Spring 5-13-2016

The Impact of Math Innovations in Elementary Mathematics Classrooms in Georgia Vision Project Districts

Karen Dozier

ACCEPTANCE

This dissertation, THE IMPACT OF MATH INNOVATIONS IN ELEMENTARY MATHEMATICS CLASSROOMS IN GEORGIA VISION PROJECT DISTRICTS, by KAREN HUMPHRIES DOZIER, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education & Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chairperson, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

_____
Nicholas J. Sauers, Ph.D.
Committee Chair

_____
Jami Berry, Ph.D.
Committee Member

_____
Kathy Garber, Ph. D.
Committee Member

_____
Date

_____
William L. Curlette, Ph.D.
Chairperson, Department of Educational Policy Studies

_____
Paul A. Alberto, Ph.D.
Dean,
College of Education & Human Development

AUTHOR'S STATEMENT

By presenting this dissertation as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this dissertation may be granted by the professor under whose direction it was written, by the College of Education and Human Development's Director of Graduate Studies, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation which involves potential financial gain will not be allowed without my written permission.

Karen Humphries Dozier

NOTICE TO BORROWERS

All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement. The author of this dissertation is:

Karen Humphries Dozier
Department of Educational Policy Studies
30 Pryor Street
Atlanta, GA 30303

The director of this dissertation is:

Nicholas J. Sauers
Department of Educational Policy Studies
College of Education
Georgia State University
Atlanta, GA 30303

CURRICULUM VITAE

Karen Humphries Dozier

ADDRESS: 30 Pryor Street, Room 450
Atlanta, GA 30303

EDUCATION:

Ed.D.	2016	Georgia State University Educational Policy Studies
Ed. S.	2011	University of Georgia Educational Leadership
M.Ed.	2006	Walden University Reading and Literacy
B.Ed.	2003	University of North Georgia Elementary Education Special Education

PROFESSIONAL EXPERIENCE:

2015-present	Coordinator of Elementary Curriculum, Instruction, and Professional Learning Newton County Schools
2011- 2015	District Elementary Instructional Coach Newton County Schools
2006-2011	Teacher Newton County Schools
2004-2006	Teacher Gwinnett County Schools

PROFESSIONAL SOCIETIES AND ORGANIZATIONS

2012	National Council of Teacher of Mathematics
2003	Professional Association of Georgia Educator

THE IMPACT OF MATH INNOVATIONS IN ELEMENTARY MATHEMATICS CLASSROOMS IN GEORGIA VISION PROJECT DISTRICTS

by

KAREN DOZIER

Under the Direction of Dr. Nicholas J. Sauers

ABSTRACT

The purpose of this dissertation was to study how teachers and school leaders perceived a specific set of classroom math innovations, and how those innovations impacted instruction in relation to the Georgia Vision Project (GVP) standards and recommendations. This was a qualitative study conducted in two GVP districts. The participants in the study were five elementary teachers, two school administrators, and two district leaders. The participants were interviewed to gain an understanding of their perceptions of recent math innovations. The innovations included (a) math instruction using manipulatives (such as counting objects and puzzles) that utilize the Concrete Representational Abstract (CRA) model, which engages students to conceive from the concrete to the abstract; (b) differentiation through flexible student grouping; (c) information about how different subgroups of students learn mathematics; and (d) math professional learning. Previous research had focused on these innovations separately. However, no research study had grouped these innovations together to see how teachers perceived them within the context of a math classroom, and how teachers implemented them in their classrooms in order to increase student achievement.

This qualitative case study included schoolteacher and educational leader interviews, observations, and artifacts. The two districts in the study were high performing in the area of mathematics. The results indicated that schoolteachers and educational leaders could not directly relate the math innovations to student success and, moreover, to the GVP standards and recommendations. During the study all GVP standards were analyzed at varying levels. The study primarily focused on the *teaching and learning* standard, which was a significant initiative for both districts. Both districts had varying levels of implementation concerning the innovations in the study: (a) use of manipulatives, (b) differentiation in classrooms, and (c) professional learning. All participants referenced the innovations as a part of their instruction, but could not directly relate the innovations beneficial to the success of the students.

INDEX WORDS: Concrete representational abstract model, Differentiation, Flexible grouping, Math innovations, Professional learning, Student subgroups

THE IMPACT OF MATH INNOVATIONS IN ELEMENTARY MATHEMATICS CLASSROOMS IN GEORGIA VISION PROJECT DISTRICTS

by

KAREN DOZIER

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Professional Doctorate

in

Educational Leadership

in

the Department of Educational Policy Studies

in

the College of Education
Georgia State University

Atlanta, GA
2016

DEDICATION

This dissertation is dedicated to my family for your support in reaching this dream.

Without your patience, love, and support, this dream would not have been a reality.

ACKNOWLEDGEMENT

I would like to express my gratitude to Georgia State University for allowing me to fulfill my dreams of earning a doctorate in Educational Leadership. It is with immense gratitude that I acknowledge the support and help of Dr. Sauers who spent countless hours reading my paper, providing feedback, answering questions, and encouraging me along the way. This dream would not have been possible without his help and support. I would also like to acknowledge the other members of my committee, Dr. Berry and Dr. Garber. Dr. Berry encouraged me to reach for my dream of earning a doctorate and reminded me that there is no better time than the present. She continued to provide support during the program. Dr. Garber provided support, encouraging words, and was always willing to read my paper. Mrs. Murphy graciously edited my paper and rekindled the passion for making a difference in education through my research. I wish to thank my fellow graduate students at Georgia State University who became a support network and helped each other become a doctor.

Finally, I would like to thank my family for their unconditional support during the last three years. My family engrained in me a strong work ethic and taught me to never give up. To my Daddy, Robert Humphries, who supported me in the beginning of this journey and offered support from heaven to help me achieve my dreams. To my Mom, Judy Humphries, who helped provide childcare so that I could attend classes and work on my dissertation. To my children, Will and Caroline, who reminded me daily of why I was working so hard to make the field of education a better place and to demonstrate the ability to reach dreams through hard work. Will blessed me with many hugs and kisses that gave me encouragement to keep working. Caroline was my special present that reminded me that God would not give me more than I could handle. She gave me the determination to finish and be a female role model to my daughter. This dissertation would have remained a dream if it had not been for my supportive and loving husband, Asher, who encouraged me to earn my doctorate and provided the support in every area to ensure that I reached my dream. Asher, thank you for your love, support, and for always pushing me to the next level.

TABLE OF CONTENTS

LIST OF TABLES

ABBREVIATIONS

CCRPI	College and Career Readiness Performance Index
CCSS	Common Core State Standards
CGI	Cognitively Guided Instruction
CRA	Concrete-Representational-Abstract
ED	Economically Disadvantaged
EL	English Learner
EIP	Early Intervention Program
GVP	Georgia Vision Project
HPPLC	High Performance Professional Learning Committee
MAP	Measures of Academic Progress
SES	Socio-Economic Status
SWD	Students with Disabilities

CHAPTER 1

TEACHING MATHEMATICS: ADRESSING "GAPS" WITH INNOVATIONS

In the 1980s it was reported that American students were falling behind the rest of the world in math and science (Gardner, Larsen, Baker & Campbell, 1983). Since that time, politicians have implemented legislation such as the *No Child Left Behind* act to help improve our students' performance in all subject areas (Hargrove, 2012; Morales, 2013). In reality, the act only served to increase expectations on tests to ensure that 100% of students passed state assessments. The act did little to improve student performance (Jennings & Rentner, 2006). In 2009, the process to develop the Common Core State Standards (CCSS) was initiated. Field experts wrote the first draft of the current CCSS while teachers, researchers, scholars, and assessment experts provided feedback (Understanding the Common Core, 2014). In 2010, the CCSS were released to ensure that students across the country learn the same content at each grade and eventually take similar state assessments (Applebee, 2013; Bomer & Maloch, 2011; Calkins, Ehrenworth, & Lehman, 2010; Porter, McMaken, Hwang, & Yang, 2011; Tienken, 2010). This set of standards was developed by experts in the field based on what they considered to be the best state standards already in existence (Common Core State Standards Initiative, 2014). Over the last decade, mathematicians have looked at many other countries, which outperformed American students, to see how the students were taught math (Common Core State Standards Initiative, 2014). The CCSS was created and developed from the collective research and understanding of these global techniques of instruction. In CCSS, the students no longer simply learned a singular process to solve a math problem, but become able to solve math problems in multiple ways and to discuss, analyze, and explain the math problem with others. Burns (2012) states that content standards tell the teacher and student what students should know

and do. The standards include expectations for each grade level and incorporate critical thinking, application, and communication to help students to be college and career ready and able to compete globally. In addition, eight mathematical practices are included to incorporate reasoning and communication (Burns, 2012; Understanding the Common Core, 2014). Burns describes the mathematical practices as standards to help our students become mathematical thinkers. The National Governors Association and Council of Chief State School Officers released the standards in 2010.

Researchers who are for or against CCSS agree on one thing: teachers must receive effective professional learning in order to see a change in student performance (Cobb & Jackson, 2011; Hess, 2014; Mathis, 2010; National Council of Teachers of Mathematics, 2013; Rothman, 2013; Wu, 2011). The National Mathematics Advisory Panel (2008) feels that teachers must receive high-quality professional learning to be able to deliver instruction to students for success. This includes (a) professional learning on differentiation and flexible grouping, (b) math instruction with the incorporation of manipulatives through the Concrete Representational Abstract (CRA) model as students begin learning concretely and move to abstract thinking; and (c) the instruction of disadvantaged students. Teachers and students need to be given the tools to achieve a deep understanding of math concepts through the CRA model (Flores, 2010; Mancl, Miller & Kennedy, 2012; Van de Walle, Karp, & Bay-Williams, 2013) with differentiated learning (Beecher & Sweeny, 2008; Ensign, 2012; Tomlinson, 2005; Tomlinson, Brighton, Hertberg, Callahan, Moon, Brimijoin, Conover, & Reynolds, 2003) so that students of all races (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter, Ladd, & Vigdor, 2009; National Council of Teachers of Mathematics, 2010; Robinson, 2010), all socio-economic statuses (Castle, Baker, & Tortora, 2005; Kususanto, Ismail, & Majeed, 2011; Latz & Adams, 2011; Petrilli, 2013), and

all genders (Gunderson, Ramriez, Levine, & Beilock, 2012; Van de Walle et al., 2013) can be successful in the classroom and be able to compete globally. Teachers will only gain this understanding and knowledge of these strategies through effective professional learning. Professional learning must be analyzed to ensure that it is not a time of filler games, manipulatives, and the latest strategies (Wu, 2011). Wu (2011) states that professional learning needs to address the way students learn and refine instructional practices. The standards will not have the desired impact unless states and districts follow up the standards with the needed resources (Kober & Rentner, 2012). The National Council of Teachers of Mathematics (2013) states that the standards may take time to produce substantial results in student achievement. Standards alone will not change students' understanding. Teachers must be trained in best practices, and both practices and standards will have to be updated as new research shows how students learn best.

Guiding Questions

This study investigated how teachers perceived the use of manipulatives, through the CRA model, differentiation, and professional learning; and whether or not it had influenced their math instruction. Literature is available related to professional learning as well as to math instruction through the Concrete Representational Abstract (CRA) model using manipulatives and differentiation through flexible grouping. However, little research is available that discusses all the innovations used together in the mathematics classroom. The purpose of this dissertation was to understand how teachers perceived math innovations, and how the innovations influenced math instruction. Strategies that have been found to be successful are using manipulatives through the CRA model (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013), a form of differentiation known as flexible grouping (Christenson & Wager, 2012; Ford, 2005; Rogers,

2012; Wu, 2013) and understanding how to work with different subgroups of students (Berry, 2004; Clotfelter et al., 2009; National Council of Teachers of Mathematics, 2010; Reardon, 2013; Yates & Collins, 2006). To make certain that these areas are implemented in the classrooms, administrators should be included in professional learning to guarantee quality math instruction (Burch & Spillane, 2003; Heck & Hallinger, 2009; Hoang, 2008; Puchner, Taylor, O'Donnell, & Fick, 2008).

This study was conducted in Georgia Vision Project (GVP) districts to analyze the impact of new classroom practice and new policy implementation. Both the Common Core Standards and the Vision Project share a common inception date – 2009. The GVP created seven standards to help districts provide each student an excellent and equitable education (Georgia School Boards Association & Georgia Superintendents Association, 2010). This study focused on math innovations through the GVP standard of teaching and learning. The two school districts that were studied have incorporated the GVP standards into their strategic plan and have worked on these standards with fidelity according to the Vision Project Director. The two districts have used differentiation and have conducted math professional learning in the past. These districts were studied to determine the impact that the teachers' perceptions of math innovations had on their instruction. Therefore, the purpose of this study was to gain an understanding of how professional learning, math manipulatives, the CRA model, and flexible grouping impact instruction through the central research question:

"How do teachers' perceptions of math innovations influence math instruction in Georgia Vision Project districts?

Review of the Literature

The review of the literature covers five main areas. The first area is related to the theoretical framework associated with this research project. This study is a qualitative study

using a multiple instrumental case study. The remaining areas include (a) information about the Georgia Vision Project, (b) math instruction, (c) differentiation, and (d) instruction of math in different subgroups to meet the expectations of the Common Core State Standards (CCSS) for math. The section on math instruction presents information about math professional learning, the use of manipulatives, and the use of the Concrete Representational Abstract (CRA) model. The section on differentiation provides a review of the use of differentiation through flexible grouping. The subgroup section discusses research in teaching math to students of different races, genders, and socio-economic statuses. The literature review provides background knowledge about differentiation, math instruction with manipulatives, and teaching math to different subgroups.

Theoretical Framework

This is a qualitative study to determine how the Georgia Vision Project (GVP) impacted the use of innovations in math instruction. The study was conducted through a multiple instrumental case study. Data was collected through interviews, observations, and artifacts. The researcher gained an understanding of how the math innovations impacted math instruction through the teachers' experiences, which is a phenomenological study.

This study was conducted through the general inductive approach to analyze the data that is collected (Thomas, 2006). This approach allows the researcher to analyze large amounts of qualitative data in a convenient and efficient framework (Latz, Speirs-Neumeister, Adams, & Pierce, 2009; Thomas, 2006). The researcher is able to collect the data, summarize the data, and then develop a theory about the data based on the data necessary to determine the functionality of a program.

Qualitative studies are composed of an epistemology, theoretical perspective, methodology, and methods to helped guide the study (Crotty, 1998). Epistemology is the theory of knowledge and how the participants construct their knowledge. For this study, the epistemology is constructivist theory in which participants are active in constructing new ideas based on past experience (Bruner, 1973; Crotty, 1998). Since the teachers were actively engaged in making sense of math innovations based on previous research and the recommendations of the Vision Project, this study was based on the constructivist theory. Constructivist theory is a common theory that is used in educational research (Mill, Bonner, & Francis; 2006). This type of research allows the researcher to describe the experiences of the participants through an explanatory narrative that is developed based on the codes that were found (Creswell, 2012). The methodology employed was phenomenological research based on the teachers' abilities to experience and express their perceptions of the results of math innovations in the classroom. A phenomenological study examines individual's experiences and his or her perspectives based on these personal experiences (Merriam, 2009).

This phenomenological study was conducted to gain an understanding of teachers' personal experiences with math innovations that had been initiated in the district through the GVP. This study used a multiple instrumental case study approach; that is, several particular individuals were selected to gain an understanding of how the math innovations impacted math instruction.

Georgia Vision Project

This study selected districts that had signed a partnership with the Georgia Vision Project (GVP), an organization that works to improve education in the state of Georgia (Georgia School Boards Association & Georgia Superintendents Association, 2010). The organization focuses on

seven standards designed to improve the education that all students in Georgia receive in order to help students be college and career ready upon graduation from high school.

The GVP was formed by the Georgia School Superintendents Association and the Georgia School Boards Association with the goal of analyzing the state's education programs and providing recommendations for improving education for all students across the state, in all socio-economic statuses (www.gavisionproject.org). This group was formed in 2009 and has over 35 partners. The partners work together to help provide instructional strategies, incorporate technology, and prepare Georgia students to be college and career ready. The GVP has seven standards that help accomplish this vision. These standards cover early learning; teaching and learning; teaching and learning resources; human and organizational capital; governance, leadership, and accountability; culture, climate and organizational efficacy; and financial resources to help support the work carried out in the districts.

The central focus of this study is the *teaching and learning* standard of the GVP. This standard focuses on ensuring that the teachers work together and plan for effective instruction through providing the best learning environment for students. An additional part of the standard is that the learning environment should provide a variety of strategies to reach all students. The lessons that teachers plan should be challenging to the students, but flexible enough to meet all needs of the students and their interests (Georgia School Boards Association & Georgia Superintendents Association, 2010).

This study was conducted using two GVP districts. The districts had signed on as partners with the GVP and include GVP recommendations in their strategic plans to improve education. This study specifically focused on the teaching and learning standard in relation to

math instruction. The GVP standards provide recommendations to assist districts, schools, and teachers in providing an equitable and excellent education to students in the district.

Instruction of Mathematics

Research shows that effective professional learning (Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2009), proper use of manipulatives (Puchner et al., 2008), and implementation of the CRA model (Van de Walle et al., 2013) are all math instruction strategies to improve student achievement in math. Teachers must receive high-quality professional learning to be able to successfully deliver instruction focusing on teaching students multiple ways of solving math problems and also gaining a true understanding of math concepts instead of teaching a process to students (The National Mathematics Advisory Panel, 2008; Wu, 2011). In CCSS, students are no longer simply to learn the process of math, but are taught to solve math problems in multiple ways, and to discuss, analyze, and explain the math problem with others (Common Core State Standards Initiative, 2014; Porter et al., 2011). Porter et al. (2011) feel that achieving these higher demanding abilities will lead to students becoming college and career ready and able to compete globally. The new math standards will be effective only if teachers and students gain an understanding of how to solve math problems in multiple ways with a deeper understanding of math concepts (Flores, 2010; Mancl et al., 2012; The National Mathematics Advisory Panel, 2008; Van de Walle et al., 2013). Not only is quality professional development needed for teachers, but instructional leaders must also be active participants in professional learning for change to take place in instruction (Burch & Spillane, 2003).

Instructional leaders and teachers must be aware of best instructional strategies, including the use of manipulatives, in order to ensure quality instruction (Puchner et al., 2008; Hoang, 2008). One model of instruction that gives students the opportunity to build better conceptual

understanding is the Concrete Representational Abstract (CRA) model, which helps provide a deeper understanding of math concepts and enables students to be more successful in mathematics (Mancl et al., 2012). This three step model begins by introducing concepts through manipulatives, then moving to pictures, and finally to solving problems with numbers through an algorithm (Access Center, 2009; Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). Teachers will need to be provided with meaningful professional learning to help with the transition of teaching CCSS (Loucks-Horsely et al., 2009; The National Mathematics Advisory Panel, 2008; Wu, 2011). The standards require teachers and students to have a deeper understanding of the math concepts and to be able to solve math problems in multiple ways (Flores, 2010; Mancl et al., 2012; The National Mathematics Advisory Panel, 2008; Van de Walle et al., 2013). The use of manipulatives through the CRA model has been found to help increase student achievement through a deeper understanding (Puchner et al., 2008; Van de Walle et al., 2013).

Professional learning in mathematics.

Professional learning is needed for teachers to gain a better understanding of math content, instructional strategies, and new resources (Burch & Spillane, 2003; Darling-Hammond & Richardson, 2009; Frede, Lamy, & Boyd, 2010; Hoang, 2008; Loucks-Horsley et al., 2009). Professional learning should be on-going to help support teachers as they learn new concepts and strategies (Darling-Hammond & Richardson, 2009) and how to provide instruction to students (Frede et al., 2010). When teachers are able to experience how students learn, they are able to better understand how to deliver instruction (Loucks-Horsley et al., 2010). Teachers need to be trained on how to use manipulatives properly during instruction (Puchner et al., 2008). Involving

professors from higher education, as well as instructional coaches, can help support teachers in this new learning (Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010).

Teachers are unable to teach what they do not know or understand. Therefore, the National Mathematics Advisory Panel (2008) and Loucks-Horsely at al. (2010) recommend that districts test to determine teachers' levels of subject knowledge in order to better plan effective professional learning. Testing teachers' understanding of math content will determine how to design professional learning. The Advisory Panel also points out that the data may help determine if certain teachers should solely teach math to students. They further stated that understanding of math teachers' levels of proficiency must be strengthened to improve student achievement. The Advisory Panel believed this is a need at all levels of teacher experience: pre-service, early career, and veteran teachers. Teachers must understand their own grade level content, as well as math content from previous and future grades, and the way skills connect to other skills.

High-quality professional learning needs to take place to ensure that pre-service teachers, new teachers, and veteran teachers are engaged and acquiring knowledge during on-going professional learning (Frede et al., 2010; The National Mathematics Advisory Panel, 2008; Wu, 2011). This engagement is necessary in order to help teachers be successful in raising student achievement in the classroom using the CCSS (Understanding the Common Core, 2014). The Advisory Panel (2008) had researched to discover the best way to conduct professional learning in math. The group found that most of the studies which they reviewed about professional development for math teachers included a "one-group pretest/posttest design." The studies included teacher surveys about how their knowledge increased due to professional learning. The studies that showed gains in teacher and student knowledge included little to no information

regarding how professional learning for teachers was carried out. The Panel recommended that well-designed professional learning should be developed in a manner that allows teachers at all levels to have a better understanding of math.

Many districts are using math specialists and coaches to provide this professional learning so that teachers gain an understanding of math content and pedagogy (Loucks-Horsely et al., 2010; The National Mathematics Advisory Panel, 2008). Coaching provides teachers one-on-one professional learning, to receive the support and modeling that teachers need (Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010). In addition, coaches can help teachers reflect on their practices, look at student work, and better understand standards and instructional practices. Darling-Hammond, Wei, Andree, Richardson, and Orphanos (2009) found that teachers who received coaching support were more likely to implement professional learning strategies and content correctly in their classrooms.

Changing practices and learning new strategies takes time (Loucks-Horsley et al., 2010). Teachers need multiple opportunities to learn new strategies to use in the classroom that are modeled for them in on-going professional learning (Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010). Loucks-Horsley et al. (2010) states that stand-alone professional learning sessions will not help teachers become successful. On-going professional learning allows teachers to know that they may fail the first time they try something, but with the support of professional learning and instructional leaders, they can be successful. Professional learning that is on-going allows for relationships to be built that provide support for teachers (Darling-Hammond & Richardson, 2009). In addition, on-going professional learning has been found to have a stronger focus on content, permitting teachers to gain a deeper understanding (Garet,

Porter, Desimone, Birman, & Yoon, 2001) while still being focused on student learning (Darling-Hammond & Richardson, 2009).

Frede et al. (2010) suggests that research related to mathematics instruction, including what has been found about teaching young children, should be provided to educators through professional learning. In professional development, Frede et al. suggests teachers should learn about math content; children's understanding of math; instructional strategies; and resources to use with young children. Building teacher knowledge will help improve instruction and increase student achievement (Darling-Hammond et al., 2009). This professional learning needs to be on-going and to provide teachers with the opportunity to network with each other and with professors from higher education, if possible (Frede et al., 2010; Hamos, Bergin, Maki, Perez, Prival, Rainey, Rowell, & Vander Putten, 2009). Districts are using professors from higher education institutes to build a deeper understanding of math concepts (Loucks-Horsley et al., 2010). The Center for Public Education encourages learning teams work together during professional learning to work on creating instructional plans to align and meet the higher-level standards of the Common Core (Understanding the Common Core Standards, 2014).

Curriculum implementation, where teachers focus on the curriculum and content of the standards, is one type of professional learning to help support teachers (Loucks-Horsely et al., 2010). This type of professional learning focuses on enhancing quality instruction. During this professional learning, teachers gain a deeper understanding of the content and learn strategies that they can use in their classrooms to help students gain a deeper understanding of the concepts. This type of professional learning allows teachers to spend time reflecting and learning how these strategies can help their students. Teachers can share their personal experiences, concerns that they may have, and build a network of support (Darling-Hammond & Richardson,

2009; Loucks-Horsely et al., 2010). Curriculum implementation sessions help teachers and schools focus on instruction and discover what they need to be successful in the classroom.

