Tackling Mathematics Differentiation: Embracing Change and Building Capacity Through School Leadership Support and Practitioner Pedagogy in K-8 Mathematic Practices

by

Debra L. Pion

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Major Professor: Sherri Albritton, Ed. D.
Roxanne Back, Ph.D.
Deborah Kindel, Ed. D.
Natalie Todt, Ed. D.

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Abstract

Recently released data from international math and science assessments indicate that U.S. students continue to underperform when compared to other countries. Mathematics achievement has not only shown a downward trend but has also been stagnant in the United States for several years (National Center for Education Statistics, 2018). The shift in the delivery of instructional content is crucial for mathematics achievement to increase. This is where differentiated curricula would prove beneficial in reaching eclectic learners in a mixed ability classroom (Tomlinson, 2001). The purpose of this study was twofold. First, to explore the support relationship between school principals and educators leading to a differentiated instruction initiative, and secondly to identify perceived barriers leading to a comprehensive mathematics DI initiative.

A single instrumental qualitative case study design was utilized to collect data to construct a meaningful explanation to the framework of a mathematics differentiated instruction (DI) initiative. This study was intended to gather data from both teachers and school leader's reflecting their insights of an effectively designed DI program in the K-8 mathematics classroom. Research questions centered on how school leaders offer support to a DI program and what teachers' perceptions are of the support given. Additionally, perceived barriers of mathematics differentiation through the lens' of teachers and school leaders were explored. Data saturation was achieved after interviews with school leaders and teachers as well as the collection of artifacts. Data gathered was merged for thematic content analysis that identified themes. Analysis revealed that school leaders and teachers agreed that time and teacher buy-in were barriers to a DI initiative. However, much of the

data collected were in direct contrast to each other and represented dissenting viewpoints of the implementation of a mathematics differenced instruction initiative.

CHAPTER ONE: INTRODUCTION

Overview

In today's evolving classrooms, reaching all learners at their readiness level is imperative to ensure knowledge is viable for all students (Tomlinson, 2001). While this statement applies to many content areas in K-8, mathematics achievement has not only shown a downward trend but has also been stagnant in the United States for several years (National Center for Education Statistics, 2018). Just how do American student fare when compared to other students around the world? As notated by Drew Desilver (2017), "Recently released data from international math and science assessments indicate that U.S. students continue to rank around the middle of the pack" (p.1). One of the tools utilized to measure academic growth and achievement is the Programme for International Student Assessment (PISA) that tabulates data over a three-year period measuring the increase in literacy, mathematics, and the sciences. Current PISA statistical information shows that the United States mathematics performance was 38th out of 71 countries (PISA, 2018). Other documented reports show that achievement levels are stationary and declining. Jill Barshay (2018) also notated from her research that math achievement of American students in 2015 declined on significant global standards for two consecutive years. This downward spiral is responsible for pushing the United States to the bottom half of 72 nations and regions around the world who participate in PISA. These findings are both disturbing and eye-opening as they indicate mathematics instruction has the ramifications of lagging rigorous instructional methodologies across the K-12 spectrum. Effective instruction is key to academic achievement with research-based connections linking teachers' efficacy to

student mastery (Tomlinson, 2005; Tzanni, 2018). Improvements needed to bridge the gap include challenging levels of education with less procedural guidance and more hands-on lessons for conceptual understanding (Wan, 2017). In addition, razor-edged focus on developing critical thinking mindsets, and avoidance of fragmented content taught thus limiting mastery of the material is vital towards student achievement (Hiebert el at. 2003).

Developing a program that embraces learning for all students while refining effective strategies capable of addressing student mathematics needs and avenues for continued student successes are paramount (Stetson, Stetson, & Anderson, 2007). If the preverbal tide is to be turned in mathematics achievement to reveal a more conscious awareness as well as rescue the struggling students' dilemma, new procedures must be implemented (Boaler, 2008). This is where differentiated curricula would prove beneficial in reaching eclectic learners in a mixed ability classroom (Tomlinson, 2001). "There is a marked distinction in educators continued expression of the need for differentiated instruction, a sense that their effectiveness might include the ability to adjust curriculum and instruction for academically diverse learners" (Tomlinson, 2005, p.12-14). This shift in the delivery of instructional content is crucial for mathematics achievement to increase. Paralleling this success for American pupils would be generating a revived importance of math for college and career success and their future contributions to a global society.

Background of the Study

As the world continues to shift towards a global workforce, the ability to relate and collaborate productively is vital to successful partnerships. As David Arnold and Fred Niederman (2001) stated, "Trends and tendencies of collaboration including education are

becoming highly specialized with greater potential for worldwide utilization" (p.30-33). Mathematics lends itself as the foundational piece on which knowledge is conceptualized and internalized. Mathematics not only needs a common language but a common purpose that is embraced and understood through analectic synthesizing, critical thinking, as well as a broad interpretation of skills. As researchers, Karen Givvin & Rossella Santagata (2010) pointed out, "Most common across lists of desirable features are an emphasis on increasing teachers' content and pedagogical content knowledge that includes a common language" (pgs.439-451)." Researchers have identified the need to cohesive mathematics programs that are established to improve mathematics skills and predispose mindsets to abstract insight and fortitude (Heacox, 2002; Lanzo, 2011; Ollerton, 2014). Educational differentiation leader Carol Tomlison (2005) stressed the point of instruction developed to reach all learners when she noted reaching mixed-ability classrooms of learners has proven to be both challenging and thought-provoking. Tomlinson (2005) goes on to note that a single methodology is powerless of reaching all learners that would constitute mastery. Mathematics ushers in the ability to problem-solve and reason which are catalysts to logical thinking (Christenson & Wager, 2012). The laws of mathematics govern the world around us and missing this firm foundation would cause significate shortcomings in life (Ollerton, 2014). Mathematics holds the distinction of being the center of our culture and can generate practicality to investigate and know the truth about life's many journeys.

Problem Statement

With mathematics scores for United States students stagnated, there is a need to differentiate instruction to improve student achievement. Establishing a mathematics

differentiated instructional program requires school leaders' intensive support to drive the initiative which in turn could circumvent potential barriers to the implementation. Incorporating differentiation in the K-8 mathematics classroom without a support system has posed challenges as well as presented barriers that ultimately affect successful implementation (Lanzo, 2011). Uniting school leaders and teachers' visions of a successful program of instruction is at the core of successful implementation (Lo, 2006).

With so much at stake, educating students to acquire essential mathematic skills remains at the forefront (PISA, 2015). While there has been forward momentum in mathematics achievement after the inception of the Common Core Standards, there is still much work needed in order to expand academic success (Checkley, 2006). Techniques for mathematics instruction such as explicit instruction, peer tutoring, cooperative learning, and making connections are changing rapidly to keep pace with the changing world (Tomlinson, 2001). Kyoko John's (2016) development of a successful mathematical differentiated program based on Common Core Standards revealed positive results. Utilizing questioning strategies to guide students to make sense of the number system produced stellar academic achievement with middle school students struggling with mathematics content. Linking knowledge to best practices John (2016) noted a deeper understanding resulting in student capability to problem solve conceptually so as to construct practical truths that were foundational toward content mastery. The study offered credibility to the differentiated instruction (DI) model of teaching that targets student modalities and learning behaviors which align with Gardner's (1983) work. As Gardner indicated, multiple intelligences not only connect how students learn best but also identified the barriers of DI through both the

teacher and school leader lens. Most noteworthy was the fact that school leader support was a vital component of implementing a successful mathematics DI program (Sebastian, Allensworth, & Huang, 2016). Traditional practices are not efficient to lead in a time where organizational environments are fluid, fast-paced, interconnected and systems-oriented (Fullan & Scott, 2009). Effective teachers foster a practice that incorporates exemplary instructional components including multi-faceted approaches of reaching students at their individual levels (Checkley, 2006). As Boaler (2006, 2008) emphatically stated, educators must become adaptive, open-minded, and most importantly hold high expectations for all students in their quest to be successful in the mathematics classroom.

Purpose of the Study

There is a clear gap in the literature regarding the barriers of (DI) with specifics to the design of DI instruction, especially related to K-8 mathematics. This study gathered data from both teachers and school leader's reflecting their perceptions of an effectively designed differentiated program in the K-8 mathematics classroom. Katterfield (2013) outlined in her research that teachers sought insight from school leaders for a more thought-provoking awareness on how to incorporate DI into the instructional day and with reliability and purpose. Stetson, et al. (2007) reiterated the importance of incorporating teacher ownership and input throughout implemented initiatives proposed by a school to create a climate of trust and acceptance. The purpose of this study is not only to explore the support relationship between school principals and teachers leading to a differentiated instruction implementation but also identify perceived barriers that cloud both school leader and teacher lens' leading to a comprehensive mathematics DI initiative.

Significance of the Study

This study was two-fold in that it examined the fundamental need of a differentiated approach to mathematics instruction within K-8 classrooms to improve student mastery of content. Connecting the understanding and support of both school leaders and teachers served as the cornerstone for the study. In addition, this study identified barriers associated with a differentiated instruction initiative. Collaboration between school leaders and teachers is essential in a program of differentiation as this support offers the foundation on which to build teacher efficacy and student achievement (Barshay, 2016). Rich conversations and insightful exchange of thoughts and ideas between school leaders and teachers would be the threshold to positive learning experience for all students (Bolman & Deal, 2002). Additionally, Brezicha, Bergmark, & Mitzza, (2014) pointed out that through collaboration barriers of such a program could be determined and evaluated to produce an advantageous instructional practice. This, in turn, would contribute to a deeper mathematics experience for students resulting in astute critical thinkers able to problem solve and transfer learning into real-world experiences (Goddard, Goddard, & Kim, 2015). This new mindset for educators is not enough to sustain a change in mathematics instruction. School leaders also need to be involved in the role of contributors throughout the initiative and support teachers utilizing a myriad of methods (Byars, 2011). From providing the necessary time, supplying needed resources, to offering support and guidance during program implementation, this study outlined the importance of administrators' roles in a successful DI initiative. In turn, the implementation of such a program would have the

capability of attaining positive student achievement from grades K-8 in a meaningful, pervasive manner (Ollerton, 2014).

Conceptual Framework

As the adage states, everything must change at one time or another lest a static society evolve (Priya, 2015). While this proverb was meant for humanity it certainly applies to education and the changes that have bombarded the profession over the years. However, change has factors and dynamics that differ between scenarios. As Fullan (2016) suggested, there are no hard-and-fast rules but rather a set of implications specific to situations. Differentiating mathematics instruction is not a newly developed concept but rather a strategy that is hard to define and even more difficult to put into practice. (Brezicha et al, 2016) School leaders and teachers alike embrace the aspiration to be impactful to students yet are held back in many ways due to misconceptions, misaligned direction, and unclear guidelines (Stover, Kissel, Haag, & Shoniker, 2011). Change is the ultimate path needed to weave together the traditional and contemporary teaching pedagogies thus enabling students a reestablished learning course that excites and ignites critical thinking, collaboration, and creativity (Tomlinson, 2005). These deeper learning goals allow for the exploration of learning and construction of knowledge via collaboration which is the premise on which Fullan (2011) eluded for educational change. While action learning is commendable, Fullan (2008) also acknowledged that action learning on the part of school leaders and teachers must be accompanied by reflective insight tied to an underlying theory that guides further action. Elmore (2004) noted that nothing materializes until people develop new capacities. He also advised that no external accountability scheme can be

successful in the absence of internal accountability. Offering multiple opportunities for educators to learn and build capacity for greater performance is the catalyst to any effective school initiative. Elmore (2004) addressed the capacity issue when he wrote, "Improvement is more a function of learning to do the right thing in the settings where you work" (p 73).

A change in theory or knowledge can be a powerful tool in education reform. However, having simply a theory is not enough. As Fullan (2006) pointed out, a push towards linking accurate strategies to desired outcomes aligned with participant buy-in is paramount for success to occur. Pressure within support does not yield a promising initiative (Fullan, 2016). Therefore, a more deeply engrained strategy rich in capacity building all the while capable of removing barriers allowing learning to take place is the cornerstone to positive reform. A school's culture must support intended reforms for deep-seeded change to not only be understood but internalized. As Richard Elmore (2004) emphasized, educators must learn and adapt new things in their work setting. Through articulating changes in teaching practices versus implementing given mandated initiatives, educators are given a structure for building instructional quality, not just student achievement (Fullan & Scott, 2009). If improving instructional practice is the cornerstone to education reform, specific intended effects on teaching and learning are vital to sustaining change. Fullan's (2006) change theory framework centering on changing behaviors conducive to creating a support system, served as the framework for this study. Dissected to garner the full intent, his change theory motivates people to invest the passion and energy needed to get the desired results. Enveloped amid respect, collaboration, building capacity, continuous learning, and

creating an enhanced system for improvement, this action strategy is foundational on which to build change in both instructional practices as well as campus learning cultures. The seven core premises of Fullan's change theory include:

1. A focus on motivation where moral purpose serves as the underlying foundation but also includes key concepts of capacity, resources, peer and leadership support, and identifying with the reform on a personal level.
2. Working with an accentuation on results vested with creating individual and aggregate information and capabilities. Positive pressure, entailing a motivation factor, is perceived as fair, and accompanied by resources, is also a significant component of this tenet.
3. Learning in context includes utilizing opportunities for workplace learning gaining insight from others confronted with similar situations.
4. Changing context involves looking to the broader environment where best practice sharing and heightened motivation through identifying with systemic changes are pivotal.
5. Bias for reflective action is the shared vision and ownership piece where self-reflection is crucial.
6. A tri-level engagement which has major stakeholders consisting of school/community, district, and state connected fostering mutual interaction.
7. Perseverance and flexibility focused on staying the course with a strong determination to keep reform momentum moving forward all the while allowing for reflection and improvement.

As Fullan emphatically stated, a theory of action aligned with key components coupled with outside pressure is missing the key ingredient to success. “If systems don’t include under what conditions improvements occur or how cultures change, they are bound to fail” (Fullan, 2006, p. 4). This inclusive mindset is paramount for all stakeholders to embrace that not only includes standards, assessments, curriculum, and training but is centered on school leaders and teachers working together to improve learning conditions that impact student learning (Fullan, 2006, p. 6). Fullan goes on to state the best theories involve changing individuals and cultures simultaneously. Cultures do not change by mandate but rather through fundamental modeling of new expected behaviors to displace existing ones (Fullan, 2006). This shared vision and ownership by school leaders and teachers are rooted in purposeful deep thinking and reflection promoting mutual interaction with student learning at the core. This interaction contributes to the support element necessary between school leaders and staff for powerful program implementations.

Additionally, Fullan’s (2008) six secrets of change also offer insight to reinforce Fullan’s change theory conceptual framework. These two intertwining structures serve as the platform on which school leaders and teachers work together in creating a differentiated program of high yield math instruction. Rich direction infused with guidance for leader support has the capability of overcoming possible barriers that may present themselves in the implementation of a K-8 DI mathematics program. This premise also functions as an outline of the methodology to culture change which is paramount if school reform is to be sustainable. These six secrets of change include creating a caring culture, including

purposeful interaction of all stakeholders, school leaders investing in the development of individual and collaborative efficacy, a “learning together at work” mindset infused with renewed instructional practice, developing cultures where the norm is experiencing solving problems, as well as learning from experiences all the while keeping a forward momentum complements the conceptual framework of this study. Utilizing these six steps interconnected with Fullan’s change theory embraces a collective learning environment. Reforms such as mathematics differentiation offer a profound learning opportunity for administrators, teachers, and students to focus on participation as well as reap the benefits for achievement from all perspectives (Donohoo, Hattie, & Eells, 2018). As Fullan (2006) ardently stated, this reflective change theory approach connects to the new nature of education. It directly correlates with alignment to incorporating school leader support and guidance for teachers as together they design and develop K-8 differentiated mathematics instruction. Additionally, this changing knowledge can provide a framework to not only identify obstructions of a successful DI program implementation but techniques and strategies to overcome perceived barriers resulting in meaningful educational change (Fullan, 2016).

Research Questions

As with any new transformation, risks are involved. However, when the risk runs counterproductive to the possible benefits and there is clear evidence that a researched-based strategy has value then change must be considered. Nelson Mandela’s quote “Education is the most powerful weapon which you can use to change the world” is the central component of the underlying thread that weaves education together. With the state

of mathematics in the United States today, it is imperative a change take place that has merit and most importantly capable of producing positive change in student achievement (Barshay, 2016). This study's focus of mathematics differentiated instruction was framed by developing an in-depth description and analysis case study utilizing multiple sources of data collection including interviews and artifacts. These data showed interlocked support and identified themes necessary for both teachers and school leaders to employ and principles that need to be addressed to ensure a clear, precise DI program. The data collection also shed light on possible barriers of a clear, precise DI initiative. Reform of both leadership practices and teacher preparation must be evident. Therefore, the four research questions that drove this study were:

1. How do school leaders offer support to teachers with regard to the implementation of differentiated mathematics instruction?
2. What are teachers' perceptions of administrative support of mathematics differentiation?
3. What do school leaders identify as perceived barriers of mathematics differentiation?
4. What do teachers identify as perceived barriers of mathematics differentiation?

As this teaching methodology is considered, emphasis will be necessary for the development of an individualized approach classroom by classroom that not only supports the mathematics initiative but assists in the development of educator expertise and knowledge (Tomlinson, 2004). Because DI happens at various levels of cognition, it is one of the most complex issues with which teachers interact (Heacox, 2002).

However, the how of DI is just as important and they why. Ollerton (2014) says it best when he wrote, "How we embrace differentiated learning in our planning-for-teaching, and in our interactions with students are crucial considerations." Reflecting on one's practice is key for positive action to take place in any school-wide initiative such as implementing a K-8 mathematics DI program. Dewey (1916) offered clear insight when he noted it's not that we learn by doing but that we learn by thinking what we are doing. Dewey's perspective was simplistic but noteworthy; people learn best through doing, reflection, inquiry, evidence, more doing, and repeating the cycle.

Limitations

A limitation of this qualitative study was its ability to simplify the results to a larger population. The small number of participants, although sufficient for this case study, also created a limitation. The participants included were a small representation of teachers and school leaders compared to teachers and school leaders nationwide. Interviews were conducted within one rural, south Florida K-8 school and included the principal and two assistant principals. Six teachers, two each from primary, intermediate, and middle school grade levels were interviewed whereby limiting the generalization to differing perspectives on mathematics differentiated instruction K-8 nationwide. Additionally, all six teachers were female and self-classified themselves as Caucasian thus limiting the data to one subgroup and gender. Administrators interviewed were all female which also limited responses from one gender. Furthermore, all administrators self-classified themselves as Caucasian thus limiting the data to one subgroup. While all participants agreed to be part of this study, not all were equally articulate. As such, some responses may have been based on

opinion. Since the researcher was also a teacher, bias may have occurred regarding interviews of teachers and the interpretation the researcher made from teacher oral responses.

Delimitations

Two practitioners each from primary, intermediate, and middle school grades were included in the interview process for this study. Because most of the staff at the sample school were teachers with ten years or less teaching experience, the established criterion for educator participants was a minimum of one year of teaching experience in the classroom thus limiting understanding and insight regarding differentiated instruction.

