeown et al., 2016; Moscardini, 2015; Ottmar et al., 2015; Vaino et al., 2013; Wong, 2013).

According to Vaino et al. (2013), collaborative action research activities can lead to changes in teacher beliefs regarding a new instructional method. Exposure of teachers in professional development can also lead to changes in curriculum, teaching practices, roles of teachers, and learning to teach (Morcardini, 2015; Tam, 2015). McKeown et al. (2016) found that professional development could enhance the efficacy, knowledge, and confidence of teachers. Being exposed to positive feedback and other collaborative activities could lead to teachers being able to address perceived constraints regarding the adoption of a new teaching approach (Vaino et al., 2013).

Professional development offers the chance to facilitate greater self-awareness using reflection and inquiry about existing teaching principles (McKeown et al., 2016). The effects of professional development on the changes in teacher beliefs can be sustained over time; however, some aspects of the beliefs of teachers appear to be resistant to change (Wong, 2013). For example, Harbin and Newton (2013) found that professional development did not necessarily change the instructional practices of mathematics teachers even when presented new information. Professional development can change the beliefs of teachers regarding a new teaching approach, but their instructional practices may not necessarily change (Harbin & Newton, 2013; Tam, 2015).

Policy-Related Factors

One of the policies that can explain the reluctance of teachers to move away from traditional instructional approaches to more student-centered approaches is the increased accountability placed on teachers for their students to meet the national, state, and local academic standards (Au, 2013; Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012). The passage of the No Child Left Behind Act resulted in high-stakes testing that standardize student achievement (Au, 2013; Milner et al., 2012). Teachers are given the responsibility and accountability to ensure that all of their students score adequately in state-mandated standardized tests and fulfill the course objectives. Teachers may be resistant to differentiated teaching approaches such as the use of CGI because of the need to comply with standardized instruction (Bauml, 2015).

Teachers often need to comply with curriculum guides and standardized practices set by the school district (Bauml, 2015). When mandated by the government, teachers are expected to comply with the requirements (Bauml, 2015). In a study conducted by Oksanen et al. (2015), the researchers found that teachers were effective in implementing state-mandated change in curriculum. Teachers were given the support to facilitate the changes in instructional style to implement the new curriculum (Oksanen et al., 2015).

The satisfaction of state requirements for academic achievement can be barriers for teachers to implement non-traditional instructional strategies (Eddy-Spicer, 2017; Kretchmar & Zeichner, 2016). Even if the current educational system may be described by some as outdated, many teachers continue to use traditional instructional methods to comply with state laws (Kretchmar & Zeichner, 2016). The accountability placed upon teachers to ensure that students pass high-stakes testing limits the ability of teachers to explore non-traditional instructional techniques (Eddy-Spicer, 2017). Moreover, the effectiveness of teachers is often assessed in terms of the academic achievement of their students (Kretchmar & Zeichner, 2016), which may also prevent teachers from adopting new or different strategies.

Section Summary

Based on the studies reviewed, the beliefs and instructional practices of teachers do not always align with each other (Harbin & Newton, 2013). The beliefs of teachers play an important role in their instructional practices, including the decision to adopt and implement new teaching methods (Archambault et al., 2012; Polly et al., 2013). Several personal, institutional, and policy-related factors may affect the willingness or reluctance of teachers to implement school reforms related to instructional practices in mathematics (Goh et al., 2017; Harbin & Newton, 2013; Milner et al., 2012; McKeown et al., 2016; Ottmar et al., 2015;

Tam, 2015). Such issues contribute to the resistance to change among teachers, which may result in lower academic outcomes of students in elementary level mathematics.

Teacher Decision-Making

The beliefs of teachers play an important role in their instructional practices, which can influence their decision-making when adopting and implementing new teaching methods (Archambault et al., 2012; Polly et al., 2013). Boschman, McKenney, and Voogt (2014) characterized the decision-making of teachers with regard to curriculum and classroom instruction as intuitive. Teacher decision-making that is based on intuition does not rely on evidence-based research but on own instructional experiences in classrooms (Schildkamp & Ehren, 2013).

Boschman et al. (2014) conducted a qualitative multiple case study to examine the intuitive decision making process of teachers within the context of technology-based learning environment. The researchers examined how different factors such as external priorities, existing orientation, and practical concerns affect their curriculum design approaches. Data were collected using individual semi-structured interviews and group discussions among three teams of teachers. The results of the data analysis revealed that at the start of curriculum design, teachers primarily relied on their knowledge and beliefs but their design reasoning was mostly influenced by practical concerns. These findings suggested that teachers put a lot of importance in the organization and the different contingencies involved when designing their curriculum.

Data or evidence-based research is another factor that influences the decision-making process of teachers (Marsh & Farrell, 2015). The assumption that student learning is more likely to be effective when supported by evidence-based research, underscoring the important role of data in the decision-making of some teachers (Hoogland et al., 2016). Because of increased accountability placed on teachers to demonstrate that their students have acquired the necessary learning, teachers often value instructional practices that are supported by research (Dunn, Airola, Lo, & Garrison, 2013).

Data can also be based on assessing student learning. For instance, Slavit, Nelson, and Deuel (2013) found that when teachers used student-based data, their time was primarily spent on collecting and analyzing the contextual factors that influence the results. However, little time was usually devoted on exploring the implications of the data to their own instructional practices. Even though teachers made an effort to understand how their teaching affects the performance of their students, Slavit et al. (2013) noted that student-based data did not impact teacher decision making regarding instructional practices.

Even though data or evidenced-based research are becoming more available to teachers, many continue to resort to their old practices (Schildkamp & Ehren, 2013). Newell and Shanks (2014) contended that this tendency to ignore data and resort to old practices is sometimes unconscious and unintentional. However, Schildkamp and Ehren (2013) found that teachers were more likely to use evidence-based research in their instructional practices when a team intervention from the school was available.

The Role of Effective Leadership on Teacher Development, Change, Teacher Resistance

Organizational leaders can influence the behaviors and attitudes of their employees or subordinates (Aldulaimi & Sailan, 2012; Drago-Severson, 2012; Hausman & Goldring, 2014; Kaniuka, 2012; Park & Jeong, 2013; Shaked & Schechter, 2016; Yoon, 2016). They can act as mediators between the external demands of stakeholders and the internal conflicts among employees and subordinates (Shaked & Schechter, 2016). As organizational leaders, they can be instrumental in the successful resolution of internal and external conflicts that can affect the effectiveness and efficiency of an organization (Shaked & Schechter, 2016).

According to Garza et al. (2014), effective leadership of principals can lead to the sustained success of schools, particularly in terms of reaching organizational goals. Hausman and Goldring (2014) examined the characteristics of effective school principals based on the ratings of 417 teachers. The results of the examination revealed that effective principals were rated to have high levels of professionalism, goal congruence, and ability to foster learning (Hausman & Goldring, 2014).

Instructional leadership also appears to be a characteristic of many effective leaders in education setting (Garza et al., 2014; Goddard et al., 2015). Principals who were considered instructional leaders were able to foster collective efficacy among teachers, underscoring the ability of leaders to influence the behaviors of other people (Goddard et al., 2015). Le Fevre and Robinson (2014) noted, however, that instructional leaders were more comfortable voicing out their own goals than understanding the perspectives of teachers. Without conscious effort to improve their interpersonal skills, instructional leaders could experience challenges in addressing the needs of teachers (Le Fevre & Robinson, 2014).

Educational leaders can play an important role in the professional development of teachers including influencing instructional practices that can positively benefit the well-being of students (Aziz, Fooi, Asimiran, & Hassan, 2015; Drago-Severson, 2012; Kaniuka, 2012; Le Fevre & Robinson, 2014; Park & Jeong, 2013). Educational leaders are particularly crucial in times of significant change, such as during the process of implementing school reforms (Aldulaimi & Sailan, 2012). One of the key factors in the success of implementing change is the planning and organization of principals (Whitworth & Chiu, 2015). Principals can play a major role both in the resistance of teachers to adopt school reforms and in their readiness to commit to change (Aldulaimi & Sailan, 2012; Aziz et al., 2015; Kin & Kareem, 2016; Park & Jeong, 2013).

Educational Leadership During Change.

Organizational change often involves questioning and doubt, underscoring the challenge of participating in a school reform (Schechter & Ganon-Shilon, 2015). During times of reform, educational leaders play an important role in facilitating adaptive change (Kershner & McQuillan, 2016; Stringer & Hourani, 2016). Educational leaders should be prepared to handle all the responsibilities that entail the implementation of school reforms (Stringer & Hourani, 2016). According to Du Plessis (2016), school leaders who were able to encourage practices that were innovative could lead for more effective and transformative leadership. Through their ability to embrace transformation and innovation, school leaders can help teachers become more engaged in participating in reforms and adaptive change (Du Plessis, 2016; Kershner & McQuillan, 2016).

Lai (2015) conducted a qualitative study to explore how effective principals build the capacity of a school to successfully cope with change and reforms. Based on the analysis of the interviews conducted with several principals, Lai (2015) found that effective leaders build the capacity of a school for change by focusing on three strategies: (a) developing communities of practice for teacher learning and participation in the decision-making process, (b) promoting connections between the school and the community in order to facilitate participation in order to enhance the learning of students, and (c) aligning the demands and concerns of external stakeholders and the internal context and culture of the school. The implication of the findings was that effective principals should be able to develop a school culture that is conducive for change before reforms are actually implemented to enhance a smoother transition.

One of the important challenges that principals need to address is resistance to change among teachers (Magee & Slater, 2013). School leaders can mediate the resistance from teachers and the demands from external influences such as parents and policymakers (Shaked & Schechter, 2016). Effective leadership can address resistance to change among teachers by implementing smoother transitions to effective instruction, particularly in elementary mathematics education (Hallinger & Murphy, 2012). Effective leaders are important in order to facilitate school readiness among teachers toward organizational change and reforms (Calik, Sezgin, Kavgaci, & Cagatay Kilinc, 2012; Drzensky, Egold, & van Dick, 2012). For instance, the instructional leadership of school principals can influence the self-efficacy of teachers with regard to the adoption of an innovative teaching strategy (Calik et al., 2012). When principals fail to practice their role as instructional leaders in their schools, the likely consequences are negative attitudes, resistance to change, and poor commitment among teachers (Calik et al., 2012; Hallinger & Murphy, 2012).

Park and Jeong (2013) quantitatively examined the role of the leadership of principals in the resistance of teachers toward school reforms. Data were collected from 967 teachers and 32 principals in schools were organizational reforms were currently being implemented. The results of the empirical analysis revealed that the leadership of principals was significantly related to the reduction of teachers' resistance to change, especially in terms of the emotions and behaviors of teachers. The limitation of this study was that the sample was based on teachers and principals in Korea, which may not be applicable to the educational context of the United States because of cultural differences.

Organizational leaders must demonstrate an understanding on how to foster readiness among employees in order for them to be more receptive to change (Aldulaimi & Sailan, 2012). Even though the leadership of principals can be instrumental in the resistance of teachers toward change, principals can also be agents or facilitators of school reforms (Aziz et al., 2015; Kin & Kareem, 2016). In addition to discrepancy and efficacy, support from principals is a factor that can facilitate change among teachers (Kin & Kareem, 2016). Conversely, principals who are not able to be effective facilitators of change can result in teacher resistance (Hallinger & Murphy, 2012).

To conclude, the literature revealed that effective leadership is often needed in order to change the beliefs and practices of teachers, consistent with the implementation of school reforms (Calik et al., 2012; Drzensky et al., 2012). The limitation of the studies reviewed in this section is that CGI was not the focus of the researchers when the relationship between the leadership of principals and the instructional behaviors of teachers was examined. Transferring the results from these studies might not be appropriate given that CGI is a different instructional strategy that requires further independent exploration.

Theoretical Frameworks

Ravitch and Riggan (2017) viewed a conceptual framework in terms of reason and rigor. Reason entails the justification of the relevance of the research topic, whereas rigor entails the alignment of the different components of the study that support the research topic. The theoretical framework of the study is a component of the conceptual framework that provides support for the topical research being explored in this study and to demonstrate rigor. The study's theoretical framework also provides an overarching foundation for understanding how neoliberalism and accountability culture pose a barrier in the adoption of CGI (Au, 2013; Milner et al., 2012).

The theoretical frameworks that served as the foundation of the conceptual framework were Vygotsky's (1967) sociocultural theory and Lewin's (1947) change theory. The selection of sociocultural theory was appropriate for the current study because of the recognition of the importance of environment in the thinking process of an individual (Vygotsky, 1978). The selection of change theory was appropriate for the current study because of the recognition that there are factors that encourage and prevent change. These theories also enabled the researcher to engage, integrate, and argue the findings from this study from an existing formal framework of knowledge (Ravitch & Riggan, 2017). These theories and model provided theoretical and conceptual bases to the understanding of the different factors that contributed to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics in elementary. Each of these perspectives will be discussed and supported by the findings from the literature review.

Sociocultural Theory

Vygotsky's (1978) sociocultural theory conceptualizes learning as a social process where culture or society is the source of knowledge. The main tenet of sociocultural theory is that cognition is determined through social interaction. According to Vygotsky, learning occurs first at the social level, which is eventually transferred at the individual level. Within the context of education, the interaction of teachers with other people such as their leaders or supervisors can influence their thinking, including the decision to use the appropriate instructional strategy in their classes.

The selection of sociocultural theory was appropriate for the current study because of the recognition of the importance of environment in the thinking process of an individual (Vygotsky, 1978). Specifically, teachers' interaction with their leaders, students, and other teachers could influence their understanding of the appropriate instruction in the classroom. Based on the sociocultural theory, the instructional decisions of teachers could be influenced by their interactions within the school organization. This interaction highlights the important role of the school environment in shaping the decisions of teachers in class.