On-going professional learning should be designed to help teachers gain a deeper understanding of their work and build relationships with other teachers, coaches, and professors (Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010). During the professional learning teachers should acquire knowledge of math content, instructional strategies, how students learn, and new resources to use with students (Frede et al., 2010; Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010).

Role of instructional leaders in professional learning.

Researchers (Burch & Spillane, 2013; Wu, 2011) have found that leaders who are active participants in professional learning send a message to teachers about the importance of the material and are able to support instruction in the classroom (Banilower, Boyd, Pasley, & Weiss, 2006; Burche & Spillane, 2003). Teachers respect leaders when they are informed of the content and are able to provide valuable feedback (Banilower et al., 2006). Effective leaders help set the goals and vision for the school and monitor progress toward achieving the goals (Leithwood, Seashore Louis, Anderson, & Wahlstrom, 2004), while ensuring time is set aside for quality professional learning (Darling-Hammond & Richardson, 2009; Loucks-Horseley et al., 2009).

In addition to teacher understanding of mathematics instruction, it is important that instructional leaders also have an understanding of math instruction (Burch & Spillane, 2003; Darling-Hammond & Richardson, 2001; Hoang, 2008). Leadership is one of the most important factors impacting student and teacher learning (Leithwood et al., 2004; Loucks-Horsley et al., 2010). Leithwood et al. (2004) found that classroom instruction is the most important factor with leadership being the second most important factor, especially in low performing schools. School

leadership and capacity building have a direct relationship on each other as well as on academic improvements (DuFour & Marzano, 2011; Heck & Hallinger, 2009; Leithwood et al., 2004). Tomlinson (Wu, 2013, p.132) states, "A leader articulates a compelling vision for people around them, invites people to join the vision, and then works diligently to make sure the vision works for those who invest in it." Leaders set goals, establish a purpose through a vision, and monitor the performance with high expectations (Leithwood et al., 2004). Instructional leaders can be confident that good math instruction is occurring in the classrooms after teachers have had professional learning.

Burch and Spillane (2003) conducted a study in which they observed grade level meetings, faculty meetings, school improvement meetings, and professional learning sessions, followed by observations that explored the impact administrators and curriculum coordinators had on subject matter. During interviews with the school leaders, literacy and math were instructional priorities in accord with state assessments. The leaders heavily relied on outside support to help with professional development for math, while looking to teachers for direction on literacy professional learning. The leaders who were well respected by the faculty were those who participated in the professional learning, were active in the classrooms and also provided valuable teacher feedback (Banilower et al., 2006; Burche & Spillane, 2003). Banilower et al. (2006) found it beneficial to the teachers when administrators actively participated in the professional learning sessions. Hoang (2008) had similar outcomes in research, finding that active leadership helped teachers learn more about the specific study necessary to improve math instruction for students based on the needs of teachers.

Instructional leaders who participate and play an active role in professional learning will have a better understanding of quality math instruction when observing classrooms (Banilower et

al., 2006). Puchner et al. (2008) found that teachers often tried to implement what they learned during professional learning, but it was not always carried out correctly. Pucher et al. completed a case-study of four teachers using manipulatives to teach math concepts. Three of the teachers used manipulatives in an ineffective way, which actually hindered students' understanding. The results of the case study showed that manipulatives are best used when they allow students to explore concepts at the beginning instead of being used at the end of a lesson or unit. Strategic professional learning on manipulatives had been overlooked for the participants in the study; it is an area that Puchner et al. determined should be included in future professional learning. Instructional leaders who participate would have a better understanding of whether the manipulatives were used correctly during the lesson. Based on the study, Puchner et al. recommended that professional development occur to ensure teachers understand how to properly teach with and use manipulatives. In the past, professional development had occurred only for teachers to increase their mathematical understanding, with the focus being on math content.

In addition to helping teachers carry out content correctly during instruction, leaders can also help teachers prepare for the instruction. Teachers in other countries such as Sweden, Japan, and Singapore spend more time planning and collaborating and less time instructing students than teachers in the United States (Darling-Hammond & Richardson, 2009). In addition to having more planning time, teachers in these high-performing countries must have at least 100 hours of professional learning time. For professional learning to be effective, teachers need time for "in-depth investigation, reflection, and continuous learning" (Loucks-Horsley et al., 2010, p. 122). This time can be difficult for leaders and teachers to find during the school day. However, Loucks-Horsley et al. (2010) suggest ways for leaders to creatively find time for teachers to

meet. Using substitutes for teachers to have release time to meet with each other and collaboratively plan. The second way is to restructure the schedule through early release days, or having students come in an hour later on certain days (Darling-Hammond & Richardson, 2009; Loucks-Horseley et al., 2009). Teachers' time can also be restructured. Instead of teachers having 45 minutes of contracted time each afternoon, the school will "buy" several afternoons to allow teachers to come in before school starts for professional learning, and trade the time. Effective leaders are looking at how they are using their given time with teachers. Instead of having faculty meetings every week, leaders are using other forms of communication to allow teachers to meet together during the scheduled faculty meetings. Effective leaders are analyzing the current professional learning time to guarantee that it is meeting the needs of the teachers. If not, they are restructuring professional learning to have teachers meet together during this time.

Another way for leaders to find time is through applying for grants to pay teachers for additional non-contracted professional learning time. The federally funded Math Science Partnership (MSP) grant provides funds for off-contract professional learning or for substitutes to be hired to allow teachers to attend professional learning for math and science in partnership with colleges and universities (Hamos et al., 2009; Loucks-Horseley et al., 2009). This grant funds off-contract professional learning, or for substitutes to be hired to allow teachers to attend professional learning for math and science. These are different ways that effective leaders have found to provide teachers with quality professional learning time.

Instructional leaders play an important role in carrying out effective professional learning and implementing the professional learning in the classroom (Leithwood et al., 2004). The leaders provide goals for the school and ensure that teachers are meeting these goals through implementation of professional learning (Leithwood et al., 2004). Leaders who play an active

role in professional learning are aware of the instructional strategies (Burch & Spillane, 2013; Wu, 2011) and can provide valuable feedback to the teachers to improve instruction (Banilower et al., 2006).

Use of manipulatives.

Learning occurs when students are actively able to construct their own understanding (Boggan, Harper, & Whitmire, 2010). Math manipulatives allow students to actively construct their understanding during the lessons and have shown an increase in students' attitudes towards math (Kogce, Yildiz, Aydin, & Altindag, 2009) helping to make a concept concrete (Moyer, 2001). Boggan et al. (2010) state that since ancient times different groups have used math manipulatives such as counting boards, wooden or clay trays, sand, abacuses, corn kernels, and string with knots to name a few. Manipulatives can be bought, found around the house, or made. Boggan et al. suggest using manipulatives that range from beans and bottle caps to Unifix cubes and base-ten blocks, and many other items. "They are used to introduce, practice, or remediate a math concept" (Boggan et al., 2010, p.2). Belenky and Nokes (2009) found that when students used manipulatives that were closely related to the problem, for example small puppies to represent a problem about puppies, that students did better than when the manipulative was abstract such as red and yellow counters. In contrast, Brown, McNeil, and Glenberg (2009) found that the more realistic the manipulative the less effective. Boggan et al. point out that an important thing for teachers to remember about using manipulatives is that they must fit the ability of the child and be chosen for the specific concept or skill.

Teachers need to receive professional learning on using manipulavites (Puchner et al., 2008). Most of the professional learning that was reviewed occurred to teach math concepts instead of using manipulatives. Puchner et al. (2008) completed a case study of teachers who

used manipulatives during instruction. The case study found that it was most effective when teachers used manipulatives at the beginning of a lesson or unit to build a conceptual understanding. Manipulatives were not as effective when used at the end of a lesson or unit.

Students at all achievement levels benefit from using manipulatives with instruction (Boggan et al., 2010; Fujimura, 2001; Johnson, 2000; Mancl, 2012). Gifted students often learn concepts at a faster pace than other students, but still benefit from the use of manipulatives during instruction (Johnson, 2000). Correa, Perry, Sims, Miller and Fang (2008) found that upper grade elementary teachers often feel that manipulatives are only for students who are struggling. Teachers use manipulatives as an intervention instead of using manipulatives with instruction. Meanwhile Correa et al. (2008) found that lower grade teachers used the manipulatives with all students during their whole group instruction.

Math manipulatives serve as a tool to allow students to actively construct meaning to math concepts (Moyer, 2001). The manipualives can be used with students at all achievement levels to build a better understanding (Boggan et al., 2010; Fujimura, 2001; Mancl, 2012). Manipulatives should be used at the beginning of concepts to allow students to make connections to algorithms (Puchner et al., 2008).

The Concrete Representational Abstract Model.

One model that teachers can use for instruction is the Concrete Representational Abstract (CRA) model to represent and solve math problems using concrete manipulatives to build understanding (Access Center, 2009: Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). The research in this section provides an understanding of how the CRA model can assist in achieving a deeper understanding of mathematics and improve student achievement. Mancl et al. (2012) found that elementary students who struggle in math often have a limited

understanding of mathematical concepts because math concepts build on each other and need a foundation for the concepts to build upon. Memorizing steps to a process is not useful when the actual process does not make sense to the students (Access Center, 2009). Mancl et al. and Flores (2010) found the CRA model to be effective for students with and without a learning disability.

The CRA model consists of three stages that are continuously repeated as new concepts are introduced, with each stage being used to teach the concept and build on the previous stage to develop a deeper understanding and lead to an algorithm (Access Center, 2009; Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). The major focus of the CRA model is not on using manipulatives, but on building conceptual understanding. The first stage, the concrete stage, begins with the teacher modeling the concept through instruction with manipulatives to demonstrate the concept in a concrete manner for the students. After demonstrating the use of manipulatives during a lesson, students are given time to master the concept using manipulatives independently. Once the students master the concept with manipulatives, then the teacher moves the students into the next stage. The second stage, the representational or pictorial stage, moves away from using manipulatives and uses pictures such as ten frames, circles, dots, tallies, etc. during instruction. Students are then given problems to practice using representations instead of manipulatives. Once this stage has been mastered, the students move to the abstract stage. The third and final step is the abstract stage, which has the teacher and students using numbers and symbols to solve the problems through the understanding that was created when using manipulatives and representations. During the abstract stage, there is a focus on fluency. Creating mnemonic devices between the representational and abstract stages may help in remembering the process of solving the problems (Flores, 2010). The amount of time spent on each stage varies from concept to concept and according to the students' needs. These stages can

be repeated if needed to ensure that students build a solid foundation and a deep understanding of the concept (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013).

Mancl et al. (2012) found that elementary students who struggle in math often have a limited understanding of mathematical concepts due to math concepts building on each other, needing a foundation for the concepts to build upon, and memorizing steps to a process when the actual process does not make sense to the students. The CRA model helps build understanding before teaching a rule (Access Center, 2009). Instruction with the CRA model includes showing how to represent and solve a math problem using concrete manipulatives to build understanding. Mancl et al. and Flores (2010) found the CRA model to be effective in helping students with learning disabilities in math to be as successful as students without learning disabilities. Think-alouds, the part of instruction where the teacher demonstrates what is being thought while solving the problem, was found to be helpful so that students understand how to use the manipulatives and how they should be thinking about the math problem.

Some researchers have not been in support of the CRA model and the use of manipulatives (McNeil, Uttal, Jarvin, & Sternberg, 2009; Carbonneau, Marley, & Selig, 2013). In one study, students who were allowed to use manipulatives to solve problems solved fewer problems correctly than the control group that did not use manipulatives (McNeil et al., 2009). However, the success rate of the experimental group using manipulatives was only slightly lower than the control group. When the errors were analyzed, students who had manipulatives that were perceptually rich made the most errors. The errors that the students made were not conceptual errors. McNeil et al. felt that manipulatives can have their advantages and disadvantages whether perceptually rich or simple manipulatives. Carbonneau et al.'s (2013)

meta-analysis of 55 studies found that the use of manipulatives had a small to medium effect size on student learning. The effect size was very small when the task required higher-order thinking.

Additional studies have found that manipulatives and the CRA model were found to be beneficial to student achievement (Flores, 2010; Mancl et al., 2012; McNeil & Fyfe, 2012; Witzel, 2005). McNeil and Fyfe (2012) found in their previous research that teaching math in a concrete way could have a negative impact on students as they became distracted from the connections by the manipulatives. They suggest that math instruction begin with lessons and activities that make the concept concrete and fade into the abstract stage. Students who learned through the CRA model performed better than students who did not, even with fewer practice problems, as students accurately developed and remembered procedural steps, resulting in higher performance (Witzel, 2005). This was true for students of all ability levels (Flores, 2010; Mancl et al., 2012; Witzel, 2005). Flores (2010) reported from teacher interviews that students who received CRA instruction had an increased ability to transfer what they learned to new skills. CRA also helped students have a positive outlook toward math and increased participation, leading to higher performance levels.

The Concrete Representational Abstract (CRA) model is an instructional strategy that is used with manipulatives to build an understanding on concepts and increase student achievement (Access Center, 2009; Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). This model allows students to build an understanding of the concept before learning the procedure for solving a problem with an algorithm (Access Center, 2009). A true understanding is the foundation for students and leads to students understanding future concepts regardless of ability level (Flores, 2010; Mancl et al., 2012)

Conclusion.

Teachers are in need of professional learning to help support students in mastering the CCSS **(**Flores, 2010; Mancl et al., 2012; The National Mathematics Advisory Panel, 2008; Van de Walle et al., 2013). Professional learning is needed to help teachers learn the content and strategies to successfully teach students (Burch & Spillane, 2003; Darling-Hammond & Richardson, 2009; Frede et al., 2010; Hoang, 2008; Loucks-Horsely et al., 2010). This professional learning should be on-going and should include instructional leaders (Burch & Spillane, 2003; Darling-Hammond & Richardson, 2001; Hoang, 2008; Loucks-Horsely et al., 2010), instructional coaches (Darling-Hammond & Richardson, 2009; Loucks-Horsely et al., 2010; The National Mathematics Advisory Panel, 2008), and professors from higher education (Frede et al., 2010; Hamos et al., 2009). The use of manipulatives (Puchner et al., 2008) and the use of the CRA model (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013) are topics to address during professional learning that would help support instruction in mathematics. The CRA model stages are continuously repeated as new skills are introduced to build a deeper understanding for students and increase performance (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). The amount of time spent on each stage varies for each skill and according to the students' needs. The CRA model can also lead to differentiated instruction, as different students can work on different stages according to each child's ability (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013).

Differentiation through Flexible Grouping

This next portion will discuss how differentiation meets the needs of students through flexible grouping (Christenson & Wager, 2012; Ford, 2005; Konstantinou-Katzi, Tsolaki, Meletiou-Macrotheris, & Koutselini, 2013) and will further explore the effectiveness of grouping

as intervention (Hong, Corter, Hong, & Pelletier, 2012; Kususanto, Ismail, & Majeed, 2011) and grouping as enrichment as two specific types of flexible grouping (Brulles, Peters, & Saunders, 2012; Linn-Cohen & Hertzog, 2007; Maggio & Sayler, 2013). This portion also discusses how the lack of differentiation provided through homogenous grouping fails to meet the needs of all students (Ansalone, 2010; Ford, 2005). Differentiation is meeting different students' needs by varying the content, process, product, or learning environment (Tomlinson, 2005). Flexible grouping is teaching students in small groups that have similar needs to help provide success (Barbour, 1990; Castle et al., 2005; Christenson & Wager, 2012; Ford, 2005; Rogers, 2012; Wu, 2013). The groups are constantly changing as the needs of the students are changing (Castle et al., 2005; Ford, 2005; Wu, 2013) and allow the teacher to focus on all students (Konstantinou-Katzi et al., 2013; Ensign, 2012; Tomlinson et al., 2003). The use of flexible groups takes more instructional time to carry out (Castle et al., 2005; Ford, 2005), but allows the teacher to challenge each student (Wu, 2013).

"Differentiation simply suggests that teachers have clear learning goals that are rich in meaning and provide various avenues and support systems to maximize the chance of each student succeeding with those rich and important goals" (Tomlinson, 2005, p.14). Students are different and learn in different ways. Tomlinson (2005) feels there is no one-size-fits-all approach; therefore, teachers should provide differentiation to meet all students' needs. Tomlinson suggests that teachers can use differentiation to meet the individual student's needs by varying the content, process, product, or learning style. Each of the students in the classroom would be working on the same standard, but the way the student is approaching the standard may be different depending on the student's needs.

Implementing this type of differentiation in the classroom can be very challenging for teachers as it is demanding and time consuming (Konstantinou-Katzi et al., 2013). Konstantinou-Katzi et al. (2013) state that planning for the instruction, groups, and activities can be overwhelming for the teacher. These researchers suggest preventing teachers from becoming overwhelmed by teachers starting small and working together in grade groups. This would enable them to help share the work and decide if and how the task should be differentiated (Gavin & Moylan, 2012). Some suggestions Gavin and Moylan (2012) offer to help with this is that teachers should start by selecting an appropriate task and then modifying the task. An additional suggestion is creating support, such as cards with hints that can be handed out as teachers see students struggle. Each card would provide additional scaffolding to help students be successful with the task. Gavin and Moylan found that this allows even the lowest performing students in the class to be able to complete the same task as the highest performing student.

Due to the wide range of ability levels in the classrooms, teachers must think about students at all performance levels. Konstantinou-Katzi et al. (2013) states that teachers are most often concerned with the progress of the average student, which composes the majority of the classroom. However, Konstantinou-Katzi et al. found that when a teacher uses differentiation, all students are the teacher's focus. This leads to all students gaining a better understanding of the material and leading to a more positive attitude toward the subject. This occurs because differentiation allows the teacher to support the student in his or her learning and builds self-esteem for the individual. Students who have repeated successful situations are able to build the self-esteem that they need for life (Tomlinson, 2005). Tomlinson (2005) states that these successful situations come from teachers providing support so that students can master standards and experience success on tasks. Providing this success can be as easy as providing three

different levels of difficulty for a similar problem and allowing students to choose to solve the problem that is the perfect fit for them (Christenson & Wager, 2012).

One way for teachers to meet all students' needs is to meet with students in small groups consisting of similar levels of knowledge in order to help students who need additional support to understand the material or to meet with advanced learners who need to be challenged (Ensign, 2012; Tomlinson et al., 2003). Ensign (2012) found that students who were in classrooms where the teacher differentiates are successful even if they have not been successful in the past. For teachers to use differentiation appropriately, teachers need to learn about their students in order to use multiple types of differentiation (Beecher et al., 2008; Tomlinson et al., 2003). Teachers can use student readiness, interest, and learning profiles in the classroom to meet the needs of students. When students are given a choice as well as assignments based on their learning styles, they are more engaged, which leads to higher levels of success (Beecher et al., 2008).

Flexible grouping.

Researchers agree that instructional time is limited in the classroom, and differentiation can help meet the needs of all students (Christenson & Wager, 2012; Ford, 2005; Tomlinson, 2005). A form of differentiation such as flexible grouping can help educators meet the needs of individual students (Christenson & Wager, 2012; Ford, 2005; Konstantinou-Katzi et al., 2013). As the students' needs change, so can the composition of the groups (Ford, 2005). Flexible grouping allows the students to move from one group to another, from lesson to lesson, depending on the material being presented. This model of differentiation has been found to be effective for low-achieving students (Castle et al., 2005; Hong et al., 2012; Konstantinou-Katzi et al., 2013; McCoach, O'Connell, & Levitt, 2006) as well as for average and gifted students (Brulles et al., 2012; Hargrove, 2012; Maggio & Sayler, 2013).

Flexible grouping is a way for teachers to differentiate and meet with small groups of students that have similar needs and help provide success (Barbour, 1990; Castle et al., 2005; Christenson & Wager, 2012; Ford, 2005; Rogers, 2012; Wu, 2013). Researchers agree that one way to provide differentiation is to meet with small groups of students in order to support or challenge the varying groups (Christenson & Wager, 2012; Ford, 2005; Wu, 2013). This prevents students lacking background knowledge from either being in the same group all year or being slowed down while the teacher addresses other students' needs. The groups are created and recreated frequently with the students' needs in mind. In the effective use of flexible groups, teachers are constantly changing the members of the groups as the needs of the students change from one lesson to another (Castle et al., 2005; Ford, 2005; Wu, 2013). This flexibility makes implementing differentiation easier. The small groups of students allow the teacher to observe and hear what the students are thinking, which builds a better understanding of the students' knowledge (Wu, 2013). To form groups, teachers think about the needs of students and then form groups to meet those needs (Castle et al., 2005; Wu, 2013). These groups are created by readiness, interest, choice, and sometimes randomly to allow new students to work together (Wu, 2013). Students who need more help may be in smaller groups that provide more teacher support, while students who understand the concept will meet in a group with less support or one that provides more of a challenge (Ford, 2005). Christenson and Wager (2012) suggest using flexible groups in math to allow students to develop an understanding of the concept at the students' rate of development and to be able to share their solution and strategy.

Meeting students' needs can require a lot of instructional time as the teacher meets with multiple small groups (Castle et al., 2005). Ford (2005) states that the disadvantage of flexible grouping is that the teacher needs to find additional time for lower performing students to work

with teacher support. In addition, the teacher needs to find time for the higher performing students to meet with her to be challenged. Ford found that while the teacher is meeting with groups, one concern is keeping the other students engaged in meaningful activities. Ford states that teachers can set up procedures such as meaningful assignments from whole group instruction, assignments that allow for connections among the groups; ongoing independent work from whole group; and ongoing alternatives to help with potential problems, thereby taking advantage of the positive impacts of flexible grouping.

On the other hand, Ford (2005) states that one of the advantages of flexible grouping, if well-planned, is that the implementation allows for more efficient use of time and materials. Also, it allows the teacher to provide additional support to those that need it, while students who need less support are engaged in other tasks. Researchers have found that teachers often prefer to teach students according to their ability, which makes it easier to address the students' needs (Ansalone, 2010; Barbour, 1990). Rogers (2012) found that ability grouping improved student achievement in math, whether the grouping occurred within the classroom or between classes, in which students are assigned to classes based on ability, as long as teachers are committed to helping students achieve success. Castle at al. (2005) tracked non-transient, below-level elementary students on multiple literacy assessments during a five-year flexible grouping implementation in a high-needs school. The percentage of students attaining mastery increased during this five-year period. Also, as the teachers saw the improvements gained, the amount of instructional time that teachers used for implementation of flexible grouping increased over the five-year period. When surveyed, teachers attributed the results to needs-based focused instruction, the ability to keep students' attention on the task, and increased confidence. The

researchers believe that flexible grouping has a positive impact on student achievement, especially students who participated in flexible grouping for three or more years.

Students who are low socio-economic status are sometimes not identified as gifted (Latz & Adams, 2011). Students are recommended for gifted testing by the teacher or parents. Latz and Adams (2011) point out that students who are from lower socio-economic status often do not have parents who recommend them for gifted testing due to a lack of time or resources. Parents from middle- and upper-classes are more aware of resources and will push for their child to be tested for gifted education or at least be placed in higher achieving classes. The researchers recommend that teachers get to know students and their abilities instead of judging them by stereotype. Latz and Adams feel that differentiation allows the teacher continuously to monitor the students and find students' strengths regardless of their socio-economic status.

This section has provided an overview of flexible grouping. Flexible grouping allows for teachers to meet with small groups of students based on their needs (Barbour, 1990; Castle et al., 2005; Christenson & Wager, 2012; Ford, 2005; Rogers, 2012; Wu, 2013). The groups are created and changed based on changing needs of the students. This allows all students to be the teacher's focus. These groups may take a lot of instructional time (Castle et al., 2005; Ford, 2005), but can be very efficient if planned correctly (Ford, 2005).

Grouping as intervention.

The research is divided on the success of grouping low-achieving students as an intervention technique (Harris, 2012; Hong et al., 2012; Kususanto et al., 2011). Harris (2012) found that the teacher's expectations changed depending on the ability of the class while other researchers (Hong et al., 2012, Kususanto et al., 2011) reported that grouping has a greater impact on classroom management issues.