Definitions

Assessment and accountability - The reporting of test results representing the simplest form of accountability. (FLDOE, 2019)

Best practices - The wide range of individual activities, policies, and programmatic approaches to achieve positive changes in student attitudes or academic behaviors. (Lezotte, 2001)

Change theory - Knowledge used in education reform strategies. (Fullan, 2006)

Collaboration - Work jointly with others or together especially in an intellectual endeavor. (Bosnjak & Krizanac, 2012)

College and career readiness - Knowledge, skills, and dispositions needed to be successful in postsecondary education and/or training that lead to gainful employment. (FLDOE, 2019)

Common Core Standards - A set of high-quality academic standards in mathematics and English language arts/literacy outlining what a student should know and be able to do at the end of each grade. (FLDOE, 2019)

Conceptual framework - an analytical tool that is applied in different categories of work where an overall picture is needed. (Checkley, 2006)

Critical thinking - The process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information to reach an answer or conclusion. (Elmore & Burney, 1999)

Curriculum - Subjects comprising a course of study in a school or college. (FLDOE, 2019)

Differentiated instruction - a framework or philosophy for effective teaching that involves providing all students within their diverse classroom community of learners a range of different avenues for understanding new information. (Tomlinson & Imbeau, 2010)

Diverse learners - A learner that is racially, ethnically, culturally, economically and or linguistically diverse. A learner who grasps concepts differently from the majority. (Tomlinson, 2001)

Framework - The theoretical framework is the structure that can hold or support a theory of a research study. (Creswell, 2013)

Instruction - The transfer of learning from one person to another. (FLDOE, 2019)

Mixed ability classroom - Class or teaching system is one in which pupils of different abilities are taught together in the same class. (Tomlinson, 2001)

Multiple intelligence - Varying specific modalities of human intelligence as opposed to being self-dominated by one specific ability only. (Gardner, 1983)

Pedagogy - The art, science, or profession of teaching. (Cohen & Barnes, 1993)

Practitioner - One who practices a profession. (Sebastian, Allensworth, & Huang, 2016)

School culture - The way teachers and other staff members work together and the set of beliefs, values, and assumptions they share. (Fullan, 2006)

Traditional practice - Teacher-directed learning through memorization and recitation techniques thereby not developing student critical thinking problem solving and decision-making skills. (Tomlinson & Allan, 2015)

Summary

This chapter began by explaining the problematic situation the United States is facing regarding mathematics instruction compared to other countries around the world. As notated by Drew Desilver (2017), "Recently released data from international math and science assessments indicate that U.S. students continue to rank around the middle of the pack" (p.1). In today's evolving classrooms, reaching all learners at their readiness level is imperative to ensure knowledge is viable for all students (Tomlinson, 2001). While there has been some forward momentum in mathematics achievement after the inception of the Common Core Standards, there is still much work needed in order to expand academic success (Checkley, 2006). Differentiated instruction is a strategy that would help close the gap in student achievement in mathematics. The purpose of this study was not only to explore the support relationship between school leaders and teachers needed in a K-8 differentiated instruction initiative, but also identify perceived barriers through both school leader and teacher lens' leading to a comprehensive mathematics DI initiative. Utilizing the conceptual framework of Michael Fullan's (2006) change theory, which centers on

changing behaviors conducive to creating a support system, served as the framework for this study. Moreover, this study was intended to gather data from both teachers and school leader's reflecting their perceptions of an effectively designed implemented differentiated program in a K-8 mathematics classroom. Fullan's (2006) change theory includes people who are involved in change reform who must push themselves to the next level to make the theory explicit. The change theory also served as a guide connecting stratagems to desired results. The study research questions addressed in this chapter were designed to determine the school leader support levels deemed necessary by teachers. The perceived support offered to teachers from school administrators was also addressed. Moreover, perceived barriers from both school leaders and teachers lens' were at the heart of the study that may cloud the implementation of a DI initiative. Limitations, as well as delimitations, were also included in this chapter, as was a list of terms and their meanings appearing throughout the study.

CHAPTER TWO: LITERATURE REVIEW

Overview

This chapter presents a review of the literature that has been published on themes of differentiated mathematics education in heterogeneous classrooms, and school leaders' perceptions with implementing differentiated instruction. The chapter includes literature pertaining to the necessity of school leaders' understanding and knowledge of differentiated instruction as a key component when implementing this instructional design. The studies reviewed include an in-depth look at differentiated instruction, mixed-ability classrooms, the theory of multiple intelligence, school leadership, school principal's support in mathematics, teacher perceptions of school leader support, barriers to implementing differentiated instruction, shifting teacher pedagogy, what does differentiated instruction look like, and school capacity for change.

Introduction

As classrooms across America become more diversified, educators must be open-minded on practices to reach a broad range of learners at different levels. As Dr. Echo Wu, a recognized as well as published expert in the field of differentiated instructional strategies indicated, utilizing a single approach of teaching all students in classrooms containing an array of diversity is missing the mark with students not learning to their full potential (Wu, 2013). Utilizing a more constructivist approach such as differentiation, where the learner and learning style is center stage, is more conducive to mathematical academic success (Ritema, Deunk, & Bosker, 2016). However, according to Tobi & Tipplett (2011), there are indications that many teachers are not utilizing differentiated instruction within the

mathematics curriculum, which has negatively impacted student academic performance and achievement scores. Recently released data from international math assessments indicate that U.S. students continue to rank in the middle of the pack behind many other advanced industrial nations (National Center for Educational Statistics, 2018). The 2017 average math score for the nation compared to 2015 showed there were no significant changes for mathematics. Additionally, *Education Week Journal* (2019) reported that current U.S. ACT scores indicated troubling long-term decline in performance with student math achievement reaching a 20-year low with no progress made since 1998. Furthermore, the Florida Department of Education (2018) state mathematics assessment scores revealed 60% proficiency in grades 3-8, a mere 1% gain from the previous year. This data corresponds to the findings Postal (2018) reported that indicated Florida students lagged the national averages with regards to the SAT and ACT standardized assessments. To combat this trend differentiated instruction, specifically when executed with school leader understanding and knowledge, is a method that allows students to conceptualize and master mathematics content at a level learners are best challenged, thereby valuing student needs (Goddard, Y., Goddard, R., & Kim, M., 2015) as well as "allow teacher reflection that can be a catalyst for change and professional growth" (Stover, Kissel, Haag, & Shoniker, 2011, p. 498).

Defining and understanding differentiation is paramount in reaching all students' mathematics potential (Tomlinson, 2005). Differentiation, a constructivist approach to education, is a method of tailoring instruction to meet individual student needs and targeting deficits with interventions to increase adeptness levels of skills being taught (Valiandes & Tarman, 2011). Whether teachers differentiate content, process, products, or

the learning environment, the use formative assessments along with meaningful grouping makes this a successful approach to instruction. Wan (2017) clarified; “Differentiation is regarded as the most effective approach to accommodate for learner diversity as it emphasizes teachers’ roles to address individual learning profiles (p. 285).” Differentiation allows a continuous process where teachers utilize feedback gained through data analysis of various assessments to improve student learning, while at the same time learners are given opportunities to reflect and build foundational understanding to take ownership for their individual learning.

Research lends itself to the fact that while differentiation is a strategy that markedly improves student achievement, schools continue to waver regarding consistent application (Bosnjak & Krizanac, 2012). As noted by Smeaton & Waters (2013), educators have trepidation about whether students would understand fully targeted concepts when differentiation is utilized. These same educators expressed a lack of confidence in the method, noting that they would most likely need to reteach utilizing the direct instruction method. The application of differentiated instruction has been responsible for higher student achievement scores resulting in progressive student outcomes. Therefore, it is crucial for teachers to overcome certain barriers preventing the implementation of differentiation within the classroom (Christenson & Wager, 2012). However, there seemingly is still a struggling paradigm shift from a teacher-centered to learner-centered instruction (Wan, 2017). Teachers face a range of obstacles such as enough planning time, lack of training, adequate resources, as well as school leadership support (Tomlinson, 2001). Building teacher capacity towards differentiated instruction needs consistent and

sustainable professional development to better equip educators as they strengthen their readiness level to embed differentiation into curricula planning and instruction resulting in appropriate pedagogical skillsets (Tomlinson & Imbeau, 2010).

School leaders play an essential role in the implementation of differentiated instruction. DeSimone and Parmar (2006) noted that school leaders' support was a significant factor in the comfort level of practitioners in adapting differentiated instruction. Teacher's need structured support to enable them to provide programs designed to integrate differentiation in classrooms. Latz, Speirs, Neumeister, Adams, and Pierce (2008) indicated that differentiation is nonexistent in many classrooms due to lack of administrative support even when educators are knowledgeable of what the concept entails. The challenge, then, for school leaders is to address both equity and excellence in today's schools. School administrators serious about developing more responsive classrooms must understand that moving toward differentiation is a long-term change process. Leaders can prepare for this journey by drawing on insights from research about change as well as the experiences of others who have provided effective differentiated learning for students of varying abilities (Brezicha, Bergmark, & Mitzza, 2014). School leaders play an essential role in the formulation and development of a successful differentiated instructional program and influence the effectiveness of implementation. Through school leader's encouragement, support, and nurturing, teachers become better prepared to infuse differentiated instruction that postulates a learning environment conducive of significant learning (Cummings, 2016).

Differentiated Instruction

The idea of differentiating instruction (DI) is a methodology to teaching that advocates active planning for and attention to student differences in classrooms, in the context of high-quality curriculums (Tomlinson & Allan, 2015). Differentiating instruction is a teaching strategy that uses numerous techniques to explain a concept with the goal being to reach an eclectic set of learners in mixed-ability classrooms. The ultimate objective is for practitioners to vary the manner they teach the content that has been mandated by state standards. How teachers initiate DI can be accomplished in many ways, but data analysis plays an integral role in establishing a program aligned with fidelity and purpose. Park & Datnow (2017) investigated the patterns and logic used by teachers when making instructional decisions for incorporating differentiated instruction in their classrooms by utilizing assessable data. Their qualitative case study concentrated on four elementary schools over a period of one year with research data gathered through interviews and observations to determine if teachers' interpretations and use of data enabled them to make credible instructional decisions. The results of this study indicated that while teachers' interpretation and synthesis of data were credible, decisions at the school and district levels guide teacher sense-making about DI in significant ways (Park & Datnow, 2017). Additionally, decisions about differentiation and student grouping in the classroom were not just a one-time event made solely by the teacher but were often a recurring process that happened jointly within the school system. "Even before teachers decided how to group students, adapt content, or adjust their presentations, district and school policies set the conditions for teachers' decisions" (Park & Datnow, p.290).

With diversity in schools increasing at a rapid pace, it is of utmost importance that instruction is diversified to reach all learners at their level. As Wan (2017) pointed out, when content is addressed at various complexities to adjust to student interest and readiness levels maximum growth can be attained. Through a mixed-method study Lanzo, (2011) purposed research concentrated on improving the mathematics attitudes of five struggling students using differentiation in cooperative groups. Over a five-week period, a triangulation of data was gathered through pre and post Likert scale questions, criteria-specific teacher observation checklist, as well as an open-ended questionnaire to answer the question, " To what extent does the use of differentiation incorporated with cooperative groups improve the attitude of underachieving mathematics secondary students." The results of the implementation of this instructional approach resulted not only a more positive attitude towards mathematics but also caused the students to become engaged learning members (p. 29). These same students signified through individual responses they strongly agreed that cooperative group work, as well their self-esteem, lead to greater confidence and a better understanding of math concepts (p. 27).

In today's schools, contemporary strategies of learning and teaching call for more efficient approaches and procedures of knowledge acquisition (Bosnjak, Krizanac, 2012). A systemic reform respecting the differences that exist among students needs to be present to ensure student academic equity. Given the prevalence of math skill deficiencies across the general school population (NCES, 2006 & 2007) a change is in order to take into consideration various student modalities that are evident in classrooms across the globe. One such strategy to address this concern is to *Detect, Practice, and Repair* (DPR), a

multicomponent class-wide mathematics intervention addressing basic math facts mastery. Poncy & Fontenelle (2013) completed a study consisting of eleven fourth grade students from central Iowa who struggled on basic math fact fluency. The researchers utilized a multiple problem set design targeting students in need of remediation with multiplication facts over an 11-day period targeting 36 distinct problems. Baseline and mediation assessment data were collected using constructed probes each day. Given the purpose of the study to investigate the overall impact of DPR on a group of students, the class-wide average scores were plotted to interpret the data (pg. 214). Because this technique used a group format to identify problems for each individual student, this approach has characteristics matching differentiated instruction and as such was hypothesized to provide structure and mastery to struggling students with math fact fluency. Although there was a marked increase when DPR was implemented, especially with regards to multiplication fact fluency, mathematic operations of subtraction and addition did not fare well as trend data was inconsistent across the sets. Poncy & Fontenelle's (2013) study established preliminary evidence supporting the use of DPR as a Tier 1 technique to successfully differentiate math fact instruction for groups of students both within and across fact skills. However, reliability for the items in the sets aligned to the differentiation model is notably unevenly distributed therefore deeming this theoretical constructivist model not a significant precursor to student mastery.

Mixed Ability Classrooms

In today's educational setting, schools are tasked to prepare students to be astute problem solvers, contributing collaborators, as well as producers of extended knowledge

(Tomlinson, 2015). To attain these monumental achievements, public schools have begun to incorporate mixed-ability groupings, replacing the outdated homogenous grouping strategy when teaching. Response to accountability dictates that districts must make data-driven decisions to implement changes in instructional arrangements including grouping practices (Musoleno & White, 2010; Popham, 2014).

Worldwide attention is currently focused on educators as they strive to promote opportunities for quality learning experiences that are designed to achieve high standards (Goldhaber & Walch, 2014; Kane, Taylor, Tyler, & Wooten, 2011). One such retrospective case study, focused on tracking and mixed ability grouping in secondary schools in Greater London, conveyed results that are concurrent to recent studies in this field of research. Venkatakrishnan & William, 2003 concentrated their study on secondary cohort mathematics classes consisting of 240 students where tracking of learners into high ability and mixed ability grouping arrangements were imposed due to parental concerns of desiring their 'high achieving" students to be separated from lower ability students. Utilizing ANCOVA and analysis of covariance to tabulate assessment scores, results showed fast track students were not significantly advantaged by assignment in these tracks. However, the progress shown in the mixed ability classes revealed a significant relationship between progress and prior knowledge inferring an advantage to these students. Conversely, it was also noted that fast tracks experienced greater learning gains while mixed group classes experienced the opposite. In addition, self-esteem became another issue of concern. The impact of setting on students' self-esteem has been widely researched. Sukhnandan and Lee's (1998) review summarized this evidence stating;

> Research suggests that streaming, compared with mixed ability teaching, has a detrimental effect on the attitudes and self-esteem of average and low ability students. Research suggests that poor attitudes and low self-esteem can lead to a decrease in achievement which can create a vicious circle from which it is difficult for low ability students to escape (p. 42).

Todays' classrooms bring uniqueness and multi-dimensional capabilities offering yet another challenge of how to reach students across a broad spectrum of learning abilities to ensure mastery of content is met. One such strategy would be infusing the aspect of care and compassion throughput mathematics instruction, a feature of education that researcher Nell Noddings believes was key to effective learning communities. Jo Boaler, 2008 conducted a four-year longitudinal study addressing equitable relationships amid mathematics classes where the goals of achievement and equity were the emphasis. 700 students in three California high schools were monitored as they progressed through four years of school. Six hundred hours of observed lessons in conjunction with student interviews and questionnaires answered research questions of whether heterogeneous classes as compared to ability grouped classes had more empathy for each other, stronger commitment of learning, as well as a sense of respect and motivation.

Boaler (2008) reported, "The diverse, urban high school where heterogeneously grouped classrooms were the norm achieved at higher levels, learned good behavior, and learned to respect students from different cultural groups, social classes, ability levels, and sexes" (p.167). This study brought to light the fact that embracing heterogeneous grouping of students translates into a more successful atmosphere where student feel valued and appreciate contributions classmates make. Goals of high achievement and equity were achieved in tandem through this mixed-ability approach. Noteworthy of this study is that

this methodology also allowed a shift in education from measures of achievement to interactions between people that is vital to equitable relationships.

While an expansive array of research accepts mixed ability grouping of classes to produce optimal student achievement, there are oppositional studies specifically when related to gifted education that do not align with this mindset. A final twelve-week study from researcher Barbara Hunt (1996) identified the effect on mathematics achievement and attitude when utilizing both heterogeneous and homogenous grouping with gifted and average/low students of 248 sixth grade students. Literature accounts and research studies identified positive academic gains for the gifted when they are grouped by ability (Hunt, 1996). This quasi-experimental pretest/post-test design was used with the independent variable of ability level and methods with the dependent variable being mathematics achievement. ANOVA was also used to determine the mean for mathematics activities. The results revealed a positive achievement in mathematics for gifted sixth-grade students in the homogenous groups whereas there no statistical difference regarding the average/low students. From this study, educators of gifted students need to address grouping of gifted students in future studies as they need flexibility in independent learning options (Hunt, 1996).

Theory of Multiple Intelligences

Ascribing to diverse learners in mixed-ability classrooms hinges on an array of factors such as how effectively educators embed knowledge of learning modalities in instruction and assessment (Gardner, 1983; Tomlinson, 2001). Since 1983, when Howard Garner published his theory of multiple intelligence (MI), which identifies personal learning

modalities to enhance learning achievement, educators have incorporated this philosophy throughout curricula to assist in student success. Gardner (1983) identified eight types of intelligence: verbal/linguistic, mathematical/logical, spatial, kinesthetic, interpersonal, intrapersonal, naturalistic, and musical. Gardner also provided extensive research to support his theory that human intelligence is not singular, but rather multi-dimensional meaning that learners could possess more than one dominant trait and therefore learn in a variety of methods. MI theory is applicable to DI because teaching and instruction incorporate a multitude of learning styles that allow students the freedom to have their individual needs met to master content taught (Gardner, 1983; Gregory & Chapman, 2002).

Glenn (2010) designed a two-year quasi-experimental longitudinal study to determine what, if any, effect MI had on the academic achievement of 115 students in six history classes as they progressed from grades eight to ten. The guiding question the researcher framed the study was seeking information as to what academic measurable outcomes were evident at the end of the two-year study utilizing the multiple intelligence theory. Data was gathered via student surveys using the Likert scale format as well as single sample t-test using independent variables of race, age, socio-economic status, living with one or both parents, as well as outside interests. The dependent variable was grade point average (GPA) results. This longitudinal study sought information as to how students implemented and utilized multiple intelligences over an extended period and if there was an increase or decrease in academic performance (Glenn, 2010). Discoveries of the study revealed sample students' grade point averages increased by an adjusted mean of .233 over the course of a two-year time frame. Additionally, 96% of students strongly agreed that MI has enabled

them to achieve at higher levels of academic performance. Results of this study indicate that by utilizing MI in the classroom, students became more productive learners through the identification of their individual dominate modalities which in turn may benefit them as lifelong learners. This aligned with Gardner's (2006) philosophy that independent learning styles are crucial for processing learning tasks, requiring consistent, stable strategies representing human nature from a cognitive perspective.

