PERCEPTIONS OF OFFERING ALGEBRA 1 USING TWO DIFFERENT COURSE DESIGNS

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PERCEPTIONS OF OFFERING ALGEBRA 1 USING TWO DIFFERENT COURSE DESIGNS

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PERCEPTIONS OF OFFERING ALGEBRA 1 USING TWO DIFFERENT COURSE DESIGNS

A Dissertation
Presented to
The Faculty of the Graduate Education Department
Southwest Baptist University

In Partial Fulfillment
of the Requirements for the Degree

Doctor of Education

By

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July, 2020

ACKNOWLEDGMENTS

In reflecting on the last few years, I have learned a lot about myself related to what I believe I am capable of doing. I never thought, in a million years, I would complete my doctorate degree, yet here I am. I believe who you are and what you become is largely determined by your own relentless persistence of accepting failure and perservering, but it is also due, in part, by the souls you meet along the way. I truly believe the people who you surround yourself by and those you meet along the way affect, not only your beliefs in who you will become, but also whether those achievements can actually become a reality.

With that, I would like to thank my husband for not letting me give up when I insisted the reason I was pursuing this degree was so I could be called Dr. Grandma some day. I love and adore you, Bill Spence. I would also like to thank my three beautiful children – Lauren, Lakynn, and Lawson. Although I chose not to miss their events in pursuit of this degree, I did miss many laughs, hugs, and simply being present in their precious lives the last few years. I hope you know how much I adore and love each of you and am so proud of the adults you have become.

I would also like to thank Dr. Benny Fong, my advisor. I am lucky to have been placed with an advisor who pushed me every step of the way and was always responsive to my questions. I can't explain why his responses to my emails within 30 minutes of sending them was so helpful, but it was. This, and his insistence to meet with me every two weeks gave me the accountability I needed to push forward. You are an amazing advisor, Dr. Benny Fong. Your students are so lucky to have you.

Lastly, I want to thank my mom, Sharon Wehling. You are the light of my life and I am so thankful to be your daughter. Every opportunity in my life has been due to the selfless acts you have consistenly blessed me with throughout my life. You have always put my needs before your own – a gift I truly treasure and has helped me achieve more than I ever thought was possible. I dedicate this paper to you. I love you so much.

These people have affected the trajectory of my life to a degree I can never repay and for that I am so thankful I have had the honor of surrounding myself by each and every one them. Thank you for not giving up on me or letting me give up on myself. There is a light at the end of this doctoral tunnel and I think I may have actually found it - thanks to all of you.

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ABSTRACT

The purpose of this qualitative case study was to explore the phenomenon incurred when a school district in southwest Missouri offered ninth grade Algebra 1 course content using two different instructional approaches – a traditional approach using worked examples delivered primarily through direct instruction and a problem-based approach delivered using varied instructional strategies and collaborative teaming. What made the school district particularly interesting was the incorporation of student choice into the equation. During enrollment, students in the school were provided a choice between a traditional approach to Algebra 1 which focused on routine tasks and algorithms or a problem-based approach which used a variety of instructional strategies and collaborative teaming. Overall, participants seemed to support the new changes and believed addressing equity issues and Algebra 1 retention rates was more about supporting student learning styles rather than believing some students are just incapable of learning mathematics. The study found multiple instances where offering students a choice in how they learned Algebra 1 course content transitioned to more equitable approaches. Using Linton's (2011) Equity Framework as the theory base for the study, the researcher was able to identify improved opportunities for relationship building, instances of access to more rigorous Algebra 1 content, and increased opportunities to offer content relevant to students' lives. Perceptions of the participants proved invaluable to exploring this phenomenon and offered a unique perspective describing the course choice offering for students. This research offers schools researching improved equity related to Algebra 1 instruction an approach rarely considered.

CHAPTER ONE

INTRODUCTION

An age-old dilemma in education is determining how to meet the needs of a diverse classroom. Similar to the one-room schoolhouse of the past, teachers today face challenges trying to reach students of all abilities, cultures, and socioeconomic statuses. Students have a variety of ways they see, speak about, and view the world around them (Tomlinson, 2014) and teachers are tasked with exploring ways to meet all needs by dividing limited time and resources.

In regards to mathematics, variables such as math anxiety, dyscalculia, and fixed mindset add to an already diverse and perplexing challenge. The belief one is incapable of learning mathematics spans all ethnicities but becomes particularly high with females, minority groups, and students of low socioeconomic status (Burris, 2013; Delpit, 2012; Linton, 2011; Parrett & Budge, 2016). Researchers have found math intelligence, like other talents in general (Coyle, 2010), is not something one is born with but rather something which takes determination and persistence to develop (Dweck, 2016). Emerging research allows people to take what is known about habits of mind (Coyle, 2010; Dweck, 2016) and relate it to learning mathematics (Boaler, 2016; Shafer, 2016). What hinders math achievement is not the rigor of the content itself, but rather the memorization of skills and routine tasks done out of context (Boaler, 2016).

Some researchers insist mathematics is a subject of patterns and creativity. Some students may need to make sense of mathematics through more contextual application or meaning prior to initially learning the most efficient and routine to solve math problems. Through a contextual and oftentimes visual approach using problem-based tasks and

complex instruction, students build mathematics capacity and understanding (Boaler, 2016; Koonlaba, 2015; Linton, 2011; NCTM, 2018). Researchers and professional organizations are realizing some students need a more conceptual approach to understanding, rather than the traditional approach of memorizing procedures and algorithms to understand mathematics at a deeper level. According to the National Council of Teachers of Mathematics (2014a), reducing or eliminating achievement gaps can be accomplished by focusing on conceptual understanding, eliminating remedial tracks and narrow curriculum, and ensuring teachers have access to collaborative structures with professional development related to equitable approaches to mathematics teaching and learning (Boykin & Noguera, 2011; Burris, 2013; Burris & Welner, 2005; DuFour, 2015; Linton, 2011).

This study fills emerging needs because Algebra 1 is described as the gatekeeper to educational opportunity (Silver, 1995). Many studies attempt to determine possible indicators of successful completion of Algebra 1 (Cavanaugh, 2008; Cortes & Goodman, 2014; Fong, Jaquet, & Finkelstein, 2014; Frazier, 2015; Silver, 1995) but very few studies have measured success of high school Algebra 1 programs purposely redesigned to ensure equitable access. In the past, attempts to ensure equitable access have resulted in tracking students on two-year Algebra 1 course paths rather than one year, or offering remedial versions of Algebra 1 (NCTM, 2018). Knuth, Stephens, Blanton, and Gardiner (2016), asserted infusing algebra content in the earlier grades is necessary to help students have greater success with the content. In the 'Algebra for All' movement of the 1990's, the mathematics education community agreed all students needed to successfully complete Algebra 1, but attempts were ineffective as more and more students were failing

(Silver, 1995). Conversely, one school district which shifted the focus to thinking, reasoning, communication, and problem-solving skills actually increased student achievement more so than respective school districts which continued to teach Algebra 1 using traditional methods (Silver, 1995). Studies providing educational practitioners empirical evidence detailing successes and failures of reform efforts as it relates to equitable mathematics instruction are needed and must continue to be explored.

Topic and Research Problem

Every school district has privileged students and every school district struggles with equity issues (Linton, 2011). Conversations about equitable teaching practices in mathematics is not new and can be seen in literature as early as the 1990s. For example, during the 'Algebra for All' movement, educators recommended engaging more students in ninth grade Algebra 1 (Silver, 1995). Professionals believed success in Algebra 1 provided opportunities for students in future math courses and beyond; however, engaging students in content focused on memorization of routine problems out of context was still an issue (Silver, 1995). The National Council of Teachers of Mathematics (NCTM) Research Committee called for practitioners to revisit and redefine equitable practices in mathematics education (NCTM, 2014b). A deeper understanding of what was causing inequitable teaching practices and achievement in the field of mathematics was needed (Gustein et al., 2005). As practitioners begin recognizing inequities do, in fact, exist, tremendous advancements have been made in defining what equitable practices look like in mathematics education. Putting the recommendations into practice is where progress is needed (Aguirre et al., 2017).

In order to address equitable issues in mathematics, Aguirre et al. (2017) concluded the community of mathematics educators and leaders must first be willing to accept children of different races, ethnicities, genders, abilities, and socioeconomic status all experience understand mathematics differently. The NCTM Research Committee also expresses their urgent position on equitable issues in mathematics:

> Together we need to find ways to solve this problem with all its facets and employ a more clearly anti-oppressive and humane course for mathematics education: a mathematics education that does not result in the negative experiences, fears, anxieties, and disaffected mathematical identities that we continue to encounter in schools and society (Aguirre et al., 2017, p. 125).

Berry (2018), NCTM President, supports NCTM's position in regards to equitable issues in mathematics stating it is time to start having critical conversations addressing indicators of mathematics success as well as taking a hard look at inequities which may benefit some student more than others. DuFour (2015), claimed the happiness and autonomy of adults has taken precedence over enacting best practices which enhance student learning. He also stated teacher unions may be partly to blame for the resistance to change by clinging to positions members of the union cannot defend. DuFour (2015) calls for teacher unions to become both champions of teachers and advocates for best practices. Although research related to equitable mathematics instruction is becoming more widely available, schools across the nation seem slow to shift toward more equitable-focused practices (NCTM, 2018). In order to ensure a highly successful mathematics program, research and practice must come together (Schoenfeld, 2014).

Several experts in the field have expressed 'Schoenfeld's (2014) view and have moved to put theory into practice (DuFour, 2015).

The problem, however, is although practices such as complex instruction, detracking, collaboration, and metacognitive strategies are what comprise a successful mathematics program (Schoenfeld, 2014; Tomlinson, 2018), many school districts in Missouri continue antiquated practices such as teacher-centered instruction and memorization of routine algorithms (Harmon, Gordanier, Henry, & George, 2007). Possible explanations for lack of equitable instructional practices in mathematics might be a lack of teacher training and fixed mindsets related to mathematics instruction (Anderson, Boaler, & Dieckmann, 2018; Bonner, 2019; Dweck, 2016). Nevertheless, as educators continue to find ways to create more equitable programs for its students, researchers are also studying what more equitable practices look like for schools of today (Linton, 2011). Unfortunately, few educators address recommended equity frameworks or if educators are addressing equity, many educators are not monitoring the resulting implications for implementing those structures. In this case study, one school district in southwest Missouri attempted to address instructional inequities by offering Algebra 1 as a choice between differing instructional strategies. In response to unusually high numbers of students repeating, dropping, or taking the two-year approach to Algebra 1, the district felt the need to intervene. The researcher in this study attempted to describe the process the district underwent, the perceptions of stakeholders, and the implications resulting from the unique response for equitable change.

Kotter (2008) believes we live in an age where change is commonplace. Reeves (2009), indicated change is not easy and where one finds change, no matter how urgent it

is, one will find someone who opposes it. When change happens, people feel their individuality is threatened. In actuality, change is loss (Reeves, 2009). Reeves (2009), believes change can bring about the stages of denial, anger, bargaining, and depression before it finally rests in acceptance. Oftentimes, traditions remain intact in order to avoid adult discomfort (Kotter, 2008). This study describes one school's answer to implementing change related to inequities existing in the ninth grade Algebra 1 courses.

Few school districts are specifically addressing equity issues related to mathematics and case studies describing this phenomenon are difficult to find. This study filled a gap in literature which includes case studies addressing a lack of equity related to mathematics. This study specifically described a school district attempting to address the needs of all types of learners by creating a more equitable approach to Algebra 1 instruction.

Purpose of the Study

The implications for NCTM's (2018) call to action asked for an overhaul of mathematics education at the secondary level. Leaders must focus efforts on reducing the achievement gap and making mathematics content more accessible to a greater, and more diverse, number of students (Balka, Hull, & Miles, 2010; Peck, 2018). Mathematics content should be viewed as a subject full of creative solutions and patterns to be found (Peck, 2018). Students should explore topics by connecting to previous knowledge and the world around them (Bonner, 2019; Collins, Joseph, & Ford, 2020; Linton, 2011; Peck, 2018). Change, however, is difficult and requires mindsets to change (Reeves, 2009). Restructuring course paths, rewriting curriculum, retraining and supporting

teachers, and eliminating tracking and changing belief systems are not easy tasks in well-established structures grounded in tradition (Kotter, 2008; Reeves, 2009).

Although many researchers (Boykin & Noguera, 2011; Burris & Welner, 2005; Linton, 2011) have established frameworks for equitable math instruction, many Missouri schools have yet to embrace equitable standards for students (Missouri Department of Elementary and Secondary Education, 2016). Math proficiency for the 5% of Missouri schools with the lowest rate of free and reduced lunch students has been found to be three times higher than the rate of the 5% of schools with the highest rate of free and reduced lunch students. Missouri schools with access to high quality, experienced educators follow similar trends (Missouri Department of Elementary and Secondary Education, 2016). Teachers in the state seem vested in teaching methods of routine tasks, memorization of procedures, and traditional tracking methods which may be leading to unequitable teaching practices (Sampson, Moore, & Roegman, 2019; Schoenfeld, 2014; Semuels, 2016). Although there is an abundance of research detailing what equitable practices look like and how to implement such practices (Akwaji-Anderson, 2017; Gustein et al., 2005), further study is needed describing administration, counselor, and teacher perceptions of implementing equitable practices within a school setting. Many school districts have attempted to overhaul their mathematics programs but have failed due to lack of teacher training or lack of community support (Boaler, 2016). Despite the tight hold on traditional practices in mathematics education, there is a district in southwest Missouri reacting to the call to implement research-based best practices and responding with an attempt to make Algebra 1 accessible to more students. This study intended to examine the district's practices and unique answer to equitable access to

Algebra 1 by describing the process used, perceptions of, and the outcomes resulting from the new structures in place.