Change Theory

Change theory was also selected as part of the theoretical framework of the proposed study. Lewin (1947) developed a theory of change process to explain how change occurs in an organization. Based on the change theory, driving forces are factors that causes change to occur, whereas restraining forces are factors that prevent change from occurring. When the driving forces and restraining forces are equal, their effects cancel each other out, resulting in a state of equilibrium where no change occurs.

According to Lewin (1947), there are three distinct and vital stages in the process of organizational change: (a) unfreezing, (b) moving to a new level, and (c) refreezing. Unfreezing pertains to the process of increasing the diving forces and/or decreasing the restraining forces. The stage of moving to a new level or changing involves changing the emotions, behaviors, or thoughts during the change process. Finally, refreezing involves the process of establishing the change as the new standard practice. The selection of change theory was appropriate for the current study because of the recognition that there are factors that encourage and prevent change. The concepts of driving and restraining forces were relevant to the exploration of the factors that influence the willingness or resistance of teachers regarding the use CGI in elementary mathematics.

Conclusion

The experiences of teachers during school reforms and organizational change are characterized by different emotions and perceptions, which may include self-doubts, lack of confidence, and resistance toward change (Kaniuka, 2012). The beliefs and perceptions of teachers do not always align with their actual instructional practices in their classrooms, reflecting the possible challenges in the adoption and implementation of innovative teaching methods (Archambault et al., 2012; Harbin & Newton, 2013; Polly et al., 2013; Purnomo et al., 2016). Several personal, institutional, and policy-related factors may affect the willingness or reluctance of teachers to implement school reforms related to innovative instructional practices in mathematics (Harbin & Newton, 2013; Milner et al., 2012; McKeown et al., 2016; Ottmar et al., 2015; Polly et al., 2013; Purnomo et al., 2016; Tam, 2015).

Contrary to the more traditional approach of teacher-directed instruction where students are told what to do, mathematics instruction has been recently regarded as an interactive learning process (Oksanen et al., 2015). CGI is a relatively new instructional strategy that aims to address the limitations of standardization by focusing on differentiation (Baker & Harter, 2015; Moscardini, 2015; Oksanen et al., 2015). Rooted in socially constructivist instructional strategies, CGI focuses on the individual learning needs of students in order to provide differentiated assistance in learning mathematics (Carpenter et al., 2015). The implementation of CGI in elementary remains limited (Moscardini, 2015), with many teachers still using traditional strategies based on standardized practices. The problems associated with implementing differentiated instruction in instruction is often a criticism that can explain the lack of widespread use of CGI in mathematics (Baker & Harter, 2015; Delisle, 2015).

Research studies on CGI in mathematics primarily focused on the beliefs of teachers and the effects of the instructional strategy on the achievement of students in mathematics (Polly et al., 2013). The gap in the literature that was identified is the limited understanding of the factors that influence the implementation of socially constructivist strategy such as CGI in elementary mathematics. This gap in the literature was addressed by exploring the different influences or factors that contribute to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics. The results of the current study lead to the expansion of the literature on socially constructivist instructional strategies by identifying the factors that affect the adoption and implementation of CGI in elementary mathematics.

Chapter 3: Methods

The aim of this study was to reach a deeper understanding of the different factors that influence the willingness or resistance of elementary math teachers regarding the use of CGI in their classroom instructional practices. This chapter will provide a detailed discussion of the methodology. The chapter will be organized into key sections that include the following: (a) research tradition and rationale, (b) role of the researcher, (c) description of the setting and data gathering methods, (d) participants, (e) data analysis plan, and (f) ethical procedures. The chapter ends with a summary what of will be done to accomplish the goals of the study.

My worldview is extremely holistic and pluralistic, as I seek the possibility for numerous answers to a question. As a teacher, I have a great dedication to my students, and as such I feel the need to find out the best way to serve them – whether through altering my strategies to fit their learning style or finding new material that would fit that existing style better. Professional development is something I am extremely preoccupied with, as I believe that all people in education and other service occupations must be as current and updated on their practice as possible. Despite that, I do believe that teachers should have the leeway to alter and adjust their teaching strategies on an instinctual and intuitional level based on the material and type of class (and even among individual students)

I tend to think of myself more as an educator than a researcher in my own practice, favoring the in-class experience of teaching over theoretical concepts and frameworks. That being said, in recent years I am beginning to desire a further exploration of those concepts, which is why I would like to gain some experience in the world of qualitative research in education. In many ways, I believe this makes me a constructivist and existentialist educator and researcher (Stake, 2010). I believe there are many ways to accomplish the collective goal of improving education outcomes – as many, in fact, as there are students. Thus, the search must continue apace for the best methods to serve these populations and offer innovative strategies instructors can use to find solutions to a variety of educational issues. By focusing on naturalistic observation and subjective assessment of teaching strategies, educators can find better ways to teach.

Research Tradition and Rationale

The research approach of the study was qualitative and interpretive in nature. Rooted from the constructivist perspective of knowledge (Stake, 1995), qualitative studies rely on subjective experiences and perceptions of participants in the generation of data (Creswell, 2013). Qualitative research is a systematic approach in acquiring a deep understanding of a social phenomenon using the perspectives of a small group of individuals (Creswell, 2013; Taylor, Bogdan, & DeVault, 2015). The exploratory nature of qualitative research often results in novel information, serving as the foundation of future studies (Merriam & Tisdell, 2015). A qualitative research approach was appropriate for this study because the use of methods that allowed participants to elaborate and express their experiences in depth led to data that answered the research questions. Quantitative research may not be able to provide the type of data needed to address the purpose of this study because quantitative research uses numbers to determine the strength of the relationships of variables without expounding on their meaning or essence.

Stake's (1995) approach to case study was selected as the appropriate research tradition for this study because it is an ideal method for examining a phenomenon in-depth within real-life context without manipulating certain key processes or variables, a process ideally suited to this research. A case study is a "study of the particularity and complexity of a single case, coming to understand its activity within important circumstances" (Stake, 1995, p. xi), a description that fits this study. The case study tradition is usually used by researchers when: (a) the focus is on determining resolution of what, how, and why questions, (b) the attitudes of the participants included in the study cannot be influenced, (c) relative situations are sought to be contained since it is believed that these are significant to the occurrence under investigation, or (d) the limitations are not defined between the milieu and the occurrence (Baxter & Jack, 2008), also descriptions that fit this study.

One of the main characteristics of case studies is responsiveness of the design to what is necessary to answer the research questions, which is why using multiple sources of data is often used in order to adequately explain or describe a complex phenomenon using tools that would be most appropriate (Stake, 1995). According to Stake (1995), case studies involve the use of different data sources such as observations, interviews, and document reviews. By using multiple sources of data in case studies, triangulation can be accomplished, strengthening the conclusions made about a phenomenon through data corroboration (Stake, 1995). Case study is the most appropriate qualitative design for this research because it allowed the researcher to look into the problem from multiple perspectives with the most relevant data collection technique possible. Phenomenology would not be appropriate given that the design is focused on exploring lived experiences (Moustakas, 1994), whereas grounded theory would not be appropriate because the design is primarily intended for the generation of new theories (Glaser & Strauss, 2017).

For this study, the case is defined as the individual experiences of 10 teachers regarding the use of cognitively guided in a single school. According to Stake (1995), case studies entail that researchers are able to know how data sources can lead to a deeper understanding of a phenomenon. In order to arrive at robust interpretations of data, researchers require both conscious and unconscious sensitivity and skepticism (Stake, 1995). The end result of a case study is a detailed explanation or description of a phenomenon using all the findings generated from the multiple sources of data that were used. The boundary of the exploration only focused on the different factors that influenced the willingness or resistance of elementary math teachers regarding the use of CGI in their classroom instructional practices. The next section will focus on the role of the researcher in this qualitative case study.

Role of the Researcher

As an educator, I have a great dedication to the students that I teach, and as such I felt the need to find out the best ways to serve them. Furthermore, I believe improved professional development for teachers creates a focus avenue for a revision of teaching practices. I personally believe that CGI is an effective method of teaching mathematics because this approach celebrates the different learning approaches of students based on their own abilities and strengths.

Based on the purpose of this study, the corresponding research question was: What factors influence the willingness or resistance of elementary mathematics teachers regarding the use of CGI? In qualitative studies, the researcher is often considered as the primary instrument (Peters, Abu-Saad, Vydelingum, & Murphy, 2002). As the primary instrument of this case study, the researcher was responsible for conducting both the individual interviews and classroom observations and for performing the data analysis. To enhance the effectiveness of the researcher during the data collection, an interview protocol and observation checklist was prepared to ensure that the research objectives are met. For the analysis of the interview and observation data, the researcher made sure that every decision could be supported by the raw data (Piantanida & Garman, 1999).

Given the central role that researchers play in qualitative research, their worldview is considered an important component of the research process (Piantanida & Garman, 1999). The worldview of the researcher was based on constructivism, which is based on the view that knowledge can be understood by going deeper into the perspectives of different individuals (Mann & MacLeod, 2015). The constructivist view is considered multiple, subjective, and socially constructed (Mann & MacLeod, 2015). Using this worldview, the researcher relied on interacting with different participants to understand and make sense of the research phenomenon. The researcher selected participants who had the ability to provide rich and detailed information about the different factors that influenced the willingness or resistance of elementary math teachers regarding the use of socially constructivist strategies such as CGI in their classroom instructional practices.

Participants

The participants for the current study were 10 elementary mathematics teachers who were undergoing CGI interventions in a school district in the southeastern part of the United States at the time of data collection. The school was given the pseudonym of Woodbury Elementary for this study. Ten participants were selected for this case study. The inclusion criteria for the study were: (a) math teachers who were teaching students in elementary – grades K-5, (b) math teachers who had at least one year of professional experience, and (c) math teachers who were undergoing the implementation of CGI, all at the time of data collection. In order to give information about the factors that influenced the implementation of CGI, all participants should have already implemented the strategy in their respective classrooms at the time of the data collection.

The final sample was 10 mathematics teacher from the target school. In addition, the selected number of informants was appropriate because 10 participants are usually an adequate number to reach data saturation. In qualitative studies, data saturation is the point when data become repetitive and adding more participants is no longer useful (O'Reilly & Parker, 2013). The next section focuses on the in-depth discussion of the data gathering methods, including the boundaries, elements, and socio-political context of the case study.

Description of the Setting and Data Gathering Methods

For the current qualitative case study, the case is defined as the individual experiences of teachers regarding the use of CGI in their classroom instructional practices in a single school. Even though the study only recruited participants in a single school, the unit of analysis was at the individual teachers. In chapter 4, more details will be provided with regard to the different contexts affecting the bounded system under study. Consistent with Stake’s (1995) approach to instrumental case study, patterns of behaviors were determined based on a small number of participants. The boundary of the exploration only focused on the different factors that influenced the willingness or resistance of elementary math teachers regarding the use of CGI in their classroom instructional practices.

The context of the case is a school in a single school district in the southeastern part of the United States. This school has adopted a CGI in teaching mathematics to elementary students. The target school had math teachers who were teaching students from kindergarten until Grade 5. The student population of the target school is estimated at 600 students. The average number of students for every mathematics class is 25.

Case studies require multiple sources of data in order to adequately understand the uniqueness and complexity of a particular phenomenon (Stake, 1995; Yin, 2013). The use of multiple sources of data can enhance the credibility of the results because information can be triangulate or corroborated. For the proposed study, data sources came from individual semi-structured interviews and classroom observations. For both data collection strategies, the researcher scheduled 10 sets of appointments for interview and classroom observations based on the availability of the participants.

The paradigmatic view of the case was based on the constructivist research framework. The topics and goals of this study were primarily rooted from exploring why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The study's conceptual framework was based on Ravitch and Riggan's (2017) views on reason and rigor, with the topical research topics on teacher beliefs and attitudes, mathematics instruction, and leadership, and the theories of Vygotsky's (1967) socio-cultural theory and Lewin's (1947) change theory. The research tradition was based on Stake's (1995') case study. The research questions were focused on exploring the willingness or resistance to use of CGI (Boohene & Williams, 2012; Park & Jeong, 2013; Terhart, 2013). The data gathering protocols can be defined by interview protocol in appendix A. Data gathering started with 10 initial interviews with participants, followed by 12 total classroom observations of the same participants. Data were analyzing using qualitative content analysis. Trustworthiness was operationalized in terms of credibility, dependability, transferability, and confirmability of the results (Shenton, 2004). These strategies are discussed with more depth in the trustworthiness of findings section.

Ethics involved using key procedures such as gaining approval from the Institutional Review Board (IRB) of the university and the district where the setting of the study took place, informed consent, protection of participants from harm and significant risks, confidentiality, voluntary participation and withdrawal process, and disposal of data. Figure 2 shows the boundaries and key elements of the current qualitative case study based on Hopscotch's visual representation (Jorrín Abellán, 2016).