The current changes towards a knowledge-based society have led to significant effects within the educational arena. Since individuals must grow all-inclusive esteemed aptitudes where information is created at phenomenal rates, productive learning limits are required. (Norel, & Laurentiu, 2011). The framework of MI is considering the diversity of the learner and the ways he or she learns best (Norel & Laurentiu, 2011) and aligns with the view that education, information, and knowledge are critical sources of wealth and influence that originate in the classroom (Carnoy & Castells, 1999).

Identifying a relationship between MI and instructional practices at an institution where teachers actively provided instruction based in MI lends itself to a study where insurmountable evidence could be collected. Teele (1994) conducted just this type of descriptive case study concentrated on a California elementary school where educators were united in establishing practices of the theory of multiple intelligences across all grade levels. Positioned within the study were the pertinent questions of how to define MI as well as the methodology teachers would utilize to incorporate into given curricula. Furthermore, student perceptions of the benefit of MI were also addressed in the case study. Through interviews, observations, and stakeholders' input to their opinions of MI infused

instruction, Teele established a framework of a learning environment that provided an educational program to capitalize on student learning opportunities. Concentrating on the four domains of classroom learning centers, organizational factors, educational stakeholders, and school culture and climate, the study determined that the overall function of the campus improved. Additionally, this mindset served as a catalyst for student academic achievement. With relevant learning, teacher commitment, a culture that embraced differences, and harmony with diverse learners and interests, this school elevated learning capacity as well as self-esteem. This case study acknowledged a strong relationship between MI and instructional practices with findings of the connection suggesting that recognizing and developing the many combinations of intelligence that students, staff, parents, and community possess, an improvement in the teaching and learning process can be made.

Due to student motivation and personal connections, educators must be inspired to explore hands-on approaches that assist in the diagnostic attitude to problem-solving (Adcock, 2014). Recognizing that students are distinctive pupils who respond differently to various instructional methods is the cornerstone of successful mathematics teaching. Douglas, Burton, & Reese-Durham (2008) proposed a quantitative study to make comparisons between two distinctly different instructional methodologies- multiple intelligence and direct instruction, in an eighth-grade mathematics classroom. For one-semester students were taught the exact content with the experimental group receiving direct instruction and the control group receiving MI instruction. A t-test analysis for non-independent samples was used to interpret content mastery. As evidenced from pre and

posttest data there was a significate difference in the instruction methods, with multiple intelligence showing a considerable increase to direct instruction thereby viewing MI to enable stronger academic achievement.

Differentiation of mathematics instruction benefits students through increased motivation and engagement as students are working at optimum stages of aptitude to reach their learning potential (Stetson, Stetson & Anderson, 2007). While state standards dictate what curriculum is to be utilized, it is the responsibly of teachers through the supported efforts of school leaders to provide DI strategies on how to present curriculum to a wide range of learners with student achievement at the forefront of all educational decisions (Tomlinson, 2010).

School Leadership

School leaders are visionaries who endeavor to empower other stakeholders, strive for a healthy school environment, serve as instructional leaders, and most importantly lead by example. Leadership is related in the literature to aspects of vision, change, and inspiration which are inseparable parts of the leaders' role (Timor 2015). Connecting guidance to differentiation as it relates to job functions has limited research but an area worthy of exploring.

Gale (2012) focused a quantitative study wrapped around how organizations attract, motivate, and retain leaders aimed at understanding what specific characteristics are necessary to be an effective leader. Driving this nonexperimental research study was how to determine the degree of relationships between domains of multiple intelligences and job roles in management to indicate leadership potential. Utilizing multiple intelligence

checklists, demographic data (sex, age, education, and years of leadership), as well as online surveys from a random sampling of 150 managers/leaders, the researcher amassed vital data to disaggregate across job functions. Interestedly, high interpersonal, intrapersonal, and logical/mathematics modalities were most representative of the sample, with all three bits of intelligence being what Gardner (2006) coined the epitome of successful leader qualities. With educational leaders holding such an integral position of power and presence, being able to explain which leadership behaviors and dispositions are more likely to strengthen school communities and generate promising conditions for learning and teaching would be highly beneficial. With the results of this study came fresh insight into the behaviors needed to manage a learning environment efficiently. Logical-mathematical intelligence for leadership self-efficacy, as well as goal orientation and interpersonal intelligence for leadership flexibility, suggest that critical thinking might be necessary for the sense of confidence or efficacy and the vision of goals, whereas relational or people skills might be essential for the openness to different options (Chan, 2007).

Ascertaining the characteristics needed for effective school leaders to achieve maximum academic learning potential is an ongoing challenge. Administrators have the potential to create lasting change in their schools which will genuinely improve the outcomes for youth in their communities (Houseman & Brand, 2001). With school leadership such a pivotal piece in school success, conceptualizing the selection process for an astute leader can be problematic as well as perplexing. School leaders serve in many roles but none more crucial than effective instructional leaders. Lezotte (1970) coined the term “instructional leadership” during a reform period within schools focused on the

effective school movement that sought to differentiate between schools that were making a positive impact on student learning and those that were not. Derived from this movement arose a list of characteristics that effective school leaders influenced and in the forefront was the role of the school principal as the skilled instructional leader (Lezotte, 2001). Research suggests that school leaders exhibiting deficits in a mathematics background are less likely to effectively support teachers as they attempt to differentiate instruction to meet the needs of diverse learners in their classrooms (Wu, 2013). With priorities placed on school leaders to provide relevant mathematics support to teachers with scarce district input, increasing demands are in place to ensure mathematics success that falls squarely on school principals' shoulders.

In a non-experimental study designed by Cummings (2016) to determine correlation to a strong mathematics background related to impactful leadership, school leaders were questioned regarding their educational and professional mathematics knowledge interrelated to their self-efficacy as administrators. Findings denoted that principals with the least amount of mathematics experience translated into less self-confidence as instructional leaders within the mathematics spectrum. Conversely, principals with extensive mathematics backgrounds revealed a statistically significant relationship with self-efficacy as instructional leaders. However, it was noted that principals with extended mathematics foundations did not possess higher levels of all-around self-efficacy in other areas outside of mathematics. This study highlights the association of content knowledge to confidence levels that Chang and Wu (2006) referred to as interwoven relationships. Chang and Wu's investigation explored relationships of new educators and their interactions with

math and science prior to being exposed to the classroom. Cummings (2016) also found that newly indoctrinated teachers who had more preparation and exposure to these content areas were much better equipped to teach them than their counterparts who did not have the same experiences.

Instructional leadership, as practiced by K-8 school principals implementing differentiated instruction, has the potential to facilitate school reform and to fulfill the goals of equitable education (Bolman & Deal, 2002). Principals have numerous opportunities to envision, plan, role-model, build confidence, provide resources, conduct and utilize research, manage, collaborate, communicate, facilitate, sustain change, and innovate (Bouton-Wales, 2016). The instructional leaders of schools effectively practicing differentiated instruction often observe, promote systemic vision and change, offer time and incentives, customize professional development, and listen and learn while they model and persist (Tomlinson & Allan, 2000).

To better examine common themes and patterns of behaviors that elementary school principals employ when implementing a schoolwide differentiation program, Rowe (2008) proposed a multiple case study approach to discover ways to increase differentiation to meet the need diverse learners in six Connecticut elementary schools. Maintaining integrity as well as highlighting student's needs, facilitating student inclusion, and improving overall academic achievement, were this study's problem centered on how to achieve a pervasive practice of DI, as well as the need for significant practical support and motivation from school leaders geared towards teachers. The study was framed around concerns of how school leaders facilitate schoolwide DI implementation, as well as what rationale is used by

administrators to prioritize practices that must be established for the application to be sustainable (Rowe, 2008).

The non-random sampling technique utilized called for narrative responses that included detailed explanations of leadership behaviors and thought processes. Data was collected via interviews, focus groups, as well as The New England Association of Schools and Colleges (NEASC) documents. Results of the study varied due to school leaders' independent circumstances at each school such as staff relationships, length of service, and level of commitment. Principals reported using various methods along with a continuum including coaching, reflection, support, providing resources, and constant modification. However, knowledge along with an in-depth understanding of the school culture was paramount in all decision making.

School leaders must be mindful that differentiated leadership, much like differentiated instruction, needs to be addressed to meet the complex needs of students and staff (Tomlinson & Allan, 2015). Instructional leaders embracing strategies of clarified agendas, positive relationships, and collegial alliances are better able to negotiate an environment conducive of empowerment, communication, and feedback (Bolman and Deal, 2002). This foundational effort serves as the basis for a human resource framework not easily broken.

School Principal's Support in Mathematics

School reform necessitates not only a leader who is knowledgeable of content but also a leader who possesses the skills of a change agent to attune with providing enough support. This transformational mindset allows for the exploration of learning and construction of knowledge via collaboration which is the premise on which Fullan (2011) elicits for

educational change. While action learning is commendable, Fullan (2008) also acknowledges that action learning on the part of school leaders and teachers must be accompanied by reflective insight tied to an underlying theory that guides further action a sentiment that Katteffield (2013) wholeheartedly agrees. The heartbeat of standards-based instruction rests on the ascribed notion that all students are offered opportunities to master content utilizing unique methods which in turn support greater equity across classrooms. Ensuring that all students encounter the kinds of challenging subject matter that provide them with opportunities to build their reasoning abilities (Spillane, Reiser, & Reimer, 2002). Equitable learning opportunities that build a foundational mathematics skill set are especially significant as mathematics success paves the way to lasting opportunities about higher education and future career pursuits (Schmidt, 2003). However, with any policy reform, teachers require relevant, effective support in order to make positive changes with fidelity (Cohen & Barnes, 1993). School-level leadership has consistently been viewed as the key support for educational change and improved student learning (Leithwood, Louis, Anderson, & Wahlstrom, 2004). Transformational leadership, with special emphasis on school administrators, is crucial in paving the way towards successful mathematics curricula. In fact, principal leadership may even be the most critical element in a district's instructional improvement strategy (Elmore & Burney, 1999). To encourage a collaborative culture that promotes continuous improvement school leaders need to build teacher capacity that in turn establishes a culture of accountability and growth (Fullan, 2007).

Researcher Bouton-Wales (2016) completed a study exploring the connection of leadership actions of middle school principals to the successful implementation of

Common Core Mathematics Standards. This study also examined the level of school leader support given to teachers and how this support translated into positive student achievement. Noteworthy of this quantitative study was that only 12% of the respondents indicated any mathematics background knowledge before becoming the instructional leader. Findings revealed that while many of the principals supported a continuous growth model through block planning time as well as a culture of teacher collaboration and sharing, staying abreast of current research in mathematics and exposing staff to cutting-edge strategies to enhance math instruction were missing from the design. With 21% of respondents indicating they had no time to participate in the district provided professional development, student learning outcomes aligned to this perspective as a statistically significant relationship existed regarding student achievement and actions middle school principals in supporting their staff in Common Core Mathematics. Another concern was the fact that secondary principals demonstrated a need for deeper involvement with corresponding actions that necessitated a managerial leadership rather than action-based attitude thus requiring more of an instructional leadership capacity (Bouton-Wales, 2016).

Teacher Perceptions of School Leaders Support

With the required accountability of reaching all learners in today's classrooms, teachers are grappling with determining not only methodologies that will assist in closing the chasm but also in obtaining the necessary support from school leaders that is both relevant and pervasive. While the need of school leaders to act for change is paramount, having the fortitude to develop a well-devised plan of implementation is crucial to ensure a clear path to sustain new initiatives. Louis, Leithwood, Wahlstrom, & Anderson (2010) alluded to this

premise when they notated that leadership is framed within an organizational improvement containing mutually agreed-upon guidelines that support people to move in those directions. School instructional leaders in tune with the changes necessary to reach the wide-ranging abilities of students in classrooms must respond by developing a blueprint. This blueprint in turn will ultimately alter how schools, as well as educators, plan for instruction. School principals can play an important role in promoting teacher leadership by delegating authority and empowering teachers in ways that allow them to influence key organizational decisions and processes (Sebastian, Allensworth, & Huang, 2016). School leaders facilitate change through a well-designed process that includes a detailed strategic plan including realistic goals with student achievement serving as the foundational cornerstone. Leadership is second only to classroom injunctive authorization as it relates to what students learn at school (Leithwood, Louis, Anderson, & Wahlstrom, 2004).

In a qualitative case study accomplished by Byars (2011), the researcher purposed to identify and explore the actions a school principal took to understand, execute, and maintain differentiated instruction within her school. Research questions were framed on the principal's understanding and ability to implement differentiated instruction, as well as teacher's beliefs related to DI. The study sought to determine how these views guided a principal's leadership for a school-wide differentiation initiative. The findings revealed valuable information that was instrumental in employing DI initiatives on any campus. Applying the mantra of "clarify, attain, and motivate the vision" Byars (2011) determined DI could be supported through professional development, modeling by experts in the field, clarifying misconceptions regarding differentiation, as well as student success

conceptualized the basis of a robust DI program. The study also noted the need to focus on individual student learning modalities to align instruction to meet each students' abilities and interests. Multiple intelligence frameworks, coined by Gardner (1983), suggested that children's life experiences promoted various forms of intellectual capabilities with which to provide a greater understanding of content taught. Also addressed in the researcher's findings was the explicit connection of professional development by experts in the DI field and the connection to positive student growth.

In yet another qualitative constructivist case study Charles (2017) sought to determine middle school teachers' perceptions regarding the effects of differentiated instruction on lower third student academic achievement. The random sample size was 35 Brooklyn, New York educators of multiple ethnicities with a minimum of five years of teaching experience. The researcher was able to extract data from semi-structured interviews that answered the research questions of middle school teachers' perceptions on utilizing differentiated instruction to improve low performing student achievement, the effectiveness of DI, and what factors affect the implementation of DI. The findings of the study aligned with published research notating most teachers agreed that differentiated instruction was a strategy that was pivotal in improving low performing students' academic achievement. (Tomlinson & Imbeau, 2010; Santangelo & Tomlinson, 2012; Tzanni, 2018). However, the biggest obstacles were time to effectively prepare and plan as well as the lack of resources that were available to teachers. Other challenges uncovered through this study were that school leaders needed to provide professional development consisting of modeling and best practices as well as administrative support. As stated by Tobin & Tipplett (2011),

"Potential barriers to any educational initiative are lack of time, curricular and assessment demands, and lack of resource."

Barriers to Differentiation

In the educational arena, policies and reforms that have the potential of impeding teachers from their optimal level of performance need to be addressed from all viewpoints. Without guidance, support, and time, even the best initiatives will produce lackluster results. Demoralization occurs when job descriptions change to such an extent that what teachers previously found good about their work is no longer available (Santoro, 2013). Educators are inundated with new reforms yearly and as a result, have a difficult time maneuvering through the maze of techniques handed down to implement. Leveraging this phenomenon and building a more solid foundation thus reducing barriers, would make for smooth transitions which are vital in education.

One such study focused on barriers to implementing differentiated instruction examined the causes of pedagogic resistance and the factors deemed most pertinent to practitioner struggles. Lo (2006) framed research centered on strategies to differentiate English instruction in Taiwan elementary schools and explored factors teachers perceived as obstacles in applying DI in mixed ability classrooms. The study included Kaplan (1986) research as well as Clark and Estes (2002) performance gap analysis document. The question driving the qualitative study rallied on strategies and decisions regarding the initiating of a DI program amongst three teacher groups namely English specialists, regular inclusion teachers, and combination teachers.

A cross-sectional survey, fashioned in Likert format, was administered to 400 teachers in 103 schools looking for commonalities and variances between the three teacher groups. The cluster sampling process included both Pearson's correlation coefficient as well as MANOVA to examine the mean differences of data gathered. Results revealed a strong, positive correlation between content and process, process and product, as well as content and product. Lo (2006) determined that the knowledge and skills barrier made the strongest contribution to implementing DI with fidelity and reliability. In addition, three obstacles were identified having the most significant setback in the program which were class size, planning, and length of instructional blocks. As evidenced by this study, teachers must routinely reflect on methodologies with regard to differentiation and integrate stratagems meeting the needs of mixed-ability learners. With student academic achievement at the forefront, educators need to be constantly revamping, reorganizing, and pondering continually how each student can be met at their independent level to achieve content mastery across curricula lines.

School systems worldwide have been under increased pressure to not only improve student achievement but in the process attend to skills enabling students to compete globally. School reforms based on systemic change entailing a multitude of strategies have been the prevalent objective of school cultures (Karam, 2015). In the process, teachers overwhelmed with the massive restructuring, along with other key stakeholders, are becoming more resistant to adopted reforms especially when these modifications involve minute teacher and stakeholder input and feedback.

Teachers struggle to select curricula choices aimed at helping students build an understanding of concepts to the degree of achieving mastery especially with regards to high-stakes testing. Utilizing Piaget's theory of constructivism, Hill, (2012) designed a study focused on implementing constructivist mathematics methods in elementary classrooms seeking to answer the questions of how educators maximize teaching and learning during math block time as well as identifying applicable resources to enhance a student-centered learning approach where learners make sense of knowledge through hands-on real-world experiences. As notated by Checkley (2006), a thinking curriculum is essential for building knowledge that students can understand, apply, and adapt in order to meet the challenges associated with skills required for jobs of the future.

In Hill's (2012) qualitative phenomenological study, which articulated a need for knowledge based on the common experiences of individuals who have familiarity with the phenomenon, ascribed meaning to collect data through Creswell's (2007) systematic approach was utilized. The information amassed applied typological analysis and categorization. A constant comparative approach of classroom observations and individual teacher interviews based on seven codes was also in place for this study. A stratified purposeful sampling as this method facilitated comparisons and illustrated subgroup similarities and differences. After analyzing data utilizing a triangulation methodology, the findings revealed common themes among teachers. While educators included in the study could discriminate between traditional and constructivist instructional methods, a majority did not utilize constructivist techniques due to the lack of prerequisite knowledge and experience. The sample group communicated through personal interviews the need for

extensive professional development to perfect their craft. Additionally, teachers indicated a need for meaningful collegial coaching that would enable them to better incorporate this strategy into lesson planning and instruction. Overall, teachers at the sites embraced ideas of constructivist math learning but felt unsupported and awkward in consistently implementing these methods (Hill, 2012).

With the push towards self-directed classrooms aimed at engaging students through a variety of stimulating techniques, practitioners must stay abreast of trends and employ the usage of instructional systems that garner student merit and interest. The social implications of transitioning to instructional practices that foster student investigation, problem-solving, and discussion of math strategies could promote enriched learning outcomes through better understanding and retention of mathematical concepts and operations (Hill, 2012).