Some studies show that grouping students with similar achievement has negatively impacted low-achieving students (Harris, 2012; Hong et al., 2012; Kususanto et al., 2011. Teachers of students in lower-achievement classes or groups have lower expectations and more limited curriculum. Harris (2012) found in interviewing teachers, 54% strongly agreed or somewhat agreed that many of the students they were teaching were not capable of learning the material that the teachers were required to teach in class. This impacted the expectations that teachers had for students, based on previous academic standings for the students or on the work that the teacher had seen earlier in the year. Teachers' beliefs about students and their families had an impact on their expectations and the success of students. When teachers used homogenous groups, researchers found that low-achieving students had higher levels of problem behavior. Teachers became more focused on behavior issues rather than on curriculum and instruction (Hong et al., 2012; Kususanto et al., 2011).

Not only do students in low-achieving classrooms have higher levels of behavior problems, but also the students in the classroom were stigmatized. Often students are labeled early in elementary school according to their abilities and they remain there for the remainder of elementary school or longer (Barbour, 1990; Latz & Adams, 2011). Barbour (1990) states that students in heterogeneous classes learn to appreciate the different students in the classroom as they learn each one is talented in different areas. The teacher has an opportunity to create a learning environment of enthusiasm and success for all students instead of using a "grouping pattern that ends as a caste system" (Barbour, 1990, p. 67).

Flexible grouping helps reduce the "caste system" and has been found to improve students' learning in reading (Barbour, 1990). Hong et al. (2012) found that low-achieving kindergarteners that were grouped together and received an hour of appropriate instructional time

improved, as did average students. Flexible groups help keep students' attention as instruction is geared to their needs. Hong et al. provides the example of low-achieving students being placed in high-achieving groups, resulting in the low-achieving students losing interest in the activity and learning decreasing. McCoach et al. (2006) found similar results: students who received reading instruction in groups based on students' needs made gains for all levels of students.

Grouping as enrichment.

Flexible grouping is not only used for low-achieving students, but can also be useful as an enrichment tool for high-achieving students (Brulles et al., 2012; Linn-Cohen & Hertzog, 2007; Maggio & Sayler, 2013). High performing students benefit from flexible grouping, guaranteeing that their needs will be met during instructional time. Tomlinson states in an interview, "Advanced learners, too, need tasks that extend their thinking and push forward their understanding, knowledge, and skills" (Wu, 2013, p. 24). This grouping allows high-achieving students, gifted or not, to be challenged.

Brulles et al. (2012) state that often teachers focus on the needs of average and below average students. The researchers feel that the students who are most often left behind are the gifted students. Brulles et al. believe that differentiated instruction with flexible grouping would benefit all students. "By incorporating methods of grouping, differentiated instruction, and accelerated curriculum in ways that facilitate yearly academic growth for all students, schools have the capacity to provide appropriately challenging instruction for their high-ability students" (p.201). Brulles et al. found that non-gifted students made similar achievement gains whether the students were in gifted clusters or non-gifted clusters.

Hargrove (2012) states that the *No Child Left Behind Act* took away educators' focus on all students and instead focused the pressure on meeting the minimum for all students as students

were expected to pass the test. Hargrove encourages educators and parents to ensure that the gifted students in classrooms are being challenged. An example that Hargrove gives is that typically the math classroom is "kill and drill" and does not challenge gifted students, or any students, through problem-solving.

The gifted pull out model is not enough for gifted students. Teachers can meet the needs of students gifted in math through enrichment and acceleration. Maggio and Sayler (2013) studied a group of fifth grade students at one school who were allowed to be in an accelerated math program to meet their gifted needs in math. The students were not required to be in the gifted program, since students are not necessarily considered gifted to be in advanced math nor are all gifted students gifted in math. Only five students at the school qualified. The students compacted fifth and sixth grade math into one year to allow the students to take seventh grade math the following year. Students who were unsuccessful with the program were allowed to drop back into the regular math instruction. The program was opened to additional schools after the initial pilot year. Middle school teachers reported that the students who were in the accelerated program were well prepared and had a positive outlook about math (Maggio & Sayler, 2013).

The use of accelerated programs may not continue to show progress for students. Ma (2010) found that the majority of accelerated students did not participate in advanced mathematics coursework in high school. Non-accelerated students were highly unlikely to pursue, and were even discouraged from pursuing, the most advanced mathematics coursework in high school due to a lack of exposure. Acceleration helped encourage students from some disadvantaged backgrounds to pursue advanced math coursework in high school, specifically non-English speakers. Ma feels one of the factors of accelerated students not completing

advanced mathematics coursework could be burnout, but this could be overcome with a positive school culture.

Flexible grouping can be used for all levels of students. Low-performing students have been found to be successful with flexible grouping since it reduces the "caste system", indicating academic improvements, as instruction is on their level (Barbour, 1990; Hong et al., 2012; McCoach et al., 2006). High-performing students have also shown gains as teachers were able to provide more challenging work (Brulles et al., 2012; Linn-Cohen & Hertzog, 2007; Maggio & Sayler, 2013).

Homogenous grouping.

In this section an overview of homogenous grouping will be examined. Homogenous grouping, different from flexible grouping, is often formed based on race, ethnicity, or socio-economic status (SES) and seldom changes for long periods of time (Ansalone, 2010). One popular form of homogenous grouping in the United States was the Joplin Plan. This form of homogenous grouping started in Joplin, Missouri in the 1950s (Bracey, 1986; Morgan, 1960; Newport, 1967; Powell, 1964; Ramsey, 1962).

A different type of grouping is homogenous grouping, also known as tracking, which is not always supported by educators, but is of common practice in American schools (Ansalone, 2010; Ford, 2005). Tracking is "unequal access to knowledge and the differential treatment of students" and "… is a defective strategy that may create a restricted learning trajectory for students which can impact on academic competency" (Ansalone, 2010, p.3, 14). Students are often grouped by race, ethnicity, or socio-economic status. Ansalone found that tracking led to students not being given equal opportunities of education or treatment. Lower achievement groups typically consisted of lower socio-economic status students, while higher achieving

groups were comprised of higher socio-economic status students. Not only were students in lower achievement classes of lower socio-economic status, but they were also usually not challenged because the teacher was often more focused on behavior than instruction (Kususanto et al., 2011).

One form of homogenous grouping is known as the Joplin Plan (Bracey, 1986; Morgan, 1960; Newport, 1967; Powell, 1964; Ramsey, 1962). In the Joplin Plan, the students are grouped in cross-grade groupings, which allow the students to have instruction at their own instructional level. Students are grouped by their ability with multiple grades together in one classroom for instruction and all students in the class learning the same subject area. The Joplin Plan came about in the 1950's in Joplin, Missouri. The plan was written about in *The Saturday Evening Post* at the same time that the USSR launched Sputnik, pressing teachers to find a way to improve student achievement in America. The answer for many was the Joplin Plan that despite little data having been collected about the grouping of students, resulted in the nationwide implementation of cross-grade grouping (Morgan, 1960; Newport, 1967; Powell, 1964). This style of grouping was formed to help give students appropriate instruction when data showed as many as six different reading levels in one fifth grade classroom (Ramsey, 1962). The Joplin Plan was designed with the belief that if the make-up of the class were more homogenous, then the instructional program would be more successful (Newport, 1967).

Results from the Joplin Plan showed mixed results. The study by Powell (1964) found that there was no significance between two similar schools- one with the Joplin Plan and one without the Joplin Plan. The school that did not implement the Joplin Plan showed slightly higher results for superior readers and substantially higher results in science. The school with the Joplin Plan showed higher student interest and enthusiasm, but this did not impact student

results. Ramsey (1962) found some teachers felt that they were meeting the needs of their students more effectively, while others felt they could better meet their students' needs in the homeroom classroom. The teachers did feel that they could better meet the students' needs if they had more time. Students in the study seemed to like the groupings because they were engaged and learning on their instructional level (Newport, 1967). Grouping allowed for a better social and emotional climate, and the teachers found that planning instruction was easier for similarly grouped students. In addition, high results were achieved in reading, but Newport (1967) points out that this may have been a result of teachers and students being enthusiastic about a new program. Morgan (1960) found positive results with the Joplin Plan in his study. Students in fifth and sixth grade were grouped according to achievement. Students in fifth grade were found to have higher gains that were significant while sixth grade students who came to fifth grade classes had gains, but not enough to be considered significant. Lower achievers were found to feel less threatened and to receive more positive feedback from reading material used in the classroom, which was on the students' reading instructional level. Morgan notes that the Joplin Plan may not be effective for all schools; each school needs to determine if it will work for them.

Flexible grouping differs from homogenous grouping, or tracking, because it holds the same expectations for all students. In non-flexible ability grouping classrooms, students with lower levels of achievement often receive a lower quality of instruction and are held to lower standards (Konstantinou-Katzi et al., 2013). Flexible grouping results in the teacher holding the same expectations for all students, since students learn the same material at the beginning of the lesson, receive additional support, and then come back together at the end (Ford, 2005).

Conclusion.

Differentiation is meeting students' needs by adjusting the content, process, product, or learning environment (Tomlinson, 2005). The use of flexible grouping, grouping students according to similar needs, is a form of differentiation to meet all students' needs (Barbour, 1990; Castle et al., 2005; Christenson & Wager, 2012; Ford, 2005; Rogers, 2012; Wu, 2013). This strategy can be very time consuming for the individual teacher because groups are re-created and use a larger amount of instructional time for the teacher to meet with multiple small groups to teach similar concepts (Castle et al., 2005, Ford, 2005). Flexible grouping has been found to be effective for low-achieving students (Castle et al., 2005; Hong et al., 2012; Konstantinou-Katzi et al., 2013; McCoach et al., 2006) and for average and gifted students (Brulles et al., 2012; Hargrove, 2012; Maggio & Sayler, 2013). Homogenous grouping, also known as tracking is different from flexible grouping in that groups are formed and seldom change for long periods of time (Ansalone, 2010). Flexible grouping allows the teacher to ensure that the individual students' needs are met, in that the groups are created around the students' needs, and groups change as student needs change (Ford, 2005).

Mathematics Instruction of Different Subgroups

This portion of the literature review summarizes the research regarding math instruction to close the achievement gaps based on race, socio-economic status (SES), and gender. An achievement gap exists among Black and White students in mathematics (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter et al., 2009; National Council of Teachers of Mathematics, 2010; Robinson, 2010). In addition, researchers have found there to be an achievement gap between students of high and low socio-economic status (Clotfelter et al., 2009; Reardon, 2013; Yates & Collins, 2006). In the past, females have not performed as well as males in mathematics

(Gunderson et al., 2012; Hyde, Lindberg, Linn, Ellis, & Williams, 2008; Van de Walle et al., 2013). These gaps in achievement based on race, SES, and gender are often caused by a lack of high-quality teachers (Blackford & Khojasteh, 2013; Mueller & Maher, 2010) and low expectations (Ansalone, 2013; Berry, 2014). The use of the CRA model (Flores, 2010; Van de Walle et al., 2013) and flexible grouping (Mueller & Maher, 2010; Petrilli, 2013) have been found to be effective regardless of race, SES, or gender. This section of the literature review will also provide an overview of a number of researchers' recommendations to reduce achievement gaps in different races, SESs, and genders.

Research of students' race in mathematics.

This section reviews the literature about the achievement gap of race in mathematics. An achievement gap that has been observed for many years is that between Black and White students (Blackford & Khojasteh, 2013; Clotfelter et al., 2009; Loucks-Horsley et al., 2010). The achievement gap has been documented and followed since the Coleman Report in 1966 (Clotfelter et al., 2009). This gap may be attributed in part to a lack of funding (Blackford & Khojasteh, 2013), which results in not attaining high-quality teachers. The lack of high-quality teachers impacts students' achievement (Mueller & Maher, 2010) and often leads to teachers with low expectations (Berry, 2004). Leaders can help close the achievement gap by having teachers focus more on instruction (Wang, 2010) and having teachers show that math concepts relate to real life (Van de Walle et al., 2013).

Blackford and Khojasteh (2013) state that achievement gaps between Black and White students have long existed in the United States. To overcome them, acts such as desegregation and the No Child Let Behind Act of 2001 aimed at reducing the gap. However, the achievement gaps among races continue to exist in our schools. One of the main causes that authors attribute

this gap is due to a lack of funding (Blackford & Khojasteh, 2013). This insufficiency, a result of low-income schools and districts, results in both a lack of resources and of high-quality teachers. The inability to retain high-quality teachers comes from teachers being paid less and leaving when positions with higher pay become available. Blackford and Khojasteh state that this results in students attending schools that provide lower quality of education, which leads to lower teacher expectations. Mueller and Maher (2010) agree that students of minority are falling behind in mathematics because of lower quality educations and expectations.

Even when Black males have shown the ability to be successful, the expectations for them are lower than those for other students (Berry, 2004). These low expectations are expressed through teacher written feedback, conversations, and actions. High expectations that teachers should set for Black males can be reached through relevant and interesting math instruction. Berry (2004) suggests that the students who struggle in math should be given additional support through extra time. Students who are doing well in math should be given after-school instruction through enrichment, so they can continue to compete with other high-performing students of other races.

The National Council of Mathematics (2010) reports that minority students closed the gap on some tests. The difference in average scores between 9 and 13-year olds among White, Black, and Hispanics has narrowed, closing the gap. However, the gap in 17-year olds among the different races still continues with little change in a 39-year period.

Robinson (2010) found similar results. When students enter school, White students have an advantage in reading and math, and White students' average scores are .41 standard deviations higher in reading and .63 standard deviations in math. This increases to .86 and .89 respectively in third grade. The achievement gap in high school has made improvements, but it

remains larger than it was during the elementary years. Robinson suggests that educators need to focus on all students and not just the bottom students to ensure the top non-White performers are and remain equally competitive with White students. Simms (2012) suggests another reason for the difference: the gap in high school scores may come from Black students not wanting to be singled out for being successful in school and competing academically with the White students.

Shuman, Harris, Young and Nicks (2012) studied factors that increased Black achievement. The researchers found that one principal ensured that he hired minority teachers who had both a desire to teach and a good heart for the students. He felt that even if the teachers were not strong in content he could work to improve this, but could not improve the motivation of the teacher. The teachers in the study of a successful school with a large minority population agreed that high expectations for all students were needed, and that students should be targeted for interventions based on academic performance. Teachers kept the parents informed about their students as the teachers were required to contact parents with positive news and to keep a log of the communication. Assistant principals reviewed the logs every three weeks, and the school ensured that they celebrated the success of the students. Lastly, the school found that they had to limit the number of parent meetings to two; otherwise parent involvement would go down.

Wang (2010) found that African American students had a higher amount of instructional time in mathematics than Caucasian students. During this time, the African American students also spent more time using manipulatives, worksheets, textbooks and board work. In addition, teachers of African American students had a stronger focus on telling time, using tools to measure, and working on estimation skills, while teachers of Caucasian students focused on data collection leading to a difference in differential opportunity. Wang suggested that teachers of African Americans increase instruction which requires higher order thinking and reduce the

amount of time with manipulatives and games. Puchner et al. (2008) suggests that teachers use the manipulatives at the beginning of concepts and then move into the representational and abstract stage to ensure mastery (Van de Walle, 2013). Loucks-Horsely et al. (2010) recommends leadership teams and teachers look at school data to ensure that all students are receiving an equitable education with high-quality teachers.

Van de Walle et al. (2013) provides teachers with some reminders when teaching minority students. Educators should try to make the math content relevant. To do this, teachers need both to connect current skills with previous skills to ensure background knowledge is built and to help students see how concepts are connected. To engage students, educators should also try to tie skills to the students' lives. This can be as simple as using students' names in the problems and using math problems that relate to the students. Lastly, Van de Walle et al. suggest that teachers empower the students instead of holding all the power. This can be accomplished through students choosing how to solve the problem and then determining if the problem was solved correctly through their own reasoning, instead of the teacher stating whether the problem is correct or incorrect.

This section has provided an overview of the research of students of racial subgroups performance in mathematics. Gaps will continue to exist if teachers have lower expectations for certain subgroups of students (Berry, 2004). The gap is shown to be reduced in certain grade levels (National Council of Mathematics, 2010; Robinson, 2010). This gap can be reduced by hiring minority teachers with high expectations (Shuman et al., 2012), increasing the use of higher ordering thinking during instruction (Wang, 2010), and helping students see the connection between math and their every day lives (Van de Walle et al., 2013).

Research of students' socio-economic status in mathematics.

Race is not the only factor related to achievement gaps in mathematics. This section reviews the research that socio-economic status (SES) impacts math achievement. Darling-Hammond (2012) states, "…Income is a much stronger predictor of school achievement than it has ever been before." Students' SES has also been shown to impact math scores (Clotfelter et al., 2009; Reardon, 2013; Yates & Collins, 2006; Loucks-Horsley et al., 2010). Achievement gaps between high and low SES are caused by reasons similar to the gaps between races. Often students of low SES receive lower quality teachers due to a lack of funding (Blackford & Khojasteh, 2013). These teachers have lower expectations for the students, which is often repeated year after year (Ansalone, 2013). The gap can be closed by having teachers who build relationships with students (Jensen, 2013) and administrators who impact classroom instruction (Raskin, Stewart, & Haar, 2012).

Researchers found the achievement gap between low SES and high SES is substantial (Clotfelter et al., 2009; Reardon, 2013). Clotfelter et al. (2009) found that the difference in central tendency widens for students of minority and White students in high SES, while the gap closes between minority students and White students in low SES. Reardon (2013) found similar results. Students of low SES have traditionally performed lower on standardized tests, classroom grades, college entrance exams, and graduation rates than students with higher SES. In the 1970s, the difference in standardized test scores in the two SES groups was .9 standard deviations and has since increased to 1.25 standard deviations. The achievement gap between the two SES groups is larger when students begin school in kindergarten. The school helps to reduce the gap, but it increases again during summer breaks. Reardon suggests that schools can help decrease the gap by providing early intervention, extending the amount of time in school with

programs like after school or summer school, and providing highly qualified teachers to teach these students. Jensen (2013) believes that the teacher makes the difference for students of poverty. He believes that demonstrating a caring, mutual concern for their success can bring out the students' best.

Blackford and Khojasteh (2013), whose research was previously discussed regarding teaching mathematics to minority students, states that high-quality teachers with experience are difficult to retain. Low economic areas are not able to compete with the salaries of high socio-economic districts. Teachers in low-income districts are constantly moving as other positions outside the district open. Blackford and Khojasteh also found that often teachers in low-income districts have lower expectations for their students than teachers in high-income districts.

Ansalone (2010), whose work was previously discussed regarding the use of tracking in American schools, states that students of lower SES are placed in classrooms with lower performances and lower expectations while students of higher SES are placed in higher performing classes. Parents of students in lower SES populations may be unaware of the resources that are available to students and may not push for the students to be in different classrooms (Latz & Adams, 2011). Nomi (2009) found that ability grouping was most effective for low SES students while it was less effective for high SES students. McCoach et al. (2006) found similar findings as they noted that girls made higher gains with ability grouping, but the gains decreased as socio-economic status increased.

Gaddis and Lauen (2014) found that the achievement gap between Black and White students often depended on the level of poverty in a school. Schools that had the lowest percentage of students below the poverty line were able to close achievement gaps between the two races, especially in mathematics. These schools were thought to be able to place more

resources toward closing the achievement gap. The schools with higher amounts of poverty were unable to close the achievement gaps.

Often schools of low socio-economic status, or schools that have a high population of minority students, are thought to not be able to perform at high levels (Raskin & Stewart, 2012). Raskin and Stewart's (2012) study found this not to be true in their research. Their study looked at elementary, middle, and high schools in urban and rural areas that performed higher than they were expected to perform. The study showed that the principal impacted the performance of the school through shared beliefs and school atmosphere. These shared beliefs influenced teaching and learning; ensured that teachers focused on learning; provided systems for teacher support; and empowered teachers.

This portion of the literature review provided the research of how SES impacts mathematics achievement. An achievement gap exists between students of high and low SES (Clotfelter et al., 2009; Reardon, 2013; Yates & Collins, 2006). Researchers found the gap may occur due to low quality teachers and funding (Blackford & Khojasteh, 2013) and through lower expectations (Ansalone, 2013). Teachers who build relationships with their students help close the achievement gap (Jensen, 2013) along with administrators who are actively involved in improving classroom instruction (Raskin & Stewart, 2012).

Research of gender in mathematics.

This next section reviews the impact of gender on mathematics achievement. In the past, researchers have found that females have not performed as well as males in mathematics; however, current research shows that females are closing the achievement gap (Gunderson et al., 2012; Hyde et al., 2008; Van de Walle et al., 2013). Researchers again believe that lower expectations play a role in the attitude that females have towards math (Gunderson et al., 2012;

Levi, 2000; Van de Walle et al., 2013). To combat this, teachers must be aware of their beliefs and set higher expectations. Reis and Graham (2005) suggest that teachers reflect on their own beliefs, expectations, and view regarding mathematics.

Researchers have looked at the attitude that girls have toward math to see if they dislike math more than boys do. Vandecandelaere, Speybroeck, Vanlaar, DeFraine and Van Damme (2012) found that fluent males with parents that received higher education valued math more than fluent girls with educated parents. In addition, males displayed a higher academic self-concept than girls, but girls enjoyed mathematics more than boys did. Niederle and Vesterlund (2010) found that males are more confident in math. Van de Walle et al. (2013) report that girls' attitudes toward math may come from their beliefs that boys are better at math. This stereotype affects female students at a young age and into their future (Gunderson et al., 2012; Niederle & Vesterlund, 2010). Parents have lower expectations for their daughters which transfers to their daughters' self-perception of mathematics ability and future performance. Female students have closed the gap, but Gunderson et al. (2012) believe the females' perception of mathematics plays a role in fewer females being in mathematic based careers, even though more females graduate from college than males. Society, parents, and even educators often believe the stereotype that females are not as good at mathematics.

Not only do teachers often believe that male students are better at math, but their actions often demonstrate this belief (Gunderson et al., 2012; Levi, 2000; Van de Walle et al., 2013). These actions are shown in the way that teachers call on students, provide feedback, and set expectations. Teachers will often rate females as being less proficient in mathematics than males that perform and behave in similar ways (Robinson-Cimpian, Lubienski, Ganley, & Copur-Gencturk, 2014). Robinson-Cimpian et al. (2014) suggested that, to combat this, teachers must

be aware of their beliefs and set higher expectations. Van de Walle et al. (2013) suggest that teachers take a video of themselves teaching and observe their interactions with the different genders, especially looking for how often boys versus girls are called upon; the type of feedback that is given; the level of groups; and which gender is asking questions about math. Teachers can help to ensure that females are active in the lesson by providing a problem-based approach and using the CRA model.

An additional way that teachers impact female students involves their own perceptions of mathematics. Reis and Graham (2005) suggest that teachers analyze their own view about math and be aware of their perceptions to prevent sending negative feelings toward math to female students. To help combat girls taking a negative view toward math and falling into society's beliefs, teachers should identify female role models in the field of mathematics for students (Reis & Graham, 2005).

This section noted that an achievement gap exists between boys and girls in mathematics. Researchers believe this is caused by lower expectations of teachers, parents, and society (Gunderson et al., 2012; Levi, 2000; Van de Walle et al., 2013). Girls pick up on this view, and it influences their perception of mathematics (Gunderson et al., 2012; Niederle & Vesterlund, 2010; Van de Walle et al., 2013). Teachers can help prevent this by making certain that they have equal expectations and analyzing their own views (Reis & Graham, 2005) and instruction in the classroom (Gunderson et al., 2012; Levi, 2000; Van de Walle et al., 2013).

Instructional strategies for different subgroups.

This section provides an overview of researchers' recommendations to reduce achievement gaps in different races, SESs, or genders. The use of flexible grouping can be helpful with minority students or students from lower socio-economic backgrounds, as well as all

students from all backgrounds who experience low mathematics achievement (Castle et al., 2005; Kususanto et al., 2011; Latz & Adams, 2011; Petrilli, 2013). Mueller and Maher (2010) felt that minority students often fell behind due to low quality education and low expectations. School climate (Ma, 2010) and teacher behaviors (Kususanto et al., 2011) influence students' attitudes toward math. Kususanto et al. (2011) continue by pointing out that teachers of low-achieving students often lower their expectations. In addition to flexible grouping, the CRA model has also been found to help disadvantaged students (Flores, 2010; Yates & Collins, 2006). Students who were identified as minority, or in the low SES subgroup, were able to do as well as other subgroups when taught with the CRA model (Flores, 2010).