The purpose of this qualitative case study was to explore the phenomenon incurred when a school district in southwest Missouri offers ninth grade Algebra 1 course content using two different instructional approaches – a traditional approach using worked examples delivered primarily through direct instruction and a problem-based approach delivered using varied instructional strategies and collaborative teaming. What made the school district particularly interesting was the incorporation of student choice into the equation. During enrollment, students in the district were provided a choice between a traditional approach to Algebra 1 which focused on routine tasks and algorithms or a problem-based approach which used a variety of instructional strategies and collaborative teaming. For the purposes of this study, equitable, investigative approaches were defined as pedagogy utilizing a problem-based curriculum and content delivered with a conceptual approach, multiple instructional strategies, methods of collaboration, and is delivered primarily using a student-centered approach. The purpose of the study was to examine perceptions of district stakeholders and outcomes resulting from the implementation of providing students a choice between two Algebra 1 courses which differed in the instructional strategies used to deliver the content of the course.

Theoretical Framework

The intent of the 'Algebra for All' movement of the 1990's was to allow more students opportunities to reach advanced mathematics topics and have better vocational opportunities (Silver, 1995). Early attempts of these increased efforts had less than sobering results (Silver, 1995). Some school districts responded to the push by requiring

a traditional Algebra course be taught in the eighth grade or simply offering more sections of Algebra 1 in the ninth grade (Cavanaugh, 2008; Maher, 1991; Sigurdson & Olson, 1992). According to Silver (1995), these attempts were followed by a publication of the federal report, 'A Nation at Risk' (National Commission on Excellence in Education, 1983) which claimed America's schools were being inundated with mediocrity. In responding to the call to increase rigor and access of course content, schools tried to implement more algebraic reasoning and thinking into Grades 6, 7, and 8 (Silver, 1995) but only schools which had access to reformed curriculum were able to show progress (Silver, 1995). Seeley (1993) argued simply changing course content in the middle grades without a more equitable approach, coupled with interesting and relevant topics, would fail to meet the critical thinking and problem-solving necessary to reach a more diverse population. Furthermore, research and reform efforts have continued to evolve as efforts to increase access to Algebra 1 content continue. In learning from past mistakes, this study described a school district in southwest Missouri which restructured its ninth grade Algebra 1 program in an attempt to create a more equitable approach to instruction.

Learning theories bring a critical lens to defining the manner in which kids learn best. Learning theories play an important role as such theories define effective instructional practices and how such practices relate with student achievement. As researchers in the field study programs related to student achievement, a focus must be kept on learning theories underpinning the design of the program of interest.

The study used John Dewey's theory of Progressive Education (1916), Vygotsky's Sociocultural Theory (1978), and the Equity Framework of Curtis Linton

(2011) as the theoretical underpinnings of the study. The marriage of these three, time-tested, learning theories of the past, together with an equity framework of the present (Linton, 2011), gives a complete picture of the manner in which the district in this case study restructured ninth grade Algebra 1 course content in an effort to increase equity for students.

John Dewey (1916) believed education should be student-centered, active and interactive, and must enable the child to make connections through the social world and community. Dewey (1916) also felt teachers must have a strong knowledge of content and their students in order to help the students make sense of their world. He believed that planning, observing, and documenting were keys to student achievement (Mooney, 2013). Dewey (1916) alleged children learn by doing and educational experiences should involve real-life applications. In his opinion, children should be encouraged through experimentation and independent thinking. Dewey (1916) asserted it was the role of the teacher to create experiences for children allowing the children to make sense of their world. Dewey (1916) warned, however, just using teaching methods departing from traditional methods was not good enough to sustain conceptual understanding. Dewey (1916) said in order to create meaningful learning experiences for children, teachers must invest a large amount of time to planning lessons with clear expectations and learning goals. He continued by saying in order to build student achievement on real-life experiences, teachers must commit to observing, documenting, and keeping records of classroom events as such events become even more important than when traditional teaching methods are used (Dewey, 1916).

Lev Vygotsky (1978) believed a child learns primarily through social interactions and makes sense of content from communicating with peers. He believed the teacher's role is to help a child develop conceptual understanding by listening to and observing the child's actions related to the learning targets (Mooney, 2013). Vygotsky (1978) said children learn through social interaction and sharing ideas, but also by synthesizing those ideas and articulating their thinking (Eggen & Kauchak, 2006). Vygotsky (1978) believed a child's sense of community plays a fundamental role in the process of understanding and making sense of the world around them (Mooney, 2013). Through the communication with peers, language and development work together to contribute to a child's learning and construction of knowledge (Mooney, 2013; Vygotsky, 1978). Vygotsky (1978) is also known for his theory of the Zone of Proximal Development which is defined as the distance between the most difficult problem a student can do alone and the problem a student can do with adult guidance or in collaboration with more capable peers (Mooney, 2013). Vygotsky (1978) believed the Zone of Proximal Development can be closed by the teacher, but also by peers already possessing the desired skill (Mooney, 2013). He believed in order to scaffold content, teachers must be keenly aware of a child's current capabilities and where the child needs to be in their understanding. Teachers, through interviews and observations, can support understanding and close the Zone of Proximal Development (Mooney, 2013; Vygotsky, 1978). Vygotsky's theory (1978) closely aligned to the design of the instructional strategies used in the problem-based Algebra 1 course observed in this study, as collaboration and teaming strategies were used extensively in the design of the new Algebra 1 course.

In order to offer a broader scope for the case in study, the researcher also included Linton's (2011) Equity Framework as a theoretical framework. In addition to viewing the phenomenon from a learning theory lens, it is also important to view the learning theory from an equity lens, especially when in regards to improving access to rigorous course content. To define equity in general, this study used the work of Curtis Linton (2011). Linton (2011) believed educational equity is achieved when educators provide all students with the individual support needed in order to reach and exceed a common standard. Linton's (2011) Equity Framework is based on observations made from visiting schools across the country who succeeded in closing the achievement gap. Linton (2011) used the observations to describe commonalities of highly equitable schools. His framework included components: high expectations, rigorous and relevant curriculum, and fostering relationships (Linton, 2011).

In Linton's framework (2011), equitable schools have teachers and administrators who hold students accountable to high expectations. In addition to a culture of high expectations, the intended curriculum is rigorous and includes a focus on meaningful content, relevant to the lives of the students (Linton, 2011). According to Linton (2011), incorporating highly demanding and relevant tasks keep students engaged in the content. Linton (2011) also believed students must have access to teachers who not only deliver rigorous course content, but are also highly effective at building relationships with the students in their classrooms.

According to Linton (2011), an equitable school culture refers to establishing a learning culture with educators who are culturally competent. Teachers are encouraged to take risks and learn without worrying about failing so teachers become aware of their

own biases and learn to become sensitive to biases when working with a diverse population (Linton, 2011). Leadership is also an important aspect of equitable schools. Effective leaders in equitable schools focus on things they can control and have strong vision and support for equitable systems (Linton, 2011). High expectations are placed on teachers, as well as school leaders, and both populations are supported to reach those high expectations (Linton, 2011). Finally, practice is the last characteristic which makes up this framework. Practice refers to what teachers do every day in their classrooms – namely, pedagogical practices (Linton, 2011). Linton (2011) suggested practice includes not only a reduced emphasis on repetitive problem sets requiring memorization of routine tasks, but also an increased emphasis on meaningful tasks, relationship building, and culture in the classroom. Accountability is non-negotiable in equitable schools and all teachers must believe they had a part should a student fail (Linton, 2011).

Linton's Equity Framework (2011), Dewey's theory of Progressive Education (1916), and Vygotsky's Sociocultural Theory (1978) served as the theoretical framework for this study. Through these theoretical lenses, one can define equitable and impactful mathematics education. Through highly qualified educators, student progress should be monitored, instruction should be differentiated when necessary, and students supported with remediation or enrichment when appropriate (NCTM, 2014b). The National Council of Teachers of Mathematics (NCTM) position statement aligns with the belief that through an equity lens, we provide disadvantaged students access to course content, and unlock doors of the future (NCTM, 2014a).

Research Questions

This qualitative case study used research questions allowing the researcher to aim for depth of the phenomenon rather than breadth. Qualitative studies generally ask a central question about a topic which leaves the content open for describing the phenomenon of the study (Creswell, 2014). The following central question guided the study: How was equity and accessibility addressed when a school district in southwest Missouri offered ninth grade students a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach? The following sub-questions helped frame the study:

1. Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?
2. How did offering students a choice between differing approaches to Algebra 1 influence a student's response to learning the content?
3. How were implemented changes perceived by teachers, counselors, and administrators?
4. What were the results after implementing the new Algebra 1 course structures?

Significance of the Study

Finding articles and research which describe United States current achievement scores in mathematics being at or below average was not a difficult task. In 2015, for example, the Program for International Student Assessment (PISA), ranked 15-year-olds in the United States at 40 out of 70 countries on a mathematics literacy scale (National Center for Education Statistics, 2015a) and the Trends in International Mathematics and Science Study (TIMSS) reported average eighth grade mathematics scores in the U.S. at

518 which was slightly above the median score of 500 for all countries assessed (National Center for Education Statistics, 2015b). Missouri mathematics scores seem to mimic the national averages as well. According to the 2017 average state testing results retrieved from American College Testing (ACT), Missouri's average ACT score of 20.5 ranked below the national average score of 21, and in 2018, the national average of 20.5 hit a 20-year low (Gewertz, 2018).

The trends on scoring below average in mathematics across the United States, and more specifically in Missouri, continue when looking at developmental mathematics statistics at both two-year and four-year colleges. According to Chen (2016), only 30% of incoming students at two-year colleges and 60% of incoming students at four-year colleges are ready for college level math classes. These statistics and trends are causing secondary schools to examine the mathematics programs currently offered and how a greater number of students can experience success in mathematics courses.

This study is significant as it examined one school district's attempt to make Algebra 1 course content accessible to more students by offering students a choice between two different instructional methods. Very little research exists which examines varied teaching practices related to the same course within the same school setting. This study examined such an occurrence from a school district in southwest Missouri which restructured course delivery, and thus course options, for ninth grade Algebra 1 students in an attempt to provide a greater number of students a more rigorous course path This study described the decisions made and implications resulting from the unique course choice offering and will deliver valuable information to other school districts attempting to increase rigor for typically underrepresented students in Algebra 1. The results of this

study could prove valuable to districts deciding whether or not to replicate the structures created by this school district.

Limitations

As with any research or scientific study, there are oftentimes variables affecting outcomes beyond the control of the researcher. In this study, the limitations are as outlined below.

1. Students were already enrolled in the courses studied.
2. Teachers were already assigned to the courses studied.
3. Researcher was employed in the district studied and does regular observations/professional feedback for the courses of the study, however is not a teacher or supervisor of the study participants.
4. Student achievement was studied over a time span of one-year.
5. Students enrolled in traditional Algebra 1 were not offered the supplemental math lab elective as a support class. Only students enrolled in the problem-based approach to Algebra 1 were offered the elective math lab class support.

Assumptions

Assumptions for this study were as follows:

1. It was assumed the monthly benchmark assessment administered by the district was a valid and reliable measure of student achievement.
2. It was assumed, regardless of the teacher assigned, each student had comparable treatment in identical courses.
3. It was assumed identical courses offered the same summative assessments.

4. The sample studied was representative of the total population of students in one district.
5. Grading policies for each teacher and each course were similar, if not identical, in nature.
6. Grade point average was comparable for all students in the same school district.
7. Intentional non-learners did not influence the outcome of the study.

Delimitations

Delimitations for this study were as follows:

1. Study was delimited to one suburban district in southwest Missouri.
2. Study was delimited to ninth grade Algebra 1 students.
3. Study was delimited to a principal, counselor, and three teachers.
4. Study was delimited to the 2019-2020 school year.
5. Students chose to take Algebra 1 or Algebra Investigations freely but may have been influenced by their eighth grade math teacher explaining the instructional strategies used in each course.
6. Course retention rate was delimited to students who remained in the same course all year long and did not transfer to a different math course within the same calendar year. Students who dropped the course to change school districts were not included in the course retention rate calculation.

Design Controls

This qualitative case study focused on themes emerging from interviews from a principal, a counselor, and three teachers (one from each of the two course designs and

one who taught both courses). Specifically, the two course designs studied were the traditional approach to Algebra 1 and the problem-based approach to Algebra 1. Instructional strategies of the traditional approach were primarily teacher-centered using direct instruction as the primary model for delivering content. The problem-based approach to Algebra 1 content, also known as Algebra Investigations, was delivered using a student-centered approach to learning with a focus on conceptual understanding and collaborative teaming as the primary models of delivery. To determine recurring themes which emerged from the interviews of the participants, the researcher reviewed transcripts recorded from each of the interviewees and looked for common themes. During interviews, the researcher used a mobile phone transcription application, called Otter, to record and aid in the transcribing process.