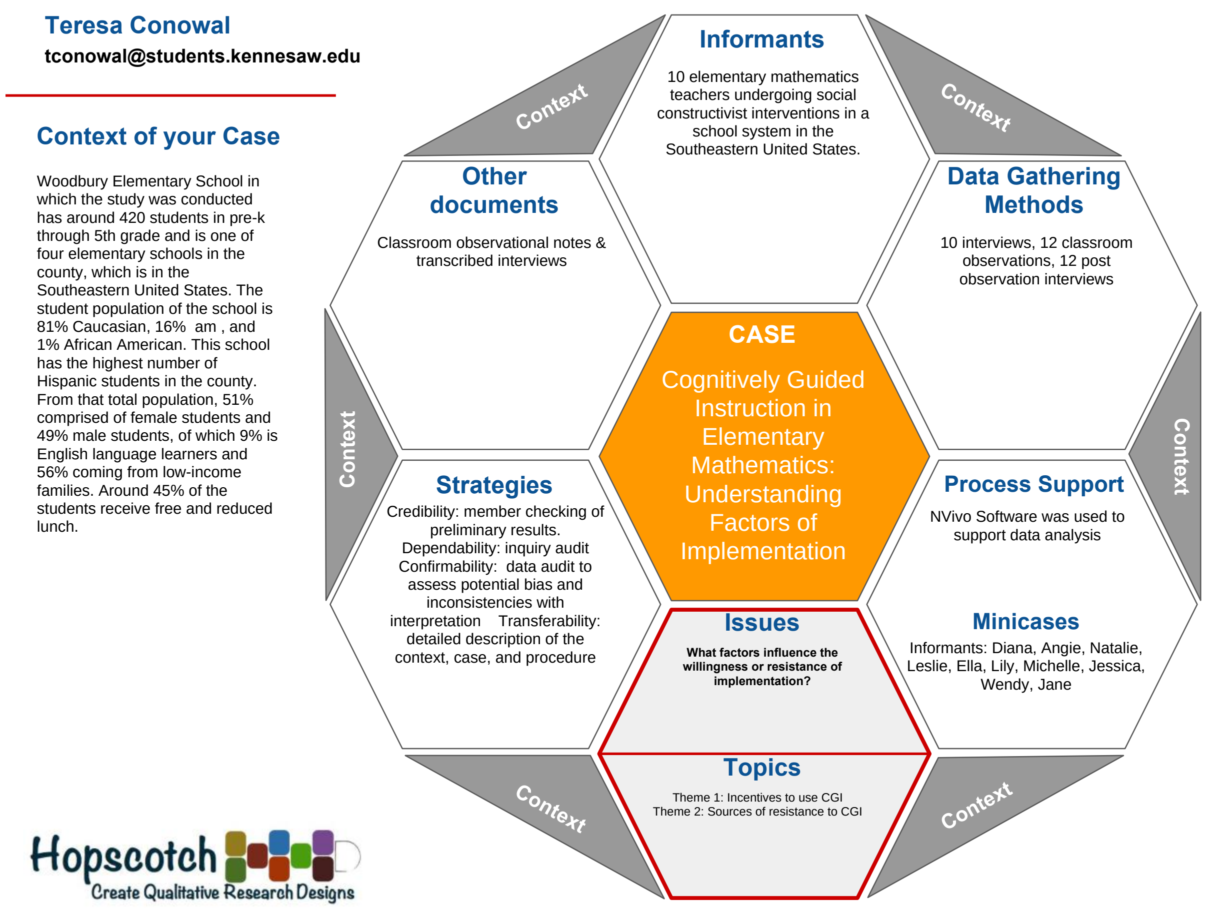

Figure 2. Boundaries and elements of the case study.

The protocols for the study were an interview guide (see Appendix A) and an observation checklist (see Appendix B) during the collection of data. The interview guide served as the tool that helped the researcher develop consistency, direction, and framework during the interview. Similarly, the observation checklist served as the framework wherein certain classroom behaviors and practices served as the focus of the data collection.

For the interview guide (see Appendix A), the goal was to develop a list of open-ended questions intended to provide insights into the different influences or factors that contributed to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics. The questions were based on the conceptual framework, consisting of Vygotsky's (1967) sociocultural theory and Lewin's (1947) change theory. The pre-determined semi-structured questions were asked to each participant verbatim, but the follow-up and probing questions were expected to be different because these questions were contingent with the individual responses of the participants.

For the observation checklist (se Appendix B), which was used to triangulate the data, the goal was to identify key aspects of classroom practices and behaviors that could provide information into the possible factors contributing to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics. The observation checklist was based on the conceptual framework of the study. The change theory focused on the possible driving or restraining factors that drive the implementation of CGI. The observation checklist also used Vygotsky's (1967) sociocultural theory in order to examine the role of the environment in the practices of teachers.

Prior to the actual data collection, informed consent forms (see Appendix C) were distributed to all the participants. The purpose of the informed consent forms was to give the participants the necessary information about the issues that may influence their decisions to be part of the study. The informed consent forms included descriptions of the topic of the study, the nature of the data collection procedure, the process for exit, confidentiality agreement, and risks and benefits of participation. All participants were asked to read the entire informed consent forms before signing them.

For the collection of individual semi-structured interview data, open-ended questions were asked to gain the data needed to answer the research question (see Appendix A). The individual interviews were conducted in a quiet location mutually agreed upon by the researcher and each participant such as café or an office. The interviews lasted approximately 30 to 45 minutes. With permission from the participants, all interview sessions were digitally recorded to preserve all the responses of the participants, verbatim.

For the classroom observations, the researcher set up an individual appointment for each participant. The researcher observed mathematics teachers who were implementing CGI in their classrooms at the time of data collection. The classroom observations focused on the experiences of teachers that might encourage or discourage their continued implementation of CGI. The purpose of the classroom observation was to gain insights into the factors that contributed to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics based on their behaviors and practices during instruction. The observation guide was not based on the interviews. The classroom observations were uniformly conducted based on a pre-determined set of criteria (see Appendix B).

Data were triangulated by comparing and contrasting the findings from the interviews and the observation, noting the similarities and the discrepancies. To enhance the credibility of the study, member checking was used by asking the participants to review the preliminary results of the study. Member checking is the process of using the feedback of the participants to determine the accuracy of the interpretation of data (Carlson, 2010). For the current study, member checking was accomplished by sending each participant a summary of the preliminary results through email. The next section will focus on the detailed data analysis plan for the study.

Data Analysis Plan

Data collected from the interviews and classroom observations were analyzed using Mayring's (2003) qualitative content analysis. Qualitative content analysis involves several key steps: (a) examination of the data sources, (b) analysis of the origin of the data, (c) the formal definition of the data sources, (d) determination of how data will be analyzed, (e) grounding the data on a theoretical lens, (f) selection of the analysis methods, (g) identification of the unit of analysis, (h) analysis of data, and (i) interpretation of findings. Each of these steps will be briefly described to have a better understanding of the data analysis plan.

The data sources of the study came from semi-structured interviews and classroom observations. The audio recordings of the interviews were transcribed and the classroom observation notes were transferred to several Microsoft Word documents. After all data had been sufficiently prepared for storage, all data was loaded in a qualitative software such as NVivo for their organization (Bazeley & Jackson, 2013). NVivo aided the researcher in the storage, organization, analysis, and interpretation of qualitative data through access to software features such as coding and categorization (Bazeley & Jackson, 2013).

The components of the conceptual framework included Vygotsky's (1967) sociocultural theory and Lewin's (1947) change theory. These theories informed how the interpretation of the data after the analysis had been completed. In terms of the actual coding of data, inductive category development was used as the analytical framework to analyze the data collected from the participants. Inductive category development involves the step-by step generation of codes and categories based on the raw data and not on pre-determined templates (Mayring, 2003).

The analysis of data was performed by inspecting the contents of the interview transcripts and observation notes to develop codes needed to generate themes. The interpretation of the findings was accomplished by integrating the results from the analysis of the interview and classroom observation data. A detailed description of the case was provided by generating a thick narrative of the factors that contributed to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics. The following sub-sections focus on the strategies that were used in order to enhance the trustworthiness of the findings.

Trustworthiness of the Findings

In quantitative studies, validity and reliability are usually the measures used to assess the quality of the results (Creswell, 2013). Validity and reliability do not easily translate to qualitative studies because of the huge structural differences between both approaches (Cope, 2014). Data in quantitative studies come from standardized instruments, whereas data from qualitative studies come from less structured sources such as open-ended interviews and observations (Creswell, 2013). Given these differences, the quality of qualitative research is often evaluated based on the credibility, dependability, transferability, and confirmability of the results (Shenton, 2004).

Credibility is the extent to which the results can be considered valid or accurate based on the assessment of the participants (Shenton, 2004). A qualitative study can be considered credible when the participants believe that the findings reflect their true experiences or perceptions. To enhance the credibility of the study, member checking was used by asking the participants to review the preliminary results of the study. Member checking is the process of using the feedback of the participants to determine the accuracy of the interpretation of data (Carlson, 2010). For the current study, member checking was accomplished by sending each participant a summary of the preliminary results through email. There was an instruction to provide a brief comment about the summary, particularly about how accurate the summary was in capturing their true experiences and perceptions. The information gained from the process of member checking was used to further improve the final results. Credibility was also enhanced through data triangulation wherein the results from the interviews and observations were examined for consistencies and discrepancies in order to arrive at a more cohesive final report of the case study.

Dependability refers to the extent to which the results will occur if the same study is conducted multiple times by outside scholars (Golafshani, 2003; Lincoln & Guba, 1985). To enhance the dependability of the study, an inquiry audit from the researcher's mentor and committee was used, and a recorder was used during the interview. Inquiry audit was accomplished by using the feedback of the researcher's mentor and committee to continue improving the quality of the research (Lincoln & Guba, 1985). The researcher documented the comments of the mentor and committee and how these comments were addressed. The use of a recorder enhanced the dependability of the study because the transcription process became more accurate and precise.

Confirmability is the extent to which the results can be corroborated by independent researchers (Lincoln & Guba, 1985). The confirmability of the results of the study were enhanced by having a data audit in order to assess potential bias and inconsistencies with interpretation (Cope, 2014). Using the Hopscotch model as a diagram of the research procedure, an audit trail was developed documenting the key stages of the study and the corresponding decisions made for each stage.

Transferability is the extent to which the results can be considered generalizable (Lincoln & Guba, 1985). Even though generalizability was not one of the goals of the qualitative research, the researcher also provided a detailed description of the context, case, and procedure used so that other researchers could assesses the transferability of the study (Morse, 2015). Rooted on the concept of naturalistic generalizations, the particulars of the results of the qualitative study may be transferable to other similar situations or contexts (Stake, 1995). The assumption was that by giving enough information about the study, other researchers could independently assess whether the results could be transferred in another research setting or context. The next section focuses on the ethical procedures for this case study.

Ethical Procedures

Conducting an ethical research is important in order to preserve and enhance the credibility and trustworthiness of a study (Sieber & Tolich, 2012). To enhance the ethical trustworthiness of the study, several strategies were used and several key issues were addressed. These key ethical principles included: (a) gaining approval from the IRB of the university and the district where the setting of the study took place; and (b) informed consent forms, (c) protection of participants from harm and significant risks, (d) confidentiality agreement, (e) voluntary participation and withdrawal process, and (f) disposal of data.

The approval of the IRB and the site authorization of the target school are often a prerequisite for many universities (Sieber & Tolich, 2012). The research proposal and the necessary application forms were submitted to the university’s IRB in order to secure their clearance and approval. The main purpose of the study was briefly discussed, including the research problem, research questions, and nature of the study. The IRB application form contained the key elements of the proposal, particularly the different ways in which ethical principles were upheld. Specific focus was given on key ethical issues, such as risk assessment, confidentiality of data, withdrawal procedure, and disposal of data. Site authorization was also secured from the district where the target school was located.

Informed consent forms were used so that participants were fully aware of the issues related to their safety and rights. The information included in the forms included an overview of the topic of the study, the nature of the data collection procedure, the process for exit, confidentiality agreement, and risks and benefits of participation. All participants were asked to read the entire informed consent forms before signing them. Questions pertaining to the study were entertained in order to enhance trust and the researcher-participant relationship during the data collection phase of the study.

Ethical standards also emphasize the importance of protecting participants from significant risks and harm. The researcher believed that participating in semi-structured interviews and classroom observations did not pose significant risks to the participants in terms of their personal lives, professional careers, or psychological well-being. Voluntary participation was also practiced by giving the participants the right to withdraw at any time during the course of the study. Participants were not forced to remain in the study even if data had already been collected. If participants decided to withdraw after the interviews and the classroom observations, the researcher would have removed all data that were collected from the said participants in the analysis.

Despite the assurance of confidentiality, complete anonymity was not possible because of the nature of the study where face-to-face interaction and classroom observations were components of the data collection process. Despite this limitation of complete anonymity, the confidentiality of the identities and personal information of the participants was protected by concealing the real names of the participants. The participants were assigned random code names so that their real identities would not be known to the public and the readers. The researcher had sole access to the names of the participants and other personal data collected.

Seven years after the study was approved and published, all data collected from the participants was to be permanently destroyed. All paper documents were to be permanently destroyed by shredding the files. Electronic documents were to be permanently deleted in the hard drive of the researcher's computer. No back-up copies were to be made after the disposal of all data is completed. All audio recordings of the interviews were to be permanently erased form the hard drive of the researcher.

Summary

The purpose of the study was to gain a deeper understanding of the reasons why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. Because of the limited information about the different influences or factors that contribute to teachers' willingness or resistance in implementing socially constructivist strategies in teaching mathematics, an exploratory qualitative research approach was appropriate to address this gap in the literature. A holistic multiple case study research design was assessed to be the most appropriate approach because of the relevance of exploring the implementation of CGI in real-life setting using multiple sources of data such as interviews and classroom observations.

The context of the case is a school in a single school district in the southeastern part of the United States. The school was given the pseudonym of Woodbury Elementary for this study. This school has adopted a CGI in teaching mathematics to elementary students. The participants for this prospective study were 10 purposefully selected elementary mathematics teachers who were undergoing socially constructivist strategy interventions in their schools at the time of data collection. The selected sample size was appropriate because 10 participants is usually an adequate number in ensuring that data saturation is achieved (O'Reilly & Parker, 2013). Data sources came from individual semi-structured interviews and classroom observations. Data collected from the interviews and classroom observations was analyzed using qualitative content analysis, based on the procedure outlined by Mayring (2003). The next chapter presents the results of the data analysis.