Shifting Teacher Pedagogy

Over the years, the definition of pedagogy in classrooms has taken on several different connotations. The key challenge facing teachers who wish to shift their craft towards a more effective practice is how to respect as well as respond to human differences in ways that include learners in, rather than exclude them from, what is ordinarily available in the daily life of the classroom (Florian, 2007). All too often these decisions and actions are influenced through assumptions of bell-curve thinking about ability, which have become naturalized in education (Thomas & Loxley, 2001). Proposing a redesign of education that is grounded in a mission to cultivate teachers dedicated to continuous improvement linked to student achievement is central to ensure success.

Florian and Black-Hawkins (2011) designed a qualitative case study focused on what ways teachers make meaning of the concept of improving pedagogy through inclusion. Also included in the research was an in-depth look into possible theories to meet diverse learners' needs through differentiation in the classroom. Throughout the study, the main premise was teacher knowledge and interpretation of how an inclusion model would look and react within mixed-ability classrooms. The concept of craft knowledge is an important aspect because it highlights successful practice and recognizes the complexity of the teaching profession which includes contemplative and real-world problem-solving (Cooper & McIntyre, 1996). This six-month study, utilizing a deductive approach, transpired in Scotland and examined the pedagogy of eleven teachers in various grades. Through interviews and observation, inclusion practices to develop a deeper understanding of true differentiation were the focal points and narrowed teacher perceptions on how to enrich and extend lessons. There were three distinct findings that emerged after data was disaggregated. Teachers believed inclusive pedagogy challenging due to school policy and procedure restraints. Outdated mandates stymied techniques and new-found approaches as teachers were made to adhere to traditional protocol. Furthermore, teacher practices varied and, in many instances, fell short of researcher expectations as they utilized less inclusive strategies leaving select students' needs unmet. Lastly, on a positive note, teachers who focused on their inherent knowledge identified multiple strategies to implement in the classroom (Tomlinson, 2005). By considering student differences, teachers in this category created ways for all learners to participate in creating valuable learning opportunities. It

was also noted that collaboration and thematic approaches to curriculum assisted in reaching all learners at their individual levels.

With a key component of differentiated instruction being to maximize the learning potential of all students regardless of their ability level, developing an attitude of continuous learning is paramount for educators to improve their pedagogy to aspire to be stellar facilitators of knowledge. The best place to impact teaching and learning is in the classroom as teachers typically apply less than twenty percent of what they learn from traditional training programs, such as conferences and in-services (Tomlinson, 2005). Through a collective effort of relationship, determination, and high expectations for all students, improved teaching practices will emerge paving the way for student achievement. In Ensberg's 2017 study Closing the Achievement Gap: High-Achieving High Schools That Serve Underrepresented Student, research was centered on comparisons between highest and lowest achieving schools and their conditions and features that led to their success in relation to student achievement as identified by 2015 California Assessment of Student Performance and Practice (CAASPP). In addition, research also sought to answer what teacher and administrator perceptions were towards these conditions and features revealed about student achievement. Four southern California high schools located in the largest county in California serving over 300,000 students were the sample campuses due to their diversity and eclectic student population makeup. These schools had an established track record of success in improving student achievement with minorities comprising 69% of total student populations across all sample schools.

This mixed-method study comparing highest and lowest performing high schools was comprised of eleven students, thirty educators, and five administrators. Quantitative analysis was utilized to determine high and low performing school, and qualitative data was utilized through surveys and interviews. Data collection was accomplished in three stages; examination of public data for school sample selection, survey dissemination, as well as personal interviews. However, the research questions needed amendment as none of the lowest performing school administrators would respond to the researcher after multiple attempts of contact. The new research design was focused on teacher and administrator perceptions towards conditions and features that enabled schools to attain consistent high student achievement. Findings from this comprehensive study indicated that while encouragement and academic support and guidance were integral components, high expectations coupled with student variations in instruction delivery such as differentiated instruction were paramount in closing existing achievement gaps (Ensberg, 2017). Ensberg's study supported Oakes (2003) Seven Critical Conditions for College Access and suggested that teacher-student relationships focused on varying instructional delivery techniques were paramount in successful schools. Furthermore, cooperative learning environments including differentiation, smaller school size, and teacher common planning time were also indicated as features of an advantageous learning environment.

Mathematics Differentiated Instruction Components

Data supports the essential need to incorporate differentiated mathematics instruction in classrooms across America and well as aboard, but the looming question is what exactly does differentiation look like? If we are to improve educational practices to nurture

mathematical creativity of students Pham & Cho, (2018) stated a balanced approach of eclectic creativity of concepts taught is vital to allow critical problem-solving skills to develop and mature. Determining what exactly differentiating in the classroom should resemble is a matter that can overwhelm and confuse many educators. Carol Ann Tomlinson (2005) says it best when she writes, "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" (p.13).

In a recent qualitative study by Ritzema, Deunk, & Bosker (2016), the researchers aimed to explore DI practices of trained educators utilizing this high yield strategy. Intent on whether tailoring of instructional practices was evident in classrooms equipped with teachers who had formalized training in delivering DI in primary grades, a two-month observational schedule was put into place. The sample of 41 teachers in grades 2-3 from a group of 18 schools located in the Netherlands was selected due to their previous training with DI with explicit directions on how to not only modify but deliver instruction to a diverse educational environment. From observations conducted during this 60-day time period, the results were less than lackluster. Even with provided professional development on implementing DI, the results showed 60% of lessons still being taught the whole group, 30% of class time students were working independently with no assistance from the teacher, and only 10% of instruction was devoted to small group work. Heterogeneous classrooms in math revealed a much higher percentage of content talk compared to reading, nevertheless extended instruction was rare. This aligned with other researchers' study

results. An example would be Prast, Bergsma, Kroesbergen, & Van Luit (2015) and their quest into determining the makeup of an effective differentiated program. As notated by this team of Dutch scholars, “The biggest factor in undermining the DI process was the absence of enrichment for the advanced learners as well no alternate methodologies presented to students identified with lower than average skill sets.” This mentality underscores the need to consider student learning levels when developing thought-provoking curricula and instruction program to meet students on their individual level. Educational intervention models must consider what works for high-achieving students, may not work for low-achieving students and vice versa. According to Prast (et. 2015), the 5-step cycle of mathematics differentiation deemed by experts in the mathematics field to be pivotal to the success of any program is the identification of educational needs; differentiated goals; differentiated instruction; differentiated practices; and evaluation of progress and process.

Differentiation has no cookie-cutter formula but rather commences when teachers view diverse learners as capable and full of potential waiting to be untapped (Scot, Callahan, & Urquhart, 2009).

School Culture Change

As Fullan (2006, p.4) notated in his work regarding school improvement, “If teachers are going to help students develop skills and competencies of knowledge creation, they need experience themselves in building professional knowledge.” This requires profound changes in teaching practices which do not change by mandate but rather by displacement of existing norms, structures, and processes (Elmore, 2004, p.11). Fullan’s (2006) change

theory is underpinned with seven core premises that lay the foundation on which to build sustainable change. The seven core principles of his change theory include:

1. A focus on motivation where moral purpose serves as the underlying foundation but also includes key concepts of capacity, resources, peer and leadership support, and identifying with the reform on a personal level.
2. Capacity building with an emphasis on results vested with developing individual and collective knowledge and competencies. Positive pressure, entailing a motivation factor, is perceived as fair, and accompanied by resources, is also a significant component of this tenet.
3. Learning in context includes utilizing opportunities for workplace learning gaining insight from others confronted with similar situations.
4. Changing context involves looking to the broader environment where best practice sharing and heightened motivation through identifying with systemic changes are pivotal.
5. Bias for reflective action is the shared vision and ownership piece where self-reflection is crucial.
6. A tri-level engagement which has major stakeholders consisting of school/community, district, and state connected fostering mutual interaction.
7. Persistence and flexibility in staying the course including a strong resolve to keep the momentum of reform moving forward at a steady pace allowing for self-correction and refinement

Additionally, Fullan's (2008) six secrets of change also offer insight to reinforce Fullan's change theory conceptual framework. These two intertwining structures serve as the platform on which school leaders and educators work together in creating a differentiated program of high yield math instruction. Rich direction infused with guidance for leader support has the capability of overcoming possible barriers that may present themselves in the implementation on of a K-8 DI mathematics program as well as outline the methodology to culture change which is paramount in school reform to be sustainable. These six secrets of change include creating a caring culture, including purposeful interaction of all stakeholders, school leaders investing in the development of individual and collaborative efficacy, a "learning together at work" mindset infused with renewed instructional practice, develop cultures where the norm is experiencing solving problems, as well as learning from experiences all the while keeping a forward momentum complements the conceptual framework of this study.

Many studies have been completed focused on differentiated math instruction that has the capabilities of improving student achievement. Many studies center on issued mandates that are expected to produce positive results and increase motivational levels for both student and teachers. One such quantitative study by Valerie Gamble (2011) was completed for the purpose of determining significant differences in math achievement of 5^{th}-grade students. Students were taught using a delegated district initiative Math Out of the Box, inquiry-based learning the program, and traditionally taught content. In addition, the study also concentrated on whether students had a difference of attitude in the areas of confidence, value, enjoyment, and motivation of mathematics. A one-way ANOVA was

completed and found no significant difference in the pre and post-test scores of 5th-grade students. As Gamble (2011) reported, there was also no significant correlation controlling for race and gender. However, there was a significant difference when controlling for socioeconomic status with the two programs. As for student attitudes, the sole area that exhibited a correlation was enjoyment as students preferred the inquiry-based option 2 to 1 over the traditional lessons. While these findings are lackluster in showing a relationship to the benefits of DI in mathematics, it is noteworthy to point out the district-mandated initiative utilized in this study showed that Elmore's (2004) research of delegated curricula may have negative repercussions related to implementation as well as student achievement. Effective school improvement involves building the capacity for change and development through a myriad of avenues (Tobi & Tipplett, 2011). Most theories of change are weak on capacity building which is one of the key reasons they fall short of their intended expectations (Fullan, 2006). The more school leaders invest in capacity building the greater the motivation for positive performance outcomes (Elmore, 2004). A recent study by T.E. Wright-Fraser (2017) investigated school leaders' perceptions, knowledge, and capacity to supervise and support teachers in the implementation of a high-quality math initiative. This descriptive design using mixed-methods data collection revealed significant themes pertinent to school administrators as they built capacity and offered support to their teaching staff. Topics involving feedback to teachers were deemed most important. However, these same school leaders discovered they lacked an understanding of current trends, best practices, and issues in math content and were least prepared to support teachers in high-quality math instruction. Furthermore, school leaders in the study had the

desire to provide time, resources, systems, and structures to DI implementation and remove barriers. Conversely, they were challenged to supervise and support teachers in math instruction due to their inadequate preparation either through the principal preparatory programs or deficits from their personal teaching experiences. Common obstacles that undermine the possibility of reform success thus became shared barriers to successful implementation including inadequate efforts to build school capacity (Sebastian, Allensworth, & Huang, 2016). This vital component is needed to implement school reform including school stakeholder knowledge of roles and responsibilities, as well as stakeholder leadership and skills (Karam, 2015). For school leaders to become change agents, they must have constant pervasive dialog in tune with building capacity in relation to the targets set (Fullan, 2006). This mindset will result in a deeply applied phenomenon embraced by all stakeholders capable of positive change (Valiandes & Tarman, 2011).

Conclusion

The review of literature has outlined practices and procedures across a continuum necessary for all stakeholders to embrace as they focus on the improvement of mathematics achievement nationwide. As Fullan (2016) noted, “If respect for and mastery of change don’t become a priority even well-intentioned initiatives will wreak havoc for stakeholders involved” (p.8). For mathematics success to occur, practitioners need to be open-minded constructivists who place students and their independent ability levels and learning styles at the forefront of the learning environment (Katterfield, 2013). In doing so, educators must overcome barriers that interfere with the implementation of differentiating instruction through professional devolvement and reflective practices (Ollerton, 2014). Teachers, as

well as administrators, must also possess the understanding and the necessary awareness needed to combat national math deficits across all grade levels (Cummings, 2016). A common language would serve to close the instructional gap in mathematics instruction. This can be achieved through professional development centered on teacher effectiveness that in turn would usher in the change needed for successful implementation (Givvin & Santagata, 2010). School leaders must serve as the instructional trailblazers with a repertoire of strategies to assist staff in transitioning from a traditional instructional mentality to a student-centered culture (Checkley, 2006). Accomplishing this goal can be attained through collaboration, resource provision, and most importantly the precious commodity of time to work together which in the process empowers staff to be change-makers attuned with high expectations for all students in the math arena (Lanzo, 2011).

Research lends itself, as Tomlinson (2001) pointed out, to the fact differentiation is a strategy that markedly improves student achievement as notated by students and staff alike. Mixed ability classrooms promote opportunities for quality learning experiences with high levels of conceptualization of content and serve to instill equity for all students (Boaler, 2008). While Gardner's Multiple Intelligence Theory (1983) serves as the foundation on which to build differentiated instruction which has capabilities of changing student mindsets and serve as the catalyst for a favorable learning climate, it is certainly not the only component necessary for operative change to occur. Brezicha, Bergman & Mitra (2014) pointed out that while focusing on student modalities is commendable, this one size fits all approach is not enough to sustain successful transformation. For differentiated instruction to impact student mathematics achievement, collective efficacy embraced by

school leadership that supports teachers and is willing to adapt and change to eclectic classrooms across their campus is needed for positive results (Donahoo, Hattie, & Eells, 2018). Through exploring relationships, examining needs, and identifying barriers associated with a successful DI mathematic initiative, a highly beneficial and purposeful program would result capable of improving student mastery of K-8 mathematical concepts (Tomlinson, 2005). Bennis and Nanus (1985) suggested that successful leaders develop a vision for the organization, engage in effective communication, cultivate trust within their organization, engage in self-renewal, and focus on success. Hussain, Haider, Ahmed, & Ali (2016) reported that every high achieving school has as its instructional leader a principal who is both effective and skilled in moving a school, staff, and community to a higher level. Successful reforms are underpinned with thinking deeply rather than just knowing the tangible stratagems. Fullan (2006) says it best when he wrote, “change is not a set of facts but rather a deeply applied mindset embraced and shared by stakeholders”.

CHAPTER THREE: METHODOLOGY

Introduction

In today's evolving classrooms, reaching all learners at their readiness level is imperative to ensure knowledge is viable for all students (Tomlinson, 2001). While this statement applies to all content areas in K-8, mathematics achievement has not only shown a downward trend but has also been stagnant in the United States for several years (National Center for Education Statistics, 2018). As notated by Drew Desilver (2017), "Recently released data from international math and science assessments indicate that U.S. students continue to rank around the middle of the pack" (p.1). Recent PISA results indicated that the US ranked 38th out of 71 countries in mathematics (PISA, 2018). Jill Barshay (2018) reported that math achievement of American students in 2015 fell for the second time in a row on a significant international benchmark. This downward spiral is responsible for pushing the United States to the bottom half of 72 nations and regions around the world who participate in PISA. Effective instruction is key to academic achievement with research-based connections linking teachers' efficacy to student mastery (Tomlinson, 2005; Tzanni, 2018). If the tide is to be turned in mathematics achievement to reveal a more conscious awareness as well as rescue the struggling students' dilemma, new procedures must be implemented (Boaler, 2008). This is where differentiated curricula would prove beneficial in reaching eclectic learners in a mixed ability classroom (Tomlinson, 2001). However, according to Lanzo (2011), incorporating differentiation in the K-8 mathematics classroom without a support system has posed challenges as well as presented barriers that ultimately affect successful implementation. Uniting school leaders

and teachers' visions of a successful program of instruction is at the core of successful implementation (Lo, 2006). Barriers may exist prohibiting DI from being included in the instructional day such as teachers lacking the skill set necessary to integrate differentiation (Park & Datnow, 2017). Furthermore, support from school leaders towards educators, a crucial component for a sustainable DI program, may also be absent causing a chasm in the implementation of a differentiated mathematics program (Wright-Fraser, 2017).

Problem Statement

With mathematics scores for United States students stagnated, there is a need to differentiate instruction to improve student achievement. Establishing a mathematics differentiated instructional program requires school leaders' intensive support to drive the initiative which in turn could circumvent potential barriers to the implementation.

Purpose of Study

The purpose of this study is to explore the support relationship imparted by school leaders to teachers leading to differentiated instruction implementation. Additionally, this study will also identify perceived barriers through both school leader and teacher lens' leading to a comprehensive mathematics DI initiative.

Research Questions

The following research questions were investigated and analyzed regarding school leaders support needed for such an initiative and potential barrier to the implementation of a mathematics DI initiative:

1. How do school leaders offer support to teachers regarding the implementation of differentiated mathematics instruction?

2. What are teachers' perceptions of administrative support of mathematics differentiation?
3. What do school leaders identify as perceived barriers of mathematics differentiation?
4. What do teachers identify as perceived barriers of mathematics differentiation?

Research Method

Current data regarding implementing mathematics differentiated programs are limited. Much is published about the outcomes of such programs after establishment, but research is scarce connected to the development and implementation of a math DI initiative. Therefore, the purpose of this research was to learn what support school leaders need to provide to teachers and what potential barriers existed in a mathematics DI initiative. A single instrumental qualitative case study was conducted that included interviews and collection of artifacts. Qualitative case studies are effective approaches for providing feedback regarding questions pertaining to the how and why of a problem (Huberman & Miles, 1994). According to Creswell (2013), a qualitative case study involves the study of a circumstance within real-life, contemporary context or setting. For example, a qualitative case study design was utilized to explore the influence of Lesson Study on how mathematics teachers plan for, implement, and understand differentiation (Hockett, 2010). Another qualitative case study design was used to discover elementary mathematics teacher perception to gather insights to overcome barriers to successful DI implementation within traditional math classrooms in a rural school district located in central Pennsylvania (Paladina, 2015).

Since the focus of this qualitative case study was developing an understanding of a mathematics differentiated instructional model, a single instrumental qualitative case study was the logical choice. This qualitative research study was designed to collect data consisting of open-ended questions in an interview format from both school administrators and teachers. In addition, artifacts, namely lesson plans and the school master schedule, were collected and examined for relevance to a mathematics DI initiative. Open-ended questions in the interview process allowed the data to be interpreted by the researcher and used to construct a meaningful explanation of necessary support to incorporate a mathematics DI program. Through this same interpretive process, barriers to implement such a program were also explored. The open-ended interview questions were designed by and administered by the researcher. The focus of this study was two-fold; to determine necessary support from school leaders to implement a mathematics DI program and examine teacher perceptions of the support given by school leaders. Additionally, barriers to a mathematics DI initiative through both school leaders and teachers lens' were also a focus of the study.

A pilot study was conducted utilizing a panel of one administrator and one teacher. A pilot study is a preliminary small-scale study that researchers conduct in order to help them decide how best to conduct a large-scale research project (Huberman & Miles, 1994). Using a pilot study, a researcher can identify or refine a research question, figure out what methods are best for pursuing it, and estimate how much time and resources will be necessary to complete the larger version, among other things (Merriam, 1998; Wolcott, 1994). It should be noted the pilot study participants were not part of the formal research

case study. The open-ended survey questions from Appendix B and C were utilized to gather data for the pilot. Analyzing data from a qualitative pilot study to assess interview questions for clarity and relevance to the study allows for reliability and relevance (Seidman, 2013). Based on feedback from the pilot study participants, changes to interview questions were made. It should be noted that the time frame of 30-45 minutes for each pilot study interview was met.