This case study also collected other artifacts to determine if other differences were noted as a result of implementation of the same course with two different approaches to instruction. To collect such data, the researcher made an appointment with the data specialist and was able to obtain course drop rate and master schedule data for the year of the study as well as the year prior to implementing the new course structures. In addition, the researcher pulled Algebra 1 End-of-Course exam data from the *Missouri Comprehensive Data System* website. Data from the three years prior to the study were examined.

It is important to note the researcher was an instructional mathematics coach for grades six through twelve at the school district studied. The researcher's role in the district was embedded professional development related to mathematics instruction. As part of her job description, it was her duty to observe the classes offered at the district and

provide occasional feedback to mathematics teachers in the building. Although the researcher played a role in selecting resources used for implementing the new courses, she did so as a collaborative effort with administration and teachers in the building. The researcher did not teach any of the courses in the study nor was she a supervisor of any of the teachers participating in the study.

Traditional Algebra 1 students were primarily instructed using direct instruction. Direct instruction usually consisted of teacher-led demonstrations of worked examples. Examples provided were generally out of context and emphasized memorization of routine tasks. Following instruction, students were given independent practice which were very similar in nature to the examples previously worked by the teacher. Independent practice in the traditional course primarily consisted of replicating example problems worked in class with a section of interleaved-type practice of previous course content. Students were assessed in the traditional course using daily quizzes and a summative assessment at the end of the unit. Resources used for the traditional course were completely teacher created.

In the problem-based approach to Algebra 1, students were taught using a variety of instructional strategies and tasks in context. Worked examples delivered by direct instruction were deemphasized in the problem-based course. Students engaged in mathematics collaboratively by working with tasks specifically aligned to learning targets. Teachers used a variety of formative assessments which included monitoring group work, purposeful questioning, student presentations, and summative assessments to check for understanding. Summative assessments were not administered at the end of the unit but rather half-way through the next unit to allow students extra time to learn the unit

objectives. Lessons in the problem-based course were delivered primarily using a student-centered approach to learning. Independent practice for students was given using the interleaved practice model and included only a few problems from the newly learned content.

The school chose *College Preparatory Mathematics (CPM) Algebra 1 Core Connections* as the resource for problem-based course. Prior to beginning the course, teachers were trained in problem-based instruction strategies during a four-day professional development workshop. Two traditional Algebra 1 teachers were included in the professional development as well because both teachers taught the traditional and problem-based courses.

It is important to note struggling students enrolled in the Algebra Investigations were offered extended time and support through an optional math lab. In this district, classes typically meet every other day as part of a block schedule format. In order to support struggling learners, extended time was given in the form of an optional math lab held on alternating days opposing their Algebra Investigations class to give students access to algebra content every day. Students enrolled in traditional Algebra 1 were not offered a math lab option.

The district did not control which course students chose to enroll as students were allowed to choose either the traditional Algebra 1 or the problem-based, investigative approach to Algebra 1. Students were allowed to pick traditional Algebra 1 or the problem-based, investigative approach to Algebra 1. Students were only influenced by their eighth grade math teacher who discussed the differences in instructional strategies

offered in each approach to learning Algebra 1 content. Students were then allowed to choose which approach to learning to take.

The district did, however, control the assignment of teachers to the courses in the study. One teacher was assigned traditional Algebra 1 courses, one teacher was assigned Algebra 1 with the problem-based approach, and one teacher taught both traditional and problem-based Algebra 1. All teachers in the study had access to an instructional math coach, who was also the researcher, to discuss instructional strategies and assessment options for monitoring learning.

This study is delimited to ninth graders, an administrator, a counselor, and three teachers in one school district in southwest Missouri. Ninth grade, traditionally, is the year students complete Algebra 1. Students were not assigned or recommended to one course over the other. Students were, however, counseled by their eighth grade teacher and given a description of the instructional strategies offered in each course. Students chose the course they felt offered the instructional strategies most closely aligned with their learning preferences. Offering student choice in instructional strategies related to one particular course, namely Algebra 1, is not commonplace. Providing students an option to choose gave the researcher an opportunity to study varying approaches to mathematics instruction with differences in demographics playing a minimal, if any, role in the outcome of the study.

Definition of Key Variables

The following are definitions of key terms used throughout this study.

Algebra Investigations. Algebra 1 taught using a problem-based approach. The purpose of the activities in the course were to develop conceptual understanding of

Algebra 1 course content through grappling with problems and discussions with peers. The lessons designed were non-routine and worthy of team collaboration. Students justified their reasoning, communicated with peers, and looked for patterns as they made sense of course content. The teacher's role in the course was to give short, targeted lectures and spend a majority of class time using continuous feedback, questioning strategies, and formative assessment techniques to guide students in their understanding. The district chose *Algebra Core Connections* from College Preparatory Mathematics (CPM) as the resource and training for this course (CPM, n.d.).

Complex Instruction. The idea there should be more than one method of accomplishing a mathematical task and more than one instructional strategy used by the teacher. This type of instruction disrupts status differences in the classroom as students are given roles as part of a collaborative team. Through mathematical agency, students work together and share responsibility to accomplish assigned tasks (Nasir, Cabana, Shreve, Woodbury, & Louie, 2014; Tomlinson, 2018).

Direct Instruction. An instructional strategy in which the teacher demonstrates and explains a topic or skill followed by student practice and feedback. This strategy is primarily used to teach concepts and procedural skills. Students analyze examples and practice skills until they are able to accomplish the task with little or no effort. Direct instruction typically has six identifying components: reviewing the previous day's work, presenting new material, guided practice, giving feedback, independent practice, and reviewing to bring together learning (Eggen & Kauchak, 2006).

Formative Assessments. Any method used by a teacher to check for student understanding usually gathered and reported for use in measuring the outcomes of skills and knowledge (Marzano, 2010).

Intentional Non-learner. Students who choose not to participate in lessons and purposely disrupt learning in the classroom (DuFour, DuFour, Eaker, Many, & Mattos, 2016).

Interleaved Practice. Studying problems from different topics in a non-systematic, pseudorandom order such that no two problems from the same topic are worked consecutively (Foster, Mueller, Was, Rawson, & Dunlosky, 2019).

Mathematical Agency. The act of expressing his or her mathematical point of view through verbal reasoning. This also occurs when a student takes ownership of a mathematical thought or idea (NCTM, 2018).

Mathematical Identity. The state of believing one is capable of participating in mathematics and also see themselves as doers of mathematics (NCTM, 2018).

Student-centered Instruction. Instruction based on student collaboration and self-directed learning strategies. Teachers are often times facilitators and not the main source of information. Students monitor their own learning and use purposeful and engaging tasks to make sense of content. The teacher's focus is on what students are learning or not learning and use the information to guide instruction. In student-centered instruction, the emphasis is on learning and not on teaching (Boaler, 2016).

Teacher-centered Instruction. Delivery of course content is primarily teacher-led. In this method, teachers primarily use lecture or direct instruction to deliver course

content. Students rely heavily on the teacher and note-taking to make sense of content. The teacher's focus is on lesson planning and teaching content (Boaler, 2016).

Traditional Algebra 1. Algebra 1, using direct instruction as the primary instructional strategy. Emphasis in this course is on routine, repetitious algorithms, and memorization of skill. The course is teacher-centered and students are usually in rows, taking notes, watching the teacher model problems. Students follow instruction with homework practice mimicking examples shown in class. Very little, if any, collaboration or student discourse is incorporated into the design of the course (Boaler, 2016).

Summary

The design of this study was unique because one school building does not typically offer the same course and intentionally use two different instructional strategies. The two different approaches to Algebra 1, both traditional and problem-based, offered the researcher a unique opportunity for a case study. Structures put in place by the district allowed the researcher to study the program without allowing demographics to play an influencing factor in the study. The uniqueness of this type of choice design, as it relates to course offerings of Algebra 1, allowed the researcher to study perceived differences and effects of the type of delivery option in a controlled environment.

The overarching design of this study was to study mathematics course development and structures through an equity lens. Opportunities to research a school district's attempt to increase access to Algebra 1 content are few. This study described the process one southwest Missouri school district went through to address access and equity for its' ninth grade students. In addition to student perceptions, this study described teacher, counselor, and principal perceptions of the new course offered, and

explored implications resulting from the new, problem-based course. The first barrier to overcome was the realization that practitioners in the field use a range of definitions to define equity. The second barrier to overcome was to demonstrate that equitable teaching is a professional responsibility not a choice (Aguirre, et al., 2017). This study attempted to assign descriptive analysis to one school district's answer to equitable Algebra 1 instruction by using Linton's (2011) Equity Framework, and well-known learning theories (Dewey, 1916; Vygotsky, 1978) to define quality, equitable instruction. The hope of the study is to enable mathematics leaders to make decisions grounded in research when creating structures at their own schools, allowing all students access to rigorous course content.

Chapter Two of this study includes a review of literature organized thematically by research-based best practices related to mathematics education and equitable teaching practices identified by experts and researchers in the field. Specifically, when identifying the issues related to student achievement in mathematics, the researcher discussed factors such as math anxiety, predictors of algebra readiness, disadvantaged groups, the tracking debate as it relates to equity, retention, and course drop rate. Theoretical best practices are discussed such as recommendations on curriculum design, research related to mathematics agency and identity, understanding problem-based learning and complex instruction, as well as recommendations related to social-learning theories, and collaborative design strategies. Finally, recommendations from professionals and researchers in the field are discussed in relation to catalyzing change in mathematics education which includes discussions about belief systems, coaching and support for

educators, systemic barriers for addressing change, research on reform efforts, and notes about mathematics leadership.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

Linton (2011) stated schools have gone to great lengths to ensure all students enter with equality in mind but do little to ensure students leave schools with equitable outcomes. The National Council of Teachers of Mathematics (NCTM) has spent two decades helping spread the message as to what equitable instruction looks like in mathematics education (NCTM, 2018). The NCTM recently released a position paper and held a firm stance on equity and placed the responsibility on today's mathematical leaders to ensure equitable practice become an obligation and not a choice (NCTM, 2018). Professors at Stanford University continue to release information and research regarding equitable practice and habits of mind. Included in this research are recommendations to create programs which will raise student achievement and change the way mathematics is taught for good (Boaler, 2016; Dweck, 2016). Using Linton's Equity Framework (2011), Dewey's Progressive Education (1916), and Vygotsky's Sociocultural Theory (1978) as the theoretical frameworks for this study, the researcher measured the defined best practices in a controlled setting and described one school district's attempt to make ninth grade Algebra 1 content accessible to more students. The following literature review examines current researcher regarding equitable practices in mathematics education and the impact such practices have had on student achievement. The literature includes the researcher's findings on current issues including mathematical success for all students, best practices related to mathematics education, and information related to catalyzing change in how mathematics is taught at the secondary level. The

purpose of the literature review is to tie together best practices, professional responsibility related to equity, and current issues related to change efforts in the field of mathematics education.

Issues in Ensuring Successful Mathematics Achievement for all Students

Math anxiety. Math anxiety affects math achievement (Beilock & Willingham, 2014; Thompson, 2014). There exists an inverse relationship between math anxiety levels and math achievement levels (Beilock & Willingham, 2014; Thompson, 2014) – the higher the math anxiety the lower the achievement. It is also not surprising that math anxiety is found in countries all over the world including the United States. In the United States, an estimated 25% of four-year college students have some level of math anxiety and community colleges the number is as high as 80% (Jones, 2001; Yeager, 2012).

The cause of math anxiety falls on one, or a combination of, three categories: parents, teachers, and/or society (Bernard, 2016; Boaler, 2016). Parents, unknowingly, send messages to their children that some people are not math people by telling them they, themselves, were not a math person (Bernard, 2016; Boaler, 2016). Teachers can also unintentionally cause math anxiety by using timed tests, doing mathematics out of context, and placing high value on state end-of-course exams (Bernard, 2016; Boaler, 2016). One study found female teachers who unintentionally sent messages to their students about their own ill perceptions of math had a higher instance of female students who also had anxiety toward math (Bernard, 2016; Boaler, 2016). Schools exacerbate students' anxiety by tracking and labeling students at the secondary level (Bernard, 2016; Boaler, 2016). Fleishman (1997), believed the answer to math anxiety was found in the well-known theories of John Dewey. He believed Dewey's constructivist approach to

learning allows students to make sense of rigorous content which, in turn, relieves the anxiety which oftentimes accompanies learning mathematics (Fleishman, 1997). In other words, embracing conceptual understanding and sound pedagogical practices alleviates math-anxious students (Fleishman, 1997). Society also places pressure on students and schools. Standardized test scores, gender and cultural stereotypes, as well as political demands are just a few ways society places undue burdens on students to perform mathematics at high levels (Bernard, 2016).