Chapter 4: Results

The aim of this qualitative case study was to reach a deeper understanding of the different factors that influence the willingness or resistance of elementary math teachers regarding the use of CGI based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. Socially constructivist strategies (SCS) are instructional methods that emphasize the importance of social interaction in the learning of children (Baker & Harter, 2015). CGI is defined as a strategy where teachers use the intuitive knowledge of children as a foundation for teaching more advanced knowledge (Carpenter et al., 2015). The research question that was used to guide this study was: What factors influence the willingness or resistance of elementary mathematics teachers regarding the use of socially constructivist strategies such as CGI?

Two major themes emerged during analysis of the data. Data associated with the first major theme indicated that elementary mathematics teachers were motivated to use CGI when they believed the strategy benefitted students and when they were encouraged by colleagues, by administrators, by observations of student performance, and by adequate training. In relation to the second major theme, findings indicated that time constraints and doubts about aspects of the strategy may increase teachers' resistance to using CGI. Table 1 depicts a summary of the themes that emerged from the data analysis, the codes that contributed to the themes, and a representative quotation from each theme.

Table 1.
Themes, Sub Themes, Contributing Codes, and Representative Quotations

Theme	Sub Theme	Codes contributing to theme	Representative quotation
Theme 1: Incentives to use CGI	Sub theme 1: CGI benefits students	Pre-observation interview codes: awareness-knowledge; student collaboration; consequence-outcome; driving factors-motivation; personal views Researcher observation and post-observation interview codes (used for triangulation): instruct strategies; consequence-outcome; interaction students	"It's intended to make them think. I mean that's what I have my intention, it's to help them think through their problems, and they're doing it. They're really doing it."
	Sub theme 2: Communication with colleagues, students, and administrators	Pre-observation interview codes: student influence; other teacher influence; admin influence instruction; instructional initiative participation	"With CGI, it was something that was first introduced by a teacher here who was using it, and she had a love for it, so she was very positive and encouraging and really wanting us to. So when it rolled out, it was like yes I wanna be on board, this is something I wanna do."
Theme 2: Sources of resistance to CGI		Pre-observation interview codes: resistance-barrier; consequence-outcome	"Sometimes lower level students are not willing to give forth the effort to push through, that struggle."

The following presentation of the study's results includes a narrative description of the results associated with each participant, in which the participants are introduced and their contributions to the major themes are described. Following the portraits, the chapter concludes with a summary of the findings across informants. Table 2 includes a summary of relevant demographic information for the study participants. In the table, participants are listed in the order in which they were interviewed. In the following presentation of results, participants are introduced in alphabetical order.

Table 2.
Summary of Participant Demographics

Participant	Educational degree	Years of teaching experience	Years of CGI experience	Taught at other schools?	Participated in other teaching initiatives?
Diana	Master's	21	9	Yes	Yes
Angie	Bachelor's	1	1	No	Yes
Natalie	Specialist	18	4	Yes	Yes
Leslie	Master's	25	1	Yes	Yes
Ella	Six-year ed. specialist	22	2	Yes	Yes
Lily	Master's	15	3	Yes	Yes
Michelle	Master's	20	5	Yes	Yes
Jessica	Master's	20	5	Yes	Yes
Wendy	Ed. Specialist	28	3	Yes	Yes
Jane	Ed. Specialist	20	4	Yes	Yes

The School as Context

According to Stake (2005), the context of a case study is complex and embedded in different backgrounds. These backgrounds may encompass factors involving historical, cultural, social, political, economic, ethical, and aesthetics of the research context. In this section, a detailed context of the school is provided in order to have a more comprehensive and nuanced understanding of the research setting.

Woodbury Elementary School in which the study was conducted has around 420 students in pre-k through 5th grade and is one of four elementary schools in the county, which is in the Southeastern United States. The student population of the school is 81% Caucasian, 16% am , and 1% African American. This school has the highest number of Hispanic students in the county. From that total population, 51% comprised of female students and 49% male students, of which 9% is English language learners and 56% coming from low-income families. Around 45% of the students receive free and reduced lunch.

The school conducts yearly assessment of students in order to help general population and students with disabilities succeed. Among the general population, only 50% was considered proficient in social studies. However, assessments have shown that students with disabilities have not been proficient in academic areas such as social studies. Only 5% of students with disabilities in this class was assessed to be proficient.

Students are grouped heterogeneously in each grade level. Grade levels 2-5 are departmentalized, and grades Pre-1 are self-contained. The student-teacher ratio is 20 is to 1, which is comparable to the national average of 17:1 ratio. Ninety percent of the teachers in this school have more than 3 years of professional experience as instructors, of which 97% are certified educators. The average salary of the teachers in this school is $55,000, which is above the national average of $53,251.

Five years ago, math scores in grades 3-5 continued to plummet and the majority of students were underperforming in the area of mathematics. Compared to other schools in the district, Woodbury Elementary School has been ranked 3rd in math achievement out of four elementary schools. Based on the math achievement test given every year, only 34% can be considered as proficient. When analyzed in terms of racial backgrounds, 38% of Caucasian students can be considered proficient, but only approximately 5% among Hispanics, and 1% of students with special needs can be considered as proficient in mathematics.

Overall, teaching was very traditional. Observational data of teachers revealed students in grades k-2 were using algorithm-based instruction. Students were rarely exposed to activities requiring problem solving in mathematics. This included concrete activities to build number sense and base-ten knowledge. We formed a math team to research strategies transforming student performance in mathematics. One of the strategies chosen was CGI. Eight out of ten teachers in this school have undergone CGI training for three years, with strong emphasis on collaboration with each other for learning.

There is a strong family support system in the school, and the building of relationships is the cornerstone for the school. Teachers give their time freely before and after school to help students succeed academically. It is a commonality to see teachers eating lunch with students to work on behavior or academic behavior expectations. In addition, we are a positive behavioral intervention and supports school, which means we focus on the teaching and reinforcing of a school-wide positive behavior system.

Portraits of the Participants

Angie

Angie is a Caucasian female in her early 20s, and this is her second year of teaching. She has a bachelor's degree in early childhood education. She has a bubbly personality and tries to create a positive energy in her classroom. This is her second year of CGI. She appears to be resourceful and seeks out others for assistance in areas of need, and she is optimistic and asks many questions during professional learning. She researches in her own private time to better understand initiatives.

CGI benefits students. Angie was encouraged to use CGI by the perceived benefits to students. For Angie, the benefits of CGI to students included the encouragement of independent learning and the availability of a means of verifying that students had processed the material in a meaningful way, through the explanatory exercises. She stated, "it allows students to explain their thinking, which is great, because if they can explain it, it shows that they know it" (Angie, pre-observation interview response). Angie also believed that it was beneficial for students to work through problems independently: "it's great to problem-solve for themselves, and they get to learn for themselves how do to those solving problem strategies" (Angie, pre-observation interview response).

Angie stated that another benefit of CGI was that it helped children understand why a problem could be solved in a certain way, rather than relying on the rote memorization of methods, a benefit she described as, "not just knowing the procedure, but knowing the 'why' behind it" (Angie, pre-observation interview response). She added that she and her colleagues had researched other teaching strategies and had preferred CGI because of its emphasis on understanding problem-solving methods rather than simply memorizing them: "that was very important and was something that stood out to me…it's become a part of my educational philosophy" (Angie, pre-observation interview response).

During the classroom observation, Angie gave students time to solve raw number problems independently. Although she appreciated the value of collaborative work, she believed that it should not take the place of independent problem-solving: "I think it's important for students to share their strategies, but it's important for students to develop on their own" (Angie, pre-observation interview response). After she had given students time to work independently, she asked students to describe the strategies by which they had solved the problems. When a student was on the right track but seemed uncertain, she provided encouragement, and then she took the student's strategy and broke it down further for the benefit of other students.

Later during the observation, she had her students use manipulatives independently to develop a richer understanding of a problem. After this exercise, students readily shared their results with the class. Angie explained that she encouraged independent problem-solving by letting students know that she would not provide them with the answers, although in walking through the classroom during independent work she occasionally suggested to students that they look again at some aspects of their work. She said, "They know that no matter what, they're going to have to push through and solve that problem" (Angie, post-observation interview response).

Communication with colleagues and mentors. Angie spoke specifically of the effect other teachers' input had had on her willingness to implement CGI: "Interaction with other teachers has definitely influenced me to continue with the CGI process, continue with conceptually teaching instead of strategically teaching." Angie had been predisposed to use CGI by instruction received in college: "In school we talked about how it's important to not just teach the methods, how it is important to let students discover their own way to solve problems" (Angie, pre-observation interview response).

Source of resistance to CGI. Angie doubted the ability of CGI to work for students of all learning styles; she described this misgiving as, "One of the only things that I've seen that could have me be like 'Huh, maybe not'" (Angie, pre-observation interview response). She indicated that not all students were willing to make the independent problem-solving efforts that CGI required: "sometimes with lower level students that are not willing to give forth the effort to push through, that struggle" (Angie, pre-observation interview response). She stated that such students learned more effectively when they were given strategies to learn by rote. She believed, however, that CGI was the most beneficial teaching method for most students: "for most students I say yes [to using CGI], absolutely" (Angie, pre-observation interview response).

Diana

Diana is a Caucasian female in her mid-40's. She has master's in education with a focus in early childhood, and she has been teaching for 21 years. She has taught at three other schools, in three other school systems, and has had knowledge about CGI for 9 years, beginning when she was introduced to CGI in a two year long guided study. She feels she was given a lot time to learn it and practice, and believes she is very aware of the strategy and could teach it to others.

One's first impression of Diana is that she presents a very calm *persona*. She seems to be confident and is very professional in her demeanor and speech. When problems arise, she is persistent in finding a solution. She provides her students hands-on work, as well as opportunities to work with each other and mentor each other. She is a grade chair of her team and believes in delegation of responsibility and building strong team dynamics. She is quick to reveal her love of math through her own school experience.

She discovered CGI at her previous school, and became so passionate about it that she led professional development for other elementary math teachers. She welcomes the opportunity to discuss CGI with teammates and often asks them to stop by to see what her students are doing in class. Additionally, she works with students who are not performing as they should in mathematics. She seeks to build their engagement by using real-life connective material in the classroom. She has phenomenal classroom management and structure, and she leads students to take a vested interest in their learning. During meetings with parents, she brings work samples and volunteers to guide parents who want to better understand math under the common core umbrella. Despite her years of experience as a teacher, she still says she faces daily challenges. Teaching is about being both flexible and dynamic at the same time, in order to cope with changes in the school and the teaching field as whole, she says. She is very quick to add that her perception of her role is to help students successfully navigate learning challenges.

CGI benefits students. Diana was more willing to use CGI because she had noted an improvement in students' ability to solve word problems: "the driving force is I am seeing children be successful in word problems, which in general seem to be the most difficult type of math problems" (Diana, pre-observation interview response). She added that her favorite part of teaching was hearing students explain their strategies for solving problems; she believed that CGI taught students to think like mathematicians by requiring them to understand why a solution worked, rather than simply applying a memorized formula.

Diana also spoke of CGI's enhancement of students' capacity to solve problems creatively, and indicated that CGI encouraged students to think more in the manner of people who attain the highest level of skill in mathematics: "the students get to act like real mathematicians, who would demonstrate their problem-solving critiques" (Diana, pre-observation interview response). In describing what she meant by *thinking like a mathematician*, Diana spoke of, "watching a child break down that two hundred and forty into pieces he can deal with, the four groups [because]…he knew that the standard division…would not work for him" (Diana, post-observation interview). She described CGI as a three-step learning process for students: “they solve, then they explain and they understand” (Diana, post-observation interview). Diana said that the explanation portion of CGI helped students grasp the “why” of the problem-solving methods they learned or discovered: “the intended consequence is to develop mathematical understanding, not just memorizing steps to solve a problem. And I think you get that through the explanation portion of CGI” (Diana, pre-observation interview response).

She stated that cooperation among students might be particularly beneficial to children who found the curriculum challenging: “If a child has been unsuccessful in solving problems, with a child who has a very concrete way of solving that problem, that’s a good stepping stone for the child who is unsuccessful” (Diana, pre-observation interview response). During the classroom observation, Diana tasked her students with creatively discovering analogies between new problems and problems posed in previous lessons, an objective which the students accomplished by building off of one another’s solutions. Posters on the classroom walls displayed the class’s solutions to previous problems, so that students were able to reference old work and draw analogies. Diana described the initiation of this strategy:

> I started just with one [problem] I thought [students] could solve and surprisingly only one person solved it that day. So, then the next day I had that poster up and we went to a little but harder problem. (Diana, post-observation interview response)

Communication with colleagues, students, and administrators. Diana’s use of CGI was greatly encouraged by tips she received from colleagues who were implementing the initiative in classrooms that were considered models, either in terms of test scores or organization: “I definitely look up to teachers who have great test scores, and I talk to those teachers, I try to find out what they’re doing, and I get materials from them” (Diana, pre-observation interview response). Diana's willingness to use CGI was also positively influenced by the way students' explanations of their problem-solving strategies contributed to subsequent instruction: "Sometimes questioning [students] they also teach me little tricks I can teach to other students. It also influences the direction of the next lesson" (Diana, pre-observation interview response). Diana's use of CGI was further encouraged by her desire to help with administrative initiatives: "I really want to meet the expectations of the school leaders, so whichever direction they would like to head in I really want to support that."

Source of resistance to CGI. Diana stated that the primary obstacle to CGI implementation was, "Definitely time. Because the lesson truly takes a full forty-five minutes at a minimum, and you know some days that's the entire amount of time I have the students" (Diana, pre-observation interview response).