Population and Sample Size

A southern Florida rural K-8 school was selected as the sample campus to complete the interviews and collect artifacts for this case study. The research setting of this school campus is located amid the inside corridor of a south Florida school district. The population for this case study sample school consisted of 53 staff members that served as the sampling frame. One year of teaching experience was the criteria for consideration as a research participant. Thirteen teachers and three administrators agreed to participant. The stratified random sampling technique was utilized to select six teacher participants. After placing the thirteen teachers in either primary, intermediate, or middle school groups based on the grade they taught, two teachers from each group were selected randomly from names submitted on paper ballots. The teachers were all education majors, however had varying degrees of education, work history, and service at the sample school. Since all three school leaders were needed to complete this case study, all were included as participants. The demographics of the school are different and diverse when compared to the district where the sample school is located. While the district has 34% Hispanic students, this campus is represented by almost 50% of the same subgroup. Additionally, the

district has a 48% African American student population, whereas this campus has less than 1% of said category. The K-8 sample school total student population demographics are comprised of 48% white, 48% Hispanic, and less than 1% in both African American and Asian populations. In addition, the campus is 100% free breakfast and lunch.

Development of Interview Questions

Using this case study's research questions as a baseline, interview questions were designed and developed by the researcher. The intent when developing the interview questions was for participants to answer with responses regarding support provided by school leaders when implementing a mathematics DI initiative and teacher perceptions of the support provided. Additionally, interview responses were designed to address barriers associated with a mathematics DI initiative through both the school leaders and teachers lens'. Through the pilot study, the researcher determined that the proposed questions for school leaders were able to provide in-depth responses that correlated to the development of a K-8 mathematics DI initiative regarding support needed and barriers that may surface. However, an additional question was added for school leaders; if after support had been given to teacher(s) and they still were unable or incapable to implement a mathematics DI program what would be your next steps? Furthermore, clarification was needed in the wording on the question "how can a school provide a bridge to close the learning deficit chasm with regard to a math DI program initiative?" Since the purpose was to determine if DI would be a significant contributor to closing the achievement gap in math, the question was reworded. The edited version read "how would a K-8 mathematics DI program be a significant contributor to closing the math gap across levels of students?" The wording

reflects a much clearer interpretation and as such the responses was more thorough and aligned to the case study. The teacher-directed question responses from the pilot study also revealed precise, detailed replies that contained clearly identified themes, revelations, and insight of a K-8 mathematics DI initiative. Nevertheless, two additional questions were added that further uncovered areas that needed attention from the researcher. The first addendum focused on school leader support or in this case the lack thereof; "is support and direction from school leaders actually offered in differentiation?" Moreover, since perspective interviewees for the study could potentially be seasoned educators, a questioned was added that centered on expectations of a DI initiative; "overall, what would a teacher with excellent data expect to gain from a K-8 mathematics DI initiative."

Table 1 Questions Rewritten as a Result of Pilot Case Study

Item #	Edits to questions after pilot study
Question added	If after support had been given to teacher(s) and they still were unable or incapable to implement a mathematics DI program what would be your next steps?
Question added	Would a K-8 mathematics DI program be a significant contributor to closing the math gap across levels of students?
Question added	Is support and direction from school leaders actually offered in differentiation?"
Question added	Overall, what would a teacher with excellent data expect to gain from a K-8 mathematics DI initiative?

Additionally, each individual interview question was cross referenced to both the research questions of this study as well as to Fullan's change theory, the conceptual framework of this study (Appendix B & C). Centering on changing behaviors conducive to

creating a support system, Fullan's theory could be aligned to this study's interview questions. Based on the main principle the researcher targeted and where this information fit in the change theory continuum questions were correlated. Fullan's (2006) change theory motivates people to invest the passion and energy needed to get the desired results. Enveloped amid respect, collaboration, building capacity, continuous learning, and creating an enhanced system for improvement, this action strategy is foundational on which to build change in both instructional practices as well as campus learning cultures.

Data Collection

For this study, an unstructured interview format was used to allow a fluid exchange of ideas and inquiries. Questions are open-ended in this type of interview to allow opportunities for open discussion. This approach was the most suitable for this study because it required the researcher to interview in order to understand what support was needed in a DI initiative as well as perceived obstacles of a differentiated mathematics program. The interview began with the researcher explaining the study's purpose and sharing with participants a copy of the research questions (Appendix B & C). The researcher then asked the teacher if they had any questions for the researcher, then answered questions as they arose from the segment interview. Building a rapport with participants was paramount and as such the researcher started the interviews with small talk to put the interviewees at ease. To shift the interview towards the designed purpose, the researcher than asked the participant about their respective classrooms or experiences in mathematics. Next the researcher moved on to the actual open-ended questions to gain insight into participants' perspectives of a mathematics differentiated instruction initiative.

The first half of questions for teachers focused on the necessary support by school leaders to begin such an endeavor. The second half of questions centered on perceived barriers that may impede implementation for such a program. For school leaders, the first section of questions focused on what support they would need to provide to teachers to support a mathematics DI initiative. The second section of questions for school leaders centered on perceived barriers that may impede implementation of such a program.

Six teachers and three school administrators were selected as participants of this study. The researcher was given the name of the possible sample school from a colleague who had background of the district and therefore was able to give the researcher the name and contact information of the school principal. The researcher contacted the principal of the sample school by email to inquire if he/she would consent to serve as the sample school for this case study. The researcher received a response via email in two days from the principal stating the school would gladly serve as the sample school. The researcher then provided to the principal via email a copy of the cover letter, as well as an explanation of the purpose, problem statement, and research questions of the study A telephone conversation was scheduled within five business days with the purpose to discuss how to get information to teachers at the school to find willing participants that met the one-year teaching criteria. Moreover, a time frame was discussed during this same telephone conversation that would allow the researcher two days to visit the school to complete the interviews and collect the artifacts such as lesson plans and the school's master schedule. During this conversation the researcher asked for the district superintendent's name and contact information to send a formal request letter to seek approval to complete the case study. However, the school

principal informed the researcher that the district superintendent's permission was not necessary as he/she was the one to give authorization for the case study. The finalized dates were also established during the telephone conversation. Thirteen teachers were willing to serve as participants. Teachers were assigned to groups primary, intermediate, or middle school based on the grade level they taught. Names were submitted on paper ballots and two from each group were randomly selected to be participants of this study. All three school leaders were included in the study. The interview questions were designed by the researcher to survey the school leaders and teachers in the study (Appendix B & C). The interview questions were developed to be completed in a 30-45-minute time frame. Interviews and artifacts collection did take 45 minutes in most cases. School leader participants were asked to respond to questions pertaining to how do school leaders support implementing a DI initiative and what do school leaders identify as possible barriers of DI? Teacher participants were asked to respond to questions pertaining to what are teacher perceptions of administrative support of DI and what do teachers perceive as possible barriers of DI? This qualitative research study was designed to collect data consisting of open-ended questions in an interview format from both school administrators and teachers. The researcher met with five participants on day one in a private, fully furnished school conference room to complete interviews and collect artifacts in the form of lesson plans and the school's master schedule. The second day the researcher interviewed and collected artifacts from the remaining four teachers and school leaders in the same conference room. Audio recordings from the interviews were professionally transcribed after the interviews were completed. Artifacts in the form of teacher lesson plans and the school's master

schedule were analyzed for alignment to responses given during interviews. Participants henceforth will be known as Teachers 1-6, and administrators known as School Leaders 1-3 for the purpose of this study. Participants were given the opportunity to read their professionally transcribed notes from their respective interviews to check for clarity and to address any misconceptions from the data. All edits from these transcriptions were submitted by teacher participants to the researcher via email prior to disaggregation and analyzation of data. Two participants submitted edits.

Data Analysis

Qualitative case study research consists of three components; preparing and organizing data, minimizing data into themes, and determinately representing data on figures, tables, or a discussion (Creswell, 2013). Data were collected from interviews as well as artifacts in the form of lesson plans and the school's master schedule from the participants of this case study. The open-ended interview question responses were used to investigate both the support needed and potential barriers associated with a mathematics differentiated initiative. The interview responses were emailed back to each individual participant and each participant was offered the opportunity to review their comments and provide additional clarification and feedback. Two participants submitted clarification edits. The interviews were analyzed separately from the collected lesson plans and master schedule to ensure only participant responses were investigated for common categories. Assembling data into categories served to better understand and maneuver the data in a more efficient manner. The coding process was then utilized to chunk the collected data further looking for themes and patterns that emerged. Identifying recurring themes, language, opinions,

and beliefs was also included in data analysis and served as the foundation on which to arrange themes in a cohesive manner. Reducing data is the initial step for researchers to present the material gathers and then analyzing and interpreting data (Wolcott, 1994). Due to unforeseen circumstances with the transcription company it took six weeks for all transcripts to be set to the researcher electronically. Data analysis was completed in one calendar month after receiving the transcripts.

Results of this research study extracted rich qualitative data. The inductive method of analysis was utilized to condense extensive and diverse raw data to determine research findings. The inductive method allowed the researcher to examine the raw data to establish transparent links in the forms of patterns and themes connecting research objectives and summary findings. After recorded interviews were professionally transcribed and data documented, transcripts, lesson plans, and the school master schedule were reviewed and organized. Only lesson plans that contained detailed information and descriptions regarding math block instructional time were used. When analyzing said lesson plans, the researcher focused on how the artifact was created, what was included and not included in the artifact, and how it correlated to a DI implementation initiative. Making sense of the data was accomplished through identifying and placing all useful information into a coding scheme. The data was then reread, structured, and classified by the evolving key concepts and trends that emerged. Data saturation was achieved after the nine completed interviews were carefully examined and came to a point where no new additional categories and/or themes emerged. Artifacts were also included in the analyzation process with data gathered and merged for thematic content analysis that identified emerging themes and patterns.

Summary

This chapter began with stating the problem and purpose of this research study. This study was intended to gather data from both teachers and school leader's reflecting their perceptions of an effectively designed implemented differentiated program in the K-8 mathematics classroom. The purpose of this study explored the support relationship between school principals and educators leading to a differentiated instruction implementation and identified perceived barriers to such a program. The pilot study correlated to this study was discussed with specific edits made to the open-ended interview questions stemming from this pilot. The population and sample where also included in this chapter. Data collection processes for all facets of the study were explained with clarity regarding the assemblage of information. Lastly, data analysis was discussed with step by step technique of the inductive method of analysis.

CHAPTER FOUR: FINDINGS

Introduction

The purpose of this study was to explore the support relationship provided by school leaders to teachers leading to a differentiated instruction initiative. Additionally, this study also identified perceived barriers through both school leader and teacher lens' towards a mathematics DI initiative. The results and evaluations of this chapter apply to the four research questions that framed this case study as well as the collection of artifacts in the form of lesson plans and the sample school's master schedule. This chapter presents the findings derived from the qualitative study consisting of six teachers, two each from primary, intermediate, and middle school grades, and three school leaders from a south Florida rural school district. They were interviewed by the researcher of the study using open ended questions (Appendix B & C).

The research selection process began in August 2019 with interviews being conducted November 2019. All nine interviews were complete face to face at the sample K8 school. These one-on-one interviews lasted between 30-45 minute each. The difference in interview time stemmed from participant responses. Some participants answered with in-depth responses while others gave brief answers. Interview responses were recorded and professionally transcribed. The transcripts were then sent electronically to each participant. Participants were given the opportunity to make edits or additions to their individual responses prior to data analysis. Two teachers returned their transcripts that contained clarification edits. These edits and additions were emailed back to the researcher prior to the formal data breakdown. The inductive method of analysis was the technique of choice

to abbreviate widespread raw data to determine research findings. In examining perceptions from both teachers and school leader regarding support needed in a DI initiative as well as barriers that may, the researcher gained knowledge as participants shared their attitudes, beliefs, and experiences (Creswell, 2013).

This chapter includes descriptions of the participants and their backgrounds and presents analysis of the qualitative results for each of the four research questions which were:

1. How do school leaders offer support to teachers regarding the implementation of differentiated mathematics instruction?
2. What are teachers' perceptions of administrative support of mathematics differentiation?
3. What do school leaders identify as perceived barriers of mathematics differentiation?
4. What do teachers identify as perceived barriers of mathematics differentiation?

It should be noted that the sample school had implemented a reading differentiated instructional program into their master schedule for the current school year of 2019-2020. Routines and procedures were in place campus wide for this reading initiative that include time allotted for the program, resources identified and utilized, as well as professional development for the entire K-8 staff that aligned to the reading DI initiative. The relevance to the reading initiative that was in place will be evident in this chapter as the data is discussed and presented.

Descriptions of Participants

The sample K-8 school utilized for this qualitative case study had three school leaders who were all participants. Administration was comprised of the school principal and two assistant principals. All three were female and self-identified themselves as Causation. The school principal has been in education for 31 years, with the first eleven years in the private school sector as a teacher. The move to public education occurred in her twelfth year in education where she has worked for 21 years in both teacher as well as administrative positions. One assistant principal has been in administration for five years after a career in the elementary and middle school classroom setting. The second assistant principal is serving under the umbrella of teacher on assignment which resembles an on the job training format. This is her first year in a school administrative role after a career in the classroom for 16 years. None of the three have a degree in graduate mathematics. Table 1 displays a compilation of school leaders demographics.

Table 2 School Leader Demographics

School Leader Demographics	
Ethnicity	
American Indian or Alaskan Native	0
Asian	0
Black or African American	0
Hispanic or Latino	0
Native Hawaiian or Pacific Islander	0
White	3
Bi-racial	0
Multi-racial	0
Other	0
Years of Service	
0-3	0
4-6	0
7-10	1
11-15	0
16-20	1
21-25	0
26-30	0
31+	1
Years in Administration	
1-3	1
4-6	1
7-10	0
11-15	0
16 or more	1
Highest Degree Attained	
Bachelors	1
Masters	2
Doctorate	0
Undergraduate Degree	
Early Childhood	0
Elementary Education	2
K-12 Education	1
Graduate Major	
K12 Educational Leadership	2

There were thirteen teachers who were willing to be participants and met the requirement for this research study. The criteria for this study specified teachers needed one year of teaching experience in a K-8 classroom at the selected sample school. The stratified random sampling technique was utilized to select the six teachers necessary for this study. Two of the teachers served in a primary classroom capacity, two taught in an intermediate setting, and two served at the middle school level. All teacher participants were female, with all six self-identifying as Caucasian. Teacher participants' responses regarding years teaching indicated three have been teaching 2-10 years, two for 11-20 years, and one for over 30 years. All teachers indicated certification for their respective grade level. One of the six participants had a graduate degree in mathematics, while the others are certified in general education. Table 2 displays these data regarding teacher demographics.

Table 3 Teacher Demographics

Teacher Demographics	
Ethnicity	
American Indian or Alaskan Native	0
Asian	0
Black or African American	0
Hispanic or Latino	0
Native Hawaiian or Pacific Islander	0
White	6
Years of Service	
0-3	1
4-6	1
7-10	1
11-15	1
16-20	1
21-25	0
26-30	1
31+	0
Highest Degree Attained	
Bachelors	5
Masters	1
Doctorate	0
Undergraduate Degree	
Early Childhood	1
Elementary Education	5
K-12 Education	0

Research Instrument

The interviews consisted of 24 questions for school leaders and 31 questions for teachers. School leader questions were evenly divided with 50% targeting how school leaders would support teachers in a DI initiative and 50% targeting identifying possible barriers to a DI initiative. Teacher interview questions 1-19 focused on teacher perceived support from school leaders towards a DI initiative. The remaining 12 questions were focused on what teachers perceive as possible barriers of a DI initiative.

In addition to interview responses, artifacts in the form of lesson plans and the school master schedule were collected and studied. Qualitative researchers observe and examine artifacts to make rich meaning of written content (Roulston, deMarrais, & Lewis, 2003). These collected graphic artifacts connected interview responses to a visual document that communicated priorities of interests as it related to a DI initiative. The lesson plans illustrated to the researcher the high priority the sample school had in place for reading differentiation as it was firmly embedded within the instructional day. The master schedule provided concrete evidence to the researcher that a reading DI program was embedded into the school schedule. However, there was no time dedicated to mathematics differentiation within the math block itself or in any other part of the school day. Additionally, all participant teachers incorporated reading differentiated instruction within their daily plan. However, only 50% of the participants noted mathematics differentiation on their respective lesson plans.

Research Questions One and Two

1. How do school leaders offer support to teachers regarding the implementation of differentiated mathematics instruction?
2. What are teachers' perceptions of administrative support of mathematics differentiation?

Because these two research questions are closely related to each other and reflect on the singular topic of support, they have been combined for reporting purposes. Three robust, common themes to these research questions, collaborative planning, the push-in model, and online math programs, became evident as the researcher disaggregated the data. Collaborative planning support had been established at the school and consistently utilized

across grade levels. Teacher 5 noted that teachers planned together to design a math DI program to better serve their students. “We utilize the math online programs provided, continually adjust instruction, and set grade level goals as a team to set a course of success for each of our students.” School Leader 3 responded that collaborative planning was instrumental in developing a DI program. “A team approach that includes accountable talk and specific direction to target all learners in each classroom is what is most beneficial to learning achievement.” This collaborative planning approach directly correlates to Fullan’s Change Theory steps four and five which states best practice sharing and learning from others heightens motivation and creates a sense of shared vision and ownership. Additionally, all school leaders and teachers unanimously agreed that the push-in model support provided served as a foundation for math differentiated instruction. This version of differentiation assigns the push-in teacher to the role of parallel teaching. All six teachers identified the push-in model to be both beneficial as a one-on-one tool and capable of closing gaps of learning. Teacher 2 indicated that this differentiated approach “is closing gaps with kids mastering content taught.” This statement correlated to the lesson plans shared by Teacher 2 that clearly outlined a math DI push-in system in place. Specific instructions were included for the resource staff assigned to the classroom. Teacher 1 stated that “as far as differentiation is concerned, we have a push in system in place using our ESE staff and paraprofessionals.” Teacher 6 added a slightly different insight; “During our reading block we have access to push-in assistance, but math is a different story as we don’t have extra personnel to help.” There did surface opposing opinions to the push-in program. Teacher 5 pointed out that there’s not enough manpower to do push-in. “Admin are continually pulling these resource people for other duties around the school and do not

replace them. This means our so-called help is nonexistent." Teacher 4 stated they had a push-in aide last year during math which made it doable because kids needed one on one instruction. "This year I don't have this help which makes teaching math more challenging." Teacher 3 stated that push-in help is a great resource but a lot of times we don't have that. Maybe on paper they (resource staff) were assigned, but they weren't there all the time. While the push-in support provided by school leaders may prove beneficial to student achievement, reliability in consistent use was lacking thus limiting its capabilities of a viable component to differentiated instruction. Interestingly, all three school leaders noted that the push-in support strategy was in place, with School Leader 1 stating that "peer professionals including the ESE staff and paras are assigned to grade levels simultaneously to assist with closing gaps of students in all grade levels." When School Leader 2 was asked what support was provided for differentiated instruction the response given centered squarely on a reading initiative. "We schedule it in our master schedule and place extra help during the reading block only for each grade level." There is no existing parallel mathematics differentiated program at this time in the school. Furthermore, another similarity focused regarding computer-based online mathematics programs that the sample school purchased for all grade levels. Repeatedly mentioned, these online supports served as a major theme regarding mathematics DI strategies. Teacher 6 specified the computer programs assessable to teachers enable us to fine-tune lessons to individual student need based on diagnostics which helps with students understanding the concepts taught. The availability of these programs used as support for math DI allowed teachers to adapt instruction for their mixed-ability classrooms. Teacher 5 indicated online programs were the "lifeline" to the school's math DI as that was all they had available as a resource to

assist in reaching all learners at their individual readiness level. Teacher 2 held a similar viewpoint and candidly responded “computer programs are the only link we have to math DI. There is a definite focus towards reading here. I feel pressured to do the reading DI when math is ultimately taking a back seat.” This teacher’s perspective held true as data revealed 83% of teachers interviewed harbored thoughts that the school placed more emphasis on reading DI then math. Interestingly none of the school leaders agreed with this mindset as all saw reading and math as equal content areas within the school. The researcher examined the school master schedule, another example of an artifact, which was used in correlation with interviews to dissect data. Reading DI was built into the school schedule with formal push-in assistance for all grade levels. However, there was no indicated time for math DI and in fact it was notated that math blocks were up to 60 minutes shorter in length than reading. In some cases, the school schedule showed reading blocks covering over two hours a day. School leader 2 indicated one of the key online programs utilized for differentiation within the math block was not only individualized for students but targets a student skill set at specific entry levels. “It seems the kids enjoy working on the math programs. It’s a way to strengthen math skill sets, have fun in the process, and incorporate DI.” While school leaders may deem the online math programs as fundamental support to assist with DI, the consensus amongst teachers had concern for loss of face to face instruction being replaced by a computer screen. As teacher 4 pointed out, “the math programs are great but there’s nothing that can replace one on one help for a struggling student.”