Researchers believe students have the ability to reduce effects of math anxiety by retraining their brains or employing other methods of growth mindset (Bernard, 2016; Coyle, 2010; Dweck, 2016; Oakley, 2014). For example, Oakley (2014) believed in order to learn math and science, students must learn how to retrain their brain. She believed the acquisition of math and science requires highly attentive, focused learning, as opposed to the more relaxed state of diffused learning. In addition, Oakley (2014) believed many difficulties in learning mathematics were due to the Einstellung Effect. Essentially, the Einstellung Effect is a preconceived notion or an initial thought about how to find the solution to a problem (Oakley, 2014). Oakley (2014) believed preconceived notions, which form roadblocks to new understandings, hinder mathematics understanding. The roadblock, or preconceived notion, sometimes becomes the focus which makes it difficult for students to look for other methods of solving complex problems (Oakley, 2014). Other researchers believe parents, teachers, and society collectively need to start sending positive messages to students and promote a climate of gender, racial, and socioeconomic equality related to mathematics achievement (Bernard, 2016; Boaler, 2016; Organization for Economic Co-operation and Development [OECD], 2013). Some believe, however,

math intelligence is a gift and people are simply born with it (Collins et al., 2020; Dunleavy, 2018; Dweck, 2016). Research on mindset, however, has helped alleviate some of these misconceptions. However, researchers have shown one can truly become good at almost anything with powerful habits of mind and intense, focused practice (Bernard, 2016; Boaler, 2016; Coyle, 2010; Dweck, 2016).

Predictors of Algebra readiness. It is not difficult to find studies attempting to determine factors predicting Algebra readiness. Ooten (2013) found fraction fluency and student self-efficacy as predictors of Algebra success. Other studies claimed one could predict Algebra readiness if the student had completed an Algebra-infused curriculum in prior grades (Knuth et al., 2016) and yet suggested that Algebra readiness correlated to success in language arts (Jensen, 2014). Practitioners in the field, however, have not found a one-size-fits-all approach to predicting success in Algebra 1.

Traditionally, high-stakes testing seems to be one of the primary sources for measuring student achievement in mathematics. In 2001, however, the No Child Left Behind (NCLB) Act made high stakes testing not come without criticism. Diane Ravitch, one of the original authors of NCLB, is now one of the biggest critics of the NCLB legislation (Muhammad, 2015). Ravitch (2013) believed federal programs such as NCLB set unreasonable targets for students, punished school districts, and resulted in teachers unfairly branded as ineffective. According to Ravitch (2013), the very policies trying to create equitable schools could possibly be adding fuel to the achievement gap fire.

Assessments measuring achievement can vary drastically from state-to-state and country-to-country. These variations make it difficult for the public and researchers alike, to infer how students around the world are performing in high school mathematics. As

mentioned before, NCLB legislation tightened reins and required school districts to demonstrate Adequate Yearly Progress (AYP) (Muhammad, 2015). As a result, some school districts found ways to hide test performance of low-performing subgroups to save the school district from public humiliation (Dizon, Feller, & Bass, 2006). The most common reaction from states was to decrease proficiency levels so low it would be extremely difficult for students to fail the test (Muhammad, 2015). Most states set proficiency levels at less than 50% and Michigan set grade school proficiency levels at 38% (Muhammad, 2015).

Educators generally agree finding consistent ways to reliably measure achievement is necessary (Muhammad, 2015), but how high schools build these highly effective programs in the first place is where the debate begins. The question, however, is whether higher achievement on standardized assessments translates to higher achievement in the classroom (Muhammad, 2015) and can standardized assessments be used to determine Algebra readiness? One might conclude it is the moral obligation of educators and researchers to find the silver bullet which will illuminate how all students can achieve at high levels in mathematics.

Linton (2011) claims it is easy for society to blame demographics, backgrounds, socioeconomic status, or race as the cause for underachievement in mathematics. He claims educators perceive they have done enough for a student and say they can do no more (Linton, 2011). If one considers Linton's Equity Framework (2011) as the lens through which schools determine what is equitable, ensuring students have access to interesting, standards driven, and culturally relevant curriculum is essential when preparing Algebra ready students.

Equity issues in mathematics. Linton (2011) believed equity is not treating all students equally but ensuring all students achieve equal outcomes through personalized instruction and appropriate supports. Linton's (2011) theories of equitable practices are framed from observations of schools who had either fully or substantially closed their achievement gaps. The most striking commonality among the schools observed was a true focus on equity formed the footing for their decisions. Linton (2011) suggests in order to create equitable programs, educators must first address their own biases regarding student achievement. Matthews (2018) suggested a standard for equitable practices must be set to include cultural, social, and the political places mathematics teaching reforms are practiced. Furthermore, once a school district identifies their own biases and works to find structures within the school limiting a student's potential by reducing access to quality curriculum and instruction, then equity can be achieved (Burris, 2013; Collins et al., 2020; Delpit, 2012; Linton, 2011).

Disadvantaged groups. Schools have equity issues and schools should address equity issues so all students can succeed (Linton, 2011). Reducing/Addressing equity issues has commonly been known as closing the achievement gap (Linton, 2011) but questions abound as to why African American students and students of low-socioeconomic backgrounds are underrepresented in advanced math classes (Boykin & Noguera, 2011; Burris, 2013; Collins et al., 2020; Delpit, 2012; Linton, 2011). One study found high-achieving students with a low-socioeconomic background had approximately a 50% chance of being placed in upper-level mathematics classes. As a result, since Black and Latino students were often from low-income families, they were misrepresented in upper-level courses as well (Burris, 2013; Collins et al., 2020). Black,

Latino, and poor students as early as pre-school and kindergarten are labeled as low-achieving and are placed academically below white and middle-class students (Clements & Sarama, 2007; National Research Council, 2001; Yelgün & Karaman, 2015). Labels including slow kids, low kids, high kids, and bubble kids are used to categorize learners; thus, set the expectations of the teachers and the type of instruction students will receive (National Council of Supervisors of Mathematics & TODOS, 2016). Furthermore, such stereotypes permeate our society and may cause a lack of diversity in STEM subjects and careers (Boaler, 2019; Collins et al., 2020).

In 2012, the Noyce Foundation found over 60% of students who passed Algebra 1 in the eighth grade were placed into an Algebra course again in high school despite having passed the California Standards Tests (CSTs) (Lawyers' Committee for Civil Rights of the San Francisco Bay Area, 2015). Furthermore, a majority of the students repeating the course were Latino and African American students. The Silicon Valley Community Foundation took the situation to a court of law and found that placement in mathematics courses, disproportionately affecting minority students, violate state and federal laws (Lawyers' Committee for Civil Rights of the San Francisco Bay Area, 2015). In addition, educators responsible for placement decisions could be liable if the decisions were based on criteria which negatively impacted minority high school students (Lawyers' Committee for Civil Rights of the San Francisco Bay Area, 2015).

Despite an underrepresentation of Black, Latino, and low-socioeconomic students in advanced math classes, school districts are seeing significant increases in the number of English Language Learners and immigrants (NCES, 2016). The National Council of Supervisors of Mathematics and TODOS: Mathematics for All (2016) called for a social

justice approach to mathematics education where a more diverse population of teachers and equitable experiences are available for students. As leaders of mathematics, providing mathematical opportunities to all students is imperative (Balka et al., 2010; Sampson et al., 2019). Unfortunately, however, more research is needed to accurately represent diverse populations. Current research indicating increased achievement in mathematics are often studied with participants who fall into largely white populations (Collins et al., 2020; Hott & Dibbs, 2020); thus equitable research related to mathematics education unreliable and oftentimes unreproducible (Hott & Dibbs, 2020).

Mathematics learning is traditionally gender biased (Boaler, 2019; Collins et al., 2020; Zoher & Sela, 2003) as is evidenced by the number of women in STEM related fields is far fewer than the number of men (Boaler, 2002b; Collins et al., 2020; Zoher & Sela, 2003). It is believed girls require a deeper level of understanding than boys and have a natural tendency to want to understand both why and how things work (Boaler, 2016). Findings show that girls are more prone to math anxiety than are boys (Organisation for Economic Co-operation and Development [OECD], 2013). During a meta-analysis study of STEM programs for girls, researchers found girls prefer learning with hands-on experiences, projects, and relevant material in a collaborative environment (Girl Scouts of America, 2008).

Few will argue a student's demographics can and will have an effect on achievement over time (Hanushek, Peterson, Talpey, & Woessmann, 2019). Factors affecting student success include but not limited to: parental education, gender, race, socioeconomic status, and geographic location. Some researchers believe a parent's education is the highest contributing factor to the achievement gap, while others believe it

is socioeconomic status (Hanushek et al., 2019; Linton, 2011). The gap in achievement has remained constant over the past 50 years despite an increase in eighth grade student achievement, the same success has not carried through to achievement at the high school level (Hanushek et al., 2019). Many believe tracking could be blamed for this disparity as most high schools track freshmen into lower-level math classes overpopulated with minority students and students of low-socioeconomic status (Burris, 2013; Linton, 2011; Muhammad, 2015).

The tracking debates. Lewis and Diamond (2015) described tracking as two high schools using the same name because students may go to school with each other for four years, but may never meet face-to-face. Typically, students of low-socioeconomic status and minority students are often underrepresented in upper-level classes and some believe it is due to unjust tracking practices (Burris, 2013; Collins et al., 2020; Linton, 2011; Sawchuk, 2018). Burris (2013) referred to the debate as "The Tracking Wars". Some believe eliminating tracking could favor one group over another (Burris, 2013). Specifically, advanced students would suffer or material would have to be less rigorous if lower-achieving students were allowed to take advanced level classes (Boaler, 2016; Burris, 2013). However, studies have found this to be misinformation (Boaler, 2016; Burris, 2013). For example, one researcher studied a school in Missouri by collecting data on average-achieving students placed in advanced eighth grade pre-algebra (Burris, 2013). The study revealed there was no effect on the level of math achievement of the high-achieving learners, but also the achievement of the average students showed significant improvement compared to the previous cohort not placed in an advanced class (Burris, 2013).

In another study, 34 average seventh graders were assigned an advanced pre-algebra class and the teacher was specifically instructed to maintain course rigor and content (Burris, 2013). In the end, the researchers reported improved performance for the average achievers compared to similar students who did not take the advanced class (Burris, 2013). Furthermore, the achievement of the advanced students was unaffected by the low-achievers in the class (Burris, 2013). According to Linton's Equity Framework (2011), setting high expectations for learners increases student achievement and allows for more opportunities for students (Burris, 2013; Muhammad, 2015).

Stereotyping students based on socioeconomic status or skin color has also had an effect, not only on the disproportionate numbers of students being placed in remedial classes, but also on how students internalize the negative stereotypes placed on them by society (Steele & Aronson, 1995). According to Steele and Aronson (1995), it is not necessarily the teachers or the content causing low achievement, it is the practice of premature labeling which causes students to think that they are less than their peers and incapable of grade level work. Delpit (2012) believed instead of branding students with labels, schools should focus and build on students' strengths. Remedial programs for socially stigmatized groups only adds to the problem (Steele & Aronson, 1995). It has been found placing students in remedial programs only fueled the belief that students identified as low achievers were less capable than other students (Delpit, 2012). Delpit (2012) suggested providing students support and additional assistance as necessary to succeed through challenging curriculum. Harry and Klingner (2006) questioned the necessity to label students in order for them to get needed assistance and believed disabilities exist on a continuum difficult, if not impossible, to identify at which point a

disability even exists. The researchers reiterated the need to provide students with supports without using questionable labels (Delpit, 2012; Harry & Klingner, 2006; Steele & Aronson, 1995).

One of the main factors affecting student achievement access to rigorous course content (Burris & Welner, 2005; Cortes & Goodman, 2014; Horn, 2006). When considering arguments for and against ability tracking in schools, the research is clear. All students, regardless of ability, should have access to course content preparing them for future academics and careers (Boaler, 2016; Linton, 2011). Tracking students in watered-down courses or allowing students to choose watered-down courses for themselves, has inadvertently increased the achievement gap for students in disadvantaged lower-ability groups. The key to student success is rigorous course content which uses rich tasks that allow entry points for students of all abilities (Horn, 2006). Training teachers to differentiate instruction (Cortes & Goodman, 2014; Horn, 2006), ensuring use of data to drive instruction, and building classroom cultures of learning and high expectations is essential (Linton, 2011). Districts must provide the support of extended time in the form of math labs during school hours (Burris & Welner, 2005; Cedeño, Martínez-Arias, & Bueno, 2016; Cortes & Goodman, 2014) and must have a vision and commitment by school administration to reduce or eliminate unequitable policies which hinder access to upper-level content (Lewis & Diamond, 2015; Linton, 2011).

Boaler (2016) suggested the solution to placing students in lower-level tracks is to discontinue the practice of offering lower-level tracked courses altogether. Boaler's (2016) findings are supported by a study which found students who are placed in a lower

track class or who repeat a course, oftentimes have grades similar to or worse than the first time they attempted the class (Fong et al., 2014). In addition, findings also suggested pushing students to accelerate when they are not ready often leads students to give up trying completely (Paek & Foster, 2012). Acceleration of course material led the students to a low conceptual understanding of content and thus caused students to lose interest. Furthermore, the study suggested accelerating students through content was both a disaster and a mistake and instead suggested upper level students should enrich grade-level content rather than speeding through extra content (Paek & Foster, 2012).