Ella

Ella has been teaching for 22 years, and has a specialist's degree in curriculum. She is soft-spoken but candid in all situations, and she is open to new ideas and seeks out others to help her better understand them. She has about three years of experience with CGI, and she admits CGI is often difficult due to an inability to create a balance of CGI and traditional algorithm strategies. She strongly believes in writing and integrates it into all parts of her classroom, and she has high parent involvement in her classroom and conducts workshops for parents to learn math curriculum.

CGI benefits students. During the classroom observation, Ella encouraged students to collaborate creatively in instruction; notes from the observation report indicate: "Teacher begins with a question…what is subtraction? Have students explain what they think" (May 10, 2017). Her methods included asking students to explain concepts such as subtraction and regrouping to the class instead of allowing the class to rely exclusively on teacher explanations. Ella's teaching method involved responsiveness to the class and the encouragement of participation from all students, and she considered this feature of CGI to be beneficial to students: "everybody is getting a chance to participate" (Ella, post-observation interview response)

Communication with students, administrators, and mentors. For Ella, student input via formal assessments was a useful means of determining instructional strategies, and this had helped her with CGI implementation and thereby lessened her resistance to the initiative: "If I see during a pre-test or some assessment, that [students] already have [an understanding], we will cover it more in a compact form" (Ella, pre-observation interview response). Ella was also encouraged to use CGI by a desire to comply with directives: "if administration says 'You have to do CGI.' I just go on board and try. If I make mistakes along the way, that's fine, I'm giving it my hundred percent" (Ella, pre-observation interview response). Ella spoke of the exceptional amount of training and instruction that was made available to teachers as an inducement to buy in to the CGI initiative: "CGI was like a two-year learning process, where someone from Pioneer RESA came in and guided us through that" (Ella, pre-observation interview response).

Sources of resistance to CGI. Although she did not say so explicitly, Ella's responses suggested that she had an unfavorable perception of CGI as a result of challenges she had encountered while implementing the initiative. She had encountered challenges in getting all students to participate fully in CGI: "no matter what I did, I found some students would just sit back and let the others take over" (Ella, pre-observation interview response). The consequence of some students' passivity was that those students did not learn: "they were never practicing, so they never got the knack of it" (Ella, pre-observation interview response). Although Ella saw the extensive training she had received during the CGI rollout as beneficial, she reported negative feelings about the complexity and rigidity of CGI: "it was very technical as far as the things you do and the things you had to go through the certain steps, and you had to say certain things. And you weren't allowed to share with the students, the students had to work through and get their own solutions" (Ella, pre-observation interview response). Ella also expressed concern about whether or not CGI would allow students to satisfy state requirements for academic achievement: "It's difficult to get the standards…Because we were always doing word problems…it's not checking off skills from the [state] standards" (Ella, pre-observation interview response). Ella added that she understood that CGI purportedly met state curriculum standards, but she stated that in her own experience, "I understand [CGI] does meet all those [standards], but I don't see it, and I don't feel it" (Ella, pre-observation interview response).

Jane

Jane has been teaching for 20 years in the same school district. She has a bachelor's degree in early childhood education as well as an English Speakers of Other Languages (ESOL) endorsement and gifted endorsement. She is a specialist in curriculum and has three to four years' knowledge of CGI. She is honest, forthright, and is an advocate for her beliefs.

She questions the validity of CGI as a means of reaching all students and views CGI as a strategy to advance gifted students. She is also concerned about implementing CGI while still teaching all of the required standards. On one hand, her teaching can be described as very traditional and algorithmic in style due to her passion for leading students to become accurate in computation fluency. On the other hand, she believes in modeling strategies for students, and she believes students should engage in a healthy struggle for learning to occur; accordingly, she allows students to arrive at answers during story problem type activities themselves.

CGI benefits students. Jane believed that CGI only benefits a certain group of students such as those considered gifted or advanced. Jane was more willing to use CGI because she believed that students achieved higher test scores and were better able to attack a problem that "stumped" them when they had been prepared with CGI: "I think it makes them think, and I think it provides rigor, and I think if we look at the standards that the state has…you're going to accomplish that really quickly once [students] understand what they're doing" (Jane, pre-observation interview response). She believed that one of the merits of CGI was that it pushed students to work independently and overcome difficulties in problem-solving through their own initiative: "Now when you get stumped, you're going to think about it and you're going to try and come up with a solution or an answer and just cause you want to solve that" (Jane, pre-observation interview response).

Jane also spoke favorably of the ways in which CGI's use of tangible quantities prepared students for more difficult word problems. She noted that CGI's use of tangible quantities helped very young children begin to understand what numbers were, so that they were better able to comprehend more abstract relationships later: "once they understand a one looks like this, a one is this piece, a one whatever, then they can start adding them together and subtracting" (Jane, post-observation interview). Accordingly, during the classroom observation, Jane used bags of jellybeans to demonstrate grouping to her students. To make word problems more concrete, she named the characters in the story after her students. She said of this strategy for personalizing the work, "It connects the story to something they're familiar with. I always put one of the students' names in the stories or I use somebody familiar to them in the school" (Jane, post-observation interview response). The use of tangible quantities and familiar names was beneficial to kindergartners, she believed, because, "Kindergarteners are concrete-thinking" (Jane, post-observation interview response). Seeing the success of these strategies had increased Jane's willingness to use CGI: "I think it's pushed the kindergarten kids to be at a higher level than that they were at previously" (Jane, pre-observation interview response).

Communication with colleagues. Jane gave examples of open communication among teachers that made the implementation of CGI a group effort, and therefore made individual teachers more willing to implement the strategy: "it's important: people in your grade, you're all doing the same thing, you're all living the same math lessons. And it's good to be able to say "This is where I had a problem." You know. "This was real successful." Share the wealth and find- you know, tap into their knowledge if you can." (Jane, pre-observation interview response).

Sources of resistance to CGI. Jane felt that CGI required students to move into application without sufficient preparation: "I think students need to know the basics like writing numbers and knowing their numbers. Starting the word problems off from day one--you know doesn't seem practical" (Jane, pre-observation interview response). She also questioned CGI's reliance on peer instruction for very young children: "I do not believe that a five-year-old teaching a math class is the exact way to go" (Jane, pre-observation interview response). The requirement that students learn from one another also had the potential to limit the participation of struggling students, in Jane's perception: "I just think sometimes there is too much focus on the [students] who are getting [the lesson] and are higher" (Jane, pre-observation interview response).

Jessica

Jessica has been teaching for 20 years, 15 of which were in middle school. Before teaching, she ran an all-boys tutoring business focused on reading and mathematics. This was her first year in an elementary school. She was more than willing to discuss the challenges of going from middle school to elementary school, especially in the area of mathematics. Jessica has only been in this school district for 3 years. She came from one of the largest, highest performing districts in the state. After her second year teaching elementary, she has decided to resign. She decided to take a position outside education where she will be working for a parent advocate center doing professional development.

She exhibits straightforward strength, and projects the impression of being frank, honest, and loyal, as well as witty, charming, and entertaining. She is tech savvy and others seek her out to assist them with integration of technology. She is quick to mention that she is good at getting students engaged through the use of technology. At times throughout the interview she made humorous observations and reflections regarding her youth and the way she performed in math. Through our conversations, she was constantly asking how we do things here as she was finding that the schools are very different in terms of instructional practices.

CGI benefits students. Like other participants, Jessica described herself as more willing to use CGI because she believed it helped students learn. Her overall evaluation of the initiative was emphatic: "I think it's wonderful" (Jessica, pre-observation interview response). She spoke of the practical applicability of CGI as particularly beneficial to students: “It’s a more practical application in their world now, like lunch money, or ice cream, money, or something they can bring in” (Jessica, pre-observation interview response). Jessica also spoke of the benefits of pairing students with different strengths for collaborative work: “you can switch up kids who may have strengths that would never work together otherwise, so I think it’s much better than doing gross memorization-type math” (Jessica, pre-observation interview response).

During the classroom observation, Jessica compared arithmetical concepts to concrete objects or actions in order to facilitate student comprehension (e.g. comparing fact families to human families and regrouping to what she referred to as “shoving”). Observation notes indicated: “Teacher tells students that this process is called regrouping, but we have been calling it shove, shove, shove” (May 9, 2017). Jessica described another example of analogizing mathematical abstractions to objects and actions:

> When we did the fact families, another strategy we use, every time we do subtraction the large number was on the left of the equal sign, and she said it was like the daddy, because he's outside of the house watching the mama and the baby. (Jessica, post-observation interview response)

Communication with colleagues and administrators. Jessica’s willingness to use CGI had increased when she found she could compare notes with colleagues who were also implementing the initiative. Peer communication had helped her to identify areas in which she needed additional assistance: “With comparing for the other first grade, how are they with this, are they the same, do we need to all redo it, or is it something just I need help on? And if that’s the case, I’ll ask for input on how to do it” (Jessica, pre-observation interview response). She had also been encouraged to use CGI by input from administrators, although she had perceived this input as somewhat pressuring: “I don’t want to use the word ‘forced’ to do it, but I have the high expectation from administration that you're supposed to do it this way" (Jessica, pre-observation interview response).

Source of resistance to CGI. While her overall evaluation of CGI was emphatically favorable, Jessica expressed doubts about CGI's ability to work for younger students who might not be ready to instruct their peers. She added, "[kindergartners] don't know all the skills yet, and they need adults to model them [as opposed to other kindergartners]. Not to show them how to do the problem, but to model and let them learn from that" (Jessica, pre-observation interview response)

Leslie

Leslie is a Caucasian female in her late 40s, and she is in her 25th year of teaching. She was an academic coach for three years and was in administration for three years at another elementary school. She is an avid planner of classroom instruction and volunteers to serve on school teams to help the school become a cohesive culture. She asks for clarification often to ensure she is compliant and has a highly collaborative classroom environment, continuously modeling for her students.

Leslie is very reserved and appears to choose her words cautiously. When the interview began, she was extremely reticent and only answered the question being asked in a matter-of-fact manner. However, as the interview progressed, her demeanor opened up somewhat.

CGI benefits students. Leslie was enthusiastic about CGI in large part because she perceived it as beneficial to students. She spoke of the academic growth students achieved when they were able to talk about how they were solving problems: "One of the things that I always used to say when I was in the older grades is I want them to be able to talk the talk and walk the walk. And with CGI they can do that, because they have to be able to explain it to the others" (Leslie, pre-observation interview response). During the classroom observation, Leslie circulated among students while they worked and asking each one to explain what he or she was doing and why. Leslie said of these interactions: "You are having a math conversation with them, not questioning did you get it right or wrong, it's a conversation" (Leslie, post-observation interview response).

Communication with colleagues and administrators. Leslie said that, in general, "If I see or hear things that others are doing that would be something good to go off of, I pull that in and try to get some of their ideas involved in what I'm doing." She was therefore encouraged to use CGI by her colleagues' willingness to share their experiences with the initiative. The necessity of responding to student input and performance made CGI's sensitivity to student needs seem sensible to Leslie: "you may have a program or a book that says to do it this way, but if you have kids don't need it that way or you think I need to do it a different way, then that's what you need to follow" (Leslie, pre-observation interview response). Leslie also reported being motivated to use CGI by a desire to comply with administrative directives, though she noted that some flexibility was necessary to meet student needs: "Of course you try to do what the leadership wants you to do…[but] sometimes you still have to…bring in some things to make what the kids need to work" (Leslie, pre-observation interview response).

Source of resistance to CGI. Leslie reported no sources of resistance to CGI.

Lily

Lily has a master's degree and has been teaching for 15 years. She is ambitious, goal-driven, focused on achievement, a good listener, and is reflective upon her practice. In addition, Lily is a rule-follower with high integrity, and is a self-starter with a calm spirit. She is a dynamic grade chair that has created a high-power team in her grade level. She greets her students at the door each morning and creates opportunities for the class to celebrate met goals. She feels she did not get all the training for CGI and is therefore a bit unsure if she is doing the CGI strategy correctly, she seeks to find a balance between traditional methods and CGI.

CGI benefits students. Lily's willingness to use CGI was increased by the perceived benefits to students. Lily said of the benefits of CGI that when children learned by doing they were able to apply the new knowledge more readily: "they're really struggling to work through [a problem], and it helps them when they get to the next problem and they're like, 'Oh yeah. We did that before, and now I know how to start this problem'" (Lily, pre-observation interview response). Lily described CGI as good preparation for later work or tests, and added that CGI's efficacy as preparation may be due to the associated method of "breaking down" problems so that students think through them, step by step: "[students] really breaking apart that problem makes them better at breaking it apart when it's time to do it, and then actually I do believe helps a lot with tests like the g math" (Lily, pre-observation interview response).

During the classroom observation Lily asked students to explain their thinking: "During work time, teacher is asking students to explain their thinking. 'How did you get your answer?'" (classroom observation, Lily, May 8, 2017). While students worked, she helped them to find the words to express their methods to their classmates. Lily said of encouraging students to break down problems collaboratively: "They like to share … then they can hear from each other and not just for me, and they like to talk to each other" (Lily, post-observation interview response)

Communication with colleagues, students, and administrators. Lily described how the departmentalized structure of mathematics instruction in her school helped promote collaboration among teachers, thereby increasing their willingness to use CGI: "We decide how we're going to do it … We base it on the needs of the students on how we're going to co-teach" (Lily, pre-observation interview response). The ability to carefully monitor students' in-class performance also encouraged her use of CGI: "If I see they can move on, then I move them on to a harder problem, or if I see that we need to redo something, that we need to spend some more time on something they need help with" (Lily, pre-observation interview response). Lily was also encouraged to use CGI by the help and guidance of administrators: "When I have a question, or when I'm not sure about something, I can come and ask [administrators]…and I can then change what I need to change or keep doing what I'm doing right" (Lily, pre-observation interview response). Lily's willingness to use CGI had been further increased by training that gave instruction in using all elements of the strategy, rather than applying those elements selectively.