While collaboration, the push-in model, and online program support to assist with a math DI initiative offered a point of agreement with school leaders and teachers, several

disproportionate perspectives did appear as common themes. School leaders all eluded to building relationships as an essential component to new curricula initiatives. Phrases from school leaders such as we encourage our staff and let them know we are here to help in any capacity, we talk them through their worries, and building relationships begins with an open-door policy permeated throughout responses. However, none of the teacher participants interviewed mentioned this component as being a relevant support in the development of a DI program. In fact, when asked if support and direction from school leaders was offered in math DI, one teacher stated they offer no support. “They just say you need to differentiate but we don’t get a lot of training, observation, or support in that area.” Another teacher participant reasoned that school leaders try to help but may not be well versed in math to answer the hard questions. One of Fullan’s change theory tenets noted that motivation and acceptance of a new program comes through school leaders building peer leadership and support. With such opposing views on relationship building as a support piece, school leaders entertained missed opportunities in the development of a DI program for mathematics through teacher acceptance.

Another area of support that exhibited disagreement between teachers and school leaders was centered on peer observations. Teacher participants universally agreed that given the opportunity, observations of a successful math DI classroom would prove to be highly beneficial. Teacher participant 6 specified how important observations would be to the implementation of a math DI initiative. “Peer observations are absolutely necessary. I’m a believer that different experiences from different perspectives, especially if the teacher has knowledge and expertise in DI would be awesome.” Teacher 2 held the same belief that peer observations would be a great support tool and stated they would really like

to see just how effective programs implement things and maybe even talk to them to get as much information as I could to do the same thing in my classroom. School leaders stated during interviews that peer observations were an existing support piece in the DI program. However, after deeper study by the researcher, peer observations were being utilized primarily for newly hired staff at the school and not specifically to observe differentiated instruction.

Another theme with regards to a DI initiative stemmed from investigating and synthesizing data. Data analysis was identified by teacher participants as an area of support that needed to be addressed for clarity and consistency. While 100% of teacher participants stated they used data in instructional decisions, responses made it clear teachers were unsure how best to utilize said data. Of teacher participants in this study, only 33% felt they had adequate knowledge with disaggregating data. Teacher 5 noted that being very data driven and constantly looking at and making meaning of data was imperative. Teacher 4 added, being on the same page as school leaders with data analysis was at times difficult because the direction indicated as the school focus many times changed course. School leaders all agreed that data was the backbone of instruction and analysis was key to drive instruction. When asked the most crucial step in a DI initiative, school leader 3 answered that gathering data to identify struggling students then differentiating instruction would be the first step to an effective program. According to school leaders' responses regarding the data support piece baseline data is reviewed, analyzed, and utilized to plan instruction by teachers. Nevertheless, with such a low percentage of teachers agreeing that data support is in place, revisiting the procedure of effective data analysis would be advantageous to reevaluate. Table 3 summarizes the finding with these two research questions.

Table 4 Findings from Research

Present Day Support	Teachers Who Agree	School Leaders Who Agree
Adequate Classroom Resources	3/6 or 50%	2/3 or 67%
Admin Open Door Policy	2/6 or 33%	3/3 or 100%
Advanced Math Classes	2/6 or 33%	3/3 or 100%
Building Relationships	0/6 or 0%	3/3 or 100%
Collaborative Planning	6/6 or 100%	3/3 or 100%
Data Analysis Support	2/6 or 33%	3/3 or 100%
Effective Vertical Teams	1/6 or 17%	1/3 or 34%
Human Resources ESE and Para Push In	4/6 or 67%	3/3 or 100%
Mathematics "Takes a Back Seat" Compared to Reading	5/6 or 83%	0/3 or 0%
Online Mathematics Programs/Resources	6/6 or 100%	3/3 or 100%
Peer Observations	0/6 or 0%	2/3 or 67%
Professional Development for Online Math Programs	3/6 or 50%	3/3 or 100%
Professional Development for DI	4/6 or 67%	3/3 or 100%
Push In Model	6/6 or 100%	3/3 or 100%
Reading DI in Place	6/6 or 100%	3/3 or 100%
Reading Top Priority Over Math	5/6 or 83%	3/3 or 100%
Technology	2/3 or 33%	1/3 or 33%
Time Allocated to Math DI	0/6 or 0%	1/3 or 33%

Qualitative Findings for Research Questions One and Two

The essential support components to a DI program as indicted by both school leaders and teachers were identified as the themes of collaborative planning, the push-in model, and online math programs utilized for math differentiation. Working collaboratively

together according to teachers and school leaders has bridged the chasm of educational practices in the school. Teacher participants agreed that the push in model support was a positive factor to implementation of a math DI program. However, the support provided by school leaders lacked fidelity and consistency when they reassigned resource staff or did not replace them due to budget constraints. Math online resources were also a support teacher and school leaders deemed as vital to math differentiation. While these programs had merit, teacher participants noted that nothing can replace face to face time with struggling students. Fitting a math DI plan into the current master schedule was also a major concern. 100% of teacher participants indicated a greater push from school leader's towards reading differentiation verses math.

Inconsistent perspectives did appear after the researcher disaggregated the data looking for themes and patterns. While school leaders solidly considered building relationships a key support piece in a DI initiative, teacher participant responses did not reference this as a support being provided. The open-door policy leaders referred was not mentioned throughout the teacher interviews as a support in place for a DI initiative. Teacher participants did not agree and in fact felt somewhat reluctant to approach administration. Additionally, peer observations were a support all the teacher participants indicated would be helpful to a math DI initiative. Teachers stated that opportunities to observe an established math DI program would assist them with implementing an effective DI program. Teacher participants also expressed a desire for a more uniform data analysis effort. While some teachers were comfortable working with data, others did not feel as knowledgeable.

Research Questions Three and Four

3. What do school leaders identify as perceived barriers of mathematics differentiation?
4. What do teachers identify as perceived barriers of mathematics differentiation?

Because these two research questions both examined perceived barriers to a DI start up program, they will be reported collectively. Explicit themes emerged regarding school leaders and teacher perceived barriers towards the implementation of a mathematics DI program. Analysis of the data revealed perceived barriers from both teachers and school leaders were centered upon teacher buy in. School leaders input revealed that direction and guidance were needed to overshadow the "hate change" attitude prevalent among many teachers. In contrast, teacher participants responses revealed they were willing to try new programs but required data that showed marked student improvement. Teacher 1 specified that it's not all about the scores but seeing statistical data focused on the improvement in students. Other teachers agreed and stated data showing improvement should be enough for us to buy in with confidence. However, school leaders maintained that teachers were hesitant to embrace change with yet another program due to the huge mandates they currently are experiencing from both the district and state level. Interestingly even with 83% of teachers identifying teacher buy in as a definite barrier, participants displayed a willingness to at least try an initiative if there was substantial data displaying improved student learning. Teacher responses were summed up with the straightforward reply of Teacher 5 who said we're not a super fan of change at this school but if we, and I'm speaking for all teachers, were shown that a program had merit and capable of increasing student achievement we'd be all in. Bridging the chasm of teacher support could be

accomplished through a transfer of ownership according to school leaders. School Leader 2 said her strategy to implementing any new program was making the idea theirs (teachers). "I plant the seed and let them take ownership." This philosophy is aligned with Fullan's change theory of shared vision and ownership through self- reflection that results in a forward momentum needed with newly introduced initiatives. Associated to teacher buy in was the next identified perceived barrier lack of professional development for a math DI initiative. A large piece of unfamiliarity of math differentiated instruction rested on the need for a through training program. School leaders agreed, as 67% of these participants noted professional development for a DI initiative would need to be focused on the components of DI, logistics of the program, as well as a common framework to guide the staff through the implementation process. Easing into the program was a mainstay with school leaders whose concerns harbored on a deliberate description to teachers as to how DI would fit into their current instructional plan. Overall, teacher participants considered thorough training necessary to implement a DI initiative with reliability. Responses from teachers stressed the importance of being proficient to implement a new program with fidelity. Teacher comments such as we need lots of training, we need the total support of admin, and sustained professional development must be supplied before the program is rolled out, framed the importance of this piece to a DI initiative. School leaders agreed that the lack of math DI knowledge as well as the absence of a school-wide common DI language could prohibit a math differentiated initiative. School Leader 1 laid out the parameters of a DI initiative and stated after assimilating the program into our master schedule, the next step would be to conduct an in-depth professional development to discuss the details of what we are looking for, and the components of the program.

Supplying teachers with the resources needed to be able to implement correctly and efficiently are vital to a math DI program. Through oral responses, teachers retorted they would be willing to undertake a math DI initiative but were limited with time to incorporate a new program into their already crammed daily schedule. Teacher 6 noted, "I feel like lots of time is set aside for language arts differentiation with programs, extra help, and push in. But math is not a priority and that can be challenging." Teacher 5 held the same viewpoint, "All we hear is everyone's a reading teacher. But you know what, everyone should be a math teacher too because math is just as important as reading." Reading DI is deeply rooted in the master schedule across all grade levels and is driven by the school leader mindset that reading instruction and differentiation is the most important piece of the instructional day. Teacher 4 had a strong opinion of the schoolwide reading priority and stated that differentiated instruction focus is so heavy in ELA you feel pressured to put your center time on ELA goals. Over half of the teacher participants made mention of the fact that math is another important piece of the puzzle in education and needed to have dedicated DI time as well. School Leader 3 stated that currently reading is the sole differentiated program being utilized that involves all resource support staff to be included. With school leaders giving reading preferential treatment, teachers perceived a hurdle for mathematics instruction had been established.

Both groups of participants also agreed that time would be a potential barrier when implementing a math DI program. Specifically, teacher concerns were positioned on the time component with regards to utilizing allotted block time more efficiently. 83% of the teacher participants notated they would embrace a math differentiated initiative but needed specific guidance and input as to the framework of such an initiative. Teacher

apprehensions ranged from struggling to find time to implement DI, planning time frequently taken away, and the need for developing a schedule conducive to incorporating small groups within math to fully embed DI were prevalent in participant responses. Furthermore, securing comprehensive resources was yet another potential barrier discovered through the interview process. The lack of resource staff was a monumental piece that both school leaders and teachers brought to the forefront during interviews. Under this umbrella, the lack of resource staff was identified as a barrier to math DI initiative. 67% of both teachers and school leaders identified the lack of consistent resource staff to utilize for differentiated instruction who served as the pivotal support to the schools' push-in model. Resource teachers connected to the push-in model format currently are in place for the reading DI program only. Teacher participants strongly noted that without these extra sets of hands a math DI initiative would prove ineffective. Teacher 6 summed up the consensus of teachers regarding this issue and stated that without another person in the room to assist with differentiated instruction, tending to the needs of a mixed-ability classroom becomes almost impossible. Overall, teachers were in favor of a math DI initiative but would need pervasive, sustained training and feedback as well as consistent resource staff to ensure the program would be effective and worthwhile.

An additional potential barrier from both school leaders and teacher perspectives was classroom management. Participants collectively agreed that without this key component in place, a mathematics DI initiative would be hard pressed to improve student achievement. Teachers 1 and 4 both notated that unruly students or students not given detailed instructions regarding expectations make small group differentiation almost impossible. Both teachers explicitly stated that without routines and procedures in place chaos would

erupt. Teacher 1 noted if your classroom management is not up to par than you can't achieve success with learning because students need an understanding of what you expect them to do. Teacher 3 added, with DI you have many things going on simultaneously. Classroom management must be key for a safe environment to ensue. School leaders also concurred that teacher skillsets to optimize the class environment were a pivotal piece to any new program. School leaders agreed that teachers needed strong management skills to have procedures in place and expectations shared. Without classroom management the result is a chaotic environment was the mantra of all three school leaders. Student behavior was also a common thread in the teacher interview responses. 67% of teacher participants mutually agreed that student behavior was a huge deterrent to any startup up initiative. Teacher 5 stated that student behaviors have worsened over time. I am constantly putting out fires from student misbehavior all day long which takes away from my teaching time. School leader participants did not address the misbehavior issue, as none of these participants voiced concern with the issue. Rather, school leaders believed classroom routines and procedures hadn't been established by teachers thus leading to the demise of the classroom culture. The lack of responses from school leaders cited a teacher problem rather than a student problem.

Funding was acknowledged as a possible barrier that connected to teacher buy in and acceptance and tied directly into the lack of resources. As Teacher 5 stated, "How can we start a new DI program in math and not have the needed resources whether it be manipulatives, textbooks, or technology to see student gaps close? This takes money, and money we never seem to get." School leaders acknowledged that funds at the district and state levels had been drastically reduced resulting in a decrease of capital. Comments from

school leaders such as; we go to the district and seek additional money but are refused, try to find avenues to explore to locate additional funding, and securing funding has become somewhat of a challenge. Yet another perceived barrier for teachers was the absence of peer observation in a math differentiation program at a school showing significant student achievement. 100% of teacher participants embraced the concept of a show me don't tell me attitude. Teachers were very clear what their focus would be if given these observation opportunities. Responses included to garner valuable insight to the framework of the program, view strategies being utilized that could be included in my classroom, witness student behavior in this type of environment, as well as established routines and procedures. Teacher 3 indicated that observing other teachers at successful DI schools would offer the opportunity to see firsthand ideas and methodologies that could be incorporated into a DI program. This observation component would lead to, as teacher 6 stated, time to digest and feel comfortable with DI. School leader responses regarding peer observations noted that teachers were given opportunities to peer observe in the school setting. However, this opportunity was given to either new teachers or teachers who needed support with instructional delivery and not necessarily to view a differentiated approach.

The final theme identified in this study stemmed from teacher participant responses regarding school leaders and their mathematic background. Teachers unanimously agreed that school leaders lacking a math background would have difficulty overseeing a math DI startup initiative. A concurrent pattern emerged from teachers who noted that school leaders without a math background needed professional development themselves to answer questions and address concerns as they arose from a startup math DI enterprise. Teacher responses interwoven throughout the interviews indicated administrators with a math

background would be better suited to implement DI. Reasons for this teacher mindset included leaders with a math background would be more passionate, because their background is math that is where the place of importance will be for them, and while school leaders are well versed in education, perhaps a more math minded person in leadership would cause us to have an equal shift with reading. Teachers also did note that the lack of school leader's math background knowledge allowed for their voice to be heard and valued. Table 4 summarizes the barriers perceived by both school leaders and teachers to the implementation of a DI initiative.

Table 5 Barriers Perceived by School Leaders and Teachers

Perceived Barriers	**Teachers Who Agree**	**School Leaders Who Agree**
Classroom Routines and Procedures	5/6 or 83%	2/3 or 67%
Coaches Nonexistent	2/6 or 33%	1/3 or 33%
Common Language/DI Knowledge	3/6 or 50%	2/3 or 67%
Funding	2/6 or 33%	3/3 or 100%
Math DI Professional Development	5/6 or 83%	3/3 or 100%
Math DI Lack of Knowledge	0/6 or 0%	2/3 or 67%
Parent Support	4/6 or 67%	2/3 or 67%
Peer Observations	6/6 or 100%	1/3 or 33%
Resources	4/6 or 67%	2/3 or 67%
School Leader w/no Math Background	3/6 or 50%	0/3 or 0%
Student Behavior	4/6 or 67%	0/3 or 0%
Teacher Buy-In	5/6 or 83%	3/3 or 100%
Time to Implement	3/6 or 50%	2/3 or 67%
Reading DI is Priority	5/6 or 83%	2/3 or 67%
Resource Staff (push-in)	4/6 or 67%	2/3 or 67%

Qualitative Findings for Research Questions Three and Four

Teacher buy in was determined to be the biggest barrier to a math DI startup program. School leaders noted that clear guidance and direction to begin a new initiative would be necessary to overcome the 'teacher hate change" attitude. Leaders also notated that teachers were overwhelmed with current mandates from the district and state levels and concurred this would have a direct effect on implementing another new program. Teacher responses indicated a willingness to incorporate math DI after data could be substantiated to support student achievement. School leaders and teachers agreed that an in-depth training period would need to be included prior to the implementation of a DI start up program. In order to design professional development activities, a thorough description of DI is required that would include a common language as well as set procedures and routines across all grade levels. The sustainability of a DI initiative implemented with fidelity would need school staff to have a thorough understanding of the fundamental understanding of a differentiated program thereby increasing conceptual knowledge. Professional development would be an integral component that would serve as the foundational structure on which to build a DI program rich in best practices. Additionally, overcoming the perceived barrier that reading is a school priority would serve to eliminate bias and create an even playing field.