Yates and Collins (2006) completed a study at a school in Columbus, Georgia, that struggled to meet the testing criteria year after year. The school had 96% of 520 students that qualified for free and reduced lunch. Nine out of ten students were Black with a mobility rate of 30%. The school offered a professional learning session to help the teachers move from procedural learning to conceptual learning, and about 90% of the teachers attended the training. Monthly early release days were scheduled in the county to allow for on-going professional learning. A math coach was available, along with a specialist, to model lessons and help support teachers. A partnership was also formed with a local university to help provide additional support and professional learning. Professional learning in the school was collaborative and on-going. After the professional learning and the transition to conceptual teaching, students met the testing criteria, and the school was removed from the state's list of schools needing improvement.

Flores (2010) found that minority students who had learning difficulties in math and received free and reduced lunch did just as well as other students when taught using the CRA

model. Instruction with the CRA model was provided three times a week for a thirty-minute segment in the special education classroom. Remedial instruction occurred in the regular education classroom. The students felt subtraction with regrouping was difficult. However, they liked using the CRA model and wanted to use the strategy in the future. Teachers reported that students improved on district benchmarks and would recommend the intervention to others. After six weeks of no instruction or practice, four of the six students demonstrated mastery of subtraction with regrouping.

Mueller and Maher (2010) who discussed the low quality education and low expectations that many minority students receive suggest that teachers of minority students select the best tasks and tools for their students. This allows the students both to experience higher order problems that are open-ended and to use manipulatives to help them solve the problems with success.

Loucks-Horsely et al. (2010) feels students are not receiving quality education across the board. Not only do teachers need professional learning to understand the content and how to teach the concepts, but they need professional learning on how to teach diverse subgroups of students. During this professional learning teachers need to examine their own feelings and beliefs about how different subgroups learn. Thereafter, teachers need to learn strategies, resources, and about the different cultures in order to relate and be able to teach diverse groups of students. Loucks-Horsely et al. feel this type of professional learning is needed to move forward in mathematics.

Research shows that an achievement gap exists among students of different races (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter et al., 2009; National Council of Teachers of Mathematics, 2010; Robinson, 2010) and socio-economic statuses (Clotfelter et al., 2009;

Reardon, 2013; Yates & Collins, 2006). These achievement gaps have been reduced through high expectations (Berry 2004; Blackford & Khojasteh, 2013; Kususanto et al., 2011; Mueller & Maher, 2010; Reis & Graham, 2005), the CRA model (Flores, 2010) and flexible grouping (Mueller & Maher, 2010; Petrilli, 2013). The CRA model and flexible grouping allow students' needs to be met, regardless of race, socio-economic status, or gender.

In recent years, the research of students' attitudes towards mathematics has become more prevalent (Kogce et al.,2009 ; Konstantinou-Katzi et al., 2013; Ma, 2010; Vandecandelaere et al., 2012). In addition, the higher the cognitive mean, the lower the academic self-concept as students. Vandecandelaere et al. (2012) found this may be due to students competing with other high-achieving students. Students with lower cognitive abilities had a higher academic self-concept. Fluent males with parents that received higher education also valued math over fluent females with educated parents. In addition, teachers who tried to motivate, activate, give feedback, and structure the instruction impacted the students' enjoyment of mathematics. The learning environment may be the most significant factor in students' attitudes towards mathematics. Ma (2010) found that school climate played a role in encouraging students to pursue advanced mathematic courses in high school. Schools with small student-teacher ratios had a higher percent of students who took advanced courses than schools with larger student-teacher ratios.

Kususanto et al. (2011) found that the individual student's self-esteem is influenced by the teacher's behaviors, and the teacher's behaviors are influenced by the ability of the students. High-achieving students viewed teachers in supporting roles, while low-performing students viewed teachers as controlling. Students in low-achieving classrooms felt that teachers who taught low-achievement learners focused on classroom control and avoiding disruptions, instead

of focusing on instruction. Kususanto et al. feel that these lower expectations affect the teachers' behaviors and may appear more controlling to the students, leading to lower self-esteem. The researchers suggest that teachers should be aware of this so that they will be more likely to keep a balance between being supportive of students and keeping control of the classroom.

Conclusion.

"Poor math skills limit not only an individual's employability and salary but also a country's competitiveness in the world economy" (Wei, Lenz, & Blackorby, 2012, p.). The goal of the Common Core State Standards is to ensure that all students are able to compete globally (Burns, 2012). The students will have a difficult time meeting these expectations without math innovations being used in the classrooms. Innovations that have been found to be successful in research include high-quality math instruction supported by effective professional learning and the use of manipulatives through the CRA model (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013), flexible grouping (Christenson & Wager, 2012; Ford, 2005), and an understanding of working with disadvantaged students (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter et al., 2009).

Literature reveals the importance of well-designed professional learning which will improve teacher understanding of math content and pedagogy (Frede et al., 2010; The National Mathematics Advisory Panel, 2008; Wu, 2011). Instructional leaders play a role in the implementation of professional learning instruction and implementation in the classroom (Burch & Spillane, 2003; Hoang, 2008). Having administrators who are active in professional learning, are present in classrooms, and are knowledgeable of the content will lead to positive changes in instruction (Burch & Spillane, 2003). During this time, teachers need to focus on the instruction of concepts.

One way to deliver math instruction is through the CRA model (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). This model begins with building the foundation of concepts through manipulatives and then moves to representations and numbers with symbols. If the CRA model and/or manipulatives are not used effectively in the classroom, instructional leaders should provide feedback to guide and support teachers and plan appropriate professional learning for the teacher to increase student achievement (Puchner at al., 2008).

Part of the professional learning should be the awareness of working with disadvantaged students in mathematics (Frede et al., 2010). Highly qualified teachers with high expectations have been found to be an important factor in working with students of minority (Blackford & Khojaste, 2013; Martin, 2009; Mueller & Maher, 2010; Shuman et al., 2012), poverty (Ansalone, 2010; Blackford & Khojaste, 2013; Reardon, 2013), and gender (Gunderson et al., 2012; Van de Walle et al., 2013). Successful teachers also use instructional strategies such as flexible grouping (Mueller & Maher, 2010; Petrilli, 2013) and the CRA model (Flores, 2010; Yates & Collins, 2006). Leaders must be aware of the research and work hard to retain high-quality teachers to impact student achievement in the district (Blackford & Khojaste, 2013).

Finding time to ensure that the material is differentiated and mastered by students is difficult for teachers in today's diverse classrooms (Christenson & Wager, 2012; Ford, 2005; Konstantinou-Katzi et al., 2013). To help support teachers in meeting the needs of all students and providing the teacher with the necessary resources, teachers need training (The National Mathematics Advisory Panel, 2008). Some innovations to support teachers in meeting this goal include math instruction with the incorporation of manipulatives and the Concrete Representational Abstract (CRA) model, differentiation through flexible grouping, and understanding disadvantaged students. Teachers and students need to be given the tools to have a

deep understanding of math concepts through the CRA model (Flores, 2010; Mancl et al., 2012; Van De Walle et al., 2013) with differentiated learning (Beecher & Sweeny, 2008; Ensign, 2012; Tomlinson, 2005; Tomlinson et al., 2003) so that students of all races (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter et al., 2009; National Council of Teachers of Mathematics, 2010; Robinson, 2010), all socio-economic levels (Castle et al., 2005; Kususanto, et al., 2011; Latz & Adams, 2011; Petrilli, 2013), and all genders (Gunderson et al., 2012; Van de Walle et al., 2013), can be successful in the classroom and able to compete globally.

Research is available regarding the use of flexible grouping, high-quality math instruction with the CRA model, and best strategies for teaching math to disadvantaged students. However, little research is available that looks at all three areas simultaneously. This literature review sought to understand how teachers perceive math innovations and how these innovations influence math instruction.

References

Access Center. (2009). Concrete-representational-abstract instructional approach. Retrieved from the Access Center Web site: http://www.broward.k12.fl.us/studentsupport/ese/PDF/CRAApproachinMath.pdf

Ansalone, G. (2010). Tracking: Educational differentiation or defective strategy. *Educational Research Quarterly*, *34*(2), 3-17.

Applebee, A. (2013). Common Core State Standards: The promise and the peril in a national palimpsest. *National Council of Teachers of English, 103,* 25-33.

Banilower, E. R., Boyd, S. E., Pasley, J. D., & Weiss, I. R. (2006). Lessons from a decade of mathematics and science reform: A capstone report for the local systemic change through teacher enhancement initiative. *Horizon Research, Inc.(NJ1)*.

Barbour, N. (1990). Flexible grouping: It works! *Childhood Education, 67 (2),* 66-67.

Beecher, M., & Sweeny, S. M. (2008). Closing the achievement gap with curriculum enrichment and differentiation: One school's story. *Journal of Advanced Academics,* 19*,* 502-530.

Belenky, D. M., & Nokes, T. J. (2009). Examining the role of manipulatives and metacognition on engagement, learning, and transfer. *The Journal of Problem Solving*, *2*(2), 6.

Berry III, R. Q. (2004). The equity principle through the voices of African American males. *Mathematics Teaching in the Middle School, 10*(2), 100-103.

Blackford, K., & Khojasteh, J. (2013). Closing the achievement gap: Identifying strand score differences. *American Journal of Business Research*, *6*(2).

Boggan, M., Harper, S., & Whitmire, A. (2010). Using manipulatives to teach elementary mathematics. *Journal of Instructional Pedagogies*, *3*, 1.

Bomer, R., & Maloch, B. (2011). Relating policy to research and practice: The Common Core Standards. *Language Arts*, *89*(1), 38-43.

Bracey, G. (1986). Ability grouping and student achievement in elementary schools. *The Phi Delta Kappan, 68*(1), 76-77.

Brown, M. C., McNeil, N. M., & Glenberg, A. M. (2009). Using concreteness in education: Real problems, potential solutions. *Child Development Perspectives*, *3*(3), 160-164.

Brulles, D., Peters, S. J., & Saunders, R. (2012). School-wide mathematics achievement within the gifted cluster grouping model. *Journal of Advanced Academics, 23*(3), *200-216.*

Bruner, J. (1973). *Constructivist theory.* Retrieved from **http://www.uni-koeln.de/hf/konstrukt/didaktik/concept/TIP%20Theories.htm**. 10 January 2015.

Burch, P. & Spillane, J. (2003). Elementary school leadership strategies and subject matter: Reforming mathematics and literacy instruction. *The Elementary School Journal, 103*(5), 519-535.

Burns, M. (2012). Go figure: Math and the Common Core. *Educational Leadership, 70*(4), 42-46.

Calkins, L., Ehrenworth, M., & Lehman, C. (2012). *Pathways to the common core: Accelerating achievement*. Portsmouth, NH: Heinemann.

Carbonneau, K., Marley, S., & Selig, J. (2013). A meta-analysis of the efficacy of teaching mathematics with concrete manipulatives. *Journal of Educational Psychology*, *105*(2), 380.

Castle, S., Deniz, C., & Tortora, M. (2005). Flexible grouping and student learning in a high-needs school. *Education and Urban Society, 37*(2), 139-150.

Christenson, B. & Wager, A. (2012). Increasing participation through differentiation. *Teaching Children Mathematics, 19*(3), 194-200.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2009). The academic achievement gap in grades 3 to 8. *The Review of Economics and Statistics*, *91*(2), 398-419.

Cobb, P., & Jackson, K. (2011). Assessing the quality of the common core state standards for mathematics. *Educational Researcher*, *40*(4), 183-185.

Common Core State Standards Initiative (2014). *Development process.* Retrieved from http://www.corestandards.org/standards-in-your-state/

Correa, C. A., Perry, M., Sims, L. M., Miller, K. F., & Fang, G. (2008). Connected and culturally embedded beliefs: Chinese and US teachers talk about how their students best learn mathematics. *Teaching and Teacher Education*, *24*(1), 140-153.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process.* Thousand Oaks: SAGE Publications.

Darling-Hammond, L., & Richardson, N. (2009). Research review/teacher learning: What matters. *Educational leadership*, *66*(5), 46-53.

Darling-Hammond, L., Wei, R. C., Andree, A., Richardson, N., & Orphanos, S. (2009). Professional learning in the learning profession. *Washington, DC: National Staff Development Council*.

DuFour, R. & Marzano, R. (2011). *Leaders of learning.* Bloomington, IN: Solution Tree Press.

Ensign, Jacque. (2012). Teacher-initiated differentiation. *Teaching Children Mathematics, 19* (3)*,* 158-163.

Flores, M. (2010). Using concrete-representational-abstract sequence to teach subtraction with regrouping to students at risk for failure. *Remedial and Special Education, 31*(3)*,* 195-207.

Ford, M. P., (2005). Differentiation through flexible grouping: Successfully reaching all readers*. Learning Point Associates / North Central Regional Educational Laboratory (NCREL).*

Frede, E., Lamy, C. E., & Boyd, J. S. (2010). Early childhood mathematics: Promoting good beginnings. National Association for the Education of Young, retrieved from http://www.naeyc.org/files/naeyc/file/positions/psmath.pdf.

Fujimura, N. (2001). Facilitating children's proportional reasoning: A model of reasoning processes and effects of intervention on strategy change. *Journal of Educational Psychology, 93*(3), 589.

Gaddis, S. M., & Lauen, D. L. (2014). School accountability and the Black–White test score gap. *Social science research*, 44, 15-31.

Garet, M. S., Porter, A. C., Desimone, L., Birman, B. F., & Yoon, K. S. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal*, *38*(4), 915-945.

Gardner, D. P., Larsen, Y. W., Baker, W., & Campbell, A. (1983). A nation at risk: The imperative for educational reform. *Washington, DC: US Government Printing Office*.

Gavin, M. K. & Moylan, K. (2012). Seven steps to high-end learning. *Teaching Children Mathematics, 19*(3), 184-192.

Georgia School Boards Association & Georgia Superintendents Association (2010). *A vision for public education: Equity and excellence.* Retrieved from http://www.visionforpubliced.org/uploads/2/0/2/7/20275263/vpe_full_report_6.21.11.pdf

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, *66*(3-4), 153-166.

Hamos, J. E., Bergin, K. B., Maki, D. P., Perez, L. C., Prival, J. T., Rainey, D. Y., Rowell, G. & Vander Putten, E. (2009). Opening the Classroom Door: Professional Learning Communities in the Math and Science Partnership Program. *Science educator*, *18*(2), 14-24.

Hargrove, K. (2012). From the Classroom: Advocating acceleration. *Gifted Child Today*, *35(1),* 72-73.

Harris, D. (2012). Varying teacher expectations and standards: Curriculum differentiation in the age of standards-based reform. *Education and Urban Society, 44*(2), 128-150.

Heck, R. H., & Hallinger, P. (2009). Assessing the contribution of distributed leadership to school improvement and growth in math achievement. *American Educational Research Journal*, *46*(3), 659-689.

Hess, F. (2014). How the Common Core went wrong. *National Affairs, 21*, 3-19.

Hoang, T. (2008). Perception, curriculum, and subject matter: Reforming instruction. *International Electronic Journal for Leadership in Learning*, *12*(3)*,* page "NA"

Hong, G., Corter, C., Hong, Y., & Pelletier, J. (2012). Differential effects of literacy instruction time and homogeneous ability grouping in kindergarten classrooms: Who will benefit? Who will suffer? *Educational Evaluation and Policy Analysis, 34*(1), 69-88.

Hyde, J. S., Lindberg, S. M., Linn, M. C., Ellis, A. B., & Williams, C. C. (2008). Gender similarities characterize math performance. *Science*, *321*(5888), 494-495.

Jennings, J., & Rentner, D. S. (2006). Ten big effects of the No Child Left Behind Act on public schools. *Phi Delta Kappan*, *88*(2), 110.

Jensen, E. (2013). *Engaging students with poverty in mind: Practical strategies for raising achievement*. Association for Curriculum and Development.

Johnson, D. T. (2000). *Teaching mathematics to gifted students in a mixed-ability classroom*. ERIC Clearinghouse on Disabilities and Gifted Education, the Council for Exceptional Children.

Kober, N., & Rentner, D. S. (2012). Year two of implementing the Common Core State Standards: States' progress and challenges. *Center on Education Policy*.

Kogce, D., Yildiz, C., Aydin, M., & Altindag, R. (2009). Examining elementary school students' attitudes towards mathematics in terms of some variables. *World Conferences on Educational Sciences, 1*(1), 291-295.

Konstantinou-Katzi, P., Tsolaki, E., Meletiou-Mavrotheris, M., & Koutselini, M. (2013). Differentiation of teaching and learning mathematics: An action research study in tertiary education. *International Journal Of Mathematical Education In Science & Technology, 44*(3), 332-349.

Kususanto, P., Ismail, Z., & Majeed, A. (2011). Students' self-esteem and their perception of teacher behavior: A study of class grouping system in Pakistan. *International Journal Of Business & Social Science*, *2*(16), 103-113.

Latz, A. O. & Adams, C. M. (2011). Critical differentiation and the twice oppressed: Social class and giftedness. *Journal for the Education of the Gifted, 34*, 773-789.

Latz, A.O., Speirs Neumeister, K., Adams, C. & Pierce, R. (2009). Peer coaching to improve classroom differentiation: Perspectives from Project CLUE. *Roeper Review, 31(1),* 27-39.

Leithwood, K., Seashore L. K., Anderson, S., & Wahlstrom, K. (2004). Review of research: How leadership influences student learning. Center for Applied Research and Educational Leadership: University of Minnesota.

Levi, L. (2000). Gender equity in mathematics education. *Teaching Children Mathematics*, *7*(2), 101-5.

Linn-Cohen, R., & Hertzog, N. B. (2007, Winter). Unlocking the GATE to differentiation: A qualitative study of two self-contained gifted classes. *Journal for the Education of the Gifted*, *31,* 227-259, 279-280.

Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., & Hewson, P. W. (2009). *Designing professional development for teachers of science and mathematics*. Corwin Press.

Ma, Xin. (2010). Effects of early acceleration of students in mathematics on taking advanced mathematics coursework in high school. *Investigations in Mathematics Learning*, *3(1),* 43-63.

Maggio, M., & Sayler, M. (2013). Trying out acceleration for mathematically talented fifth graders. *Gifted Child Today, 36(1),* 21-26.

Mancl, D., Miller, S., & Kennedy, M. (2012). Using the concrete-representational-abstract sequence with integrated strategy instruction to teach subtraction with regrouping to students with learning disabilities. *Learning Disabilities Research & Practice, 27(4),* 152-166.

Martin, D. (2009). Does race matter? *Teaching Children Mathematics, 16*(3), 134-139.

Mathis, W. J. (2010). The "Common Core" standards initiative: An effective reform tool. *Boulder and Tempe: Education and the Public Interest Center & Education Policy Research Unit.* Retrieved from: http://www.greatlakescenter.org/docs/Policy_Briefs/Mathis_NationalStandards.pdf

McCoach, D. B., O'Connell, A., & Levitt, H. (2006). Ability grouping across kindergarten using an early childhood longitudinal study. *Journal of Educational Research, 99*(6), 339-346.

McNeil, N. & Fyfe, E. (2012). "Concreteness fading" promotes transfer of mathematical knowledge. *Learning and Instruction,* 22, 440-448.

McNeil, N., Uttal, D., Jarvin, L., & Sternberg, R. (2009). Should you show me the money? Concrete objects both hurt and help performance on mathematics problems. *Learning and Instruction,* 19, 171-84.

Mills, J., Bonner, A., & Francis, K. (2006). The development of constructivist grounded theory. *International journal of qualitative methods*, *5*(1), 25-35.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco: Jossey-Bass.

Morales, J. (2013). *Evaluation of the Effects of Ability Grouping in Sixth-grade Math at ABC Elementary* (Doctoral dissertation). California State University, San Marcos.

Morgan, E. (1960). The Joplin Plan of reading vs. a traditional method. *Journal of Educational Psychology, 51*(2), 69-73.

Moyer, P. S. (2001). Are we having fun yet? How teachers use manipulatives to teach mathematics. *Educational Studies in Mathematics, 47*(2), 175-197.

Mueller, M. F., & Maher, C. A. (2010). Promoting equity through reasoning. *Teaching Children Mathematics*, *16*(9), 540-547.

National Council of Teachers of Mathematics. (2010). Mathematics professional development. *The National Council of Teachers of Mathematics.* Retrieved from: http://www.nctm.org/Publications/mathematics-teaching-in-middle-school/2010/Vol15/Issue9/?ref=1

National Council of Teachers of Mathematics. (2013). Supporting the Common Core State Standards for mathematics. *National Council of Teachers of Mathematics.* Retrieved from http://www.nctm.org/ccssmposition/

National Mathematics Advisory Panel. (2008). Foundations for success: The final report of the National Mathematics Advisory Panel. Washington, DC: U.S. Department of Education.

Newport, J. (1967). The Joplin Plan: The score. *The Reading Teacher, 21*(2), 158-162.

Niederle, M., & Vesterlund, L. (2010). Explaining the gender gap in math test scores: The role of competition. *The Journal of Economic Perspectives*, 129-144.

Petrilli, M. (2013). The diversity dilemma. *Educational Leadership, 70*(8), 44-48.

Porter, A., McMaken, J., Hwang, J., & Yang, R. (2011). Common core standards the new

US intended curriculum. *Educational Researcher*, *40*(3), 103-116.

Powell, W. (1964). The Joplin Plan: An evaluation. *The Elementary School Journal, 64*(7), 387-392.

Puchner, L., Taylor, A., O'Donnell, B., & Fick, K. (2008). Teacher learning and mathematics manipulatives: A collective case study about teacher use of manipulatives in elementary and middle school mathematics lessons. *School Science and Mathematics, 108*(7), 313-325.

Ramsey, W. (1962). An evaluation of a Joplin Plan of grouping for reading instruction. The *Journal of Educational Research, 55*(10), 567-572.

Raskin, C., & Stewart, C. (2012). Outperforming demographics: Factors influencing nine rural and urban schools' culture of student achievement. *Social Justice Competition, and Quality: 21st Century Leadership Challenges*, 99.

Reardon, S. F. (2013). The widening income achievement gap. *Educational Leadership*, *70*(8), 10-16.

Reis, S. M., & Graham, C. (2005). Needed: Teachers to encourage girls in math, science, and technology. *Gifted Child Today*, *28*(3), 14-21.

Robinson, K. (2010). Black-White inequality in reading and math across K-12 schooling: A synthetic cohort perspective. *The Review of Black Political Economy*, *37*(3-4), 263-273.

Robinson-Cimpian, J. P., Lubienski, S. T., Ganley, C. M., & Copur-Gencturk, Y. (2014). Are schools shortchanging boys or girls? The answer rests on methods and assumptions: Reply to Card (2014) and Penner (2014). *American Psychological Association, 50*(6), 1840-1844.

Rogers, C. (2012). *The impact of math ability grouping on second grade student growth* (Doctoral dissertation). Northwest Missouri State University; Maryville, Missouri.

Rothman, R. (2013). Putting the pieces in place. *Educational Leadership, 70*(4), 18-22.

Shuman, J., Harris, S., Young, J. K., & Nicks, R. (2012). Factors that increased Black student scores and narrowed the achievement gap at one high performing high school. *Issues of Social Justice*, *171*.

Simms, K. (2012). Is the Black-White achievement gap a public sector effect? An examination of student achievement in the third grade. *Journal of At-Risk Issues*, *17*(1), 23-29.

Thomas, D. (2006). A general inductive approach for analyzing qualitative evaluation data.

American Journal of Education, 27(2), 237-246.

Tienken, C. H. (2010). Common Core State Standards: I Wonder? *Kappa Delta Pi Record*, *47*(1), 14-17.

Tomlinson, C. A. (2005). Differentiating instruction: Why bother? *National Middle School Association, 9*(1), 12-14.

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C., Moon, T., Brimijoin, K., Conover, L., & Reynolds, T., (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms. *Journal for the Education of the Gifted, 27*(2/3), 119-145.

Understanding the Common Core Standards. (2014). *Education Digest, 79*(8), *16-21.*

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2013). *Elementary and middle school mathematics: Teaching developmentally*. New York: Pearson.

Vandecandelaere, M., Speybroeck, S., Vanlaar, G., De Fraine, B., & Van Damme, J. (2012). Learning environment and students' mathematics attitude. *Studies In Educational Evaluation*, *38*(3-4), 107-120.