Source of resistance to CGI. Lily spoke of time constraints as a negative aspect of CGI, saying that the method required her to spend a seemingly inordinate amount of time on each problem, and that this caused her anxiety when she was trying to incorporate all the required material into each lesson: "I just get a little antsy with like, well we've only done this one problem and now how am I going to do a different problem…I want to make sure I'm covering it all" (Lily, pre-observation interview response). She had successfully addressed her concern about the time constraint by breaking each class period into half-hour blocks when she planned her lessons. Structuring the lessons around a manageable but substantial unit of time allowed her to pace her classes so as to include all the required material.

Michelle

Michelle has been teaching for 20 years in the same district, and she is dedicated to her profession. She is reserved but confident. She has strong classroom management and wants hers to be a model classroom. She is willing to put in time after school and on weekends to make her classroom better. She seeks to see how initiatives fit into her philosophy inside the classroom, and she is protective of her environment and must see value in an initiative before allowing it to enter her classroom structure. She has had knowledge of CGI for five to six years. She has strong beliefs about how students learn and needs time to process and experiment with information before arriving at an opinion about its worth.

CGI benefits students. Michelle indicated that CGI offered students a more adequate preparation for the curriculum of later grades than other teaching initiatives did, and that this characteristic of the method made her more willing to use it: "I think [CGI is] a good strategy to increase the rigor with, the way I used it for kindergarten, because currently in go math, it's not rigorous for kindergarten" (Michelle, pre-observation interview). Michelle was seen during researcher observations circulatory among students, asking them to explain what they were doing (May 10, 2017). When a student made an error, Michelle encouraged the student to locate the mistake independently. Michelle explained how the participation of struggling students was encouraged: "If we saw one thing they did right, we would ask them just to stand and say 'Oh, what did you do that was like them?' And maybe pair them with someone who had solved it correctly" (Michelle, post-observation interview response).

Communication with colleagues and students. Michelle had been encouraged to use CGI by information-sharing among teachers. In Michelle's description of this information-sharing, the most useful tips from colleagues were acquired selectively, with due consideration of the needs of one's own specific classroom and students: "I think you have to look at what's in your classroom. You listen, and you take advice, and you listen to what they do, and you see if it works for you" (Michelle, pre-observation interview response). Michelle also liked being able to take advantage of student input in the form of objective performance measures to determine the distribution of instructional resources: "I look at [students'] ability…so that my Para works in support with the ones who need the support" (Michelle, pre-observation interview response).

Source of resistance to CGI. The only challenge Michelle had encountered during her implementation of CGI was the tendency of different kindergartners to work at different paces, such that some students would complete an in-class assignment and have nothing to do while other students were still struggling with the problems. She had addressed this challenge successfully, however, by including on each worksheet a picture for the faster students to color when they were done with the problems.

Natalie

Natalie is a Caucasian female in her early 40s. She has an education specialist degree in leadership and has been teaching for 18 years. She is a teacher-leader in the building, often leading professional development in the area of mathematics. She has looped with her current 4th grade class since they were in kindergarten. She considers herself a co-learner and facilitator in the environment and has strong feelings about changing student opinions about themselves as mathematicians. She is very open about her experiences in having to relearn how to do math concepts in her current teaching assignment.

In Natalie's own words, she is still a work in progress. Natalie is entertaining, witty, and charming, as well as self-assured, energetic, and positive. She discusses her past experiences with math when she was in school and has very negative associations attached to it. Her demeanor is one of experience in the field of teaching, and she presents herself as strong and capable of handling the stress and challenges that are present in the classroom setting on a daily basis. She has strong relationships with students and although she has strict procedures, she manages her classrooms so students feel free to take risks in their own learning.

CGI benefits students. As with other participants, Natalie's willingness to implement CGI had been increased by the perceived benefits to students. She mentioned specifically the benefits to children of becoming independent problem-solvers, and also suggested that CGI enhanced students' creative potential, saying, "It's the best way to have kids figure out their own method of solving problems, and really pushes them past their boundaries and out of their box" (Natalie, pre-observation interview response). Natalie also discussed word problems, noting that students who had been taught with CGI were no longer "scared" of word problems: "They look at it and get the information they need and they can solve multi-step word problems" (Natalie, pre-observation interview response). Natalie also expressed approval of the collaborative nature of CGI, saying, "[Students] are able to talk through their strategies with each other. Share how they solved it, look at different methods, and try out those different strategies with each other" (Natalie, pre-observation interview response).

During classroom observations, Natalie acted as a facilitator while students worked through problems, encouraging student collaborations, making suggestions, listening to student input, and allowing students to lead the class during sharing time. Natalie suggested that the collaborative nature of the classroom, as well as teacher modeling, made students more comfortable with sharing their work and making mistakes: "at the very beginning when I was doing it I'd get up there, I'd mess up, I'd write the wrong number, do it wrong. And they're like …'I can mess up'" (Natalie, post-observation interview response). Natalie also spoke of how teachers and students worked together to solve problems creatively with CGI: "It's opened it to those discussions, and those questions they ask me that I don't have a clue. It's like hold on a minute, let's go find out" (Natalie, post-observation interview response).

Communication with students. Natalie indicated that students influenced her to use CGI by instilling her with a desire to improve and refine her instructional methods, "Because they challenge me. They push me to be better, they make me want to be better. They've made me be a better math teacher" (Natalie, pre-observation interview response).

Sources of resistance to CGI. Natalie reported no sources of resistance to CGI.

Wendy

Wendy has been teaching for 28 years and has a strong background in special education. She is blunt in her conversations with adults, is a teacher leader in our building, and has conducted professional development in CGI. Wendy has a deep understanding of CGI and adopts the philosophy of allowing students to do the thinking. She is an expert in team building and student behavior and is a mentor to administration because she is very candid and loyal. She cultivates excitement for students for the problem-solving process, and she creates an environment where students are comfortable with taking risks. During observations, she acted as a true facilitator of learning.

CGI helps students learn. Wendy said of her students' experiences with CGI, "[the students] have learned leaps and bounds and can solve problems beyond their grade level." Wendy spoke, in a pre-observation interview, of the ability of discoveries made by students during independent work to stimulate and incentivize collaboration during sharing time. During the classroom observation, the researcher saw Wendy telling students who were working in a group, "Listen to yourself, you know, even when others in the group may be leading you in a different direction," thus encouraging students to think for themselves as a means of contributing to the group. Wendy gave students a word problem to solve and also furnished them with a checklist of information to be included in their work. She had derived the list of required content from her own CGI checklist, which she carried on a clipboard during the lesson. The information she required students to present in their work included the number sentence and a drawing (for students in lower grades, e.g. tally marks) or an algorithm (for students in higher grades). Students in higher grades who were required to include an algorithm also had to show their work. She stated that she was often surprised by the skill with which her students solved the assigned problems.

Asked about her grouping of students into pairs for collaborative work, Wendy again emphasized how students were encouraged to contribute the products of their independent efforts to the group discussions: "When they're sharing ideas and when I have them pair,…[I remind them] to listen to the [collaborators'] ideas, but if you know you're right, let that voice be heard" (Wendy, post-observation interview response). She also spoke of the importance of letting students solve problems on their own, with as few instructors prompts as possible: “A lot of times as a mom or as a teacher, we want to fight their battles for them, but by letting them work it out has helped them be more able to do it” (Wendy, post-observation interview response). Wendy was a strong advocate for student collaboration, and she indicated that collaboration enhanced the independent thinking she encouraged in her students. According to Wendy, independent discovery often served as an inducement to collaboration:

> The students collaborated better than I could even imagine. They wanted to share, and it took away the copying aspect…they became more of helpers to each other…a lot of times they would go and ask another student, “Can you show me how you did this?” Because they liked their strategy. (Wendy, pre-observation interview response)

Communication with colleagues, students, and administrators. Wendy was inspired to implement CGI wholeheartedly by the enthusiasm and successes of a colleague: “With CGI, it was something that was first introduced by a teacher here who was using it, and she had a love for it…So when it rolled out, it was like yes I want to be on board” (Wendy, pre-observation interview response). Wendy knew two other teachers who were using CGI, and she said of the effect of their successes on her willingness to try the initiative: “they had such a love for it, and such an enthusiasm for it, it made me want to do it” (Wendy, pre-observation interview response). She added that the enthusiasm of colleagues during the roll-out of the initiative had contributed further to her own willingness to try CGI: “because there was so much buy in, I loved doing it and I wanted to be the best I could be at it” (Wendy, pre-observation interview response).

Wendy noted that important feedback could be gathered from students when teachers monitored children’s emotional reactions to the curriculum: “You always look at how they’re feeling. And then you guide your lessons on that” (Wendy, pre-observation interview response). In comparing CGI to the Go Math initiative with reference to student reactions, Wendy had found that students responded much more positively to CGI: “I think CGI lets them feel better about themselves than perhaps the go math does. Go math I saw a lot of frustration and anxiety” (Wendy, pre-observation interview response). She attributed students’ positive feelings about CGI to the sense of success the initiative gave them, even when they were unable to find the right answer: “in CGI, even if [students] didn’t solve the problem they feel success…with CGI it’s about what you can do and finding your way through it” (Wendy, pre-observation interview response).

Wendy’s preference for CGI as a teaching method had coincided with administrative support for the initiative. This agreement had further reinforced her enthusiasm for CGI. Wendy stated that administrative support had given her the freedom to follow her inclination: “the leaders had such a desire for CGI to continue…I feel very free that I can do it” (Wendy, pre-observation interview response).

Sources of resistance to CGI. Wendy indicated that, in her experience, CGI was not always effective, and that she became resistant to using it when it seemed to be failing. Wendy was specifically concerned about CGI’s efficacy in preparing students for standardized tests. She stated of the effect students’ performance on standardized tests had on her teaching strategy, “if the students don’t do well, then I panic and go back to the book [i.e., default to traditional teaching methods]” (Wendy, pre-observation interview response). Wendy reported that she also occasionally reverted to older teaching methods in anticipation of poor test results: “because there’s such emphasis on each grade level, on each test that the kids can’t do bad, then you start looking for other things [besides CGI] to bring in” (Wendy, pre-observation interview response). She added that when she began to worry about students’ test scores, “I think that sometimes you see that you go back to the old way [of teaching]”

(Wendy, pre-observation interview response). She believed, however, that CGI was more conducive than older teaching methods to student learning, and that the tests were inadequate in assessing students' knowledge: "even though the scores may not look like [students are] doing it, they're making leaps and bounds" (Wendy, pre-observation interview response).

Cross-Analysis of Participants' Findings

Theme 1: Belief in the Strategy

During the pre-observation interviews, the first theme of *belief in the strategy* was discovered and this also coincided with external influences, both of which increase the willingness of elementary mathematics teachers regarding the use of CGI. In her pre-observation interview, Michelle indicated that she felt CGI offered students a more adequate preparation for the curriculum of later grades than other teaching initiatives did. Like Michelle, Jessica also described herself as more willing to use CGI because she believed it helped students learn. Her overall evaluation of the initiative was emphatic: "I think it's wonderful" (Jessica, pre-observation interview response). A belief that higher test scores were achieved by Jane who also believed that students indicated better ability to tackle problems that "stumped" them when they had been prepared by CGI. Following this, two sub themes emerged from the analysis of the data relating to this theme.

Teachers were willing to use CGI when they believed that it would help students learn. Participant response to this theme indicated that they believe that CGI strategies helped students learn by encouraging them to collaborate with each other. This required students to think through problems independently and creatively and by doing so, required the students to explain their problem-solving methods. Participants Diana, Angie, Natalie, Leslie, Jessica and Jane all indicated that students used creative problem-solving methods, encouraged by independent learning, which helped students explain their problem-solving methods. Both Wendy and Jane indicated that through CGI learning, they found that students were pushed to a higher level and were able to solve problems beyond their grade level. Participants 3, 6, 7 and 10 (Natalie, Lily, Michelle, and Jane) described the effectiveness of CGI in preparing students for later work which also included word problems, standardized tests, and more advanced grade levels. After triangulating the data from the research observations and post-observation interview responses, it confirmed that teachers were implementing CGI strategies effectively.

Past studies support the findings that teachers are likely to use CGI when they believed that it would help students learn. These results coincided with Baker and Harter (2015), Moscardini (2015), Patsiomitou (2014), and Carpenter et al. (2015), who found that CGI was based on the assumption that children have intuitive knowledge of mathematics, which should serve as the foundation for the further development of more formal and advanced knowledge. Carpenter et al. (2015) also addressed that teachers explored and analyzed the cognitive strategies of students when solving mathematics problems in order to determine the appropriate teaching approach, when using CGI teaching methods.

Training and communication with students, colleagues, and administrators encouraged teachers to use CGI in the classroom. Angie, Leslie, and Jane expressed collaboration between teachers assisted in giving confidence and more willingness to trying new CGI techniques in their classes. Leslie reported that she was motivated by a desire to comply with administrative directives. The data associated with this sub theme indicated that the participants were encouraged by the enthusiasm and collaboration of colleagues, their directives, help and encouragement from administrators to use CGI, and by the results of the objective and subjective assessments of student progress. Diana's willingness to use CGI was positively influenced by the ways students' explanations contributed to subsequent interactions. Student input and performance made CGI's sensitivity to student needs seem sensible according to Leslie. Wendy also reported that they were inspired by the implementation of CGI and by the enthusiasm and success that their colleagues had shown. The participants were also encouraged to use CGI by the thorough training that they received during the roll-out of the initiative.