Retention and course drop rate. It is difficult to find research and literature linked specifically to course retention rate in mathematics. It is not, however, difficult to find research related to high school dropout rates. Studies predicting high school dropout rates examine factors such as academic achievement, absenteeism, family background, self-efficacy, and student behaviors (Alivernini & Lucidi, 2011; Parr & Bonitz, 2015; Rumberger & Larson, 1998). According to the National Center for Education Statistics (NCES), high school dropout rates hit an all-time low in 2015 at 5.9% but then increased to 6.1% in 2016 (Chen, 2016). The dropout rate from 2016 differs significantly to the 1960 dropout rate of 27.2% (Chen, 2016). High school dropout rate often correlates with lower wages, poor health, reliance on public assistance, single parents, and higher instances of divorce (Parr & Bonitz, 2015). High school dropouts also have a higher instance of incarceration compared to high school graduates and have a negative impact on the economy as a whole. Lost tax revenue, both at the federal and state levels, and increased spending on social programs are both effected by students who drop out of high school (Parr & Bonitz, 2015).

The variables shown to correlate with high school dropout rates are family background, academic achievement, and student's self-efficacy (Parr & Bonitz, 2015). School leaders trying to prevent dropouts have a particular interest in student self-efficacy (Parr & Bonitz, 2015). Unlike demographics and socioeconomic status, self-efficacy is one variable which may be possible to redirect (Parr & Bonitz, 2015). Motivation and how it effects student achievement and dropout rate are often sources of interest among educational researchers. Parr and Bonitz (2015) found higher motivation rates resulted in lower dropout rates. In other words, the more motivated a student was to achieve, the less likely the student was to dropout. Lemos and Veríssimo (2014) found with elementary students, both intrinsic and extrinsic motivation could coexist and do not contradict each other; however, intrinsic motivation steadily led to better academic achievement. Another study more closely tied to mathematics education, found self-efficacy and student's opinions about the relevancy of mathematics were not necessarily predictors of dropping out (Parr & Bonitz, 2015). In the same study, a significant relationship existed between mathematics achievement and dropout rates with the relationship of mathematics performance being the biggest indicator of all paths in the study (Parr & Bonitz, 2015). A study of student achievement within the Los Angeles Unified School District found students who pass Algebra 1 in the ninth grade were significantly more likely to graduate in four years over students who failed or dropped the course altogether (Saunders, Silver, & Zarate, 2008).

Equity issues in mathematics education exist as a disproportionately low number of students from various ethnicities are found in upper-level math classes (Burris, 2013; Linton, 2011; Muhammad, 2015). Many researchers believe this is largely due to

inadvertently widening the achievement gap with the practice of tracking students in mathematics (Burris, 2013; Linton, 2011). Studies following students who are tracked in lower-level classes result in reduced achievement gains (Burris, 2013). According to Burris (2013), schools should provide rigorous course paths for all students, support teachers with training in differentiation and varied instructional strategies, and ensure struggling learners receive the support needed to remain in challenging classes (Boaler, 2016; Burris, 2013). As researchers gain an understanding about the effects of tracking and motivation on high school dropout rates and the high correlation with success (or lack thereof) in mathematics, they can suggest best practices and key recommendations in mathematics education.

Theoretical Best Practices and Key Recommendations

A focused and coherent curriculum. Marzano (2003) identified the primary factor having the most impact on student achievement is ensuring all students have access to a guaranteed and viable curriculum. Thinking about how to move students from their current knowledge to a state of deep understanding is essential when considering mathematics curriculum (Marzano, 2003; Taylor, 2016). Effective teachers identify skills taught by studying state standards, breaking the standards into a set of lessons, and communicating the lessons to students as criteria for student success (Hattie, Fisher, & Frey, 2017). A curriculum focused on conceptual development of intentional learning outcomes, allows students to build on prior knowledge. Students progress from surface level knowledge to deep learning and then transfer knowledge to the application of the topic or skill. Mathematical fluency comes from a deep, conceptual understanding of content (Hattie et al., 2017).

A strong mathematics program focuses on developing a curriculum coherent among specific learning progressions. A strong program allows the student to make sense of mathematics through connections to previous knowledge and other areas of mathematics (Dewey, 1916; Peck, 2018). Through the lens of The Equity Framework (Linton, 2011), this is an essential part of ensuring equitable access to rigorous course content. Access to curriculum which is not watered-down, slowed-down, or has unequitable access restrictions allows more opportunities for children to learn higher-level mathematics (Boaler, 2016; Burris, 2013). Curriculum which is relevant to students and allows for conceptual understanding of course content aligns with Linton's (2011) Equity Framework and is the foundation of Dewey's (1916) Progressive Education. Building understanding through scaffolding and allowing students to make sense of content before introducing algorithms, allows more students access to the content and more confident doers of mathematics (Boaler, 2016; Dewey, 1916; Linton, 2011).

Mathematics agency and identity. It is believed one's ability to see oneself as a doer (or not a doer) of mathematics is a result of a series of micro events which causes students to develop this belief (Symons, Pierce, & Redman, 2016). In order for a student to have a productive disposition in mathematics, a sense of mathematical identity must exist (Boaler, 2016; Symons et al., 2016). Mathematical identity has become an extension of Wenger's (1998) work on Social Theory by Boaler (2002a). Wenger's (1998) development of the Social Learning Theory came from a process of learning he referred to as an "experience of identity" (p. 215). He believed accumulating knowledge is not the sole bi-product of learning, but also the student's ability to develop an identity and purpose (Wenger, 1998). Boaler (2002c) added to Wegner's work in relation to one's

belief as a capable doer of mathematics as she related it to mathematics learning. Linton (2011) believed teachers can help students develop a sense of agency and identity through building relationships with students, supporting cultural identities, and holding students accountable to high expectations.

Stories of students labeled as poor math students who became famous mathematicians, scientists, and other high achievers in our society are plentiful (Boaler, 2019). One such story includes a boy named Nicholas who lived in Australia. Nicholas was learning disabled, grew up with a very low IQ, and was labeled as the worst child teachers had met in years (Letchford, 2018). In 2018, Nicholas graduated from Oxford University with a doctorate in applied mathematics (Letchford, 2018). Many believe such instances like Nicholas are rare and far from the norm (Boaler, 2019). However, what is now known about neuroscience has caused a shift in what was previously believed about learning mathematics (Boaler, 2019). Researchers now believe the brain's ability to grow and change at any stage of life should bring about a shift in the way educators teach, give messages to students, and parent children (Boaler, 2019; Jankvist & Niss, 2018). Studies on adult learners in an eight-week intervention have affirmed the plasticity of the brain through intense practice and perseverance (Boaler, 2019). The new findings of the brain's ability to grow, change, and build new connections has caused math leaders to rethink traditional grouping practices and the message sent to students (Boaler, 2019) regarding inabilities to learn rigorous mathematical topics and being incapable of learning rigorous mathematical topics. Boaler (2019) believes no one can know the capability of any one student and the practice of putting a ceiling on students learning should be radically rethought.

One way students develop mathematical identity on the micro-level is through discourse (Cohan & Lotan, 2014). Researchers identify a student's level of mathematical identity simply by observing peer-to-peer discourse in the classroom. A student who spoke with authority and acted as a decision-maker seemed to have a greater sense of mathematical identity when compared to another student who seemed mathematically helpless and unsure of how to work the problems (Cohan & Lotan, 2014). However, off task behavior seemed to contribute to postive relationships and trust within the group (Bishop, 2012; Langer-Osuna, 2018). According to Langer-Osuna (2018), a majority of the off-task instances were necessary to support and sustain the collaborative process. Specifically, these behaviors allow students to warm up to collaboration, gain attention from peers, recruit others to join the collaboration, avoid concentrated authority in the group, and extend the learning (Langer-Osuna, 2018). Additionally, teachers must pay careful attention to the role status plays during group or collaborative instruction (Horn, 2012). As teachers observe groups and notice students who seem to have less status than other members, teachers can assign competence to typically struggling learners by acknowledging work ethic or perseverance; therefore, engaging and giving confidence to an otherwise math avoiding student (Horn, 2012).

Van Wagoner (2015) sought to demonstrate if a secondary teacher played a role in a college student's disposition towards mathematics when the student was currently enrolled in a developmental mathematics course. The findings of this study included strong evidence that meaningful student-teacher relationships, as well as student-mathematics relationships, had an effect on a strong mathematics identity (Van Wagoner, 2015). Jankvist and Niss (2018) also believed a focus on best practices related to the

teaching and learning of mathematics in addition to the content itself. Additionally, in Linton's Equity Framework (2011), also suggested building positive student relationships is key to reducing anxiety and promoting learning for all students. The interconnectivity of the student-teacher-mathematics relationship is critical in student's believing they are capable doers of mathematics (Boaler, 2016; Linton, 2011).

Supporting mathematical success for all students. All students should have access to high-level content (Boaler, 2002a; Boaler, 2016; Lambert, 2018; Linton, 2011). To provide supports to accomplish the goal of providing all students access to high-level content, schools with a low socioeconomic population need increased funding (Semuels, 2016). Semuels (2016) claims it is the very system of inequities people have created to fund school districts which have caused much of the problem. According to Semuels (2016), school districts are run by local cities and because those cities are funded by local property taxes, an inequitable system is inevitably created (Semuels, 2016). The federal government, in an attempt to support struggling learners of low-socioeconomic status, recently responded to recovering achievement deficits by reauthorizing Title I funding through the federal Elementary and Secondary Education Act (ESEA) (Cooper, 2018; Dynarski & Kainz, 2015; Executive office of the President, 2015; Michelman, 2016; Skinner, 2016). Dynarski and Kainz (2015), however, found policies enacted in the Every Student Succeeds Act to be spread too thin and ineffective. The study found ineffective professional development for teachers and low per-pupil expenditures (Dynarski and Kainz, 2015). They suggested narrowing the scope and investing in programs research-based and proven successful (Dynarski and Kainz, 2015). In doing so, it becomes

necessary to identify instructional strategies which allow students to feel supported as they learn the content (Dynarski and Kainz, 2015).

Boaler (2016) suggested work first on belief systems which hinders access to upper-level mathematics. Mindsets of both students and teachers have the potential to open or close doors related to mathematics (Boaler, 2016; Dweck, 2016; Lambert, 2018). New evidence from research shows less than five percent of students actually have a disability in mathematics, far less than previously thought (Boaler, 2016). Lambert (2018) added students with learning disabilities have more potential than was previously thought. Specifically, students can benefit from inquiry-based instruction, constructing their own mathematical strategies, and engaging with multiple strategies (Lambert, 2018). Lambert (2018) boldly made the assertion, students with disabilities can learn rigorous mathematical topics but mindsets (both teacher and student) are holding students back. Lambert's (2018) work aligns with Linton's (2011) equity framework. He claims students who work on engaging, meaningful tasks, allow for a more equitable approach to instruction (Lambert, 2018).

Researchers suggested students work collaboratively on meaningful tasks (Cohen & Lotan, 2014; Peck, 2018; Vygotsky, 1978). Working collaboratively provides a support system for students to work on tasks which require increased cognitive demand (Cohen & Lotan, 2014; Peck, 2018; Vygotsky, 1978). The findings in one study revealed different ethnic groups were performing vastly different in a Calculus class. African American students seemed to be failing and dropping the course but Chinese American students were performing at much higher levels (Treisman, 1992). In looking more closely at the data, the researcher found Chinese American students put together work

groups in the evenings and worked collaboratively on problem sets, whereas African American students worked primarily in isolation (Treisman, 1992). Groupwork is an extremely effective method for academic achievement, social development, conceptual learning, and creative problem solving and groupwork supports equitable instruction in the mathematics classroom (Cohen & Lotan, 2014; Vygotsky, 1978).

In addition to groupwork, educators must also use what is known about brain research to engage students in deep conceptual development of abstract mathematics content (Boaler, Chen, Williams, & Cordero, 2016; Coyle, 2010). Engaging students to think deeply builds capacity, strengthens neural pathways, and builds understanding at a conceptual level (Boaler, 2016; Boaler et al., 2016; Coyle, 2010; Paek & Foster, 2012). Students taught using primarily routine and procedural mathematics do not develop a deep understanding of topics because they are not allowed to make sense of the mathematics on their own (Dewey, 1916; Paek & Foster, 2012; Peck, 2018).

Another strategy for supporting students in learning rigorous course content is to encourage girls and students of color to sign-up for high-level course content (Collins et al., 2020; Young, Young, & Ford, 2017). Stereotyping specific groups of students has the potential to cause underachievement (Steele & Aronson, 1995). In one particular study, simply checking female in a gender box before an assessment caused a group of girls to perform lower on an assessment than girls who were not required to do so (Boaler, 2016).

Boaler (2016) suggested eliminating, or at least changing, homework practices. Several studies have consistently shown homework neither positively or negatively affects student achievement (Baker & LeTendre, 2005; Mikk, 2006; Program for International Student Assessment [PISA], 2015). Potential barriers that may prevent

students from completing homework include: no access to the internet at home, parents who may work evenings, or students working after school (Boaler, 2016; PISA, 2015). To respond to inequities, school districts should support socio-economic differences by offering mathematics support as part of the normal school day (Boaler 2016; Linton, 2011). This should include extended time to work on homework, remediation of pre-requisite knowledge, and time to receive additional support from a math teacher (Boaler, 2016; Linton, 2011). Without support structures, homework only increases disparities in student achievement for students from low-socioeconomic homes (Boaler, 2016; Linton, 2011; PISA, 2015).