Wang, A. (2010). Optimizing early mathematics experiences for children from low-income families: A study of opportunity to learn mathematics, *Early Childhood Education, 37*, 295-302.

Wei, X., Lenz, K. B., & Blackorby, J. (2012). Math growth trajectories of students with disabilities: Disability category, gender, racial, and socioeconomic status differences from ages 7 to 17. *Remedial and Special Education*, 0741932512448253.

Witzel, B. (2005). Using CRA to teach algebra to students with math difficulties in inclusive settings. *Learning Disabilities: A Contemporary Journal, 3*(2), 49-60.

Wu, E. H. (2013). The path leading to differentiation: An interview with Carol Tomlinson. *Journal of Advanced Academics*, *24*(2), 125-133.

Wu, H. (2011). Phoenix rising: Bringing the Common Core State Mathematics Standards to Life. *American Educator*, *35*(3), 3-13.

Yates, H. M., & Collins, V. K. (2006). How one school made the pieces fit: Elementary school builds on a learning community to lift achievement for Black students in reading and math. *Journal of Staff Development*, *27*(4), 30-35.

CHAPTER 2

THE INFLUENCE OF STANDARDS AND RECOMMENDATIONS

The foundation of this study was to examine how teachers perceive math innovations and how those innovations influenced math instruction in Georgia Vision Project districts. The innovations included (a) differentiation through flexible grouping; (b) the use of math manipulatives through the Concrete Representational Abstract (CRA) model; (c) math professional learning; and (d) information about how subgroups learn mathematics. This chapter will outline the methodology and the results of the study. The first section will discuss the purpose of the study and the GVP recommendations in the area of teaching and learning, specifically in the area of mathematics. The next section discusses the methodology of the research to include how the study was conducted, the sample, the data collection and analysis. The last section discusses the findings of the research and implications for future research.

Purpose of the Study

The Georgia Vision Project (GVP) has the goal of ensuring that all children receive an excellent and equitable education that will prepare them to be college and career ready (Georgia School Boards Association & Georgia Superintends Association, 2010). The Vision Project has seven standards to help districts reach these goals. The purpose of this study was to determine to what degree have the GVP recommendations, specifically the GVP standard of *teaching and learning*, impacted school districts.

Through the teaching and learning standard of the Vision Project, this study looked at how teachers perceived math innovations and how the innovations influenced math instruction. The innovations were (a) differentiation through flexible grouping, (b) manipulatives through the Concrete Representational Abstract (CRA) model, (c) math professional learning, and (d)

information about teaching diverse populations mathematics. The information from this study will provide awareness for educators and school leaders in making decisions that impact instruction in the mathematics classroom. Flexible grouping (Christenson & Wager, 2012; Ford, 2005; Rogers, 2012; Wu, 2013) and CRA (Flores, 2010; Mancl, Miller, & Kennedy, 2012; Van de Walle, Karpe, & Bay-Williams, 2013) has been found to support students in building a deeper understanding and creating a successful learning environment for many populations of students. However, there is little literature available that combines the use of flexible grouping with the CRA model in diverse populations.

The purpose of this study is to describe how teachers perceive math innovations and how the innovations influence math instruction. This study is one of several investigations that form a larger project to evaluate the influence of the Georgia Vision Project's recommendations on GVP participating schools. While this dissertation is part of a larger project, it also employed an instrumental case study approach (Boozer, 2015). That is, the participants were specifically selected to get a multilevel perspective of the influence of math innovations under the normative presents of core standards and GVP recommendations. It is hope that this approach will be instrumental in influencing educational discourse and decision-making. The participants in the study were five elementary teachers, two school administrators, and two district leaders. Instrumental case studies allow the researcher to study a topic and apply results to the specific case. The researcher studies multiple cases to gain a better understanding of the results. This study used a cross-case analysis to determine how the Georgia Vision Project had impacted math innovations in two school districts. After the research was completed, the results of each case were analyzed and then compared to the other GVP districts. Other studies in the larger project were conducted at the same time to determine how the GVP had impacted other standards. Each

researcher looked at how different standards of the GVP impacted different case studies in different school districts. The following main questions were used to guide the larger project of evaluating the Georgia Vision Project's recommendations (Berry, 2014).

[Focus on context]

1. How have the internal contexts coupled with the implementation of the Vision Project impacted learning and leadership in your school?

[Focus on learning]

2. What are the features of the Vision Project that have specifically impacted learning in your school?
3. How has the Vision Project impacted the use of math innovations in math instruction?

[Focus on leadership]

4. How has the implementation of the Vision Project helped build the capacity of self and others in your school?

Methodology

The main research question guiding this dissertation was: *How do teachers' perceptions of math innovations influence math instruction in Georgia Vision Project districts?* This section of the dissertation discusses the methodology used for the research design, the sample, the data collection, and data analysis. This study was a qualitative study that utilized an instrumental multiple case study approach. That is two districts were chosen with participants selected from the district level, the school leadership team, and the pool of math teachers. In addition to interviews, observations were conducted and artifacts were collected. The data was collected and

analyzed for themes to help understand the perception of math innovations and the impact that they have on instruction in a GVP district.

Research Design. Qualitative research allows the researcher to become part of the natural environment and collect data through observations and conversations with the participants (DeMarrais & Lappin, 2008). During qualitative research, researchers ask questions of participants to gain ideas and develop a deeper understanding of their views (Creswell, 2012). A case study allows the researcher to observe from within the real-world environment (Yin, 2014) and to learn about its operation without predetermined thoughts (Stake, 1995). A case study should be bounded by the time, location, or other characteristics to separate it from other research (Creswell, 2012). Conducting the study through the GVP, each district was specifically chosen to ensure that the sample would relate to the study. Studying the districts through an instrumental multiple case study will allow each case study focus to be on a smaller subject, but studied at a deeper level to gain a better understanding (Curtis, Gesler, Smith & Washburn, 2000).

This instrumental multiple case study looked at two school districts, a small rural district and a large suburban district, to examine the use of the GVP in the district during the 2015-2016 school year. In addition, the study focused on how teachers perceive math innovations of flexible grouping, and manipulatives through the use of the CRA model. The two school districts were chosen based on the Vision Project Director's recommendations. That is, the district leaders had agreed to engage the Vision Project recommendations with fidelity, specifically through the inclusion of differentiation in the district's strategic plan. This helped increase the opportunity to see districts, schools, and teachers using differentiation with other innovations such as manipulatives in the math classroom. Many districts could have been chosen for this study, but

these two districts were used to help learn how the GVP has impacted districts and, specifically, the teachers' perceptions of math innovations. These two school districts were chosen not to learn how the GVP had impacted these districts, but to learn how the GVP might impact education in other school districts. This is an example of an instrumental case study where a few cases are chosen for examination in an effort to learn about the issue more globally (Creswell, 2012; Stake, 1995).

Sample.

This section describes the districts and participants involved in the study. Both districts are partnered with the GVP. The GVP director recommended both districts for the multiple instrumental case studies. Other researchers used the districts at the same time to determine the impact of the GVP with other standards. The other standards that were researched during this time included (a) early learning; (b) teaching and learning; (c) teaching and learning resources; (d) human and organizational capital; (e) governance, leadership, and accountability; (f) culture, climate and organizational efficacy; and (g) financial resources. The other standards were studied to see how the GVP impacted other GVP districts in other areas. The names of the districts and participants have been changed to provide confidentiality. Each of the participants were selected through purposeful sampling (Coyne, 1997; Creswell, 2012; Merriam, 2009). Merriam (2009) suggests using this type of sampling when choosing the criteria that "directly relates to the purpose of the study and guide in the identification of information-rich cases" (p. 78). This type of sampling allows the researcher to select participants that will directly relate to the study (Creswell, 2012). Each participant was chosen based on a recommendation from the GVP director, district leader, or school leader. Following the district interview, a school in each district was selected based on the district representative's recommendations of schools

implementing the math innovations. The information from the informants allowed the participants to be those who were implementing the innovations in their district, school, and classroom.

Two districts were chosen for this study based on recommendations from the GVP director. These recommendations came based on the focus of math innovations and what the two districts were working on and included in the district's strategic plan. The recommendation of the two districts helped to increase the opportunity to see how the GVP impacted the teaching and learning, especially through math innovations, during the study. One district representative was appointed through the GVP director to discuss the impact of the GVP on the district. Then the district representative selected a school based on the study of math innovations to increase the opportunity for knowledgeable leaders and teachers (Coyne, 1997; Creswell, 2012; Patton 2002). These school leaders then helped to select teachers to participate in the study through purposeful sampling, a common type of sampling used in qualitative research (Coyne, 1997), using the school administrator as an informant.

District A is a small school system located in the northern, rural part of the state. The county population is around 20,000 people and consists of 70-80% White and 20-30% Black residences (Table 1). The district population of about 3,000 students mirrors the demographics of the county. In comparison with the state, the population has a higher percentage of White and a lower percentage of Black. The median household income is in a range of $40,000 to $50,000 and mirrors the state median household income. The poverty level of the district is in the range of 10% to 20%, which also mirrors the state poverty level. However, the school serves a range of 50% to 60% of students who qualify for free and reduced lunch. Around 1% of the population at the school is composed of limited English learners. The school has been designated as a Georgia

School of Excellence and a Title I Distinguished School for multiple years in addition to other awards (Governor's Office of Student Achievement, 2015; United States Census Bureau, 2014).

In District A, contact began with a district level leader. The district representative was previously a district administrator when the district signed as a partner with the GVP, and helped align the strategic plan with the GVP. The district representative selected the elementary school that would participate in the study.

Table 1

District A Demographic Profile

Name	County Demographics	School District Demographics	School Demographics	State Demographics
Total Population	20,000	3,000	1,000	10,097,343
Asian	>1%	1-5%	1-5%	3.8%
Black	20-30%	20-30%	20-30%	31.5%
Hispanic	1-5%	5-10%	5-10%	9.3%
White	70-80%	60-70%	60-70%	62.1%
Median Household Income	$40,000-$50,000	N/A	N/A	$49,179
Poverty/ Free and Reduced Lunch	10-20%	50-60%	50-60%	18.2%

At the elementary school, the principal participated and selected school level participants. The participants included two third grade math teachers, two fifth grade math teachers, and one school instructional coach (Table 2). Each teacher participant had between ten and twenty-three years of experience. Some teachers had only taught in District A, while other teachers had taught in other districts and at various grade levels including middle school mathematics and special education. Currently, all of the teachers are general education teachers. However, the classes are grouped according to gifted and high-achieving, average, low-achieving, special education and English Language Learners. Classes are created based on a norm-referenced test that the district

gives multiple times per year. The students can be moved based on the scores during the year as well as teacher recommendation.

Table 2

District A Participant Profiles

Name	Grade Level	Years Teaching	Ethnicity	Gender	Class Grouping
Allie	5th	10	White	Female	4 homogenous classes
Beth	5th	14	White	Female	3 homogenous classes
Cassidy	3rd	16	White	Female	Inclusion of Special Education
Diana	3rd	16	White	Female	EIP & Gifted

District B is a large school system located in the northern, suburban part of the state. The district population is over 200,000 people (Table 3). District B consists of between 60-70% White, less than 5% Black, and between 10-15% Asian and Hispanics. The district has a higher percentage of White and Asian population than the rest of the state with the Black population being much lower. The district population mirrors the school population. The median household income is in a range of $80,000 to $90,000, which is almost twice the state median household income. District B School has a poverty level of less than 10%, which is also lower than the state poverty level and school district's free and reduced lunch population. Less than 10% of the population is limited English learners. The school that participated in the study is a relatively new school and is currently in its fourth year of existence (Governor's Office of Student Achievement, 2015; United States Census Bureau, 2014).

Table 3

District B Demographic Profile

Name	County Demographics	School District Demographics	School Demographics	State Demographics
Total Population	200,000	43,000	1,300	10,097,343
Asian	10%	10-15%	5-10%	3.8%
Black	5%	1-5%	1-5%	31.5%
Hispanic	10%	10-15%	5-10%	9.3%
White	80%	60-70%	75-80%	62.1%
Median Household Income	$80,000-$90,000	N/A	N/A	$49,179
Poverty/ Free and Reduced Lunch	10%	10-20%	5-10%	18.2%

In District B, contact began with a district level leader and school administrator. The district leader selected the elementary school based on the school leader having a mathematics background. The principal selected school level participants, which included third grade teachers. Each teacher participant had between thirteen and eighteen years of experience (Table 4). All of the teachers are general education teachers with classes grouped by achievement.

Table 4

District B Participant Profiles

Name	Grade Level	Years Teaching	Ethnicity	Gender	Class Grouping
Elizabeth	3rd	13	White	Female	Average to Gifted
Fran	3rd	13	White	Female	Lower to Average
Ginger	3rd	13	White	Female	Average to High
Heather	3rd	14	White	Female	Low to Average
Isabella	3rd	18	White	Female	Inclusion to Average

This section describes the research sites and participants. The section includes the demographics of each district. Each of the districts is a partner with the GVP to help understand the impact that GVP has on districts and the perceptions of teachers to math innovations. In each

district, a district level representative, a school administrator, and five additional people, including teachers and instructional coaches were interviewed.

Data Collection. The following section discusses the process for collecting the data for this study. The data that was collected included interviews, observations, and artifacts. In both districts, interviews were conducted with a representative from the district office, a school principal, and teachers. An observation was conducted in both districts and artifacts were collected to help triangulate the data and gain a deeper understanding of the perceptions of math innovations.

Data were collected through interviews with district level participants, school administrators, and teachers. Before each interview, the participants were told about the research project and interview process. Each participant gave consent before beginning the interview. Interviews were conducted from June 2015 to October 2015. The interviews were scheduled for a maximum of one hour with the majority of the interviews lasting between thirty and forty minutes.

Questions were asked to understand the impact that educators' perceptions of math innovations had on math instruction through the teaching and learning standards of the GVP. Two different sets of questions were created for the study. The first set of questions addressed the role of the GVP in the district strategic plan (Appendix A). These questions were asked in other studies that were conducted at the same time in the other GVP case studies to gain a larger perspective of how the GVP has impacted districts. The professor who coordinated the GVP study along with the GVP director developed the questions (Berry, 2014). Following the development, the questions were provided to the individuals conducting the studies. These questions were asked to the district participant to gain an understanding of how the GVP had guided the district.

The second set of questions addresses the perception of the math innovations in the district (Appendix B). These questions were created specifically for this study based on the innovations that were studied. Relevant research was reviewed to create questions that would better inform this study. These innovations included math professional learning, the use of manipulatives through the CRA model, differentiation through flexible grouping, and strategies for instructing different subgroups of students in mathematics. These questions were asked of the school level leadership participant, individual teachers, and a school instructional coach.

Each district that participated in the GVP project identified one individual who is knowledgeable of the GVP's implementation at the district office. The district representative participated in the interview to discuss the district's implementation of the project. The school principal participated in an interview about math innovations that had been implemented in the school. After the principal's interview, teachers were interviewed to gain their perspective of math innovations. Five teachers were selected in each district and interviewed for the study, with one district including an instructional coach as one of the five participants. The coach was asked to be included based upon having a clear instructional understanding of what is occurring in all classrooms. The teachers selected were from third or fifth grade due to these two grades being seen as high-stake testing years in Georgia (Washington, 2014). Third and fifth grade students have been required in the past to pass sections of the state assessment to be promoted to the next grade. Students in third grade are required to pass reading while students in fifth grade are required to pass reading and mathematics. The school level interviews helped triangulate the information gained at the district level interview and gave insight into the perception of the math innovations and the implementation of math instruction.

Professional learning and planning sessions were observed to see how the GVP impacts mathematics instruction and has guided professional learning. Observations help the research to identify the "physical, social, cultural, and economic contexts of the members of the study" (Jebreen, 2012). During this time, field notes were taken of the setting and observation with personal reflections of the observation to the side (Creswell, 2012; Jebreen, 2012). The observations included a minimum of one hour with one grade level during math professional learning/planning. The observations were pre-arranged so that the teachers knew that it would be occurring. Both districts were observed once during the research. District A had one grade level planning session and District B had one professional learning session to look at the vertical alignment of the vocabulary in the math standards for observation.

The last set of data that was collected and analyzed included documents such as strategic plans, school websites, lesson plans, and testing data. The documents were collected and coded to help with the organization and understanding of information gathered from the documents (Merriam, 2009; Thomas, 2006).

Interviews, observations and artifacts were collected and provided support for summarizing multiple cases (Boozer, 2015). The statements that were made during an interview could be cross-referenced against other interviews, documents, or during the observations to ensure credibility (Merriam, 2009). Merriam (2009) states that reliability is difficult when studying people because people react differently over time. Therefore, a replication of the study would not necessarily produce the same results. However, triangulation allows for researchers to show trustworthiness in a study. To obtain trustworthiness in this study, the information that was gathered from participants during the research was shared with the participants to check for accuracy in content and perspective as described by Krefting (1991).

The identity of all participants, schools, and districts remains confidential. Consent was gained from the participants; interviews were recorded; and the interviews were transcribed with each participant receiving a copy and being given an opportunity to provide input about the transcript. Only the researcher and one other person had the password to access the transcripts. The audio recording and all transcripts were secured to maintain confidentiality and security.

The data collection for this study was through interviews, observations, and artifacts. The interviews were conducted at three levels: district, school leader, and teacher. The observations were during planning and professional learning. The observations and artifacts helped to triangulate the information that was gained during the interviews. The names of all participants and districts were kept confidential and transcripts were secured.

Data Analysis. This section will provide insight into the process used to analyze the data for this study. Data was collected from two GVP districts through interviews, observations, and artifacts. First the data from each district was analyzed independently and then compared to the other district in the study to help understand the impact that the GVP has on districts.

After transcribing the interviews, the interviews were repeatedly read to familiarize the evaluator with the content (Thomas, 2006), notes were made in the margins of interesting observations (Creswell, 2012; Merriam, 2009), and NVivo, a computer data analysis software, was used to code the transcripts. To learn how the GVP has impacted instruction with math innovations, open coding (Creswell, 2012) was used to look for common themes. Coding helps with the use of general inductive approach (Thomas, 2006). This study used thematic analysis to provide detailed data through analyzing data for themes (Braun & Clarke, 2006). This method is flexible and allows the researcher to compare and contrast data sets. Thematic analysis was used to report perceptions of participants in GVP districts. NVivo allowed the transcripts to be read

and the information in the documents to be selected and organized into different themes according to the GVP standards. The general categories were created and then through additional readings additional categories were created as outlined by Thomas (2006) and Spronken-Smith and Walker (2010). The themes were created through a theoretical approach causing the data to be analyzed in certain areas of the data (Braun & Clarke, 2006). This collective case study will allow the researcher to make generalizations (Boozer, 2015) about how the GVP has impacted participating districts.

The observation notes and artifacts were used to help determine what is occurring in the districts. The notes from the observations were read, notes were written in the margin, and sections of the notes were used to help support the GVP standards and math innovations in the district/school. These artifacts were studied and used to support what was said during interviews and observed during observations.

This study used cross-case analysis to determine how the GVP has impacted math innovations in two districts. After the research was collected, the data from both cases were analyzed separately and then compared to the other district in the study to see how the program is being implemented (Boozer, 2015; Merriam, 2009). Each case was analyzed independently to fully understand the case, and then after both cases were independently analyzed, the cases were compared to allow the researcher to understand the impact of the GVP on math innovations (Merriam, 2009).

This section discussed the process of analyzing the data in the study. The interviews, observations, and artifacts were used to support each other and look for support of the GVP recommendations and use of math innovations. Data from each district was analyzed

independently first before the data was compiled together to gain a better understanding of the impact of the GVP on math innovations.

Results

There were four GVP standards that were reflected in the findings of the research in the two districts. The first theme focused on governance, leadership, and accountability. This standard had a focus on providing an equitable education for all students. Through this standard it was found that teachers lacked adequate professional learning in planning for diverse populations. The second standard that was identified was the culture, climate, and organizational efficacy, which focused on the learning environment that both districts create for the students, parents, and employees. The research found that both districts have created a safe and inviting learning environment. The third standard that was related to the study was teaching and learning resources. This standard focused on the instructional models and technology that were used in the districts. Both districts were found to have teachers who preferred a grouping model that reduced the number of ability groups in the classroom making differentiation easier to provide. Technology was found to help support teachers in providing differentiation as programs provided content according to the students' needs. The last standard that was related to the study was the teaching and learning standard, which included professional learning, flexible grouping, and the use of manipulatives through the CRA model. Finally, neither district felt that the GVP directly impacted their district in the areas of context, learning, and leadership. Both district leaders felt that they could not directly determine that the GVP had an impact on the results of the district.

Limited professional learning targeting differentiation for subgroups.

One of the GVP standards is the governance, leadership, and accountability standard. A recommendation of this standard is that districts provide an equitable education to all students. A code that was determined through the interviews was diversity. Providing an equitable education

for all students in diverse subgroups falls under the governance, leadership, and accountability standard. Researchers have found achievement gap exists among students of different races (Berry, 2004; Blackford & Khojasteh, 2013; Clotfelter, Ladd, & Vigdor, 2009; Robinson, 2010) and socio-economic statuses (Clotfelter et al., 2009; Reardon, 2013; Yates & Collins, 2006). Overall, both districts have results that demonstrate high results on state assessments in mathematics. As the subgroups are analyzed, not all subgroups in either district meet the state performance target in math. Teachers stated during interviews that they did not plan differently to meet the needs of the different subgroups. There is limited planning for diverse groups of students and both districts lack professional learning to address the needs of different subgroups.

The GVP has the recommendation to ensure all students across the state receive an equitable education. When the data is analyzed for the 2013 and 2014 Mathematics CRCT results, both districts are above the state average (Georgia DOE). Table 5 shows the 2013 Mathematics data for the CRCT. In 2013, District A had almost 50% exceed and over 90% meet or exceed in third grade. District B had over 60% exceed and over 90% meet or exceed in third grade. At the school level in District B, almost 65% exceed and almost 90% meet or exceed. In comparison the state had 43.7% exceed and 78.5% meet or exceed the standard. All district scores were above the state scores in exceeds and meets or exceeds for 2013. The same is true of the 2014 scores. Table 6 shows the scores for the 2014 Mathematics CRCT assessment. The state increased to 44% exceeds and 80.7% meets or exceeds. District A had over 50% and 90% respectively. District B had almost 70% and over 90% respectively. The District B School had almost 90% and over 99% respectively.

Table 5

2013 CRCT Scores

District	Exceeds	Meets or Exceeds
District A-3rd	47.1	91.4
District B-3rd	66.8	90.8
District B School-3rd	64.9	89.2
State-3rd	43.7	78.5
District A-5th	52.2	95.7
District B-5th	76.7	98.4
District B School-5th	50.3	94.0
State-5th	47.0	89.5

Table 6

2014 CRCT Scores

District	Exceeds	Meets or Exceeds
District A-3rd	50.2	91.0
District B-3rd	68.3	92.0
District B School-3rd	87.8	99.3
State-3rd	44.0	80.7
District A-5th	42.9	94.8
District B-5th	74.4	97.7
District B School-5th	62.1	94.7
State-5th	43.8	87.7

The fifth grade scores once again have a high percentage of meets or exceeds for the districts and schools. In 2013, the state had 47% exceeds and 89.5% meets or exceeds. District A had over 50% and 90% respectively. District B had almost 80% and over 95% respectively. The District B School had over 90% and almost 95% respectively. In 2014, the state decreased to 43.8% exceeds and 87.7% meets or exceeds. District A had less than the state in exceeds with almost 45% but was higher than the state in the meets or exceeds with almost 95%. District B was almost twice as much as the state with close to 80% in exceeds and over 95% in meets or exceeds. District B School had over 60% and 90% respectively.

Overall both districts have scored as high performing districts on the state assessment and demonstrate high performance on the state assessments. Analyzing the subgroups helps to provide insight into how the different subgroups are performing and how schools plan accordingly. Researchers have studied instructional strategies to help teachers and students of diverse backgrounds be successful in the mathematics classroom (Castle, Deniz & Tortora, 2005; Kususanto, Ismail, & Majeed, 2011; Latz & Adams, 2011; Petrilli, 2013). However, the teachers in the interviews did not consciously plan according to the strategies to help their students of diversity be successful. Both districts have not provided any professional learning to help support teachers in learning instructional strategies for different subgroups. This is evidenced by the fact that all teachers responded "no" when asked if they had received professional learning covering strategies for teaching math to diverse subgroups.