Sufficient training is an important factor that may influence the willingness of teachers to adopt new instructional methods (Brody & Hadar, 2017; Sedova et al., 2016; Zimmerman et al., 2017). Moreover, Oksanen et al. (2015) also confirmed these findings with their study that examined the successful implementation of school reform by school leaders, gaining the cooperation of the teachers. Given these findings, organizational leaders must demonstrate an understanding on how to foster readiness among employees in order for them to be more receptive to change (Aldulaimi & Sailan, 2012).

Theme 2: Sources of Resistance to CGI

Whereas the first theme focused on the positives of the adoption and implementation of CGI, the second theme is more focused on drawbacks and difficulties experienced by teachers and students. Forming the main theme, teachers found that time constraints and a lack of confidence in aspects of the strategy increased the resistance of using CGI in elementary schools. Diana and Lily both spoke of time constraint difficulties associated with CGI, with Diana indicating this as being the primary difficulty. Lily felt that mathematical problems can sometimes take too much time out of a lesson if focused on for too long, knowing that there is much to be completed in the curriculum. Both of the participants reported that they had encountered difficulties in implementing CGI due to the strategies being so time consuming. Additionally, seven of the participants reported their doubts about aspects of CGI. Participants Angie, Ella, Lily, Michelle, Jessica, Wendy, and Jane all indicated a lack of confidence in certain aspects of the strategy increased their resistance to implementing CGI, with Wendy saying that she would default back to older teaching methods when CGI seemed to be failing. These aspects of CGI that seemed to be questionable to the participants included the use of peer instruction for very young children, compliance with the state educational standards, and the suitability of CGI for all styles of learning and ability levels for children. Angie and Jessica indicated that they doubted the ability of CGI to work for all student learning styles, as sometimes lower level students were not willing to give the effort required to push through the struggle. It was also expressed by Jane that she felt that CGI required the students to move into application without sufficient preparation, and that by allowing very young students to instruct one another might not be advisable. This consensus was also reached with Michelle who agreed with Jane, about their expectation that kindergarten learners would learn from one another was a concern.

The findings of the study align with studies conducted by Archambault et al. (2012), Bobis et al. (2016), Oksanen et al. (2015), Polly et al. (2013), and Purnomo et al. (2016). These studies indicate that beliefs and attitudes of teachers can influence their instructional practices, which means what teachers use in class is based on their own personal beliefs. The first theme was also in agreement with the study which stated that, institutional factors such as the availability of school support can influence the instructional practices and behaviors of teachers (Holzberger et al., 2014; McKeown et al., 2016; Oksanen et al., 2015). Though there were positive aspects that agreed with the literature, there were also negative aspects which were also highlighted in previous literature. The study found that teachers wanted to use innovative strategies in teaching mathematics, but there is a tendency to resort to the approaches that they have always used in the past, which is in agreement with the study by Harbin and Newton (2013).

Summary

The problem addressed by this study was that some teachers tended to resort to instructional strategies that they have traditionally used in the past, thus failing to use more innovative strategies such as CGI (Harbin & Newton, 2013; Moscardini, 2015). CGI focuses on the individual student's learning styles in order to provide them with differentiated assistance in learning mathematics (Carpenter et al., 2015). With many teachers still using what would be considered traditional teaching strategies on standardized practices, the implementation of CGI in elementary schools remains limited, even though there are noted benefits associated with this teaching technique (Moscardini, 2015). The gap in the literature indicated a limited understanding of the factors influencing implementation of socially constructivist strategies such as CGI in elementary mathematics.

Two major themes emerged during the cross-case analysis to answer the research question. The first major theme, *Incentives to Use CGI*, which comprised of two sub themes. For the first sub theme, *CGI benefits students*, all participants reported that perceived benefits to students made them more willing to use CGI. In discussing why, they perceived CGI as beneficial to students, six participants gave reasons that included the use of creative problem-solving methods, the encouragement of independent learning, the requirement that students explain their problem-solving methods (which helped students understand why those methods worked), practical applicability, and the use of tangible quantities to develop students' understanding of the concept of numbers. Five participants perceived CGI as beneficial to students because it involved collaboration among learners, including peer instruction. Three participants said they were more willing to use CGI because they saw it as an effective means of preparing young students for later work, which included word problems, standardized tests, and more advanced grade levels. Triangulation of researcher observations and participants' post-observation interview responses provided robust confirmation that CGI was working for students in the ways that the participants had cited. For the second sub theme, *communication with colleagues, students, and administrators*, all participants reported that communications with other teachers had increased their willingness to use CGI. Participants were likewise unanimous in reporting that communications with or monitoring of students had increased their willingness to use CGI. Furthermore, all participants reported that help, encouragement, training, and/or directives from administrators had positively influenced their willingness to use CGI.

The second major theme was, *Sources of Resistance to CGI*. Seven out of 10 participants reported that they had experienced challenges while implementing CGI that had increased their resistance to the initiative. Two participants reported that they had encountered difficulties in implementing CGI because the strategies were so time-consuming. Seven participants reported that they had doubts about aspects of CGI. Aspects of CGI that seemed questionable to one or more participants included the use of peer instruction for very young children, compliance (or apparent lack thereof) with state standards, and the perceived unsuitability of CGI for children of all learning styles and ability levels. Chapter 5 includes interpretation and implications of these results.

Chapter 5: Conclusions and Recommendations

Introduction and Summary of the Key Findings

The purpose of the study was to gain a deeper understanding of the reasons why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The study aimed to assist leaders in identifying factors that could facilitate the adoption of CGI in teaching mathematics in elementary. The study additionally looked to provide insight into how CGI is implemented given the presence or absence of key factors. Results of the study expanded on the literature of CGI by acquiring a deeper understanding of the decision-making process of teachers regarding CGI.

The conducted qualitative case study sought to reach a deeper understanding of the different factors that influence the willingness or resistance of elementary math teachers regarding the use of socially constructivist strategies (SCS) such as CGI in their classroom instructional practices. This was accomplished by classroom observations, one-on-one and semi-structured interviews with 10 elementary mathematics teachers currently undergoing SCS interventions in a southeastern school district of the United States. The data was analyzed using Mayring's (2003) qualitative content analysis, whereby the all the data was loaded into a qualitative software called NVivo (QSR International, n.d.) for their organization, aiding in the storage, organization, analysis and interpretation of the data through coding and categorization (Bazeley & Jackson, 2013).

The research question addressed by the study was: What factors influence the willingness or resistance of elementary mathematics teachers regarding the use of socially constructivist strategies such as CGI? This led to two major themes being discovered with a number of sub themes linked to each major theme.

How CGI Positively Impacts Student Thinking

There are three main reasons according to Emerling et al. (2015) as to why standardization is not effective and causes problems in better instruction: (a) the focus is on activity and not on achievement, (b) it has the possibility of uncoupling learning goals from instructional methods, and (c) it can encourage a one-approach-fits-all environment. In relation to the first reason for ineffectiveness – a focus on activity rather than on achievement – three of the participants reported that CGI enhanced student capacity to solve problems creatively and that it helped students to think mathematically. These three participants also indicated that students who had experiences with CGI learned to effectively solve problems beyond their grade level and were pushed to a higher level than they previously were**.** These results align well with the study conducted by Carpenter et al. (2015), in which researchers found that students were more likely to succeed better in learning mathematics if they were given the opportunity to invent their own problem-solving strategies and styles.

CGI has the Possibility of Uncoupling Learning Goals from Instructional Methods

In their discussions, four of the 10 participants described CGI as an effective method for preparing students for later work, far and beyond their current syllabus. It better prepared them for word problems, standardized tests, and more advanced grade levels. Lily was quoted saying "I think it helps the students to think through their problems, and I'm not giving them the answer." These results coincided with Baker and Harter (2015), Moscardini (2015), Patsiomitou (2014), and Carpenter et al. (2015), who found that CGI was based on the assumption that children have intuitive knowledge of mathematics, which should serve as the foundation for the further development of more formal and advanced knowledge.

CGI discourages a one approach fits all environment. Two of the participants addressed the third sub theme when they discussed how students collaborated together in a creative manner which allowed them to explain concepts. This meant that there was an overall greater responsiveness in the class and a sense of encouragement and participation from all of the students. They also noted a lack of rigor in traditional teaching strategies other than CGI which lead to students not being able to explain what they were doing or to effectively problem solve. Carpenter et al. (2015) also addressed that teachers explored and analyzed the cognitive strategies of students when solving mathematics problems in order to determine the appropriate teaching approach, when using CGI teaching methods.

Administrators' influence on implementing CGI. The use of socially constructivist approaches in the instruction of mathematics has increasingly become more accepted as an alternative to the traditional instructional strategies in mathematics (Baker & Harter, 2015; Sharma, 2015). Three of the participants were positively influenced by their students to implement CGI and by the encouragement from administrators regarding CGI. Oksanen et al. (2015) confirmed these findings with their study that examined the successful implementation of school reform by school leaders, gaining the cooperation of the teachers.

Direct instruction typically involves giving classroom lectures and demonstrating to the students how to solve mathematical problems and equations, in which teachers show students the necessary steps in solving various mathematical problems (Skarr et al., 2014). In this traditional teaching approach, the same conceptual method is used to teach mathematics to children of all learning types. This was once again shown that CGI would be beneficial in teaching mathematics to students based on five participants who indicated that CGI prepared students for the more difficult sections of the syllabus.

Purnomo et al. (2014) discovered that rote memorization in mathematics can often lead to negative student outcomes as students tend to make errors, not knowing how to interpret mathematical concepts, and a lack of sensitivity and ability to perform problem solving. This was confirmed by two of the participants who spoke on how CGI enhanced students' capacity to solve problems creatively, indicating that they were encouraged to think in a manner of people who attain the highest level of skill in mathematics. They also indicated that students became more receptive to openly solving problems when CGI teaching methods were used, students dug digging deeper into their minds to solve problems creatively. This finding was consistent with the results of the studies of Baker and Harter (2015), Moscardini (2015), Patsiomitou (2014), and Carpenter et al. (2015). Preparation associated with breaking down the problems and allowing students to think through them step by step was observed by the participants in preparation for later work and tests.

CGI is not a popular strategy in teaching. It has been found that the utilization of CGI in the classroom is not a popular strategy in teaching mathematics (Harbin & Newton, 2013; Moscardini, 2015). Teachers are continuing to resort to standardized instructional methods used by the majority of elementary schools (Harbin & Newton, 2013; Moscardini, 2015). This research found similar results, with almost all of the participants indicating a lack of confidence in certain aspects of the CGI strategy which increased their resistance in implementing CGI and made it easier to resort to traditional methods of teaching elementary mathematics. Gallimore and Ermeling (2012) also found that mainstream approaches and frameworks in mathematics instruction indicated that teaching methods fell within the scope of standardization of the past.

Teachers revert back to departmentalized ways of teaching. Ermeling et al. (2015) and Fallace (2015) found that when teachers were forced to standardize their instruction, that pedagogical insights that may be gained by teachers during their instructional experiences are often ignored. New information and insights that teachers gain from the classroom and from years of experience are not transferred into instructional practices effectively. One of the participants from the study indicated that they found it most useful in acquiring and applying tips that they had received from colleagues who had the CGI model in their classrooms, while another of the participants described how the departmentalized structures of mathematics instruction in the school helped promote collaboration among the teachers, thereby increasing their willingness to use CGI in their classes.

Time constraints influence CGI implementation. With increasing importance in following pedagogy-based teaching standards in mathematics, innovative instructional practices in elementary mathematics have become increasing complex and difficult to implement for educators (Blazar, 2015). This was supported by this current study as well, with eight out of the 10 participants confirming that implementing CGI was difficult due to time constraints and a lack of confidence in aspects of the strategy was a concern. Furthermore, three participants also doubted the ability for CGI to work for all students learning styles, and noted without sufficient preparation, allowing the instruction of young children to be conducted by their peers caused difficulty in implementation. Increased accountability placed on teachers to meet academic deadlines and standards was confirmed by Au (2013) and Milner et al. (2012) who found that teachers often resort to standardized instruction to meet their obligations.

Implications of the Findings

The purpose of the study was to gain a deeper understanding of the reasons why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The study aimed to help leaders identify the factors that can facilitate the adoption of CGI in teaching mathematics in elementary schools. Additionally, the study aimed to provide insights into how CGI is implemented given the presence or absence of key factors. The results of the proposed study have expanded the literature on CGI by acquiring a deeper understanding of teacher decision making processes in regards to CGI.

Addressing a Positive Social Change

With the limited information on the different influences or factors contributing the willingness or resistance implementing CGI in teaching elementary mathematics, this study's findings aimed to bring more information about this gap in the literature to the forefront. It was found that all 10 of the participants indicated strong positive attitudes towards the implementation of CGI in their classes and indicated that there were numerous benefits in the development of the students' thinking, such as preparing students' level of problem solving beyond their grade level, enhancing their abilities to solve problems creatively, and allowing students to collaborate together to solve mathematical problems. This positive attitude towards CGI could be further expanded through educational and teaching interventions which could help broaden the knowledge and use of CGI in the classrooms. The wider use of

CGI may lead to more effective teaching practices from elementary to college level classes. However, correlations regarding the informants' initial training, style of teaching, personality, age, and experience with their beliefs toward CGI cannot be determined given that the design of this study was qualitative in nature. To determine these possible connections, future quantitative researchers can utilize a correlational study to determine if such relationships exist.