Other barrier themes that emerged were time, funding, classroom management, and student behaviors. Teachers were concerned how they could best to utilize math block time, as well as protect planning time with which to build the necessary framework to build a math DI program. With the push in model so prevalent at the sample school, teachers also

voiced concern on the necessary resource staff to staff a math DI initiative. Teacher participants expressed the need for consistent resource staff to ensure an effective DI startup program. The lack of funding available to purchase necessary resources for the classroom as well as finance additional resource staff to assist teachers in the classroom was a voiced concern. From school leaders to all teacher participants included in the case study, the mutual element of money, or lack thereof, resonated a clear picture. Teacher participants likewise notated a direct correlation to classroom management and student behaviors to the consistent support of resource staff provisions for a DI initiative. Classroom management was addressed as a barrier due to routines and procedures not being established in classrooms. However, teacher participants responses indicated that current student behaviors were requiring time taken from instruction and a potential deterrent to implementing a DI program. Without resource staff in place teachers were called upon to attempt an DI program initiative on their own. Teacher participants stressed the fact that students have become more unruly over time causing difficulty in implementing not only the educational process but start up programs as well.

Peer observation was also identified as a barrier to the implementation of a math DI initiative. Affording teachers opportunities to observe in classrooms where differentiated instruction is being utilized with positive learning results would prove to be highly beneficial. A firsthand look into DI would offer teachers the experience to witness a program in action and gather valuable information. For clarity and understanding to transpire, viewing another educator's teaching practices would, as teacher participants pointed out, prove worthwhile in perfecting one's craft with regards to DI. School leaders' viewpoints were that observations were already a vital part of the school's instructional

practices. However, teacher responses from interviews, while acknowledging that observations did occur occasionally, pointed out these observations focused on new teachers seeing seasoned teachers with no specific reference to differentiated instruction. Lastly, 100% of teacher participants unanimously agreed that school leaders with no math background may not be as passionate for and able to assist with a math DI startup initiative due to limited knowledge and understanding of the subject area. Table 5 summarizes the major and minor themes identified pertaining to the study research questions.

Table 6 Common Interview Themes

Interview Questions	
1. How do school leaders offer support to a DI initiative? 2. What are teacher perceptions of school leaders support offered in a DI initiative?	Themes
	Major themes identified by both school leaders and teachers: • Collaborative planning • Push-in model support • Online mathematics programs. Theme dissenting viewpoints of support: • Teachers stated push in model only staffed with personnel for reading and not math. • Teachers perceived reading is a priority over math. • Teachers unanimously agreed peer observations needed for implementation. • Teachers needed clarity and consistency regarding data analysis support. • Teachers did not include relationship building as a provided school leader support. • School leaders viewed reading and math as equal priorities. • School leaders identified building relationships as a vital component to initiative. Minor theme: • Teachers stated school leader building relationships focus not witnessed.
Interview Questions	
3. What are perceived barriers by school leaders to a math DI initiative? 4. What are perceived barriers by teachers to a math DI initiative?	Themes

Major themes identified by both school leaders and teachers:

- Teacher buy-in due to lack of knowledge and common language
- Professional development focused on components, logistics, and framework
- Resources both personnel and classroom manipulatives.
- Time to fit into both master and classroom schedules
- Funding
- Classroom management including routines and procedures.

Theme dissenting viewpoints of support:

- Teachers viewed student behavior as a deterrent to a Di initiative.
- School leaders noted student behavior not an issue to implement DI.
- School leaders stated teacher ownership is key to an initiative.

Minor theme:

- Teachers notated that a school leader with a math background better equipped to implement a math DI initiative.

Summary

There are many problems faced by teachers, including disparities in learners' levels in which the educational environment, levels of readiness, interests, and learning profiles play a huge role. These problems have been studied by educational researchers to come up with ideal teaching methodology to achieve useful results (Tomlinson, 2005). This has made it possible to adapt teaching methods to learner's levels and needs. The differentiated instruction entails as the procedures for the reorganization of classroom instruction and learning strategies to afford learners different options of accessing information. Aside from collaborative planning and the belief campus wide that additional resource staff are two of the mainstays of support needed to implement a mathematics DI initiative, there are discrepancies between the though patterns of teachers and school leaders. This chasm is evident throughout the support needed facet of a DI start up program with school leaders overall having the mindset that support is in place where teachers feel like support is lacking in most areas. Barriers of a math differentiated instructional program centered

around teacher uneasiness with the rollout of such a program with no insight or direction on routines and procedures. Both school leaders and staff were unified in a professional development piece that would lay out the parameters, constraints, and guidelines for differentiated instruction. A continuous learning model in the form of observational opportunities was deemed crucial by all teachers prior to a startup DI program. Funding was identified as an enormous barrier that directly correlated to lack of necessary resources in the form of human capital as well as hands-on manipulatives for classrooms. Additionally, student behavior issues served as a deterrent to a DI program as much time and effort in recent months has been given to attending to negative behaviors school wide. Lastly, school leader background knowledge of mathematics was viewed by teacher participants as a potential barrier to a math DI program. Teachers agreed that leaders with a math background would be better qualified to offer assistance, guidance, and feedback regarding a math DI initiative.

CHAPTER FIVE: CONCLUSIONS AND RECCOMENDATIONS

Introduction

Given the research that mathematics achievement in the United States has stagnated (Barshay, 2018, Desilver, 2017, PISA, 2018) and that effective instruction is the key to mathematics academic achievement (Tomlinson, 2005, Wan, 2017) this study could be beneficial to school district curriculum specialists, school leaders, and teachers in designing a DI initiative as there currently is limited research and information collected regarding the implementation of a mathematics DI program.

This qualitative case study, conducted in a south Florida rural district, sought to gather data from both personal interviews and the collection of artifacts regarding a DI initiative. Specifically, the research examined the basis of a DI initiative within K-8 classrooms woven around Fullan's change theory. The focus for this study examined the support school leaders could provide to a DI initiative and teacher perceptions of school leader support provided. Additionally, this study identified potential barriers associated with a differentiated instruction initiative through both school leaders and teachers lens'. Data revealed themes necessary for both teachers and school leaders to employ and principles that need to be addressed to ensure a clear, precise DI initiative.

Problem Statement

With mathematics scores for United States students stagnated thus placing America in the middle of the pack of other counties around the world, there is a need to differentiate instruction to improve student achievement. Establishing a mathematics differentiated instructional program requires school leaders' intensive support to drive the initiative which in turn could circumvent potential barriers to the implementation.

Purpose of the Study

The purpose of this study was not only to explore the support relationship between school principals and teachers leading to a differentiated instruction implementation but also identify perceived barriers that cloud both school leader and teacher lens' leading to a comprehensive mathematics DI initiative.

Research Questions

The following research questions were investigated to identify school leaders support toward a DI program, teacher perceptions of school leader support, and potential barriers from both school leader and teacher lens'.

1. How do school leaders offer support to teachers with regard to the implementation of differentiated mathematics instruction?
2. What are teachers' perceptions of school leader support of mathematics differentiation?
3. What do school leaders identify as perceived barriers of mathematics differentiation?
4. What do teachers identify as perceived barriers of mathematics differentiation?

Research Method

A single instrumental qualitative case study was conducted that included interviews and collection of artifacts in the form of lesson plans and the sample school's master schedule. Qualitative case studies are effective approaches for providing feedback regarding questions pertaining to the how and why of a problem (Huberman & Miles, 1994). This qualitative research study was designed to collect data consisting of open-ended questions

in an interview format from both school administrators and teachers. The criteria for teacher participants was a minimum of one-year teaching experience at the sample school location. Thirteen prospective teachers and three school leaders from a southern Florida rural school agreed to participant. A stratified random sampling technique was utilized to selected two teachers from primary, intermediate, and middle school grade levels. All three school leaders were part of the research. This study was intended to gather data from both teachers and school leader's reflecting their perceptions of what support was needed and potential barriers of a mathematics differentiated initiative in K-8 mathematics classrooms.

In considering the qualitative format for this study, Creswell's (2013) five approaches to qualitative design were utilized to gain insight and direction in the selection of the format best able to collect the necessary information correlated to this research. Because a case study can provide a deep understanding of a topic through the uses of multiple data sources such as interviews and artifacts (Seidman, 2013), it was the logical choice for this study. A search of online dissertations focused on the similar topic of a mathematics differentiated instruction initiative using a qualitative approach produced seven theses meeting this criterion. Upon further examination of results and data gathered from this body of research, the case study was the overwhelming choice of the best methodology applied by other researchers to conduct these similar studies that produced the richest amount of data. The inductive method of analysis was utilized to condense extensive and diverse raw data to determine research findings. As Thomas (2006) notated in his research, the inductive approach provides an easy, systematic set of procedures for analyzing qualitative data capable of producing reliable and valid findings.

Results and Conclusions

Research Questions 1 and 2

How do school leaders offer support to teachers regarding the implementation of differentiated mathematics instruction?

What are teachers' perceptions of administrative support of mathematics differentiation?

School leader responses derived from the interview open-ended questions indicated they collectively agreed upon several tenets of support being provided towards a math DI initiative. All stated that math online programs had been a support provided to teachers to be utilized as a tool to differentiate math instruction. Included in these provisions of online resources, school leaders also stated professional development for both online programs as well as math differentiating in the classroom had been a support provided. Additionally, 100% of school leaders concurred that collaborative planning was a pivotal component to teachers and time was scheduled each week for the teachers to meet and plan together. Leaders also noted that resource teachers were in place to staff the push in model of differentiation the school utilized. However, school leaders also notated that the push in model, centered around resource teachers serving in a parallel position with classroom teachers, was only being utilized for reading. The school master schedule and teacher lesson plans reflected the school's priority and focus was placed squarely on reading. Another support 100% of the school leaders specified as being in place towards a math DI initiative was relationship building. School leaders identified this support piece as the cornerstone that focused on an open-door policy of support, guidance, and assistance to teachers. Peer observations, according to school leaders, was yet another support in place to assist with a math DI initiative. However, after deeper investigation by the researcher it

was discovered observations were primarily for newly hired staff members and not specifically to observe math differentiated instruction. School leaders also stated that data analysis guidance was a strong support in the school including guidance on how to create small groups effectively in each classroom. All leaders agreed that data was the backbone of the instructional plan for the school and as such was a pivotal piece to student achievement.

Teacher perceptions of the support offered by school leaders had areas of agreement and areas of dissention. 100% of teachers were in one accord with school leaders regarding collaborative planning. All teachers agreed that planning schoolwide was consistent and pervasive. This planning premise connected with Fullan's change model, the theoretical framework for this study, correlating the tenets of best practice through learning from others. Additionally, 100% of teachers agreed math online programs as being a support provide for math differentiation. Teacher responses indicated these assessible online programs were the only link to incorporating math DI into their respective classrooms. Teachers also noted that reading DI was in place, however 83% of teachers felt like school leaders had given preferential treatment to reading. Furthermore, 83% of teachers were also in agreement that math was being overlooked and disproportionally resourced primarily in the area of resource staff personnel. Teacher participants also noted that professional development was not consistently being provided for both online as well as DI classroom training. Data also revealed teachers universally agreed that peer observations of a successful DI program could be beneficial. Teacher responses indicated peer observations would allow opportunities to grasp firsthand different perspectives and provide an access to build a knowledge base towards a DI initiative. Teacher responses also revealed that while

all teacher participants utilized data to make instructional decisions, they were unsure how to best apply the data for fullest impact. Only 33% of teacher participants felt they possessed adequate knowledge with disaggregating data effectively with most responding they wanted to be on the same page as school leaders. Teacher participants wanted a connective link to data analysis practices that were uniform school wide to better impact student achievement. The largest disconnect surfaced regarding building relationships. None of the teacher participant responses indicated that relationship building was a support in place in the school. Teachers indicated they lacked the guidance and feedback necessary from school leaders to implement a math DI initiative stating that they were told to incorporate math DI with little training or support.

Research Question 3 and 4

What do school leaders identify as perceived barriers of mathematics differentiation?

What do teachers identify as perceived barriers of mathematics differentiation?

School leaders viewed teacher buy in as the largest potential barrier to the inception of a math DI initiative. Leader responses revealed direction and guidance to teachers would be needed to implement a DI math program to overshadow the "hate change" attitude of teachers. 67% of the school leaders indicated their hesitance to implement a math DI initiative was due to the state and district mandates teachers are already facing. Easing into any new program was also noted by school leaders as an essential component. Transferring ownership to teachers was the best practice leaders indicated would be most beneficial for acceptance to occur. This directly correlates to Fullan's change theory view that shared vision and ownership through self-reflection increase the forward momentum of any new initiative. 100% of school leaders also noted that a pervasive, in-depth training period

would need to be designed to establish a common language and develop a framework for a DI initiative. Additionally, 100% of school leaders identified funding as a barrier with emphasis regarding resource staff serving as push in model assistance. Responses from school leaders indicated the lack of funding was tied directly to teacher buy in and acceptance. With inconsistent resource staff being provided for the push in model of differentiation, teacher perceptions unanimously agreed this posed a barrier that could be detrimental to a DI initiative. Time was also revealed to be a barrier to the implementation of a math DI initiative. Specifically, time in the school day to incorporate a DI program into the school master schedule was deemed a barrier to school leaders. 100% of the school leaders acknowledged that reading was a priority and as such a reading differentiated instructional time was built into the master schedule. School leader responses indicated that an enormous obstacle would be the ability to work a mathematics DI initiative into the already full master schedule. School leaders acknowledged that reading was a priority and as such all resources supported reading including resource staff thus leaving math with only the online programs to support a DI initiative. School leaders also deemed classroom management as a deterrent of a math DI initiative stating routines and procedures were not consistently in place. Leaders stated in their responses that routines and procedures would need to be established and prevalent in all classrooms for a math DI initiative to be effective. It is noteworthy to include the fact that none of the school leaders believed student behavior was a barrier issue to the implementation to a math initiative. However, teacher participants perceived student behavior issues school wide to be both challenging and problematic to a math DI initiative.

Teacher participant responses indicated that buy in was a barrier for them, however 83% of teachers indicated that if shown the supporting data that improvements were possible through a DI initiative they would agree to implementation. Overall, teacher responses revealed they would be willing to try differentiated math instruction. However, they pointed out they would need in-depth professional development to bridge the components and logistics of a DI program. Teacher responses specified professional development would be necessary prior to a roll out to implement a math DI initiative with fidelity along with total administration support. Time to plan for a new initiative was also seen as a potential barrier. Time constraints were identified as time to decipher what DI looks like, planning time that included pervasive, consistent support from school leaders, as well as time to learn the framework of a math DI program. Since reading DI is already in place as noted on the school master schedule as well as teacher lesson plans, teachers unanimously stated through their responses that an even playing field between reading and math must take precedence to avoid a barrier to a math DI initiative. Teachers made note that resource personnel utilized for the push in model are allocated towards a reading DI program. 50% of teachers felt that math was an integral content area too and needed dedicated time for a DI initiative to be established. Funding linked to resource staff was also a perceived barrier for teachers. 83% of teaches agreed that resource staff were nonexistent or had been reassigned to reading from the math content areas. While teachers stated routines and procedures were established in their respective classrooms, they have witnessed a rise in discipline problems with students. These disruptions were problematic thus causing instructional time to be lost and served as a barrier to an implementation of math DI. Another barrier perceived by teachers was the lack of peer observations. Teachers stated

they would greatly benefit observing a highly effective DI program in place. Gaining insight and witnessing firsthand how a DI program is run efficiently would serve as an information gathering training rich in techniques and strategies. Interestingly, school leaders indicated through their responses that peer observations were in place at the school. However, after deeper investigation by the researcher, it was noted that observations were utilized for newly hired teachers to observe the logistics of teaching and not necessarily to observe math differentiated instruction. Lastly, teachers were unanimously in agreement regarding school leaders lack of a mathematics background. All teacher responses aligned to the fact that school leaders with a math background would be better equipped to give guidance, focus alignment, and oversee a math DI initiative. Additionally, teachers felt like school leaders with a math background would be more passionate regarding math and able to offer deeper insight when teachers had questions and concerns regarding a math DI initiative.

Implications and Recommendations

Research Questions 1 & 2

How do school leaders offer support to teachers regarding the implementation of differentiated mathematics instruction?

What are teachers' perceptions of administrative support of mathematics differentiation?

The results from analyzing transcribed interview responses as well as collected artifacts revealed there were three supports that both school leaders and teachers unanimously agreed were in place. Findings from this study indicated that collaborative planning, the push in model, where resource personnel parallel teach with classroom teachers, as well as online math programs were identified as supports in place to utilize in a

math DI initiative. The researcher recommends that school leaders continue to utilize these three support pieces in the development of a math DI initiative. Collaborative planning, the foundation to best practices, is a key support in a math DI initiative. As educational researcher Rufo-Tepper (2014) stated, when teachers go through a design process and emerge on the other side with a designer identity, they have a greater degree of agency in blurring the line between teacher and student, and in supporting each other. Moreover, extending the push in model to include mathematics would serve to evenly disperse support to both reading and math content areas. Establishing an even playing field for reading and math instruction would result in a more well-rounded education. Improving the quality of science and mathematics teaching are issues that are deemed to be critical to the national interest (National Research Council, 2001). Additionally, the researcher recommends that resource staff be consistent and pervasive regarding the push in model and that school leaders work closely with district and state personnel to secure the necessary funding to ensure this resource is a provided support. Employing online math programs as a DI support provides an effective math solution. However, it is important to note these programs don't advocate automaticity as a substitute or replacement for one on one instructional assistance towards conceptual understanding in mathematics (Dynarski, 2018).

Building relationships under the premise of an open-door policy was deemed by school leaders to be an essential support in a school wide initiative. However, none of the teacher participants identified relationships as support provided to a math DI initiative. This finding implies school leaders share the goal for a united school but have missed opportunities to develop a math DI initiative through teacher acceptance. The researcher

recommends school leaders communicate their intended message to teachers in a more forthright manner. Specifically, this could be accomplished through gaining a deeper insight into each staff member amid creating a supportive environment focused on positive engagement.

The results for analysis of collected data also revealed there were differences in the perceptions of school leaders and teachers regarding how peer observations were being used as a support towards a math DI initiative. Teachers indicated peer observations of an established program would be beneficial to a math DI initiative. They expanded their thoughts by stating these observational opportunities would allow teachers to build a knowledge base towards a math DI initiative as well as view differing perceptions and strategies used in mathematics differentiated instruction. Interestingly, school leaders indicated through their interview responses that peer observations were currently incorporated as a school support. However, after deeper investigation by the researcher these observations were being used primarily for new staff members to gain insight into best practices of established teachers and not specifically for math differentiated instruction. The findings from this study suggests an implication that school leaders believe peer observation support is in place. However, this support is not aligned to observations of a math DI program but rather to generalities of new teachers garnering best practice strategies with no specifics to math differentiated instruction. The researcher recommends that these observations for newly hired staff members be continued but in addition add another observation component specifically on mathematic instructions with a focus on differentiated instruction. School leaders should also work closely with math teachers to

obtain their input and feedback both individually and collectively to determine the specific needs towards a math DI initiative.