Problem-based learning model. One might ask where problem-based learning models first originated. According to Boud and Felatti (1997), problem-based learning was first seen in the medical field. In an attempt to rectify ineffective and "inhumane" (Boud & Felatti, 1997, p.2) teaching methods of lecture followed by a clinical teaching program, a university in Canada created a problem-based method first known as the Tutorial Process. The Tutorial Process is focused on a student-centered approach which was a combination of hypothetical-deductive reasoning more similar to methods actually used in the field (Walker, Leary, Hmelo-Silver, & Ertmer, 2015). Research which studied the new methods of instruction over traditional methods soon followed (Barrows & Tamblyn, 1980). Studies found a problem-based approach to instruction, versus a traditional approach, was equal in terms of achievement results on medical board examinations; however, students who were taught using a problem-based approach had better clinical problem-solving skills (Albanese & Mitchell, 1993; Vernon & Blake, 1993). Studies also showed equal performance on exams from either method, but students

of a problem-based approach reported a preference for problem-centered instruction potentially due to more engagement with the content (Dağyar & Demirel, 2016; Torp & Sage, 2002).

Another study, however, reported there is insufficient data to support the claim stating problem-based instruction is superior to traditional methods (Walker et al., 2015). Researchers claim studies which show problem-based as a more effective strategy of teaching, are basing the claim on insufficient proof of content knowledge in addition to critical thinking skills (Osada & Supatmono, 2019; Sanson-Fisher & Lynagh, 2005). Further studies are necessary to truly measure the effectiveness of one strategy over another (Walker et al., 2015).

Problem-based learning models, effectively, bring together the learning theories of Dewey's Progressive Education (1916) model and Vygotsky's (1978) Sociocultural Theory (Eggen & Kauchak, 2006). Dewey (1916) and Vygotsky (1978) communicated children learn best when they collaborate and engage in content meaningful to their lives. Vygotsky (1978) stressed the importance of learning by exchanging ideas with peers as this allows children to be active participants in the learning process. Eggen and Kauchak (2006) believed teachers implement problem-solving lessons by identifying the learning objectives and guiding students through the phases of the learning model, either directly or through collective inquiry. The phases in a problem-based model include identifying the problem, modeling the problem, choosing a strategy, implementing the strategy, and evaluating the solution to determine if the solution makes sense (Eggen & Kauchak, 2006). In a problem-based model, teachers must consider alternative assessment strategies to ensure learning is taking place and must do so by monitoring and circulating

while students are engaging with the problem (Eggen & Kauchak, 2006). The problem-based model has evolved over the years and includes other strategies such as group interactions (Cohen & Lotan, 2014; Boaler, 2016). The problem-based model is more currently known as complex instruction (Boaler, 2016).

Complex instruction. A guaranteed and viable curriculum, although critical, is not the only factor effecting student achievement. The instructional methods employed by teachers and the different approaches to learning used, play a significant role in understanding content (Boaler, 2002c; Cohen & Lotan, 2014; Dewey, 1916; Tomlinson, 2018). Boaler (2016) suggested in order to effectively differentiate instruction and provide for the needs of all learners, teachers must use the multi-dimensionality approach known as Complex Instruction. Boaler (2016) defines Complex Instruction as "multi-dimensionality, roles, assigning competence, and shared student responsibility" (p. 121). Complex Instruction is designed to provide support to students engaged in rigorous course content in a heterogeneous classroom (Tomlinson, 2018). Tasks are typically group worthy and create equitable access to curriculum by offering students with a broad range of abilities opportunities to successfully complete (Tomlinson, 2018; Vygotsky, 1978).

In typical mathematics classrooms, there is only one right answer (Boaler, 2016; Eggen & Kauchak, 2006). Students are taught how to work routine problems using a predetermined set of procedures which give either a correct or an incorrect response (Boaler, 2016; Eggen & Kauchak, 2006). In a multi-dimensional approach to learning, students use reasoning and sense making skills to determine how to arrive at a solution (Boaler, 2016). Tasks are oftentimes open-ended and allow for more than one correct

way of solving (Boaler, 2016; Dewey, 1916; Vygotsky, 1978). Students are encouraged to discuss solutions with a partner or in groups and together work to find a solution (Boaler, 2016; Cohen & Lotan, 2014; Dewey, 1916).

Problem-based tasks are particularly interesting because they allow the brain to achieve a state of disequilibrium (Boaler, 2019; Coyle, 2010). This state of disequilibrium or struggle, occurs when people are working on challenging and engaging tasks, making mistakes, correcting the mistakes, making more mistakes, and working on more challenging tasks (Boaler, 2019). The process of disequilibrium is what allows the brain to grow and change the most (Boaler, 2016). Teachers traditionally insist math problems be correct and will oftentimes save the student from struggling by giving the correct answer and therefore reduce the cognitive demand (Boaler, 2019). One study compared Japanese students to American students and found Japanese students spent 44% of their time creating, struggling, and thinking about fundamental content but Americans only spent 1% of their time on similar tasks (Stigler & Hiebert, 1999).

Complex Instruction addresses multiple facets of The Equity Framework (Linton, 2011). The higher order tasks typically used to implement Complex Instruction, requires a culture of learning, relevancy, sense making, high expectations, and rigor (Dewey, 1916; Vygotsky, 1978). Engaging students in tasks with purposeful lesson goals and providing for conceptual understanding is critical to developing equitable courses (Linton, 2011). Grappling with conceptual, relevant content is equitable and supported within Linton's Equity Framework (2011). Students, however, must be taught the value of struggle and teachers must reject the idea struggle is unproductive (Boaler, 2019). When students work on tasks during Complex Instruction, students must feel safe in

doing so and feel valued for even sharing wrong answers (Boaler, 2019). A culture of relationships, respect, and learning where mistakes are valued are critical components to the success of Complex Instruction and equitable structures (Boaler, 2016; Boaler, 2019; Linton, 2011).

Catalyzing Change in Mathematics Education

In 2018, NCTM and their team of 15 writers from universities, mathematics organizations, and high schools around the country published a book called *Catalyzing Change in High School Mathematics* (NCTM, 2018). The book's purpose was to describe the shift in content as well as pedagogy recommended for high school mathematics courses and programs of the future (NCTM, 2018). According to the Nation's Report Card (2017), National Assessment of Educational Progress (NAEP) scores have remained constant over the last ten years. ACT (2016) also reported fewer than 50% of U.S. high school students were prepared for college level mathematics and the Program for International Student Assessment (PISA) reported U.S. high school students scored lower than average expressing, delivering, and construing mathematics in a variety of ways. The reports, coupled with the push to ensure rigorous mathematics content is accessible to more students, is where the sense of urgency begins.

Belief systems. The idea some people are math people and some are not is a belief which has plagued society for centuries (Anderson et al., 2018). Research now reveals, however, people are not born mathematically inclined but become math people through hard work and perseverance (Anderson et al., 2018; Coyle, 2010). Anderson's (2018) and Coyle's (2010) work is based on studies finding the brain's neuroplasticity can change with focused learning and practice.

Believing some people are math people and some are not is particularly damaging students when the belief is affirmed by educators (Bonner, 2019; Dunleavy, 2018). A recent survey conducted at the university level revealed professors believed students needed to be gifted in their academic field in order to be successful (Chestnut, Lei, Leslie, & Cimpian, 2018; Leslie, Cimpian, Meyer, & Freeland, 2015). The belief one must be gifted in a particular field to be successful seem to be particularly damaging to women and may be affecting the number of women who choose STEM career fields (Chestnut et al., 2018; Collins et al., 2020).

Mindset work with teachers is not as abundant as work with instructional strategies with students, but may be just as important (Anderson et al., 2018). In 2018, Anderson et al., collected data on teacher and student belief systems, instructional practice, and achievement from state standardized tests. The study showed positive improvements in three areas after engaging in professional development: brain science, the myth of the math person, and differentiated instructional strategies (Anderson et al., 2018). The recommendations from the study implied professional development of teachers should shift from how to teach mathematics to ideas about who can achieve in mathematics (Anderson et al., 2018).

Students also demonstrated improvement when their fixed mindsets were challenged with growth mindset interventions (Boaler, Dieckmann, Pérez-Núñez, Liu Sun, & Williams, 2018; Dweck, 2016; Frazier, 2015). Work with students, however, is difficult when a shift in teaching practices is not also present (Boaler, 2016). Teachers must incorporate open-ended questions so students can access the content without a clear right or wrong answer (Boaler, 2016). Questions resulting in only one correct answer

tend to send messages to students that they are either intelligent or not and are damaging to a student's growth (Boaler, 2016).

A successful reform effort in a California high school, noted several belief systems as recurring themes when researchers conducted interviews of teachers involved in the mathematics reform (Nasir et al., 2014). The study noted all teachers and students were learners in the classroom that worked from their own strengths and allowed themselves to be vulnerable as they grew (Nasir et al., 2014). The phrase "smart" was redefined and students were doing math instead of having it done for them and lastly, relationships were considered a priority (Nasir et al., 2014). Other researchers noted a common practice in schools enacting successful mathematics reform was a shift from a focus on practicing routine procedures and memorizing tasks to a focus on developing understanding through problem solving, relevant tasks, and discourse (Linton, 2011; NCTM, 2014a; Raymond, 2018). The teacher as the sole resource for information in the classroom, telling students definitions and procedures rather than allowing students to research and experience the procedures themselves, is an unproductive belief (NCTM, 2014a; Peck, 2018; Taylor, 2018). Particularly, one unproductive belief is that high school mathematics is simply preparing students for abstract college math (Peck, 2018; Raymond, 2018; Taylor, 2018). Unproductive beliefs disrupt effective instructional practices, effect student's self-efficacy, create inequities, and limit student access to course content (Linton, 2011; NCTM, 2014a). In order to achieve equitable access to course content, teachers must have high expectations for students and believe mathematics must focus on more than student knowledge and performance (Linton, 2011). The myth mathematics must focus on student knowledge and performance has led

to content narrow in scope with too much focus on routine problems out of context (Peck, 2018; Raymond, 2018; Taylor, 2018). Taylor (2018) explained the myth of the technical nature of mathematics curriculum is due to the nature of the subject itself. According to Taylor (2018), people believe other subjects lend themselves to sophisticated questions, narratives, and creative works. Taylor (2018) also found people believe mathematics can incorporate creativity, relevancy, and rigor but feel school-age students are not mature enough to engage in such rigorous course content (Taylor, 2018). According to Taylor (2018), myths and belief systems cannot be addressed until we are ready to understand why such exist. The belief that some students are not capable of a deep understanding of rigorous mathematical concepts is what scholars believe must be debunked before all learners can be identified as doers of mathematics (Boaler, 2016; Linton, 2011; NCTM, 2014a).

Professional development and support for educators. In NCTM's position publication *Principles to Actions: Ensuring Mathematical Success for All* (2014a), the guiding principles for school mathematics are clearly defined. At the top of the list was teaching and learning (NCTM, 2014a). One method of supporting mathematics educators in developing effective mathematics learning is through instructional coaching (Chapman & Mitchell, 2018). Coaching cycles are an effective method for helping teachers develop equitable strategies and productive dispositions toward mathematics learning (Chapman & Mitchell, 2018). Professional development related to a teacher's mindset can indirectly effect student achievement, especially in elementary classrooms (Bonner, 2019; Dweck, 2016).

Professional development supporting change is critical to the implementation of any new program but should be a process and not one singular event (Bonner, 2019; Borko, Mayfield, Marion, Flexer, & Cumbo, 1997; Heck, Banilower, Weiss, & Rosenberg, 2008). Professional development is especially important when multiple innovations are implemented at the same time as is true with complex instruction (Hackett, 2019). Regular check-ins to help teachers make sense of how new innovations support each other will also support teachers' new strategies in the classroom (Golding, 2017; Hackett, 2019). Experiences to be most effective with lasting effects in the classroom should be designed with sustained support, collaborative in nature, and supported with embedded coaching (Bonner, 2019; Foster, 2017; Patton, Parker, & Tannehill, 2015).

Collaboration and the professional learning community. In order to enact change, teachers must engage in Professional Learning Communities (PLCs) (Balka et al., 2010). The three focuses of a true PLC include ensuring learning by all students, a collaborative culture, and a focus on results (DuFour et al., 2016). In a PLC, working collaboratively is a requirement of employment and not optional (DuFour et al., 2016). Teachers who work alone are unable to reflect on their teaching, share ideas, and learn from colleagues (Balka et al., 2010; DuFour et al., 2016). Teachers who work in a collaborative environment will collectively hold each other accountable (Balka et al., 2010; DuFour et al., 2016). Teachers are empowered to improve their instruction by people they work with and will strive to try things they would not otherwise try (Balka et al., 2010; DuFour et al., 2016). A collaborative community is a learning community (Balka et al., 2010; DuFour et al., 2016).