The following discusses the performance for subgroups in both districts. The College and Career Readiness Performance Index (CCRPI), the state's evaluation system, analyzes the performance of students by subgroups (College and Career Readiness Performance Index, 2014). Districts are awarded different flags for each subgroup. To gain a green flag, the subgroup had to have enough students to participate for a subgroup, meet the state performance target, and meet the subgroup performance target. If a subgroup does not meet a state or subgroup performance target then they are given a yellow flag. A red flag is given if the participation rate is high enough but both the subgroup and state performance targets were was not met. Subgroups that did not have enough students in the subgroup are given an N/A.

District A met the participation rate, the state performance target, and the subgroup performance target for the White, English Learners (EL), and economically disadvantaged (ED) student subgroup in 2013 (Table 7). The Black and students with disability (SWD) subgroup did

not meet all targets. The Black subgroup of students met the participation rate and subgroup target, but not the state performance target. The SWD subgroup met the participation rate, but did not meet the state performance target or the subgroup performance.

Table 7

2013 District A CCRPI Subgroup Performance

Subgroup	Participation Rate	State Performance Target	Subgroup Performance Target
Black	X		X
White	X	X	X
English Learner	X	X	X
Economically Disadvantaged	X	X	X
Students with Disabilities	X		

** Target areas met are reported in table*

In 2014, the White and EL subgroup met the state performance target again. Again, the Black and SWD did not meet all performance targets along with the addition of the ED subgroup. The Black, ED, and SWD subgroups met the participation rate, but did not meet either the state or the subgroup performance target (Table 8*)*. During 2014, the Black and ED subgroup went from a yellow flag to a red flag on the CCRPI. The Black subgroup had previously met participation rate and subgroup performance targets in 2013. In 2014, the participation rate was again met but the Black subgroup failed to meet the subgroup performance target. In 2013, the ED subgroup met the participation rate, subgroup, and state performance targets which resulted in the school being awarded a green flag. In 2014, the ED subgroup only met the participation rate performance target and failed to meet the subgroup or state performance targets which resulted in the school being awarded a red flag. Both of these subgroups showed a regression in

performance from 2013 to 2014. The Black, SWD, and ED subgroups did not meet the performance targets for both years.

Table 8

2014 District A CCRPI Subgroup Performance

Subgroup	Participation Rate	State Performance Target	Subgroup Performance Target
Black	X		
White	X	X	X
English Learner	X	X	X
Economically Disadvantaged	X		
Students with Disabilities	X		

** Target areas met are reported in table*

In District A, the administrator and teachers were able to identify the subgroups that were falling behind. However, the teachers openly admit that they do not think of gender, race, or socio-economic status in planning lessons. The instructional coach said that she does not think that teachers necessarily think about the different subgroups when they plan, but that some of the best math teachers naturally incorporate it into their math plans. During the interview the instructional coach states, "I feel like our teachers are trying really hard to reach every kid but that gap just seems to keep growing." One teacher discussed how she does notice that a student's socio-economic statue often is an indicator of student experiences and background knowledge. She tries to incorporate a lot of vocabulary into her lessons to help build background knowledge. The teacher feels that the instructional models [Concrete Representational Abstract (CRA) and Cognitively Guided Instruction (CGI)] help give the students background to help students be successful in math. The teacher states

> "Poverty, or the economically disadvantaged, the students with special needs, a lot of them, not all the time but a lot of them, they are the same students. So a lot of the things that they are lacking is the background knowledge, the vocabulary, and really and truly is the experience with these things. So CGI and the CRAs is giving them the background knowledge."

Another teacher tries to think about students' background experiences as she wrote word problems. She had made a conscious effort to make the word problems relevant to the students by using their names and things of interest to them. A fifth grade teacher says that she has learned how boys are much more active. The teacher states, "[The boys are] more active and they're yelling out, whereas most of the girls are doing what they, most of the time, should be doing." She tries to plan activities that will let them move around the classroom and feels this also benefits the girls because even though they are better at sitting still, she finds they enjoy the movement as well. She also notices that students of lower socio-economic status are in her lower level classes. Over the years she has noticed that her Black students are lower performing in her mathematics classroom. However, she has noticed this year that the gap is closing and that their parents are more involved.

> "In the past I've seen more with the African American students are typically a little bit lower and the lower socioeconomic students are typically just lower performing. I have actually made the comment this year that I feel like the African American students are, I feel like this year, the gap is closing."

Administration is aware of the gaps in subgroups, and this is an area that administrators are focusing on. District A administrator states, "It's a constant struggle. Our African American

students tend to be…about a year [behind] and it is consistent with gender….” To help inform the teachers of the discrepancies in student achievement, the teachers have been asked to report classroom test results that include subgroups to administration. This is in line with the district growth plan to ensure that students who typically do not do well are being noticed and instruction is changing to meet their needs. The gap is consistent in comparison to economically disadvantaged, as well as gender. This trend is noticed in the early years. Both Black and White students are making about the same amount of growth, which leads to the gap remaining between the races. The gap for economically disadvantaged is less than the subgroups of Blacks and students with disabilities. According to administration and testing data, the English Learner subgroup does very well.

According to CCRPI, in 2013, District B met the participation rate, the state performance target, and the subgroup performance target for the Black, White, ED, and SWD student subgroups (Table 9). The EL subgroup of students met the participation rate and subgroup target, but not the state performance target. In 2014, the Black and White subgroup met again with the addition of the EL subgroup (Table 10). The ED and SWD subgroups met the participation rate and the subgroup performance target, but did not meet the state performance target. During 2014, the EL subgroup increased while the ED and SWD subgroup decreased.

Table 9

2013 District B CCRPI Subgroup Performance

Subgroup	District B			District B School		
	Participation Rate	State Performance Target	Subgroup Performance Target	Participation Rate	State Performance Target	Subgroup Performance Target
Black	M	M	M	N/A	N/A	N/A
White	M	M	M	M	M	M
English Learner	M	DNM	M	M	DNM	M
Economically Disadvantaged	M	M	M	M	DNM	DNM
Students with Disabilities	M	M	M	M	DNM	M

** M=Meets, DNM=Does Not Meet, NA=Not Applicable for Subgroup Size*

Table 10

2014 District B CCRPI Subgroup Performance

Subgroup	District B			District B School		
	Participation Rate	State Performance Target	Subgroup Performance Target	Participation Rate	State Performance Target	Subgroup Performance Target
Black	M	M	M	N/A	N/A	N/A
White	M	M	M	M	M	M
English Learner	M	M	M	M	DNM	M
Economically Disadvantaged	M	DNM	M	M	DNM	DNM
Students with Disabilities	M	DNM	M	M	DNM	M

** M=Meets, DNM=Does Not Meet, NA=Not Applicable for Subgroup Size*

At the school level, in 2013, the White subgroup was the only subgroup to meet the subgroup target (Table 9*)*. The EL and SWD subgroup was progressing with meeting the subgroup target, but not the state performance target. The ED subgroup did not meet the state or the subgroup performance target. For this report the Black subgroup is not reported.

The results were the same for 2014 (Table 10). In both years that data is reported, the EL, SWD, and ED subgroups all failed to meet the performance targets that the White subgroup met both years. Further evidence of the performance divide is the data showing that in both years, the ED subgroup also failed to meet the subgroup performance targets which the EL and SWD subgroups did meet. The data also shows that these building-level subgroups are underperforming the mirrored system-level subgroups. In 2013, the building-level ED subgroup only met participation rate performance targets while the SWD subgroup met subgroup performance targets. However, both of these subgroups met state and subgroup performance targets at the system level. Similarly, in 2014 the building-level EL subgroup met subgroup performance targets and the ED subgroup only met participation rate targets while the system-level EL subgroup met both subgroup and state performance targets and the SWD subgroup met subgroup performance targets.

District B has also not received any professional learning on teaching mathematics to different subgroups. During the interviews, the teachers said that they did not teach differently to the diversity of students. The teachers reported that they teach according to the students' strengths and weaknesses. Only one teacher who had a high population of EL students in her class referenced a strong focus on vocabulary and visual representations to help her students. "I've taught ELL students for the past couple of years and … there's a language barrier. So using the manipulatives gives them a visual representation that they need so they can connect the vocabulary and the concept to something visually." The EL students in the school met the participation and subgroup performance target, but not the state performance target. Another teacher felt that not all subgroups were a focus in school data as she stated, "Socioeconomic status is not a real concern for again probably 98-99% of them." However, the school population

had enough students to meet the participation rate for the CCRPI, but this subgroup did not meet the subgroup or state performance target. The subgroup having a large enough population to measure the subgroup's performance, while not meeting the performance targets, reduced the school's CCRPI score.

The two districts are organized differently and have different subgroup performances. The only performance consistency is that the White subgroup at both schools met the subgroup and state performance targets both years (Table 11 and 12). The Black subgroup met the state and subgroup target both years for District B, but did not meet the state target either time in District A. The EL subgroup met the state and subgroup target both years in District A and increased from not meeting the subgroup target to meeting in District B (not at the school level). Both districts experienced a drop for the ED subgroup from meets to only participation rate for District A and the District B School while District B met the subgroup performance target. SWD stayed the same in District A and for the District B School while District B dropped from meeting to only meeting the subgroup performance target.

Through the conducted interviews and documentation, there is evidence of the governance, leadership, and accountability standard being implemented in both districts. Both districts provide a high quality education in their district in the area of math instruction with standardized test scores being high. The state assessment shows both districts are performing above the state average in mathematics in third and in fifth grade. The subgroup performance does vary from district to district and year to year. Professional learning has not been conducted in either district to address the needs of planning for different subgroups.

Table 11

2013 GVP Districts CCRPI Subgroup Performance

Subgroup	District A	District B	District B School
Black	Subgroup	All	N/A
White	All	All	All
English Learner	All	Subgroup	Subgroup
Economically Disadvantaged	All	All	Participation Rate
Students with Disabilities	Participation Rate	All	Subgroup

Table 12

2014 GVP Districts CCRPI Subgroup Performance

Subgroup	District A	District B	District B School
Black	Participation Rate	All	N/A
White	All	All	All
English Learner	All	All	Subgroup
Economically Disadvantaged	Participation Rate	Subgroup	Participation Rate
Students with Disabilities	Participation Rate	Subgroup	Subgroup

Inviting learning environment.

The next GVP standard that was identified during the study was culture, climate, and organizational efficacy. This standard has recommendations that include developing safe learning environments; creating inviting places for students, parents, staff, and the community; establishing the school as the center of the community; determining the perception of the stakeholders; developing a culture and climate that fosters innovation; being sensitive and responsive to the community that they serve; and being willing to listen to the students. The research revealed that both districts have created a safe and inviting environment for students, parents, staff, and the community.

District A often spoke of serving the community and the culture that is created in the school. The district leader spoke of the traditionally high retention rate of the teachers and administrators in the district. Currently, however, the district has newer administrators in their buildings, with four years being the longest tenure due to retirements and other promotions. At the beginning of the 2015-2016 school year, the district currently has 96% of their teachers returned to the district. This is lower than in the past due to a high number of teacher retirements after the 2014-2015 school year. The district leader expects the rate to go up again at the end of the school year. In addition, the district leader shared many positive comments about how supportive the community is to the schools in their district. As a school administrator, she felt that the parents and community always met any need that the school had. The parents still reach out to support her as she has moved to the district office. The district leader stated,

> "…I think our community involvement, parent involvement here is wonderful. I know as a principal I never questioned the support that I had here from the community from the parents. Anytime I needed anything they were always there, volunteering many times to do things to support the district. "

This same attitude was mentioned at the school level as well. The district leader felt that the faculty of the school created a culture of learning and went above and beyond to meet the students' needs.

> "Climate is so critical to student success. If people are not happy and do not want to be there then you have a problem….The climate overall is very good. A lot of that is attributed to the fact that they work collaboratively together."

One challenge that the district leader mentioned is the changes that occur in education, often times without the input of educators. "When so many things are changing overnight…that

creates climate issues, creates culture issues where people don't know what to do. So I do feel we are in a transition time whether it be from leaders [or] curriculum." The school administrator spoke of how he helps to support the teachers in all of the changes. "I am more of a pull model. I get people to try it once and they really see the result….The kids are successful and then I don't have to mandate anything." The administrator gave examples of purchasing curriculum, technology, and the use of manipulatives in mathematics. Administration provides input and resources, but teachers choose whether to try new things and resources. Teachers validated the administrator during their interviews as they spoke of the expectations and support that they received from administration.

The administrators are not the only ones that work to make the culture and climate of the school inviting. The teachers also work to meet the needs of all the students. Administration and teachers spoke of different examples of how they work to meet the needs of the students and create a safe and inviting place for students. During one interview the faculty member talked about a team of teachers working with a student who came from a difficult situation.

> The teachers … "worked with her for about three months until they proved to her that they loved her and would be there for her every day. This then became her safe haven and then she never wanted to go home in the afternoon. She wanted to stay here. That's typical of what our teachers will do. They will do whatever it takes to meet the needs of the students."

Teachers also spoke of creating individual behavior plans; lunch and learns for tutoring; before or after school tutoring; community parent night math meetings; and inviting parents to be a part of the classroom. These actions helped to create a learning environment with a positive culture and climate for the students and parents.

The parents and community of District A also play a role in the culture and climate of the school. The district is a charter district. The district leader discussed how the governance of a charter could be intimidating, but not in this district. The district feels that the governance teams are supportive and want to support the efforts of the schools. When the district created their district plan, over three hundred people were a part of creating the plan. Many of these representatives were parents and community leaders along with school employees.

District B referenced the culture, climate, and organizational efficacy at multiple levels in the interviews. The district leader felt that the district created an inviting culture for the employees as she spoke of the high longevity rates for teachers and administrators. At the administrative level she stated that the administrators have been consistent for years. The only reasons for administrators to change were due to new schools opening in the district, retirement, and promotion to the county office. The elementary level has had less longevity in their schools, but this is due to more elementary schools opening and administrators moving to open new schools.

The district has created a customer service program to help ensure that the employees, parents, students, and the community are supported. The district leader said that the program is an example of "…how our system views culture and knows that it is an important facet of supporting the learning process."

The district representative often spoke of the community involvement in the district. In the mid-nineties, between one hundred and one hundred fifty community members came together to create the district's strategic plan. The community continues to serve the district in this capacity. The district is in their last year of the current strategic plan, and the community will help with the next strategic plan. The community also helps with a program that they use to

help improve their graduation rate. About one hundred twenty people came together from the district, chamber of commerce, and community to brainstorm recommendations to improve the graduation rate. This program has been in place for at least three years and has led to a graduation rate in the high nineties. However, the goal for the district is to have one hundred percent of the students to graduate and lead the nation in graduation rates. The last area of community involvement that the district representative referenced was a program that they started in which community members became a principal for the day. Each school had a community member come in and spend the day with the principal. This allowed the community to see what the principals do and what the schools do for the students. Principals for the day are able to share with the community the work that educators are doing in the schools.

Teachers in District B felt that they did work in a great school. The teachers expressed that their administrators supported them in their job to help the teachers meet the students' needs. One teacher said, "…we've been working on being a family and just different things as a school. So I think that the students and the staff all view learning as engaging and exciting and they're wanting to learn and focus."

In this section the findings of the GVP recommendations for culture, climate and organizational efficacy were discussed. These recommendations include developing safe learning environments; creating inviting places for students, parents, staff, and the community; establishing the school as the center of the community; determining the perception of the stakeholders; developing a culture and climate that fosters innovation; being sensitive and responsive to the community that they serve; and being willing to listen to the students. Both districts showed through interviews, observations, and documentation that the learning environment is a safe and inviting place for students, parents, staff, and community members.

The involvement of the community in both district demonstrate the perceptions of the stakeholders.

Instructional grouping and technology as differentiation tools.

The third standard that was related to the study was the teaching and learning resources standard. This standard recommends that schools and districts use and evaluate instructional models; integrate technology; and implement and use a data system to monitor student achievement. This study provided evidence that both districts demonstrated evidence of this standard through the use of instructional grouping and technology. Teachers found that they could meet the needs of their students through the implemented instructional models and the grouping of students. Technology was a tool that helped the teachers meet the needs of the students at different levels and helped provide differentiation.

Instructional grouping.

The teaching and learning standard focuses on the instructional models that are used for instruction. Both schools have implemented similar programs related to grouping. The students are grouped in general ability groups with grouping around six ability levels; (a) special education, (b) Early Intervention Program (EIP), (c) below average, (d) average, (e) above average, and (f) gifted. EIP is a program for low-performing students to get additional support. Only a certain number of students qualify for the EIP program based on performance on an assessment instrument. Teachers in both districts were generally receptive to the instructional model that was used.

District A currently has in place multiple instructional models that include regular education, special education, an EIP, gifted, and a math interventionist. Most of the teachers felt that the instructional programs that were provided were beneficial to the students. The only

program that did cause some concern was the structure of the EIP classes in which the EIP teacher pushed students into the classroom three days a week and pulled students from the classroom two days a week. Teachers were concerned with how often students are pulled and the instruction that they are missing during math class, as well as other subject areas.

The placement of students in each program is determined by a norm-referenced test called the Measures with Academic Progress (MAP). The district uses the MAP test multiple times a year to determine the growth of the students. At the beginning of the year students are placed in the class, or in a program, that is most appropriate according to their MAP score. Teachers and administration do have the ability to move a student from one program to another if they see the MAP score is not a true reflection of the student's ability. The MAP score has helped teachers plan instruction for their students. One grade level noticed that the majority of students had mastered the grade level's geometry standards. Instead of teaching the standards to the students, the team used between-class flexible grouping and pulled the students who had not mastered the geometry standard to one teacher's classroom to learn geometry while the other students worked on other concepts. "We had a situation at one grade level where in geometry all but thirty students did very well on the MAP. So the discussion was 'why teach geometry?' Restructure and pull those twenty or thirty students and let someone teach them geometry, but let the others move on." Administration reports that the district has had great success with the MAP test, especially in math.

District A administrator stated, "We had 85 to 95% meet their growth target. It doesn't mean they are on grade level, but it means that they are growing. That is what we are looking for."

District B has similar instructional models to District A. Teachers are assigned ability-

grouped classes that include regular education, special education, gifted, and EIP. The gifted teacher and EIP teacher push students into the classroom for math instruction. Students are placed in the different classrooms and programs based on previous state standardized assessments and other forms of screening. The teachers were very supportive of the instructional models and felt that the administration did their best to ensure a grouping that would provide a quality education for each student.

District A and District B offer similar instructional models to meet the needs of their students. The students are placed in the different classrooms based on test scores that allow the students to be in the educational environment that the school feels is best. District A uses the MAP test multiple times during the year to measure growth and for placement of their students. District A uses multiple different computer programs to help track student progress and adjust instruction. District B uses state assessments to help with placing their students.

Teachers in both districts felt that the ability based grouping of students in their school allowed them to best meet the needs of their students. The groupings placed students in a similar ability level together to help reduce the number of different levels of students in one class.

Technology.

The standard for teaching and learning resources includes the recommendation of using technology in schools. Both schools in the study used technology to meet the needs of the students. District A used technology specific to instruction in mathematics and tracked student achievement through the programs. District B used technology as a general resource as well as for math support. District B did not use technology to track the progress of their students.

Technology has also played a role in the success that the county has seen in math in District A. Teachers in the school are using programs such as Kahn Academy and Study Island

to help provide appropriate instruction for students. The teachers use the programs to differentiate assignments for homework or in centers. Both programs provide teachers with data to let them know how students are doing and either provide interventions or challenge students at a higher level. In reference to Kahn Academy, a fifth grade teacher stated,

> "I think it's great as far as differentiating for the kids. The gifted kids can move at a faster pace, get through a grade level and move on. The ones that are struggling with adding and subtracting we can very easily move them down to a third grade program if we need to."

One teacher has her students use Kahn Academy for homework instead of the traditional textbook or workbook. Students are encouraged to watch the videos for support with the assignment. In addition, she also uses the videos for a flipped classroom in which the students are exposed to the content before class and then provided support and practice during class. The teacher stated, "So I'm trying to get them to use that, so kind of like the flipped classroom, so then when we get to it in class they are much more comfortable with it." The teacher felt that this helped the students be more successful during instructional time.

The teachers in District B who were interviewed did discuss technology during their interviews, but not to track data for the students. Teachers referenced programs such as Kahn Academy, Gizmos, and an on-line classroom website.

Teachers in both districts use ability based grouping to differentiate instruction for their students. This instructional model allowed classrooms to be composed of students at similar ability levels. Teachers supported this instructional model and felt that it was effective. Also, both districts are using technology to help support instruction in their district. Technology allows for supplemental instruction which can be based on the current ability level of the student.

Instructional computer programs are used to help differentiate the math content that students are learning. District A is also using technology to track the students' progress.

Teaching and learning environment.

The teaching and learning standard, a main focus of this study, stresses the importance of providing an environment where students can learn; and where teachers can plan together and provide quality instruction; use a variety of technologies to teach and measure student achievement; challenge students through lessons that are flexible and interesting to the students; and measure student achievement to provide students with an environment that allows students to learn. This section specifically demonstrates how professional learning; differentiation and flexible grouping; and use of manipulatives and the CRA model are demonstrated in the two GVP districts studied.

The teaching and learning standard was a focus in both districts during the interviews from all participants. The district leader of District A felt that instruction has improved over the years and that looking at data has helped improve instruction.

> "Because the focus is on the learning and because the focus is on adjusting the teaching so that learning takes place….I really feel we see a lot more teachers using data to drive instruction. That students who aren't learning in this area, the data show this and adjusting the instruction to get there."

The District B district representative felt that the teaching and learning standard was of great importance in their county.

> "We know that teaching and learning, the learning part, is the central part of what we all do…Teaching and learning is the hub of the system and everything else is supposed to work toward it and with it and support it. So the culture is that teaching and learning is

our first job. And then whatever we need to do to support that."

The teaching and learning standard was a main focus for both districts through their interviews, observations, and artifacts.

Professional learning.

Professional learning is conducted in the districts to ensure that quality instruction, a recommendation of the teaching and learning standard, is provided for the students. Professional learning was discussed in all of the interviews and was observed in both districts. The professional learning observations were pre-arranged by the school principal. District A was observed during a collaborative planning session and District B was observed during a grade level professional learning meeting. In addition to these observations, both districts stated during the interviews that they receive professional learning from their peers, from hired consultants, from district leaders, and from regional educational service agencies. This section discusses how both districts use professional learning to meet this standard.

During the interviews in District A, all participants stated that professional learning is provided for teachers. During some of the interviews teachers said instructional coaches, special education and gifted teachers, as well as administrators attended professional learning while other teachers did not view participation from the administration. During the collaborative planning observation, the teachers met together while the instructional coach and administrators came in and out. The teachers discussed the classes that they had observed at the middle school that morning, began to plan their family math night, and worked on upcoming events. The group did get off task as one question may have led to a different conversation. When the instructional coach and administration was present in the room, the teachers were on task and had questions answered.

During the interviews for District A, very few teachers recall having professional learning on differentiation. Some teachers did remember doing a book study many years ago. However, most teachers expressed the importance of differentiation in the classroom and gave examples of how they use it in their classroom. A team of teachers created a rubric for teachers to use with differentiation. Currently the teachers have only used the rubric for self-evaluation.

At the school level, the administrator at the elementary school in District A provides the teachers of each grade level content area time to plan together and receive professional learning. They have four collaborative planning sessions during the year in which the teachers are able to meet together for half the day to plan and discuss how things are going. In math, a consultant is hired to work with the teachers as they focus on specific upcoming topics. During this time the teachers learn about the standards and discuss strategies for teaching the concept. Potential lessons are modeled for the teachers, and lessons are created. During this training, the teachers are provided all of the manipulatives that are used by the consultants so that they can take the tasks back to their classroom to teach their students. The consultants have gone into the classroom to model a lesson with the students and also observe the teacher teaching a lesson and provide feedback.

Teachers also train other teachers in the building. The third grade teachers at the elementary school learned about the CGI model that the teachers at the primary school use. They did this to help bridge the transition from the primary school to the elementary school. Then the third grade teachers attended a regional educational service agency training and found success with the CGI program in their classroom. The third grade teachers were given the opportunity to train other teachers on the program. The teachers were able to observe the third grade teachers as they used the CGI model. This helped them have a better understanding when the third grade

teachers provided professional learning on the model.