Additionally, results from this study revealed both school leaders and teachers regarded the use of data to make instructional decisions as being a pivotal component to a math DI initiative. School leaders reported through their responses that in order to provide a learning environment conducive to student achievement, data analysis must be incorporated. Teachers stated they utilized data as a support to instruction, however only 33% of teacher participants felt they had adequate knowledge pertaining to the disaggregating of data and expressed a desire to be on the same page as administration so as to have a connected link to data use. The findings of this study imply that school leaders believe data analysis is paramount to instructional decisions. A primary role of a leader is to ensure a culture in which data can be collected and analyzed to form the baseline for instructional improvement. Directed communication needs to be planned to include the purpose relevant to achieving the best outcomes for student achievement (Bourne, 2016). The researcher recommends that school leaders provide data analysis leadership and provide opportunities of professional development. The contradictory findings imply that school leaders need to reevaluate their data training practices to include a more pervasive professional development allowing teachers opportunities to better understand the logistics of the procedures of disaggregating data which in turn will establish a deeper foundational understanding of data use in instructional decisions. When educators are knowledgeable about data use, they can more effectively review their existing capacities, identify weaknesses, and better chart plans for improvement (Balow, 2017).

Research Questions 3 & 4

What do school leaders identify as perceived barriers of mathematics differentiation?

What do teachers identify as perceived barriers of mathematics differentiation?

The results from analyzing transcribed interview responses as well as collected artifacts revealed there are similarities as well as pronounced differences regarding barriers to a math DI initiative. All school leaders identified teacher buy in as a barrier towards the implementation of a DI initiative citing direction and guidance would be needed to overshadow the "hate change" attitude of teachers. Additionally, school leaders noted that teachers would be hesitant to embrace a math differentiated program due to the huge amount of district and state mandates imposed on schools. While 83% of teacher participants agreed that teacher buy in would be a barrier, these same participants noted that if data was shared that substantiated marked improvement with a math DI program, they would be motivated to try the program. This indicates that school leaders lacked a sense of urgency to impart ownership towards a shared vision pertaining to a math DI initiative. This shortfall thereby negated peer leadership and support resulting in teacher confidence regarding buy in. This evidence correlates to Fullan's change theory that states identifying with new reforms is directly linked to heightened motivation. The researcher recommends that school leaders continue to build relationships through a communicated vision thus gaining insight to be better equipped to implement a math DI initiative. The findings further imply that with open communication and a directed purpose aligned to vision, school leaders could bridge the chasm that separates school leader and teacher mindset towards a math DI initiative.

Furthermore, the results of this study identified the lack of professional development as a barrier to a DI initiative. 67% of school leader advocated for focused training on the components of differentiated instruction, explanation of the logistics of the program, as well as a common framework and language. School leaders specified professional development would be essential to the implementation of a DI initiative. Teacher participants concurred as 100% of teacher responses revealed that thorough training would be needed to implement a DI initiative with fidelity. Additionally, teachers agreed that total administrative support prior to a rollout initiative would need to be in place to circumvent barriers of DI misconceptions and knowledge. The findings from the study suggest that school leaders need to organize and carry out professional development in a strategic manner to build teacher capacity focused on results. This approach aligns to Fullan's change theory signifying building teacher efficacy focused on results allows persistence and flexibility to stay the course in a math DI initiative. The researcher recommends that administrators continue with capacity building towards a math DI initiative through the involvement of district and or state personnel to assist in expanding training opportunities to increase teacher knowledge and insight of a math DI initiative. The power of building school leaders' capacity to translate research and data into improved practice leading to improved outcomes can positively impact students (Pitcher et al. 2016).

Moreover, the results gained from the analysis of data from this study revealed that 67% of school leaders and 67% of teachers acknowledged resource staff necessary for the push in model was a barrier to a math DI initiative. School leaders tied this barrier directly to inadequate funding stating that requests to district for allocation of money were more often denied that approved. This barrier correlates with Fullan's change theory of the needed tri-

level engagement of school/district/and state working together to build both a relationship on which to build acceptance of new reforms such as a math DI initiative. Leaders also stated that while reading DI push in staff were in place both in the classroom and imbedded into the master school schedule, mathematics did not have the same support in place thus causing a barrier. Teacher participant comments included, "push in teachers may be on paper but they don't show up in my room," and "how can small group instruction occur if I'm the only one in the classroom." The findings from this study suggest school leaders believe that reading is a priority over math. Furthermore, school leaders identified funding as a problematic issue regarding securing resource staff thus producing a barrier to a math DI initiative. The researcher recommends a consistent placement of resource teacher in classrooms to assist with differentiated instruction for both reading and math. In addition, the researcher suggests that school districts strengthen funding to supply resource staff to assist with the push in model being utilized as a differentiated instructional strategy.

The results also indicated school leaders and teacher's collectivity identified time as a barrier to a DI initiative. Administrators placed time barriers amid incorporating into the master schedule as well as time to implement a math DI initiative with reliability. Teacher time concerns stemmed for time to decipher the context of differentiated instruction and incorporating needed time to plan with purpose. This indicates while time was an issue of concern as a formidable barrier, school leaders and teacher had differing viewpoints. The researcher recommends that administrators continue with reading DI incorporated into the master schedule as well as develop a long-range plan to incorporate a math DI initiative into the schedule. Additionally, further dialogue should occur between school leaders and

teachers regarding how best this reform could be included in and implemented with consistency and fidelity.

Recommendations for Future Research

This study's objective was to identify school leader support needed in a math DI initiative and teacher perception of this support provided as well as identify barriers from both school leaders and teachers lens' to such an implementation. The results and conclusions of this study suggest there is a need for more in-depth research when developing a differentiated mathematics initiative at a K-8 school.

Since the population of this study was limited to one K-8 school in rural south Florida, the findings cannot be generalized to the larger population. The restricted sample size of this study could provide a need to duplicate the study on a more comprehensive basis with a larger sample size. A larger sample might provide additional insight into necessary school leader supports to sustain a math DI initiative as well as identify additional barriers to the development of a DI initiative.

Replicating this study in Florida as well as other states would serve to validate the research findings in the qualitative case study. Additionally, since this study included only two teachers from primary, intermediate, and middle school grades, a broader range of responses would be available when utilizing all K-8 grade level educators.

Future research would also benefit from the inclusion of a more eclectic group of participants that is comprised of multiple ethnicities as well as male participants. Additional areas of research to elaborate this study with richer data might also include an

intensive study exclusively for school leaders to glean their specific insight with support need from a broader mix of participants.

While the qualitative case study format did garner in-depth responses from participants, observing in classrooms would offer better insight to the readiness of a school in undertaking a K-8 mathematics differentiated initiative.

Deeper research on the push in model would also prove to be valuable to collect data on the effectiveness of this strategy in a differentiated setting. Moreover, an in-depth study to determine the effectiveness of computer-based programs verses differentiated instructional strategies would be advantageous with regards to differentiated instructional student learning outcomes.

Great importance of the observational piece that teachers deemed to be critical to the implementation of a mathematics DI initiative was woven throughout this study. Future research to determine the effectiveness of teacher's witnessing a program of merit in place and the impact these observations would have on a new campus mathematics K-8 differentiated instruction initiative would serve to substantiate a startup programs framework.

Conclusion

Designing effective differentiated instruction in mathematics involves balancing understanding of mathematical concepts with procedural fluency. Effective instruction involves intentional approaches, strategies, and learning activities based on mathematical and pedagogical knowledge and understanding of student mathematical development. Because student readiness, interests, and learning preferences vary greatly within any

mathematics classroom, a solid program built on a strong foundation is necessary. This study identified school leader support needed to implement a program of value and sustainability. Additionally, the research of this study analyzed teacher perceptions of the support needed to begin a DI program, with areas that were vital to such a program recognized. Barriers to a mathematic DI initiative as seen through both school leader and teacher lens' were identified and expanded as to why teachers are hesitant to weave differentiated practices into their classroom pedagogical practices.

Diversity is a rich golden nugget offering all eclectic members of a diverse group multiple ideas, perspectives, and solutions to problem solve. Maximizing the potential of each student utilizing differentiated instructional techniques is an ideal way to avail diversity thus enabling engaging, pervasive learning to take place. Differentiated instruction will take both school leaders and practitioners alike to embrace change to build the capacity needed to implement a DI program that has the capabilities of reshaping education in a more positive, direct manner.

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Appendix A

Request for Approval to Conduct Research at Institution

Dear K-8 School and xxxx County School Board of Education,

I am in the process of completing my educational doctoral dissertation at Florida Southern College and am seeking your approval to conduct my research at a K-8 campus in Polk County. The purpose of this study is to explore the support relationship between principals and teachers leading to a successful differentiated instruction (DI) implementation and to identify perceived barriers through both the administrator and teacher lens that could impede a DI initiative. The approach to research will involve a single case study design. I plan to collect data during the timeframe of August 2019 to December 2019. Within this time period, I will be visiting the school on various occasions to gather relevant information. Prior to my visit, I will provide notice of visitation to the school principal and research participants. Data will be collected in two different ways: through interviewing, and by collecting relevant documents. I will perform interviews with individuals using an interview protocol with questions pertaining to my specific research questions that help to address the purpose of my study. I will also collect documents (including lesson plans, curriculum, and lesson artifacts) to enhance the interview process offering insight into the support relationship established as well as the incorporation of the DI process. Please know that there are no risks and/or anxieties associated with this research. All participants in the study will be included on a volunteer basis. The district's name along with the teachers who volunteer to be a part of the research will not be associated with the findings. I will be the only one who will know the identities of those participating. The research will not alter or impact instructional time with students. Although I cannot share my specific findings

with you because of confidentiality purposes, it is my hope that the published study will help to further enhance differentiation professional development efforts for the district, as the findings of my study will be made public. The benefits of the district's participation include being able to help add to the bank of research on the way teachers make sense of new reform initiatives, especially those related to the support framework necessary to build teacher capacity to implement a DI initiative. You should be aware that the K-8 school is free to decide not to participate and is free to withdraw at any time without affecting your relationship with me, the school, or Florida Southern College.

Please do not hesitate to ask any questions before, during, or after my study. Thank you for your time and consideration,

Debra L. Pion,

Ed. D Candidate, Florida Southern College

Appendix B

School leader interview questions are as follows.

Research Question Correlation	Administrator Interview Question	Fullan's Change Theory Correlation
How do school leaders support implementing a DI initiative?	1.How could school leaders support DI instruction?	1
How do school leaders support implementing a DI initiative?	2.Are school leaders with a math background better able to offer support?	1, 2
How do school leaders support implementing a DI initiative?	3.How can time be best utilized to implement a DI program?	1, 3
How do school leaders support implementing a DI initiative?	4.How would you develop a core group that would encourage a teacher to buy-in for a DI initiative?	1, 2, 3, 5
How do school leaders support implementing a DI initiative?	5.What would the implementation structure look like in developing a DI initiative?	1, 2
How do school leaders support implementing a DI initiative?	6.How would money be allocated to provide resources for DI?	1
How do school leaders support implementing a DI initiative?	7.Where would these funds derive?	6
How do school leaders support implementing a DI initiative?	8.Could your current resource staff be utilized to directly impact student achievement through DI?	1, 3
How do school leaders support implementing a DI initiative	9.What do administrators deem most important for teachers to change regarding their personal pedagogy?	1, 2
How do school leaders support implementing a DI initiative	10.What do you deem as most important for teachers to change their personal pedagogy?	1, 2

How do school leaders support implementing a DI imitative?	11.How could your student population be organized to best serve individual needs through DI?	4, 6
How do school leaders support implementing a DI initiative?	12.What professional development support for DI would be most beneficial to teachers?	1, 2, 3
What do school leaders identify as possible barriers of DI?	13.What do school leaders identify as possible barriers of DI?	1
What do school leaders identify as possible barriers of DI?	14.What do you perceive as possible barriers of DI? Why?	1
What do school leaders identify as possible barriers of DI?	15.Are school leaders hesitant to implement DI? Why or why not?	4, 5
What do school leaders identify as possible barriers of DI?	16.Would you as a leader be hesitant to implement DI? Why or why not?	1, 2
What do school leaders identify as possible barriers of DI?	17.Is the collective bargaining agreement (CBA) conducive to the implementation of a math DI initiative? Why or why not?	5, 6
What do school leaders identify as possible barriers of DI?	18.Does the CBA prohibit admin from appropriate time to work with teachers and or provide professional development for a math DI program? Explain?	1, 4
What do school leaders identify as possible barriers of DI?	19.Would classroom management be a factor in the implementation of a DI program? Why or why not?	2
What do school leaders identify as possible barriers of DI?	~~20.What can be done with your discipline program to better address student academic, emotional, and mental health in a math DI initiative?~~ Would a K-8	7

	mathematics DI program be a significant contributor to closing the math gap across levels of students	
What do school leaders identify as possible barriers of DI?	21.Would parental support at home impact student learning through a DI initiative? Explain?	6
What do school leaders identify as possible barriers of DI?	22.How can a school provide a bridge to close the learning deficit chasm with regard to a math DI program initiative?	2, 3, 4
What do school leaders identify as possible barriers of DI?	23.How does teacher buy-in impact the quality of DI?	5
What do school leaders identify as possible barriers of DI?	24.What rollout framework would be most beneficial to implement a math DI initiative? Why?	1, 4

Appendix C

Teacher Interview Questions

Research Question Correlation	Teacher Interview Question	Fullan's Change Theory Correlation
1.What are teacher perceptions of administrative support of DI?	In what ways could school leaders support teachers with the implementation of a DI initiative? Explain with specifics.	1, 2
2.What are teacher perceptions of administrative support of DI?	Has the support you've received for the implementation of a math DI initiative been sufficient? Why or why not?	1, 2
3.What are teacher perceptions of administrative support of DI?	Are school leaders with a math background better able to offer support? Why or why not?	1, 2
4.What are teacher perceptions of administrative support of DI?	How can teacher investment time be best utilized to implement a DI program? Explain?	1
5.What are teacher perceptions of administrative support of DI?	What would the structural framework look like in developing a DI initiative?	1, 2
6.What are teacher perceptions of administrative support of DI?	How would this framework benefit you in implementing a DI initiative? Explain.	2, 3, 5
7.What are teacher perceptions of administrative support of DI?	What resources would be most beneficial to teachers in the implementation of a DI initiative? Explain?	1
8.What are teacher perceptions of administrative support of DI?	What resources would be most beneficial to you in the implementation of a DI initiative? Explain?	1
9.What are teacher perceptions of	Can you think of other human resources other than admin that could	1, 2, 3

administrative support of DI?	assist in a DI implementation initiative?	
10.What are teacher perceptions of administrative support of DI?	Who are these other human resources and why would they be beneficial to you in a DI initiative?	3
11.What are teacher perceptions of administrative support of DI?	What resources would be most beneficial to you in the implementation of a DI initiative? Why?	1,2
12.What are teacher perceptions of administrative support of DI?	What do teachers deem as the most important support to improve their pedagogy with regards to a DI initiative?	1, 2
13.What are teacher perceptions of administrative support of DI?	What do you consider the most important support to improve your teaching pedagogy with regards to implementing a DI initiative?	1, 2, 3
14.What are teacher perceptions of administrative support of DI?	What professional development support for DI would be most beneficial to teachers?	1, 2, 6
15.What are teacher perceptions of administrative support of DI?	What professional development support for DI would be most beneficial to you? Explain.	1, 2, 6
16.What are teacher perceptions of administrative support of DI?	Would an observation of a successful program benefit teachers? Why or why not?	3, 4, 5
17.What are teacher perceptions of administrative support of DI?	Would an observation of a successful program benefit you? Why or why not?	3, 4, 5
18.What are teacher perceptions of administrative support of DI	Is support and direction from school leaders offered in differentiation?	1, 2
19.What are teacher perceptions of	Overall, what would a teacher with excellent	3, 5

administrative support of DI	data expect to gain from a K-8 mathematics DI initiative?	
20.What do teachers perceive as possible barriers of DI?	What would teachers identify as possible barriers of DI?	1, 4
21.What do teachers perceive as possible barriers of DI?	What do you consider as possible barriers of DI? Explain.	1, 4
22.What do teachers perceive as possible barriers of DI?	Are teachers hesitant to implement DI? Why or why not?	1, 2
23.What do teachers perceive as possible barriers of DI?	Would you be hesitant to implement DI? Explain your thoughts.	1, 2
24.What do teachers perceive as possible barriers of DI?	Would classroom management be a factor in the implementation of a DI program? Why or why not?	2
25.What do teachers perceive as possible barriers of DI?	Would parental support at home impact student learning through a DI initiative? Explain?	6
26.What do teachers perceive as possible barriers of DI?	Does teacher buy-in impact the quality of DI? Why or why not?	1, 2, 5
27.What do teachers perceive as possible barriers of DI?	Would your willingness to buy into the program impact the quality of DI? Why or why not?	1, 2, 5
28.What do teachers perceive as possible barriers of DI?	Would a rollout framework be necessary for teachers to benefit most to implement a math DI initiative? Why?	1, 4
29.What do teachers perceive as possible barriers of DI?	Would a rollout framework be necessary for you to benefit most to implement a math DI initiative? Why or why not?	1, 4

30.What do teachers perceive as possible barriers of DI?	Would time be a factor for teachers in a DI initiative? Why or why not?	1, 7
31.What do teachers perceive as possible barriers of DI?	Would time be a factor for you in a DI initiative? Why or why not?	1, 7

Appendix D

Guidelines for Doing an Open-Ended Question Interview Case Study

I. ANTICIPATION

Expectations of pending case study.
Contemplate questions, theories, or topics raised.
Current published literature assessment.
Classify and categorize the case.
Outline limitations of the case.
Anticipate major complications, actions, or mindsets.
Contemplate audience for concluding report.
Develop proposal of action plan.

II. PRIOR TO INTERVIEWS

Arrange preliminary access, negotiate plan of action.
Write a formal agreement indicating obligations of host (school leaders), interviewees and researcher.
Refine access rules with people involved.
Discuss opportunity costs with hosts.
Discuss need for persons to review draft to validate interview responses.
Develop instrument for interviews.
Discuss publicity to be given during and following study.
Revise plan of action.
Pilot study completed.

III. PREPERATIONS FOR INTERVIEWS

Allocate spaces, persons, and methods.
Identify participants and sources of data.
Work out record-keeping system for files and tapes.
Develop a coding system, with protected storage.
Theoretical structure to guide data gathering.
Sketch plan for final report.
Identify possible multiple realties of participant perspectives.
Allocate attention to different viewpoints and conceptualizations.

IV. GATHER AND VALIDATE DATA

Complete interviews, debrief participants, and gather artifacts.
Keep records of inquiry arrangements and activities.
Select vignettes, special testimonies, and illustrations.
Redefine issues, case boundaries, renegotiate arrangements with host as needed.

V. ANALYSIS OF DATA

Transcribe data professionally.
Review data under various possible interpretations.
Search for patterns of data.
Seek to clarify any misunderstood or unclear interview data with interviewee input.

Seek links between interviews and artifacts.
Draw tentative conclusions, organize according to issues, and organize final report.
Review data deliberately seeking disconfirmation of findings.

VI. PROVIDING AUDIENCE OPPORTUNITY FOR UNDERSTANDING

Describe the setting within which the interviews occurred.
Consider the report as a story; look for ways in which story is incomplete.
Draft reports and reproduce materials for audience use.
Help audience discern typicality and relevance of situation as base for generalization.
Revise and disseminate reports.