With a focus on learning, mathematics understanding becomes clear through the purposeful use of assessments (DuFour et al., 2016; Schoenfeld, 2014). As teachers elicit student work and ideas, both quantitative and qualitative data, can be used to make instructional decisions and guide how a team will respond to student learning (DuFour et al., 2016; Schoenfeld, 2014). Addressing misconceptions early gives educators the opportunity to proactively correct student thinking and adjust instruction as necessary (DuFour et al., 2016; Schoenfeld, 2014). Assessment becomes a tool PLCs can use to move student learning forward (DuFour et al., 2016; Schoenfeld, 2014). A successful mathematics curriculum includes focused assessments, both formative and summative, aligned to curriculum and help a team of teachers make decisions about instruction (DuFour, 2015).

Linton's (2011) Equity Framework establishes the culture of collaboration as part of the equitable structures of successful schools. According to Linton (2011), schools successfully eliminating or reducing the achievement gap, focus not only on teacher teaming and collaboration, but on relationships and building a culture of community within the school. Within a professional learning organization which empowers collaboration and involves a variety of stakeholders, a culture of innovation and success is achieved (Linton, 2011).

Systemic barriers for change. Change is difficult. Reeves (2009) sums this up in one sentence, "The fear of pain and death is not, for many people, greater than the unwillingness to change." (p. 1). In order to bring about true reform, there must also be a cultural change (Reeves, 2009). Reeves (2009) defines cultural change as "the way we do things around here" (p. 37) and cultural change is reflected in the behavior, attitudes, and

beliefs of the organization. Beliefs of an organization, however, must be consistent and continually enforced (Reeves, 2009). If an organization claiming cultural equity, for example, sacrifices student interventions by implementing traditional schedules and adult conveniences, then cultural equity is not the true belief of the school (Reeves, 2009). DuFour (2015) agrees calling such practices as a tradition of avoiding discomfort for adults. DuFour (2015) believed bringing about change to promote high levels of learning for all students creates a certain level of anxiety for teachers as the teachers move out of the comfort zone of traditional practices to a new way of teaching. Such change causes teachers to avoid digging into new practices and often results in a modified version of new strategies combined with old strategies (DuFour, 2015).

Leaders must be careful about enacting true cultural change (Kotter, 2008). Asking educators to change but not willing to change oneself, is a recipe for disaster (Kotter, 2008; Reeves, 2009). In order to enact true change, leaders must create a true sense of urgency, define what will not change, implement specific leadership actions, use the right tools for the organization, and be willing to do work typically thought of as beneath the leader (Kotter, 2008; Reeves, 2009).

Enacting true reform also has its common misconceptions (Reeves, 2009). One misconception is when the leader believes small changes are good enough (Reeves, 2009). According to Reeves (2009), small actions do not change schools but rather a common vision and belief system which become part of the culture of the school is what enacts true change. Contrary to popular belief, research has found moderate, haphazard, or implementation without focus was not any better than non-existent implementation (Reeves, 2009).

Another common false assumption among leaders is the belief others want to be changed when, in actuality, people really want *others* to change (Reeves, 2009). Kotter (2008) asserted that in order to create a true sense of urgency, leaders should not always shield people from troubling data. According to Kotter (2008), leaders often resist sharing information with employees because leaders believe people are not smart enough to understand, the information might not make them look good, or the information might hurt morale and increase anxiety. Kotter (2008) explained, data should be presented to employees more often and keeping information actually blocks action rather than creating the necessary sense of urgency.

If equitable instruction is the goal, it is crucial the organization, as a whole, accepts the responsibility (Muhammad, 2015). It is unreasonable to think people benefitting from a particular system will become catalysts for change (Muhammad, 2015). Muhammad (2015) believed those who have benefitted from privilege have to recognize such privilege and become advocates to ensure equity.

Research on reform efforts. Research measuring the effects of reform efforts on student achievement in mathematics is lacking (Boaler, 2002c). Boaler (2002c), however, was able to measure reform efforts by observing two schools in England possessing very similar demographics over a three-year period. The differences between the schools was their approach to mathematics instruction. One school used a very traditional approach relying largely on memorization of routine tasks and repetitive work. The other school offered a progressive approach – a problem-based curriculum where students used rich tasks to develop concepts and given time to process them. Overall, the students taught using a progressive approach to learning did better on mathematics assessments;

however, performance on standardized assessments were similar. The traditional students did better on the procedural aspects of the exam; however, the progressive students did better on questions relying on conceptual understanding. Overall, the progressive students performed significantly better on applications and problem solving (Boaler, 2002c). Further analysis revealed students in the traditional classroom could not transfer knowledge as readily as children taught using a progressive approach to learning mathematics. The method of problem solving was to look in the textbook to find an example similar to the one they were working on. When given any form of a contextual problem and a textbook reference was not available, students had no resource to reference in order to solve the problem (Boaler, 2002c).

A similar study in Oklahoma was performed in 2006 (Parr, Edwards, & Leising, 2006). The purpose of the study was to determine the effects of a mathematics program redesigned to offer a contextually-based delivery of content, with a focus on agriculture and technology. The study found students who learned contextually actually increased mathematics achievement and were able to retain information longer than students learning traditionally taught mathematics (Parr et al., 2006). The recommendations following the study cautioned in moving forward with agriculturally enhanced mathematics classes based on the findings of one study. The researchers mentioned although findings were significant, the shortened time of the study (one semester) limited the findings (Parr et al., 2006).

Research on reform efforts, however, do not always show favor to conceptual approaches over traditional approaches. Grady, Watkins, and Montalvo (2012) found a constructivist approach to mathematics instruction did not result in improved

achievement over traditional approaches when comparing student achievement of sixth graders in rural schools. In the study, the researchers found no significant difference on state assessments between students taught using the different approaches (Grady, Watkins, & Montalvo, 2012). The researchers did find students using the more problem-based, constructivist approach actually scored lower on algebra subtest results than students taught using traditional methods (Grady, Watkins, & Montalvo, 2012).

Trends across the country continue to push school districts to ensure equitable access of rigorous course content and discontinue practices which increase the achievement gap (Bonner, 2019; Muhammad, 2015). The leaders in a high achieving school district in Monmouth County, New Jersey took a closer look at overall student achievement and found amidst aggregate high performance there were also instances of low performance in students receiving special education services, Latino and African American students, and students of low socioeconomic status (Sampson et al., 2019). In order to combat this long-standing, unacceptable trend of inequitable achievement, leaders kick-started the conversation by redefining the phrase "all students" (p.58) (Sampson et al., 2019). The school district's initiative included a focus on unconventional approaches to data analysis, grounded with an emphasis on equity and excellence (Sampson et al., 2019). Using data to create a sense of urgency, the district began to concentrate on changing students' course-taking trajectories by eliminating lower-level tracks and creating more heterogeneous classes. The district's leadership team also examined and eliminated policies, such as teacher recommendations, which can prevent students from taking upper level courses.

The policies first took effect in English and social studies courses, as the team considered the subjects easier to detrack than mathematics (Sampson et al., 2019). After a closer look at the mathematics curriculum, leaders found students placed in the lower level Algebra track were disproportionately repeating coursework which did not adequately prepare the students for the state exam or minimum college entrance requirements (Sampson et al., 2019). Furthermore, it was found students on the lower level Algebra track were far less likely to take four years of high school mathematics and essentially received a fundamentally substandard academic experience (Sampson et al., 2019). To redirect practices adding to inequities in mathematics, leaders first reconfigured Algebra 1 curriculum to allow for more differentiation and additional time supports for students. In addition, students were given the option to enroll in a concurrent math class usually taught by the same Algebra 1 teacher (Sampson et al., 2019). Next, leaders eliminated the lowest level of ninth grade mathematics, which made regular Algebra 1 more heterogeneous and also provided teachers with professional development on differentiation strategies prior to implementing the change. Lastly, the district created an 11th grade course which served as a bridge for students caught within the tracked system and were then more likely to take a fourth-year mathematics class. The 11th grade course was designed to help students with the state assessment and give students opportunity for success in more rigorous 12th grade classes such as statistics (Sampson et al., 2019).

As a result of the changes, the school district saw a dramatic decrease in the number of students decelerating in mathematics by their senior year (Sampson et al., 2019). Specifically, deceleration dropped from 72 percent of students in subgroups in

2014 to 12 percent in 2017 (Sampson et al., 2019). The district was also successful in becoming more proactive in spreading the message to students about the benefits of the new math options and how the courses were designed to prepare students for college and career pathways. The district found students who were more aware of their course path options were more likely to enroll in challenging courses (Sampson et al., 2019).

Change is hard (DuFour, 2015; Kotter, 2008; Reeves, 2009). Even school districts successfully defeating the odds can succumb to the pressures of maintaining new programs (Nasir et al., 2014). One cannot discuss catalyzing change in high school without mentioning two decades worth of work in an urban California high school (Boaler & Staples, 2008). The Railside High School mathematics department was highly successful in developing and sustaining equitable pedagogy in their courses (Boaler & Staples, 2008; Nasir et al., 2014). Despite significant achievement gaps and deeply rooted racial inequities, the teachers were able to take their urban mathematics department and transform the department into a renowned program which has been studied by many scholars in the field (Boaler et al., 2018; Boaler & Staples, 2008; Nasir et al., 2014). The process of transforming the mathematics program was not an easy task when proponents of reform versus traditional approaches to teaching math inundated the world of mathematics education (Nasir et al., 2014). The transformation of the program was not achieved by only a small group of teacher leaders, but rather a cooperative effort of administrators as well (Nasir et al., 2014). Unfortunately, however, the work to achieve equitable mathematics had surrendered to local education politics during a time of economic recession, standardization, and high-stakes accountability (Nasir et al., 2014). Such pressures made it difficult for teachers to sustain the pedagogy they had worked

hard to develop. Pressures became so great from district-level decisions, several teachers left the school district and the remaining teachers felt unable to continue the program they had worked so hard to develop (Nasir et al., 2014). Without administrative support, the mathematics team could no longer do the important work they were doing to provide rigorous course content for all students (Nasir et al., 2014).

Ironically, in looking for further research related to mathematics reform, most studies found were from countries outside the United States (Athappilly, Smidchens, & Kofel, 1983; Keedy & Drmacich, 1994; Maher, 1991; Resnick, Lesgold, & Bill, 1990; Sigurdson & Olson, 1992). Research completed in the United States, and more specifically the Midwest, is scarce. The school district in this case study provided the researcher an opportunity to study attempts at integrating equitable approaches in mathematics instruction.

Mathematics leadership. The need for leaders in mathematics education who can bring research-based practices, related to equity and achievement, to teachers in the field is critical to ensuring equitable access for all children (Balka et al., 2010; Nasir et al., 2014). As jobs requiring skills in mathematics increase, so becomes the need to level the playing field for access to rigorous course content (Linton, 2011). Strong mathematical leadership is necessary to enact change in our schools and should not fall on just one individual in the building (Akwaji-Anderson, 2017; Nasir et al., 2014). Closing the achievement gap and ensuring equitable instruction should become a high priority for mathematical leaders today and encourage the creation of rigorous mathematics programs which provide opportunities for all students to learn (Balka et al., 2010; Nasir et al., 2014).

Dismantling inequities in schools across the country does not come without challenges (Sampson et al., 2019). One of the first steps to consider as part of the process of transforming instructional practice is establishing a shared vision among the organization relating to the redesign and infrastructures supporting the change (Kotter, 2008; Senge, 2006; Spillane, Hopkins, & Sweet, 2018). In order to ensure an entire school and district move in the direction of addressing systemic inequities, the district must have relentless focus on the mindsets and capacities of teachers, counselors, and principals (Nasir et al., 2014; Sampson et al., 2019). Teachers must learn differentiation strategies, counselors must learn how to support students in rigorous course placement, and principals must create and maintain the sense of urgency within their buildings (Nasir et al., 2014; Sampson et al., 2019). Principals can support collaborative goal setting with district office teams, as well as building teams, to ensure teachers and counselors receive the support they need to teach new groups of students (Nasir et al., 2014; Sampson et al., 2019).

The work schools do should not only be supported by school district administration, but must also be supported by mathematics leadership efforts at the state and national level. The National Council for Teachers of Mathematics (NCTM), the Association of Mathematics Teacher Educators (AMTE), and the National Council of Supervisors of Mathematics (NCSM) all share a common vision of what excellence and equity in mathematics should resemble. It has become the mission of such organizations to communicate these visions broadly. In a joint position paper by the organizations NCSM and TODOS: Mathematics for All (2016), a call for action, was made to level the playing field for all students and provide access to rigorous mathematics a priority for all

students. According to the collective position of these national organizations, high expectations and equitable access should become non-negotiable and leaders in mathematics education answer the call to action (National Council of Supervisors of Mathematics & TODOS: Mathematics for All, 2016; National Council of Teachers of Mathematics, 2018; National Research Council, 2001). Linton's Equity Framework (2011) called for leaders to be relentless as they develop and pursue a coherent focus on what equity means in their buildings. Linton's (2011) call for leadership must not only be a top-down approach but also require actions from teachers to build relationships and encourage students. Staff must be included and empowered to take appropriate actions and ownership of best practices (Balka et al., 2010; Linton, 2011). Ensuring excellence in mathematics and rigorous course content requires systematic and purposeful policies enacted in our high schools from staff at all levels (Linton, 2011).