The third grade teachers learned about the CGI model through the district level vertical alignment team meeting. District A has vertical alignment teams that are led by leaders at the district. Teachers from kindergarten to twelfth grade meet together. During these meetings the group discusses trends that they notice in the data as well as strategies that have been successful. Rigor is discussed for each of the grade levels in instruction and assessment to ensure that all grade levels are building on concepts from the previous year. The alignment of the standards is discussed during these meetings, which has helped with the roll out of the Common Core Standards and the Georgia Standards of Excellence. Teachers discuss what the standards require at each grade level and the expectations of what students should know from previous grade levels. Representatives are able to share what is going well in their grade level to help other teachers better prepare their students.

District B has days scheduled that provides district-wide professional learning. During the 2015-2016 school year, the district has set aside three full days of professional learning along with a half day. The focus of the professional learning days depends on the needs that are in the schools' improvement plans. The focus is then differentiated to help meet the needs of the teachers according to where they are currently performing.

District B did report that they have had differentiation professional learning at the district level. The teachers also reported that a district representative comes to their school to provide math professional learning. During the professional learning the teachers have learned about number talks, organizing centers, and aligning the framework tasks with standards. Teachers reported that the professional learning was helpful. A teacher commented, "He comes and

he…shows us new things to do with the class…he gets everything organized online where its with centers…and standard aligned too which is really helpful."

District B also has teams of teachers meeting at the county office to work together. Each elementary school in the district has a kindergarten through second grade and a third through fifth grade representative. One of the teachers who participated in the study serves as the school's representative for the third through fifth grade for the school. The team meets twice a year.

At the school level, math professional learning has also been conducted to support the teachers. The administrators have hired math manipulative companies to come in and provide math professional learning about using manipulatives. The administrators in the building are strong with math so they have modeled math instruction in the classrooms. They have also hired retired teachers who are strong in math to come back and have placed them in co-teaching classrooms to help model and support math instruction. The school has a math committee in which teachers are on the committee and they will share different strategies that they are using in their classroom.

The administration at the school feels that it is important for teachers to receive math professional learning at one time instead of spreading professional development out over an extended period of time. This allows teachers to get the big picture instead of having to wait to see the rest of the information. The school also always gives teachers a little time at the end of the professional learning to discuss how they can apply the new concept in their classrooms. The school leadership team has found that if teachers are given this time to think about applying it to their classrooms, then the teachers are more likely to use the new concept. The concepts that the teachers are learning help to improve instruction when used in the classroom. "I would say the

biggest thing I see is the need for very intensive and specific professional development for teachers about understanding math concepts because once they understand it, it translates to what the kids are understanding." The administration in the school provides professional learning in the building to help teachers understand the math concepts that they are teaching.

In this section the role of professional learning was discussed in each district. Both districts provide professional learning to their teachers at the school and district level. Teachers were also able to learn from each other, as well as from others outside the school, in order to improve the instruction in their classroom. Administration is sometimes able to attend professional learning to help support teachers.

Differentiation and flexible grouping.

The teaching and learning standard recommends providing an environment where students can learn; challenging students through lessons that are flexible and interesting to the students; and measuring student achievement to provide students with an environment that allows students to learn. This section shows how both District A and District B use differentiation and flexible grouping to achieve this standard. Teachers in both districts found that differentiation allowed them to better meet the needs of their students.

District A has been working on differentiation and flexible grouping for many years. The district leader who was interviewed said that this was something that they worked on when she was at the school level. The district has not had formal professional learning in differentiation for several years. However, the elementary school has been discussing the use of differentiation in their professional learning committees due to differentiation being a part of the new teacher evaluation system. The High Performance Professional Learning Committee (HPPLC) created a rubric for teachers to use as a guide in their classroom. Teachers used the rubric to do pre-

assessments on themselves. At the end of the year the teachers will assess themselves again to determine growth. The rubric is also used by the instructional coach and administrators as they do classroom observations and by teachers to do peer observations.

The expectations for providing differentiation vary. The administrators and coaches do not have a certain expectation for how often differentiation is implemented. They feel that differentiation cannot be implemented every day since some lessons do not lend themselves to being differentiated. Sometimes differentiation will not be listed in lesson plans, but teachers will see a need for differentiation to meet a certain student's needs. Teachers feel that administration wants to see differentiation in almost all lesson plans, especially math. When administrators come into the classroom, teachers believe they want to see small group instruction, differentiated centers, and students working on different things that match their level. A teacher stated, "

> They expect us to do differentiation every day…. When they come in….they need to be able to see that the kids are doing different activities. Everyone…should not be doing the same thing because they're on totally different levels….And so that's their expectation and so we're bringing that into the room and you're seeing you know three and four different things going on based on what we're working on."

The third grade team will begin using between class flexible grouping in which students switch classes each week based on their personal needs. Each teacher will teach different skills to address the needs of the particular group.

> "…From 2:10 to 2:50 we are doing remediation and acceleration in our classrooms… Now that we have our MAP data and we have a few formative assessments, we're going to start flexible grouping within our classrooms because it's been very difficult, because you're constantly having to remediate the lower kids, so the higher kids are on Kahn and

Study Island, which is great, but they need to be pushed as well. So we're going to have the classroom set up to where these students will be with one teacher working on this and then my higher students will be with another teacher so they're getting that."

Teachers and administration expressed that planning and implementing differentiation is a lot of work. Not only do teachers have to plan, but also teachers have to know their assessment results. This allows them to know which students are struggling and how to meet their needs. Teachers are able to determine the students' levels by using formal and informal assessments. The assessment that the teachers use several times during the year is the MAP assessment. This is used to help with providing the appropriate environment when placing students in classes.

The teachers described differentiation as "giving the students what they need". Many of the teachers reflected on the instruction in their classrooms and how the instruction varies to provide interventions for struggling students and enrichment to challenge higher-performing students. The teachers plan based on what they feel each student needs because they know that each of their students is different and needs different tasks and instruction. For struggling students, the teacher provides additional support, teaches the concept with smaller numbers, and incorporates standards from lower grades. For high performing students, the teacher provides less support, has the students work with larger numbers, and challenges the students. Teachers have a focus on ensuring that their higher performing students are pushed and challenged in the classroom.

In District B, the attitude of the teachers toward differentiation was positive. The teachers felt that the use of differentiation allowed the teachers to meet all of the students' needs. Differentiation is carried out in the classroom by using pre-assessment data to place students in groups and plan center activities. One teacher stated, "I guess this kind of goes with flexible

grouping as well… I did a pre-assessment today and then I quickly put them in groups and their center activities." Teachers are incorporating differentiation in their centers and small group instruction. Some teachers shared examples of how they are also able to use differentiation in whole group lessons as they challenge certain students by extending the standard. The use of gifted pull out groups and differentiation allowed the teachers to provide support for the low performing students while high performing students are not being held back. A teacher of a lower performing group of students mentioned that she does flexible grouping, but has a difficult time with behavior in her classroom.

A teacher reported that with the leveled classes and differentiation within the classes that the students experience less frustration and are more confident than when the classes are mixed. She stated, "I find that if you have a huge range it's a lot more difficult to meet everybody's needs, but if you have just the two levels it's a lot easier to meet their needs." One teacher reported that meeting in small groups allows her to interact with the students more ensuring that they do understand the concept. She said that often times in whole group instruction she may think that the student understands the concept due to his expression, but will later find out that the student does not understand the material. When asked about the additional planning time teachers felt that it was worth the extra time because of being able to meet all students' needs.

The view of the school leader was different than the teachers. The leader felt that the teachers spent more time on the remedial level of instruction than on challenging students. Teaching to higher levels would bring about a quality education for all students. "…The more you raise your level of instruction across the board, you move all learners….It's every teacher teaching at the highest levels of instruction." To help teach to higher levels, the school has identified their gifted students and the high performing math students. These students have been

placed in a classroom together. The administration reports that instruction observed in these classrooms is at a faster pace with a deeper understanding of the mathematical concepts. Students are explaining their thought process and showing multiple ways to answer a problem. The classrooms with lower performing students are usually more remedial based with rote memorizations.

The school administrator stressed that the largest component of flexible grouping was that teachers and students had to understand that the groups were flexible. The leader felt that flexible grouping was discussed more than it was carried out in the classrooms. Teachers analyze data and use the data to place students in groups, but the groups never change keeping them from being flexible.

This section discussed the use of differentiation in both districts. The teachers spoke positively of differentiation and felt that they were able to meet the students' needs through flexible grouping and differentiation even when it required additional planning time. The expectations and implementation of differentiation differs from the perspective of administrators and teachers.

Manipulatives and Concrete Representational Abstract Model.

Both districts used manipulatives to help students build a foundation for math concepts, and both districts were using the Concrete Representational Abstract (CRA) model to help guide their instruction. Manipulatives are a tool that allows students to understand mathematical concepts (Moyer, 2001). The CRA model is an instructional model that is used in the instruction of mathematics (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). District A is familiar with the CRA model and has used it for years. This school year, the district has combined the CRA model with an additional model. District B was using the CRA model

without realizing the instructional model had a formal name.

A math manipulative is a material object that the student can use to physically perceive a mathematical concept (Moyer, 2001). A teacher reported that the students are able to solve the problems when using manipulatives. The teacher continues to make manipulatives available for the students to use to assist in solving problems. In addition, students are able to draw a picture. The use of manipulatives and representations at the beginning of the concept allow the students to build an understanding of the concept before moving to an algorithm. When students were presented with a larger number, the students did not want to draw a picture so they used algorithms instead of manipulatives or pictures. Teachers credited the use of manipulatives to help their lower level students gain a better understanding of the material. The lower level students were more willing to use the manipulatives than the higher-level students. Multiple teachers said that their gifted students often felt that they did not need the manipulatives. A fifth grade teacher explained her struggle with trying to get the gifted students to use manipulatives and that they would help the students gain a deeper understanding of the concept if they would use them.

The CRA model expands on the use of manipulatives by bridging the gap from the concrete use of manipulatives through the representational stage in which pictures or diagrams represent the mathematical problem and finally into the abstract stage where mathematical problems are understood and solved completely in the abstract (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013). District A had been using the CRA model consistently in all grade levels at the elementary school. However during a vertical planning meeting at the district office they realized that the primary school was using another model called the Cognitively Guided Instruction (CGI) model (Wisconsin Center for Education Research, 2007). The CGI model

allows the teacher to build on students' understanding through problem solving. Students are presented a problem and use their own strategies to solve the problem. Problems can be solved with manipulatives, pictures, and student created algorithms. After solving the problems, the students share their strategies with their classmates. Students were confused when they came to the elementary school and heard different letters being used so the school has made a shift to the CGI model. Some of the teachers talked about still using the CRA model in their classrooms and how the two models work well together. Other teachers only referenced one model or the other. Teachers who use both models talked about how well the two models work together because the CGI model used the word problems and the CRA model helped the students find multiple ways to solve the problems. One grade level did mention adding an "E" to the CRA model so that students explain their thinking. The CRA model has helped increased the teachers' expectations to meet the Common Core Standards. "…The expectations that I have for my kids now are so much more than they were from when I was teaching the Georgia Performance Standards. A huge part of that was using the CRA and it just makes sense." The teacher went on to explain that with this model the students understand the concepts because it is a progression that builds on previous concepts. Another teacher stated that with the use of the CRA model and manipulatives, students are better mathematicians and they know multiple ways to solve a problem. Solving math problems in multiple ways and creating student-invented strategies requires the teachers to have a better understanding of the material and the instructional coach says this has been the case in her school.

The administrators at both schools have a similar view of the use of the CRA model and manipulatives. Teachers have a learning curve of using the manipulatives to teach concepts due to this not being the way teachers were taught mathematics. Some teachers are more eager to

embrace using the manipulatives and using them correctly. The administrator in District B said, "… the lower grades, more of a “let’s explore and play,” than using them as math manipulatives, kind of a discovery type of model.” The lower grade teachers are more likely to use manipulatives in math instruction, but often they are used for discovery and play instead of understanding a concept. Fourth and fifth grade teachers in both districts are coming around to using manipulatives. Teachers in District A often use manipulatives for teaching fractions. In District B teachers are learning how to use the manipulatives and learning that base ten blocks can be used to teach more than just place value. The administrator in District B credits good math instruction to a teacher who has a good understanding of mathematics. “…There‘s a very distinct difference in teachers’ use of manipulatives if the teacher knows how to teach math and if they themselves understand conceptual pieces of math and they effectively use manipulatives.”

The teachers in District B were not familiar with the term CRA, however, as they were told about the CRA model teachers felt that they did use it in their classroom. One teacher stated that she used the Georgia Frameworks Units, which uses the model of CRA. The teachers discussed how they naturally use more manipulatives at the beginning of their units to introduce concepts. Then they will place manipulatives in centers and use them in some of their small groups. The teacher who has the ELL students uses a lot of manipulatives in her math instruction so that the student can learn the concept and vocabulary through a visual representation.

This section discussed the use of the CRA model in mathematics classrooms. Both districts in the study use the structure of the CRA model in their instruction. District A has been using the CRA model and has also transitioned and/or incorporated the use the CGI model. The District B School leader was aware of the CRA model and the impact that it has in the classroom. District B teachers were unaware of the CRA model, but have incorporated the

concepts into their lessons through the Georgia Frameworks and how they naturally feel mathematics should be taught.

Impact of the Georgia Vision Project.

The GVP was discussed at the district level interviews. Both districts stated that they were unable to determine the impact of the GVP on the three areas of context, learning, and leadership. The GVP standards and recommendations were used to help guide the strategic plans and the work in both districts. One district stated that they took the GVP recommendations and looked to see how the GVP recommendations lined up with their strategic plan. The leader felt that in the future it might be more beneficial "to develop the strategic plan more around [the GVP recommendations] instead of looking at where it fit around the strategic plan." The district leader felt that people in the district knew the strategic plan aligned to the GVP recommendations, but was not sure they would say the GVP impacted the results of their district. The other district shared similar beliefs about the GVP. The GVP recommendations could be matched up to items in their strategic plan, but the strategic plan was not created around the recommendations of the GVP. The district supports what is in the GVP recommendations, which supports the initiatives in their district and helps give a "language" to what they are doing.

Both district leaders stated during their interviews that the most important thing that they do in their district is teaching the students. One district leader stated that the central office is there to support the teaching and learning and without that they would not be needed. The teachers also spoke of the importance of teaching and learning. All of the teachers spoke positively of the innovations in this study, which included differentiation, instruction through the CRA model, and the use of manipulatives. The teachers in the study expressed that these areas were important in instruction and led to meeting students' needs. One area that teachers were not

as positive about was professional learning. Some teachers and/or administrators expressed a need for additional professional learning in the area of differentiation, implementing the CRA model, and using manipulatives. The implementation of these innovations may have led to the districts' high performance in the area of mathematics.

Evidence did not support that the GVP had an impact on internal contexts of learning and leadership; building capacity; or learning. The district leaders felt that the GVP aligned to their strategic plans, but was not the result of their strategic plans. When asked about the GVP during the interviews they did not feel that they could say the results of the district were due to GVP. What the district leaders could say was that the GVP aligned to what they were doing and that their focus was on teaching and learning. Teachers and administrators felt that the math innovations in this study did impact their instruction.

This study found that four GVP standards were reflected in the findings for the two districts. The first theme focused on governance, leadership, and accountability with a finding of planning and professional learning in regard to diversity not being implemented in both districts. The second finding was that both districts provided a safe and inviting learning environment based on the recommendations of the culture, climate, and organizational efficacy standard. In the teaching and learning resources standard, it was found that teachers preferred classes formed based on similar achievement ability and used technology to support the use of differentiation. The standard of teaching and learning included findings in the area of professional learning, flexible grouping, and the use of manipulatives through the CRA model. Finally, the research found the districts were not able to link the recommendations of the GVP to the impact of the work in their district.

Discussion

The two districts look very different in their size and demographics, but both are alike in that they are high performing districts. Both schools are ranked among the top schools in the state according to community reviews, test scores, graduation rates, and teacher quality (Best School Districts in Georgia, 2015). GVP's governance, leadership, and accountability standard is reflected in both districts as an equitable education is provided through instructing diverse populations. Teachers and administration were proud of their school districts and expressed the idea that they wanted what was best for students even when it was a lot of work. The teachers use differentiation, manipulatives, and traits of the CRA model. The districts provide professional learning, but have not provided professional learning in all of these areas.

Implications regarding diversity.

Both school districts have been ranked in the top districts in the state (Best School Districts in Georgia, 2015). A large part of this distinction is a result of the success that both districts have had on their standardized testing scores. The two districts have performed higher than the state average in 2013 and 2014 on the state standardized test for both third and fifth grade. The results lead one to think that almost all students are performing well in both districts. However, as the data is broken down into subgroups the idea of an equitable education for all may not be true. Teachers in both districts have received little to no professional learning on teaching diverse students. The teachers rarely think about the different subgroups of students as they are planning. Instead the teachers think of the ability grouping and how the instruction should be structured.

The instructional coach in District A believes that teachers automatically plan for diverse students naturally without thinking about the subgroups. However, teachers may benefit from

understanding instructional strategies for teaching diverse students. Training may improve their performance on standardized tests, which impacts the school's accountability measure on the CCRPI.

The District A administrator was on target with identifying the subgroups that struggle in their school. The one gap among subgroups that all teachers mentioned in their interviews was the gap between the Black and White students. The Black subgroup did not meet the state performance target either year, while the White subgroup met both years. This achievement gap is common in research between the two races (Blackford &Khojasteh, 2013; Clotfelter et al., 2009; Loucks-Horsley, Stiles, Mundry, Love, & Hewson, 2010). One of the teachers mentioned that a strategy that she used with her diverse populations, which is to relate the word problems to the identity of the students. The teacher uses the students' names in the word problems or chooses word problems based on the students' interest. Van de Walle et al. (2013) supports this strategy. The researchers found that engaging students in mathematics is as easy as using students' names or relating math problems to the interests of the students.

An additional subgroup that was mentioned in many of the interviews was the ED subgroup. The ED subgroup went from meeting both performance targets to not meeting either target. Research has shown that students' of low SES often perform at lower levels of achievement (Clotfelter et al., 2009; Reardon, 2013; Yates & Collins, 2006; Loucks-Horsely et al., 2010). Jensen (2013) found that achievement gaps in ED subgroups can be closed by teachers who build relationships with their students. The actions of teachers in the school such as after school tutoring, lunch and learns, parent communication, etc. demonstrates that teachers understand the importance of relationships in meeting the needs of this subgroup. Ma (2010)

found that the learning environment that teachers created was one of the most significant factors in students' attitude and achievement in math.

The subgroups for District B varied from District A's. The district and the school met performance targets both years for the White subgroup. The overall district had a large enough participation rate to have a Black subgroup, which met both targets each year. One factor that may have impacted District B's Black subgroup meeting the targets and District A's Black subgroup not meeting the targets is the county's poverty level. District B's poverty level is much lower than the average of the state and of District A. Gaddis and Lauen (2014) found that schools that had a lower poverty level had an easier time closing the achievement gap between the two races. The school did not have a large enough participation rate to form a Black subgroup. The school's EL subgroup did not meet the state performance target either year, but the district did meet during the 2014 school year.

Teachers and administrators in the District B School need to analyze and determine the subgroups that impact the school. One teacher stated that the majority of the students were White and that socio-economic status did not impact the school. The teacher was correct in saying that that the majority of the school's students were White. On the CCRPI subgroup performance, the school did not have enough Black students to make a subgroup either year. However, both years the school did have enough students to make an ED subgroup during both years, and this subgroup only met the participation rate each year. The ED students did not meet the subgroup or state performance target, thus impacting the school's CCRPI score. Additional subgroups that the faculty may want to analyze are EL and SWD since both groups only met the subgroup performance target and not the state performance target.

District B could also benefit from some professional learning on teaching diverse populations. Loucks-Horsely et al. (2010) states that teachers need professional development, not only in content areas, but also in strategies for teaching diverse students. Teachers should be given a time during this professional learning to examine their own beliefs about teaching different subgroups. The administrator is aware of different perceptions that teachers have of diverse populations. During the interview, the administrator discussed the role that gender has had in the way students learn mathematics. Another perception that teachers have is that if a student is an EIP student or a low-performing student in one subject then the student will be low in all subjects. Teachers forget that students have strengths in different subject areas and plan for student instruction to be the same in all subjects. When teachers were interviewed these perceptions did not get mentioned. The teachers reported that they did not think about subgroups as they planned.

Both schools have earned a lower CCRPI score on their state accountability reports due to not meeting the needs of all subgroups. The schools would benefit from identifying the subgroups that are performing below average. Then the schools should provide professional learning to bring attention to these subgroups and what researchers say about teaching mathematics to these students.

Implications regarding differentiation.

Differentiation (that is, ability grouping) was one of the innovations that the districts' educators referenced that impacted the student performance in all subgroups and ability levels. Differentiation was implemented in both districts as district leaders, school leaders, and teachers discussed how it impacted their instruction. Teachers felt that planning with differentiation did require more work on their part, but they did so to meet the needs of their students.

Both schools implemented ability grouping at the classroom level to help reduce the number of levels in each classroom. Many of the teachers in the study reported that they liked the ability grouping and made it easier to meet the needs of the students in the classroom. Ansalone (2010) and Barbour (1990) found similar perceptions of teachers in their studies as teachers found that having fewer ability levels in one classroom made it easier to meet the needs of all students. One teacher did express how difficult it was when she had the lower level classes and her expectations for the students were lower and experienced more behavior issues. Harris (2012) found that teacher's expectations changed to match what they felt students had the ability to do. Classes with low-performing students had teachers with low expectations. Others researchers (Hong, Corter, Hong, & Pelletier, 2012; Kususanto et al., 2011) felt that grouping the students by ability level led to lower performing classrooms having more classroom management issues.

The idea of flexible grouping allows for students to move from group to group to meet their needs. The math classes in District A were created by homogenous groups from multiple teachers' classrooms. This allowed the teachers to create classes that were closer to the same ability level. Teachers in District A mentioned that the students could be moved to different classes as new data was analyzed. One teacher reported that this does not happen and students remain in the same class every year. Research has found that students usually remain in the same class when ability grouping is used, often remaining in the same ability level for years (Barbour, 1990; Latz & Adams, 2011). Ansalone (2010) found that often when ability grouping is used to form the classrooms the lower performing classes have a higher percentage of minority students and students who are economically disadvantaged. A teacher in District A did notice that the

numbers of Black students in her higher performing classes are lower. However, she has started to see an increase in the number of Black students this year in her high performing class.

A teacher also mentioned that it is difficult when students are grouped according to their identification as gifted because students may be gifted in reading, but not in math and vice versa. Being served in the gifted section makes it more difficult when the student is not gifted in math. However, with differentiation all students' needs are met in any class in which they are served.

Both districts used ability grouping to differentiate the learning for students. Teachers in both districts liked the current grouping method and felt that it helped them meet their students' needs. Some teachers did identify problems with this grouping. This model made it difficult for students to change ability levels, included little diversity, and may have included some gifted students in classes where the student was not gifted. Overall, teachers had a positive outlook on this model, which helped reduce the ability levels that they planned for and taught.

Implications regarding the Concrete Representational-Abstract Model and manipulatives.

The CRA model and use of manipulatives provides a mechanism for differentiation, which enables teachers to meet students' needs. The second innovation that was implemented in the two districts was the use of manipulatives and instruction through the CRA model. District A has used CRA in the past and has added the CGI model. District B has used the concept of the CRA model in their classrooms without using the official name.

District A was able to provide an additional framework, the CGI model, to bring together the three stages of problem solving. District B teachers felt that the use of the CRA model was a natural way of teaching mathematics. The teachers felt that manipulatives were important to use

at the beginning of the unit to build an understanding of the concepts and leading to abstract algorithms for solving problems.

Several teachers stated that they find that students' perceptions of using manipulatives differ. Teachers found that gifted students were less likely to use manipulatives and were sometimes more resistant to using them during whole group instruction. The lower performing students embraced the manipulatives and built an understanding of the concept through the manipulatives. Correa, Perry, Sims, Miller and Fang (2008) found that upper grade teachers in the United States held a similar perception, as the students and teachers used manipulatives as an intervention instead of during instruction with all students. Students' perceptions could possibly be learned from teachers' perceptions and the use of manipulatives in lower grades.