The participants described how CGI teaching methods improved student thinking and laid a good foundation for them in the future to come. A positive step toward implementing CGI in schools found that educators were more likely to implement these teaching techniques when fellow colleagues had expressed success and were collectively sharing ideas and methods with one another. This positivity also stemmed from school administrators who had a positive outlook on how CGI would be beneficial and how it could be implemented in the institution. This meant that educators were more willing to participate due to their willingness to please their administrators. According to Vygotsky (1978), the importance of the environmental thinking process of an individual, and the importance of the role of the school environment in shaping the decisions of teachers in the class, a recommendation in positively influencing this change would be to actively involve and engage school administrators in the CGI process. The data indicated the positive influence CGI had on both the students and the educators, so furthering this study and expanding on the data already collected would encourage greater institutional roll-out and the support of CGI to become a reality with more information being discovered. By doing this, teachers will feel more inclined and comfortable in implementing CGI practices in their classrooms which may lead to widespread positive attitude in the adoption of CGI by more teachers and schools. By adapting current teaching methodologies to use the positive outcomes of CGI, it may lead to a generation of students capable of solving problems of all scales which have yet to be solved.

Limitations of the Study

Qualitative studies do not easily translate validity and reliability as the differences in the data collected from the research is in vast contrast to that of quantitative studies (Cope, 2014). Quantitative studies focus on standardized instruments, whereas data from qualitative studies come from less structured sources such as open-ended interviews and observations (Creswell, 2013). Given these differences, the quality of qualitative research is based on the credibility, dependability, transferability, and confirmability of the results (Shenton, 2004).

The research data acquired during the study was made through pre-determined, semi-structured questions presented verbatim to participants during interviews, but the follow-up probing questions differed because these questions were contingent with the individual response of the participants. All these responses were recorded with a digital recording device and were transcribed verbatim as to relay credible accuracy of the data. The participants were also afforded an opportunity to review their responses to the study, which was done using a member checking process to enhance the credibility of the data.

Another limitation to this study would be that nine out of the ten participants had advanced degrees in education, including no less than 15 years of teaching experience. This may have led to the sample of participants being skewed to a particular side, based on education and experience. With only one participant being the anomaly among the participants, the variety of responses may have been limited.

The researcher also limited the study to participants within a southeastern portion of the United States. This meant that the teaching experience regarding the use and implementation of CGI in their classrooms may or may not have been similar due to them being in the same school district. This also meant that the sample of participants was limited which lead to the participants already participating in CGI teaching methods in their classes at the time of the study being conducted. A larger demographic sampling size consisting of teachers both using and not using CGI techniques in their classrooms would have provided a better analysis of the factors that influence the implementation or resistance to CGI in teaching elementary mathematics.

Another limitation is that the perspectives of teachers were the only group considered, possibly limiting the comprehensiveness of the understanding of the phenomenon. The perspectives of other key stakeholders such as leaders, parents, and teachers were not included in this study. As a result of this decision, the results may not be reflective of the complexity of the research topic.

The manner in which the interview was conducted was also a limitation of this study. Often at times, there was an impression that the actual opinions of the teachers were not reflected in their responses. Some of the participants were noticeably nervous, preventing them from expressing their experiences and perceptions with depth and details. The inability of the researcher to adapt to the interview environment such as changing the questions to put the participants more at ease may have led to responses that are more accurate and honest.

Recommendations for Future Research Projects

Though approached with a worldview in mind, this study focused on a small group of participants, which limited the amount of data that was collected to only 10 participants. A recommendation of a larger demographic is suggested in order to attain whether or not the same factors of influence are widespread or if they are limited to a specific demographic in the United States. Future researchers can use a more diverse set of participants in order to determine the transferability of the findings in different groups and contexts.

The participants in this study were all teachers of elementary mathematics in a school district that was already implementing CGI. The 10 participating teachers indicated that they were currently making use of CGI strategies in their classrooms and in their general consensus from the outset was positive toward the use of CGI in their classrooms. Linking back to the broader problem, the research set out to find the factors both influencing the adoption or resistance to CGI in teaching elementary mathematics. A recommendation of using both schooling districts who currently implement, and those who do not use CGI in their classrooms would provide a better collaboration of data to effectively determine what these adoptive or resistive factors are.

With the leadership styles of administrators, directors, and headmasters of schools playing a vital role in the implementation of CGI in schools, this is another aspect that could have been explored, or can be explored in future research. The current study has not covered this in depth and is a very probably cause for districts and educational institutions in adopting CGI techniques in their classrooms. It was displayed in the data analysis from the participants that they were strongly influenced by the decisions made by their administrators and headmasters as to what instructional practices were to be implemented in their classrooms. A recommendation would be to expand the study beyond just the experiences of the teachers but to also include administrators, directors and headmasters of the schools and districts to gather a broader study of data on the influencing factors.

The last recommendation for this study would be to expand the study of participants to more subjects than mathematics. Participants should include teachers of multiple disciplines and subjects to establish whether the factors influencing adoption or resistance to CGI is subject specific or whether it is part of a widespread influence on schooling as a whole. This could help identify whether specific subjects have better adoption or resistance rates to CGI.

Summary and Conclusions

The purpose of the study was to explore the reasons why mathematics teachers were or were not using CGI in teaching elementary math based on the practices of mathematics instruction; beliefs and attitudes in terms of personal, institutional, and policy-related factors; and educational leadership. The 10 participants offered a concise and data rich analysis on the factors that both drive teachers to implement CGI in their classes which indicate great results, and the factors that created resistance and gave insight into what caused a lack of confidence in CGI. The participants indicated that students showed learning levels beyond their grade, developed creative problem-solving techniques which not only assisted in the current curriculum but would be beneficial for students in future grade levels, and how teachers were positively influenced by their colleagues and administrators who had positive, meaningful experiences with CGI. While the positives seemed to outweigh the negative factors causing resistance to the implementation of CGI in classrooms, the biggest resistive factor towards CGI for the participants was the amount of time needed during lessons in order to fulfill the requirements in carrying out a lesson or exercise based on CGI practices. This meant that teachers often defaulted back to their more traditional methods of teaching when faced with these challenges. The findings from this study have highlighted the willingness to implement CGI, as well as the resistance in implementing it, with these both being common themes in current literature. Among the 10 participants, not one was completely for or against the use of CGI. This could be due to a number of reasons, but the researcher believes it can be attributed back to the schooling system as a whole. The participants all attended college and graduated with a Bachelor’s degree or more advanced degrees in education. These degrees are taught to a set standard, much like traditional teaching methods in elementary classrooms. These teaching standards do not seem to make use of CGI methods and thus the implementation or adoption of CGI in the classroom is either institutional or by the willingness of the teacher. This combination of skills or circumstance is the likely cause of teachers showing positive adoption towards CGI, while still displaying resistance toward its implementation. This also translated into the willingness of the participants to implement CGI, as based on the findings of the study, experience or educational level did not have a significant impact.

The current literature also highlighted the need to engage students in problem solving, and to prepare students for future grades more effectively, while also highlighting the time constraints, and lack of confidence in implementing CGI, all of which were confirmed in the study’s findings. The impact and implications of the findings of this study further the awareness of the benefits of CGI in adapting and evolving teaching methods for the future benefit of students to come. By expanding on this study, future research could be conducted on a broader scale, including a larger demographic, teacher base, and more subjects, in order to truly understand the beneficial impact of CGI in teaching. Doing this will help expand on the factors that influence the adoption or resistance to using CGI by teachers and schools. Though there are certainly challenges in the implementation and sustainability of CGI in the classroom, the positives, such as enhanced student problem solving through creative thinking, greater active student involvement in solving problems, and collective encouragement and learning by students, teachers, and administrators forms a compelling case for the future of education and how it is approached.

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Appendix A: Interview Guide

Demographic and Background Information:

1. How long have you been teaching mathematics?
2. Have you taught any other grade levels? If so, which ones and how long for each?
3. What is your educational degree?
4. How long have you been teaching?
5. Have you taught at other schools?
6. How long have you known about CGI?
7. Have you had to participate in other instructional initiatives? If so, how did it turn out in your teaching practice?
8. What was the same or different about previous initiatives and CGI in its implementation?

Main Questions:

1. How do your interactions with school leaders influence your instructional practices in mathematics?
2. How do your interactions with your students influence your instructional practices in mathematics?
3. How do your interactions with other teachers influence your instructional practices in mathematics?
4. How would you characterize your awareness of CGI as a teaching strategy in mathematics?
5. How would you characterize your informational knowledge of CGI as a teaching strategy in mathematics?
6. What are your personal views about CGI as a teaching strategy in mathematics?
7. What are your management practices in implementing CGI as a teaching strategy in mathematics?
8. How would you characterize the intended consequence of CGI as a teaching strategy in mathematics?
9. How do you view collaboration in CGI as a teaching strategy in mathematics?
10. How do you improve or refine your implementation of CGI?
11. What are the driving factors that contribute to your willingness to implement CGI in teaching mathematics?
12. What are the restraining factors that contribute to your resistance in implementing

CGI in teaching mathematics?

13. Do you have anything else to add that can provide insights into your implementation of CGI in teaching mathematics?

Appendix B: Observation Checklist

	Observation Notes
Interaction with Students	
Instructional Strategy/Approach	
Classroom environment	
School environment	
Awareness of CGI	
Information/Knowledge of CGI	
Consequences of Instruction	

Appendix C: Informed Consent Form

Title of Research Study:

Socially constructivist strategies in mathematics: factors that influence a teacher's willingness or resistance for implementation in the elementary classroom.

Researcher's Contact Information:

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Introduction

You are being invited to take part in a research study conducted by Teresa Conowal of Kennesaw State University. Before you decide to participate in this study, you should read this form and ask questions about anything that you do not understand.

Description & Purpose of Project:

The purpose of the study is to gain a deeper understanding of the reasons why mathematics teachers are or are not using socially constructivist strategies in teaching math. The study will also help leaders identify the factors that can facilitate the adoption of CGI in teaching mathematics at the elementary level. Additionally, the study will provide insights into how CGI is implemented given the presence or absence of key factors. The results of the proposed study will expand the literature on CGI by acquiring a deeper understanding of teacher decision making processes in regards to CGI.

This study will help fulfill the requirements in obtainment of my doctoral degree in Teacher Leadership at Kennesaw University. Individual semi-structured interview data, open-ended questions will be asked to gain the data needed to answer the research question. The individual interviews will be conducted in a quiet location mutually agreed upon by the researcher and each participant. The interviews will approximately last for 30 to 45 minutes. An interview guide will be prepared to help the researcher address all the key questions that need to be asked. With permission from the participants, all interview sessions will be digitally recorded to preserve all the responses of the participants verbatim.

For the classroom observations, the researcher will set up an individual appointment for each participant. The researcher will observe math teachers who are currently implementing CGI in their classrooms. The classroom observations will focus on the experiences of teachers that might encourage or discourage their continued implementation of CGI.

Explanation of Procedures:

As a participant in this study, your classroom mathematics instruction will be observed and one-on-one interviews will be conducted. Researcher will record anecdotal notes during observations and these will be used during interviews with participants. Said interviews will be audiotaped and transcribed to ensure accurate representation of the events.

Time Required:

Classroom Observations: 30 min. x 3 per month.
Post Conference: 25 min. x 3 per month.

Risks or Discomforts:

Participants may experience discomfort in expressing their decision to resist an initiative required by administration. In such case, and in all accounts, the confidentiality of participant actions and interview content will be maintained. In reference to this study, participants will be held harmless to any and all future repercussions.

Benefits:

The results of the proposed study might expand the literature on CGI by acquiring a deeper understanding of the adoption and implementation barriers that prevent mathematics teachers from adopting this innovative instructional strategy. The results of the study can also serve as the foundation for future qualitative studies in terms of expanding the framework of understanding regarding the different factors that influence the willingness or resistance of elementary math teachers regarding the use of socially constructivist strategies such as CGI in their classroom instructional practices.

Additionally, the study will improve the understanding of the facilitating factors that can encourage teachers to adopt socially constructive teaching strategies in mathematics instruction. The findings can be instrumental in discovering the different factors that prevent the widespread use of socially constructivist strategies in elementary mathematics. The results of the study can be used by school leaders to facilitate the implementation of socially constructivist strategies within mathematics classrooms by ensuring that key factors are either present or provided to teachers.

Compensation: Not applicable

Confidentiality:

The results of this participation will be anonymous. Concealing the real names of the participants will protect the identities and personal information of the participants. The participants will be assigned random code names so real identities will be protected from the public and the readers. The researcher will have the sole access to the names of the participants and other personal data that may be collected. Seven years after the proposed study is approved and published, all data collected from the participants will be permanently destroyed. All paper documents will be permanently destroyed, by shredding the files. Electronic documents will be permanently deleted in the hard drive of the researcher's computer. No back-up copies will be made after the disposal of all data is completed. All audio recordings of the interviews will be permanently erased form the hard drive of the researcher.

Inclusion Criteria for Participation:

The intended 10 participants of this study will be elementary school teachers, holding a PSC certificate. These participants are at least 18+ years and teach at least one mathematics course to students in grades K-5.

Withdrawal from Study:

Participants reserve the right to withdraw from the study at any time. In such circumstance, the participant will be held harmless for any material obtained and no repercussions will occur. Furthermore, any data collected would be destroyed and any information obtained will not be used in this study.

Signed Consent:

I agree and give my consent to participate in this research project. I understand that participation is voluntary and that I may withdraw my consent at any time without penalty.

Print Name of Participant

Signature of Participant or Authorized Representative, Date

Signature of Investigator, Date

PLEASE SIGN BOTH COPIES OF THIS FORM, KEEP ONE AND RETURN THE OTHER TO THE INVESTIGATOR

Research at Kennesaw State University that involves human participants is carried out under the oversight of an Institutional Review Board. Questions or problems regarding these activities should be addressed to the Institutional Review Board, Kennesaw State University, 585 Cobb Avenue, KH3403, Kennesaw, GA 30144-5591, (470) 578-2268.