Administrators reported that they also saw a difference in teachers and the way that they use manipulatives. Teachers in lower grades were more likely to use manipulatives. One administrator who sees a kindergarten through fifth grade perspective said that lower grade teachers use the manipulatives more, but they often are used for discovery instead of instruction. District A administrator who only sees a third through fifth grade perspective felt that teachers focused the use of manipulatives for certain content areas such as fractions. The administrator for District B felt that when teachers truly understood the math concepts, they were able to use manipulatives correctly. The administrator also felt that teachers needed more professional learning to build an understanding of the concepts and working with manipulatives. Research supports the administrator's view that teachers need more professional learning to gain a better understanding of concepts and using manipulatives during instruction (Loucks-Horsely et al., 2010; The National Mathematics Advisory Panel, 2008; Puchner, Taylor, O'Donnell, &Fick, 2008). Loucks-Horsely et al. (2010) found that when teachers did not receive proper professional

learning in content and instructional strategies, the students were not receiving a quality education.

The CRA model had been implemented in District A while new terminology to District B. However, both districts are actively using the first stage of the model by making the concepts concrete to students through the use of manipulatives. The use of manipulatives were found to be used more in lower grades as well as with struggling students in upper grades. Administration found that teachers who had a better mathematical understanding were correctly using the manipualives while other teachers needed content training as well as training on how to use manipualtives.

Implications regarding professional learning.

The tool to help teachers learn, professional learning, is provided in both districts. Teachers need professional learning in content and strategies to provide students with a quality education (Loucks-Horsely et al., 2010). Regarding innovations that are used in this study, the districts have either not provided professional learning or have not provided the professional learning in those areas in years. The innovations include differentiation; math instruction through the CRA model and manipulatives; and teaching mathematics to diverse populations.

District A and District B have provided professional learning over differentiation in the past. In District A, several teachers were aware of the professional learning while others have come since the professional learning took place. In the past, the school did a book study on differentiation. Currently the school staff is taking a closer look at differentiation and what it looks like in the classroom. The High Performance Professional Learning Committee (HPPLC) has developed a rubric to help teachers self-assess and know what differentiation should look

like. The rubric will help teachers and administrators prepare for the state teacher evaluation, which includes a section on differentiation.

District B teachers stated that they had district-level professional learning in differentiation during the 2014-2015 school year. The county leader stated that this year's professional learning would be differentiated to provide instruction according to what teachers needed and to model the expectation of differentiation in the classroom. The administrator felt that the teachers knew about differentiation and flexible grouping, but that the use of differentiation was not used as often as teachers thought it was being used. The school could possibly use a rubric like District A to help teachers self-assess how differentiation is being implemented in their classrooms.

Professional learning on the instruction of mathematics and manipulatives also varies. District A has shifted its focus from the CRA model to the CGI model this year. The third grade teachers are training the other grade levels on using the CGI model. The fifth grade teachers seem to have a little more difficulty implementing the CGI model in their classroom due to working with larger numbers and finding four different ways to solve the problem. The fifth grade teachers feel some of the numbers are too large to model with manipulatives, reducing the number of strategies. The third grade teachers have integrated the CGI model with the CRA model and feel that the two models complement each other. Additional professional learning and classroom observations may be helpful to support the transition to using the CGI model in all classrooms. The fifth grade teachers may benefit from professional learning from the regional educational system agency to provide more support in making the CGI model fit with fifth grade standards.

The National Mathematics Advisory Panel (2008) and Darling-Hammond et al. (2009) state that teachers' understanding of mathematics needs to be strengthened in order to improve student achievement. To continue to help support teachers in math instruction, administration in District A has hired consultants to come in and provide professional learning on grade level standards. The consultants answer questions and model lesson tasks. Teachers are provided with all of the manipulatives that the consultants use during their training. This allows the teachers to implement what they see during their professional learning. During this time teachers also work on lessons. Loucks-Horsley et al. (2010) found that this type of professional learning helped enhance quality instruction by allowing teachers to gain a deeper understanding of the content through strategies and modeling. Administration has removed the barrier of teachers not having the materials available. Teachers are not required to use the manipulatives in their classroom, but the teachers who were interviewed feel that they should use the manipulatives since money was spent on them and they make the learning more concrete for students.

District B has provided teachers with a variety of math instruction professional development. The teachers received math professional learning from a district representative who has helped them plan instruction; introduced and reviewed math strategies and resources; and modeled lessons. The school administration has brought in companies to teach about different math manipulatives and how the manipulatives can be used in the classroom. The school also uses their math committees to learn more about math instruction. The administrator is aware of the CRA model and feels that the school is at the beginning stages of implementation. He feels that teachers are beginning to understand the shift from solving problems with procedures and fluency to developing a deeper understanding. Teachers were not aware of the CRA model, but were implementing the concepts of the CRA model and understand the

importance of building a deeper understanding of mathematical concepts. Teachers might benefit from formal professional learning on the CRA model to help them implement this model in their classroom.

The two districts in the study are both top performing districts in the state. The districts are using the math innovations from the study in varying degrees in their district. Providing professional learning to teachers is one of the first steps that can be taken to provide teachers with tools to help students succeed. Additional professional learning is needed on differentiation; math instruction through the CRA model and manipulatives; and teaching students of diverse backgrounds.

Both districts are high achieving districts in the state according to community reviews, test scores, graduation rates, and teacher quality (Best School Districts in Georgia, 2015). As the data is disaggregated for the state assessment, some of the subgroups in each district are not performing as well as other subgroups. Knowledge of the subgroup scores could impact the instruction that teachers provide to the different subgroups after receiving professional learning. Teachers in both districts were positive about differentiation and feel that they meet the needs of their students. However, administration feels that the use of differentiation varies among teachers. Administration also feels the use of manipulatives and the implementation of the CRA model varies from grade to grade and teacher to teacher. Lower grade teachers appear to have a better grasp of implementing CRA in both districts. Professional learning, again, could help support the use of manipulatives and the CRA model, as well as differentiation.

Limitations & Possible Sources of Bias

This section discusses the limitations and possible sources of bias for the study. The study included only two districts and both districts were partners of the GVP. The districts vary in their size and demographics, making it difficult to compare the districts to each other. The study uses only a sample of individuals from each district to gather the information for the study.

One of the limitations of this study is that only two school districts were included in the study. Therefore, the findings of this study will not be transferable to all districts that are implementing the GVP. One of the districts has only one primary and one elementary school, making it difficult to study whether the Vision Project is guiding the area of study through the district or if it is through the specific leadership of the school administrator. In addition, both of the districts are located in the northern part of the state. Both districts are within a two-hour drive from the capital of the state, allowing ease of access to resources and transportation. This part of the case study would not include how the GVP and math innovations have impacted instruction in other parts of the state. Also, both districts have traditional performed very well on state assessments in the past (Georgia DOE). The results of this study may be different for schools that are lower performing, have different demographics, or have a higher population of economically disadvantaged that is more similar or above the state average.

The main focus of this study is only a small portion of the GVP. The teaching and learning standard is serving as the focus of the study. Therefore, the results of the study are not a true representation of the GVP as a whole. The impact of the GVP should include the opinion of all participants in the study. The study only asked the district leaders about the GVP and its impact. To truly understand the impact of the GVP, or the lack thereof, administrators and teachers should have been asked about the GVP and how it impacts their math innovations.

School level participants were thought not to have an understanding of the GVP. This is a bias in the study and should be eliminated in any future studies of the GVP.

Yin (2014) suggests that when the researcher enters into qualitative research that the researcher refrain from having preconceived notions. One must also ensure that the research is secure, accurate, and a reflection of one's own work. When reporting findings, Creswell (2012) cautions the researcher to refrain from using attitudes or assumptions based on race, gender, age, or disability. The researcher must address individuals, participants, and labels at a high level of respect.

Limitations and possible sources of bias in the study were discussed in this portion of the chapter. The study included only a small sample of GVP districts and a small sample of the population in these districts. The study focused mainly on only one GVP standard and would not provide a true understanding of how the district was impacted by the GVP as a whole. Questions should be asked to all participants about the GVP to understand the impact of the GVP work and recommendations.

Suggestions for Future Inquiry

Future researchers may want to consider some adaptions to the research study. A future study may separate the study of math innovations from the GVP. A researcher may choose to use additional districts in the study to help triangulate the data in a different way. Also, a similar study could be conducted in the future after teachers have had more time to get used to teaching the standards of mathematics.

In the future, a similar study could be conducted with the focus of the study being narrowed down to help determine the impact. The math innovations of GVP could be the main focus of the study. A researcher could look at how teachers' perceptions of the math innovations

are impacting instruction without using GVP districts. Another option is to focus on the GVP and look at only one system with all GVP recommendations being studied. Also, a researcher may choose to study only a certain part of the GVP with three or more school districts. The use of at least one additional district would allow for the study to be triangulated in a different way. The study of both math innovations and GVP made the findings of the study too broad and should be narrowed down for future study.

Future research may choose participants for the study by using a different sample or with more specific recommendations. The participants in the study did not include a diverse sample. The administrators in both districts are white males. All of the teacher participants are white females. Due to the participants being selected from a purposeful sample, all participants embraced the use of the math innovations. This may not be a true representation of the perceptions of other teachers in the district or in another GVP district.

Lastly, the Common Core State Standards (CCSS), at the time of the study, have been recommended by the state for teachers to use as the standards for instruction for only three years. The CCSS have been a controversial issue among educators and politicians. During this study, the mathematics standards were changed from Common Core Georgia Performance Standards to Georgia Standards of Excellence to allow the state to modify the standards (georgiastandards.org, 2015). A researcher may choose to repeat the study after teachers are more comfortable with the standards to determine if the GVP and math innovations have impacted the math instruction and student results.

This section discussed implications for future research. Separating the study of math innovations from the GVP would help narrow the focus of the study. Including additional districts in the study would help to triangulate the data in a different way. In a few years after the

standards have become less controversial and teachers have had time to teach to the standards, the study may be conducted again to determine if different results would be found.

Conclusion

In the past, there has been a focus to increase student achievement through initiatives such as *No Child Left Behind*; however, this act placed a stronger focus on test scores than on increasing student achievement (Hargrove, 2012; Morales, 2013). The CCSS were then introduced in the United States based on research of successful instruction (Common Core State Standards Initiative, 2014). The standards call for students to understand problems and solve math problems in multiple ways with the broader goal of having American students be college and career ready and able to compete globally (Common Core State Standards Initiative, 2014). However, these standards will not improve instruction or prepare students to complete globally unless teachers receive the proper training in instruction and instructional practices (Frede, Lamy, & Boyd, 2010; The National Mathematics Advisory Panel, 2008; Wu, 2011). Teachers will need to receive training in mathematics content knowledge to ensure that they have a thorough understanding of the concepts before teaching those concepts to students (The National Mathematics Advisory Panel, 2008). During instruction, teachers may use strategies that have been found to be successful when studied independently. These instructional strategies include the use of manipulatives, the CRA model, flexible grouping, and an understanding of teaching mathematics to different subgroups of students.

This study examined the impact of teachers' perceptions on these innovations and how it impacts student achievement in GVP districts. Teachers were interviewed about their perceptions of the innovations. The interviews were followed up with observations of professional learning and grade level planning sessions as well as examining documents such as

lesson plans, test scores, school websites, and strategic plans. The interviews, observations, and documents contributed to an understanding of teachers' perceptions of professional learning and the impact on student achievement with the use of manipulatives through the CRA model (Flores, 2010; Mancl et al., 2012; Van de Walle et al., 2013) and flexible grouping (Christenson & Wager, 2012; Ford, 2005), and an understanding of teaching mathematics to different subgroups (Berry, 2004; Clotfelter et al., 2009; National Council of Teachers of Mathematics, 2010; Reardon, 2013; Yates & Collins, 2006).

Districts in the study could not state that the GVP impacted the student achievement results in the districts. However, both districts were able to explain and demonstrate their focus on teaching and learning in the district. Teachers spoke of the math innovations that they used in their classrooms to help the students be successful. Both districts demonstrate high performance in their test scores (Georgia DOE) and are ranked as top districts according to community reviews, test scores, graduation rates, and teacher quality (Best School Districts in Georgia, 2015).

This study explored the impact of the GVP and teachers' perceptions of math innovations. The qualitative study demonstrates for leaders and educators how the innovations have been used in the two districts and their results. Studies have presented research of the math innovations separately. This study sought to provide research on how teachers' perceptions of differentiation, manipulatives through the CRA model, and professional learning impact student achievement. Wei, Lenz, & Blackorby (2012) found that poor math skills not only impact students individually, but impact our world economy. These math innovations are not just strategies to add to the list of things for teachers to do. These math innovations play a role in helping American students be college and career ready and able to compete globally.

References

Ansalone, G. (2010). Tracking: Educational Differentiation or Defective Strategy. *Educational Research Quarterly*, *34*(2), 3-17.

Barbour, N. (1990). Flexible grouping: It works! *Childhood Education, 67*(2), 66-67.

Berry, J. (2014). EPS 8360 class 3 [PowerPoint slides]. Retrieved from https://www.livetext.com/misk5/c1/assignment/959204/1221879/1224516

Berry III, R. Q. (2004). The equity principle through the voices of African American males. *Mathematics Teaching in the Middle School, 10*(2), 100-103.

Best School Districts in Georgia. (2015). Retrieved from https://k12.niche.com/rankings/public-school-districts/best-overall/s/georgia/.

Bitsch, V. (2005). Qualitative research: A grounded theory example and evaluation criteria. *Journal of Agribusiness, 23(1),* 75-91.

Blackford, K., & Khojasteh, J. (2013). Closing the achievement gap: Identifying strand score differences. *American Journal of Business Research*, *6*(2).

Boozer, Wm S. (2015) *Approaches to summarizing multiple case studies* [unpublished manuscript]. Atlanta: Georgia State University Center for Evaluation and Research Services.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3, 77-101.

Castle, S., Deniz, C., & Tortora, M. (2005). Flexible grouping and student learning in a high-needs school. *Education and Urban Society, 37*(2), 139-150.

Christenson, B. & Wager, A. (2012). Increasing participation through differentiation. *Teaching Children Mathematics, 19*(3), 194-200.

Clotfelter, C. T., Ladd, H. F., & Vigdor, J. L. (2009). The academic achievement gap in grades 3 to 8. *The Review of Economics and Statistics*, *91*(2), 398-419.

College and Career Readiness Performance Index (2014). *CCRPI Score.* Retrieved from http://ccrpi.gadoe.org

Common Core State Standards Initiative (2014). *Development process.* Retrieved from http://www.corestandards.org/standards-in-your-state/

Correa, C. A., Perry, M., Sims, L. M., Miller, K. F., & Fang, G. (2008). Connected and culturally embedded beliefs: Chinese and US teachers talk about how their students best learn mathematics. *Teaching and Teacher Education*, *24*(1), 140-153

Coyne, I. T. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries?. *Journal of advanced nursing*, *26*(3), 623-630.

Creswell, J. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Boston: Pearson.

Curtis, S., Gesler, W., Smith, G., & Washburn, S. (2000). Approaches to sampling and case selection in qualitative research: Examples in the geography of health. *Social Science & Medicine*, *50*(7), 1001-1014.

Darling-Hammond, L., & Richardson, N. (2009). Research review/teacher learning: What matters. *Educational leadership*, *66*(5), 46-53.

DeMarrais, K. & Lapan, S. (2008). *Foundations for research: Methods of inquiry in education and the social sciences.* Mahwah: Lawrence Erlbaum Associates.

Flores, M. (2010). Using concrete-representational-abstract sequence to teach subtraction with regrouping to students at risk for failure. *Remedial and Special Education, 31*(3)*,* 195-207.

Ford, M. P., (2005). Differentiation through flexible grouping: Successfully reaching all readers. *Learning Point Associates / North Central Regional Educational Laboratory (NCREL).*

Frede, E., Lamy, C. E., & Boyd, J. S. (2010). Early childhood mathematics: Promoting good beginnings. National Association for the Education of Young, retrieved from http://www.naeyc.org/files/naeyc/file/positions/psmath.pdf.

Gaddis, S. M., & Lauen, D. L. (2014). School accountability and the Black–White test score gap. *Social science research*, *44*, 15-31.

Georgia Department of Education (2014). *CRCT State Scores.* Retrieved from https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages / CRCT-Statewide-Scores.aspx

Governor's Office of Student Achievement. (2015). *K-12 Public School Report Card.* Retrieved from https://gaawards.gosa.ga.gov/analytics/saw.dll?dashboard

Georgia School Boards Association & Georgia Superintendents Association (2010). *A vision for public education: Equity and excellence.* Retrieved from http://www.visionforpubliced.org/uploads/2/0/2/7/20275263/vpe_full_report_6.21.11.pdf

Georgia Standards.org (2015). *Georgia Standards of Excellence*. Retrieved from https://www.georgiastandards.org/Georgia-Standards/Pages/default.aspx.

Hargrove, K. (2012). From the Classroom: Advocating Acceleration. *Gifted Child Today*, *35*(1), 72-73.

Harris, D. (2012). Varying teacher expectations and standards: Curriculum differentiation in the age of standards-based reform. *Education and Urban Society, 44*(2), *128-150.*

Hong, G., Corter, C., Hong, Y., & Pelletier, J. (2012). Differential effects of literacy instruction time and homogeneous ability grouping in kindergarten classrooms: Who will benefit? Who will suffer? *Educational Evaluation and Policy Analysis, 34*(1), 69-88.

Jebreen, I. (2012). Using inductive approach as research strategy in requirements engineering. *International Journal of Computer and Information Technology, 1*(2), *162-171.*

Jensen, E. (2013). *Engaging Students with Poverty in Mind: Practical Strategies for Raising Achievement*. ASCD.

Krefting, L. (1991). Rigor in qualitative research: The assessment of trustworthiness. *American journal of occupational therapy*, *45*(3), 214-222.

Kususanto, P., Ismail, Z., & Majeed, A. (2011). Students' self-esteem and their perception of teacher behavior: A study of class grouping system in Pakistan. *International Journal Of Business & Social Science*, *2*(16), 103-113.

Latz, A. O. & Adams, C. M. (2011). Critical differentiation and the twice oppressed: Social class and giftedness. *Journal for the Education of the Gifted,* 34, 773-789.

Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., & Hewson, P. W. (2009). *Designing professional development for teachers of science and mathematics*. Corwin Press.

Ma, Xin. (2010). Effects of early acceleration of students in mathematics on taking advanced mathematics coursework in high school. *Investigations in Mathematics Learning*, *3*(1), 43-63.

Mancl, D., Miller, S., & Kennedy, M. (2012). Using the concrete-representations-abstract sequence with integrated strategy instruction to teach subtraction with regrouping to students with learning disabilities. *Learning Disabilities Research & Practice, 27*(4), 152-166.

Merriam, S. (2009). *Qualitative research: A guide to design and implementation.* San Francisco: Jossey-Bass.

Morales, J. (2013). *Evaluation of the effects of ability grouping in sixth-grade math at ABC elementary* (Doctoral dissertation).

Moyer, P. S. (2001). Are we having fun yet? How teachers use manipulatives to teach mathematics. *Educational Studies in Mathematics, 47*(2), *175-197.*

National Mathematics Advisory Panel. (2008). Foundations for success: The final report of the National Mathematics Advisory Panel. Washington, DC: U.S. Department of Education.

Newport, J. (1967). The Joplin Plan: The score. *The Reading Teacher, 21*(2), 158-162.

Patton, M. (2002). *Qualitative Evaluation and Research Methods.* Thousand Oaks: SAGE Publications.

Petrilli, M. (2013). The diversity dilemma. *Educational Leadership, 70*(8), *44-48.*

Puchner, L., Taylor, A., O'Donnell, B., & Fick, K. (2008). Teacher learning and mathematics manipulatives: A collective case study about teacher use of manipulatives in elementary and middle school mathematics lessons. *School Science and Mathematics, 108*(7), 313-325.

Reardon, S. F. (2013). The widening income achievement gap. *Educational Leadership*, *70*(8), 10-16.

Robinson, K. (2010). Black-White inequality in reading and math across K-12 schooling: A synthetic cohort perspective. *The Review of Black Political Economy*, *37*(3-4), 263-273.

Rogers, C. (2012). *The impact of math ability grouping on second grade student growth* (Doctoral dissertation, Northwest Missouri State University).

Spronken-Smith, R. & Walker, R. (2010). Can inquiry-based learning strengthen the links between teaching and disciplinary research? *Society for Research into Higher Education, 35*(6), 723-740.

Stake, R. (1995). *The art of case study research.* Thousand Oaks: SAGE Publications

Thomas, D. (2006). A general inductive approach for analyzing qualitative evaluation data. *American Journal of Education, 27*(2), 237-246.

United States Census Bureau. (2014). *State and County Quick Facts*. Retrieved from http://quickfacts.census.gov.

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2013). *Elementary and middle school mathematics: Teaching developmentally*. New York: Pearson.

Washington, W. (2014, May 13). Reading pass rates flat, but changes in math results on state tests. *The Atlanta Journal Constitution, retrieved from*

http://www.ajc.com/news/news/local-education/school-district-results-on-statewide-tests-expecte/ngR8Y/

Wei, X., Lenz, K. B., & Blackorby, J. (2012). Math growth trajectories of students with disabilities: Disability category, gender, racial, and socioeconomic status differences from ages 7 to 17. *Remedial and Special Education*, 0741932512448253.

Wu, H. (2011). Phoenix Rising: Bringing the Common Core State Mathematics Standards to life. *American Educator*, *35*(3), 3-13.

Wisconsin Center of Educational Research. (2007). *CGI Math Encourages Ingenuity and Reasoning*. Retrieved from http://www.wcer.wisc.edu/news/coverStories/cgi_math_encourages_ingenuity.php

Wu, E. H. (2013). The path leading to differentiation: An interview With Carol Tomlinson. *Journal of Advanced Academics*, *24*(2), 125-133.

Yates, H. M., & Collins, V. K. (2006). How one school made the pieces fit: Elementary school builds on a learning community to lift achievement for Black students in reading and math. *Journal of Staff Development*, *27*(4), 30-35.

Yin, R. (2014). *Case study research: Design and methods.* Los Angeles: SAGE Publications.

APPENDIX A

How the GVP plays a role in the district/school's instruction

1. What is the background of this district/school?
2. Describe the current mission and vision of the school and how these connect to the Vision Project.
3. Describe the culture of the school as it pertains to learning.
4. How has the Vision Project impacted the learning environment in your district/school? Specifically how have the teaching and learning standards impacted the learning environment?
5. What long-term learning goals have you set for your district/school and included in your strategic plan, and how are these tied to the Vision Project?
6. What challenges does the school face in strengthening a culture of learning?
7. How does the internal environment of your district/school impact learning?
8. How does the external environment of your district/school (parent, community, policy, political and system/central office stakeholders) impact learning?
9. How have you developed and distributed leadership in your district/school?
10. What short-term/long-term goals have you set to build capacity in your district/school?
11. How does the external environment of your school (parent, community, policy (state/federal), political and system/central office stakeholders) influence leadership practices and processes?
12. Are there any other ideas that you would like to share that have not been covered?

APPENDIX B

Teachers' perceptions of math innovations and the impact they have on instruction

1. How does your system define differentiation and how has differentiation been used in your district/school/classroom?
2. How does your system define flexible grouping and how has flexible grouping been used in your district/school/classroom?
3. How does differentiation and flexible grouping impact the classroom?
4. What programs does your district/school have in place for students who are high performers, gifted, low-performing, or have special needs in the area of math? Do you feel that these programs are successful or do any changes need to be made to the programs?
5. What type of math professional learning has been carried out by the district/school?
6. Who participates in the math professional learning?
7. How are manipulatives used in the math classroom and during instruction?
8. How has the district/school used the Concrete Representational Abstract (CRA)model in mathematics instruction?
9. How has the CRA model impacted math instruction?
10. Research has found there to be academic gaps in certain subgroups in math. How has teaching diverse students (minority, socio-economic, gender) played a role in the way math is taught in the district/school/classroom?
11. Describe the composition of the students in your classroom?
12. How would you describe the learning environment?
13. Are there any other math innovations that help you and your students be successful in the area of math?