Summary

This study used Linton's (2011) Equity Framework and the well-known theories of Dewey (1916) and Vygotsky (1978) to frame the design. The researcher used these collective theories to frame and describe the reform effort of the school district used in this case study. Most studies involving reform efforts fail to report on diverse populations (Hott & Dibbs, 2020). According to Hott and Dibbs (2020), in a synthesis of qualitative studies, it was found over 50% of the studies included participants who were predominantly white, from suburban school districts, and not eligible for free and reduced lunch. As a result, implications resulting from these studies made it difficult to draw conclusions related to Algebra achievement in regards to females, students of color, special education students, and students in rural school districts (Hott & Dibbs, 2020).

Many researchers claim traditionally taught mathematics, using memorization of out of context, routine procedures, may inadvertently be creating these inequities (Burris, 2013; Cortes & Goodman, 2014; Linton, 2011; Nasir et al., 2014). Equity issues prevent students from accessing rigorous course content and often result in math anxiety and a relative dislike for mathematics (Jankvist & Niss, 2018; Maloney, Ramirez, Gunderson, Levine, & Beilock, 2015). Along with differentiating instruction, providing supports for students needing extended time, and reducing or eliminating tracking students into dead-end course paths, researchers also believe mindsets must change (Boaler, 2016; Bonner, 2019; Dweck, 2016). Educators must have the capacity and will to differentiate instruction, build relationships with students, and focus more on the social and emotional aspect of learning so more students can achieve at high levels (Young, Jean, & Citro, 2019).

Chapter Two reviewed literature centered around issues affecting the mathematical success of all students as found by experts and researchers in the field. According to Linton (2011), schools must ensure all students have access to rigorous and relevant course content, and are held to high expectations. Issues which adversely affect mathematics achievement include math anxiety, tracking practices, and algebra readiness. In order to remedy these inequities, practitioners recommend taking a hard look at the preconceived notions of professionals in the field as the preconceived notions relate to student's abilities to learn mathematics. Sustained professional development, access to professional learning communities, and a commitment to building relationships with all students are just a few of the common themes found within this literature review (Boykin & Noguera, 2011; Burris, 2013; Cortes & Goodman, 2014; Linton, 2011; Nasir et al.,

2014). Chapter Three will discuss the methodology of the study, including the process of selecting students, the design of the problem-based Algebra 1 class using investigation and collaboration, and how student achievement would be measured following the course.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

Introduction

Culture, practice, and leadership must come together to frame an equitable experience for all students (Linton, 2011). Linton's (2011) Equity Framework further examines this to include an understanding of relationships, relevant content, a rigorous curriculum, and making high expectations for all students a non-negotiable. The Equity Framework (Linton, 2011), Dewey's Progressive Education Theory (1916), and Vygotsky's Sociocultural Theory (1978) were the theoretical frameworks of this study. The theories helped frame this case study of a school in southwest Missouri which restructured Algebra 1 offerings to ensure equitable teaching practices were available options for students.

Chapter Three describes the methodology used during this study. Included is the purpose of the study, research questions, the design of the study, the researcher's role, and site/sample selection structures. Also included is a description of participants, data collection techniques, methods used to manage and record data, instruments used to collect data, and procedures used for data analysis.

Purpose of the Study

The purpose of this qualitative case study was to provide a descriptive analysis of the phenomenon of offering ninth graders in one southwest Missouri school a choice between Algebra 1 courses offering the same content but differing instructional strategies. Data was collected through interviews, document analysis, and the

researcher's own observation data in order to examine results of the instructional changes, the perceptions of the changes, and the implications resulting from the changes.

The school district which participated in this study, purposefully implemented the same mathematics course but used different instructional strategies in an attempt to address equity issues and potentially allow more students access to Algebra 1 course content. One Algebra 1 course used traditional methods of teacher-centered, direct instruction, with an emphasis on routine memorization of out-of-context skills primarily. The other Algebra 1 course implemented a student-centered, problem-based approach to learning with embedded, collaborative teaming strategies. What made the study particularly interesting was the incorporation of student choice as students were offered the choice between the two Algebra 1 courses during enrollment. There were no requirements or parameters which restricted students to choose one course over the other. Students chose the Algebra 1 course which best met their learning style preferences.

Research Questions

This qualitative case study used research questions which offered a broad scope for the study. Qualitative studies generally ask a central question about a topic leaving the content open for describing the phenomenon of the study (Creswell, 2014). This study was guided by the following central question: How was equity and accessibility addressed when a school district in southwest Missouri offered ninth grade students a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach? The following sub-questions helped to frame the study:

1. Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?

2. How did offering students a choice between differing approaches to Algebra 1 influence a student's response to math?
3. How were implemented changes perceived by teachers, counselors, and administrators?
4. What were the results after implementing the new Algebra 1 course structures?

Research Design

The components of a qualitative case study are described as multi-method in focus and should involve a descriptive, informational, and natural approach to the subject of the study (Creswell & Creswell, 2018; Gay, Mills, & Arisian, 2009). In this study, the researcher described the phenomenon in its natural setting by using a qualitative analysis case study. Qualitative research describes personal experiences through interviews, observations, textual, and numerical data to understand the phenomena of the study (Creswell & Creswell, 2018; Gay et al., 2009; Merriam, 1998). The purpose of this qualitative case study was to describe phenomenon leading up to the implementation of new course offerings, perceptions of participants experiencing the phenomenon, and the implications resulting when students were offered a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach. This study described the process, structures, and outcomes of one public school in southwest Missouri in an attempt to increase rigor and access to ninth grade Algebra 1 courses.

In a qualitative case study, it is common for data collection to include interviews, observations, and document analysis (Merriam, 1998). Early researchers believed only using a single data source within a study resulted in greater instances of bias and

weakness within the study (Creswell & Creswell, 2018). Triangulating data sources allowed for more of a mixed-method approach, thereby providing greater validity and reliability (Creswell & Creswell, 2018). This study used triangulation of data sources through interviews, observations, and document mining to tell the story of the phenomenon.

Stakeholder's perceptions were an important part of the study. To gain perspective of the stakeholders, the researcher conducted interviews of a principal, a counselor, and three teachers (one teaching the traditional approach to Algebra 1, one teaching the problem-based approach, and one teaching both courses). Participants in the study were provided a non-disclosure statement (see Appendix B) and asked to sign an Informed Consent Form (see Appendix C) explaining the confidentiality of their responses. The interviews were conducted one at a time at a time convenient for each participant using Google meet in a face-to-face interview.

Conducting interviews and cross-referencing responses allowed the researcher to identify common themes which emerged among the responses from selected participants. Interviewing and cross-referencing allowed the researcher to describe participants perceptions of implementing a student choice design when offering Algebra 1 courses which differed only by instructional strategies. In doing so, the researcher created verbatim transcripts of one-on-one interviews then used the transcripts to look for differences and commonalities between responses of each participant. Member checking ensured participants had the opportunity to change thoughts or enhance their thinking while reflecting on their responses. To ensure accuracy of transcripts, the researcher

recorded the interviews and used the tapes to ensure transcripts were precise. For more details regarding the interview questions and protocol, see Appendix A and B.

The researcher also collected data by obtaining documents relevant to the study. Documents were not subject to the obtrusiveness which oftentimes occurs by the presence of a researcher and are also not affected by the whims of participants in the study (Merriam, 1998). Documents such as the school's master schedule before and after implementation, benchmark assessment data, and the researcher's own observation artifacts for each type of course are examples of data collected by the researcher. The documents, collectively, helped the researcher understand and describe the phenomenon of the study and completed the triangulation of data.

Research Setting

The site of the study was a suburban school district in southwest Missouri. District total enrollment at the time of the study included 6222 students. Demographic breakdown for the district can be found in Table 1. The average years of experience for teachers in the district was 12.4 years with an average salary of $49,302. In the district, 58.4% of teachers had a master's degree or higher. The population of the study was comprised of ninth grade students enrolled in Algebra 1. The ninth graders in this district were located at the junior high, which encompassed only eighth and ninth grade students. Demographics for the 971 students enrolled at the school can be found in Table 2.

Table 1

School District Demographics

Demographic Category	Percent of the District
Females	47.7%
Males	52.3%
Hispanic	4.7%
Black	0.8%
White	89.4%
Asian	0.4%
Indian	0.5%
Mixed Race	4.1%
IEP	13.2%
Free and Reduced Lunch	34.4%

Researcher's Role

Qualitative research is descriptive in nature as well as interpretative (Creswell & Creswell, 2018). The role of the researcher usually involves a continuous and concentrated experience with the participants (Creswell & Creswell, 2018). The true nature of a qualitative design presents a variety of ethical and personal issues into the enquiry process (Creswell & Creswell, 2018). The researcher of this study was an instructional math coach at the participating school district. Although she did not teach the courses described in the study, she often helped coach and train teachers implementing new, problem-based courses as well as observed, and provided feedback to all math teachers in the building. The researcher did not, however, supervise the teachers participating in the study and maintained very minimal interaction with the students in the study. The researcher understood the role bias can play in a qualitative study and took very seriously the challenge of presenting data in a clear and objective manner.

Site and Sample Selections

The site for the study was a school district in southwest Missouri. District enrollment during the 2019 - 2020 school year included 6222 students. The demographic breakdown of the district is represented in Table 1 above.

Table 2

Junior High Building Demographics

Demographic Category	Percent of the Junior High
Females	48.0%
Males	52.0%
Hispanic	4.6%
Black	0.6%
White	89.6%
Asian	0.3%
Indian	0.4%
Mixed Race	4.4%
IEP	13.0%
Free and Reduced Lunch	35.4%

Creswell (2014) does not suggest randomly selecting participants for interviews but rather purposefully selecting participants who will help the researcher create a clear understanding of the problem and research questions (Creswell, 2014). Samples for the interview process were dependent on how many individuals existed in the population itself. For example, there was the building principal at the school so he was selected as the principal of the study. The study included a population of one problem-based Algebra 1 teacher, one traditional Algebra 1 teacher, and one teacher who taught both courses. The participants were given $25 Amazon gift cards in appreciation for their time given to the study.

Participants

In order to get a complete understanding of the phenomenon of the study, the researcher chose to include a principal, counselor, and three teachers. Total Algebra 1 enrollment at the school included 291 Algebra 1 students which totaled 161 students enrolled in the problem-based approach to Algebra 1 and 130 students enrolled in traditional Algebra 1. Table 3 represents the demographic breakdown of the 130 traditional Algebra 1 students and Table 4 represents the demographic breakdown of the 167 students taught Algebra 1 using the problem-based approach.

Table 3

Traditional Algebra 1 Demographics

Demographic Category	Percent of the Total Building
Hispanic	1.5%
White	98.5%
Black	0%
Special Education	3.8%
Free and Reduced Lunch	37.7%
English Language Learners	8.5%

Table 4

Problem-based approach to Algebra 1 Demographics

Demographic Category	Percent of the Total Building
Hispanic	1.9%
Black	0.6%
White	97.5%
Special Education	6.9%
Free and Reduced Lunch	35.4%
English Language Learners	8.1%

The student population were ninth graders assigned to courses based on their own declared learning style preferences. Students who preferred a more collaborative,

investigative approach to mathematics, chose the problem-based approach to Algebra 1. Students who preferred courses taught using direct instruction as the primary instructional strategy, chose traditional Algebra 1.

Participants for interviews included three teachers assigned to the courses taught in the study. One teacher taught using the traditional approach to instruction, one taught using the problem-based approach, and one teacher taught both courses - two sections of traditional Algebra 1 and three sections of problem-based Algebra 1. The principal chosen for the study was the principal at the building where the Algebra 1 courses are offered and the counselor chosen was the one responsible for enrolling students in their ninth grade courses.

Research Procedures

Following proposal, the researcher submitted the paper to the Southwest Baptist University Research Review Board for approval. Once approved, the researcher contacted participants at the site, beginning with the principal and counselor. This contact was made through email and asked if each participant would participate in the study by answering a few interview questions at a time and place convenient for them. The first person interviewed was the principal in the building where the study took place. After agreeing to participate, the principal and counselor each signed a consent form (see Appendix D). The principal was asked five questions which provided the researcher a historical picture of the challenges the district currently faced and the reason for implementing the new course structure (see Appendix A and B). This same process was then repeated for the counselor interview. Interviewing the counselor also allowed the researcher to collect documents, artifacts, or data related to the implementation of

Algebra 1 as a choice in instructional strategies. The principal and counselor were each allowed to member check their responses for additions or edits. Following the interviews, the researcher looked for common themes related to each of the responses. Similarities and differences were noted among identified themes. The principal and counselor were offered $25 Amazon gift cards for their time given to the study.

The researcher then contacted the three teacher participants in the study by email. The teachers were asked if each would participate in a short interview at a time and place convenient for them. Interviews included one teacher from each of the courses, traditional and problem-based, as well as one teacher who taught both courses. The teachers were each asked the same questions (see Appendix A and B). Teachers were each informed of non-disclosures related to the study and signed Informed Consent Forms (see Appendix D). Each teacher was allowed to follow up with any additional information they would like to add to the study and were allowed to member check their responses for additions or edits. Following the teacher interviews, the researcher looked for common themes related to each participant's answers from a teacher's perspective. Similarities and differences were noted among identified themes.

Data Procedures

Data collection techniques. In qualitative studies, the researcher collects data in the field at the site where participants are experiencing the phenomena of the study (Creswell, 2014). The researcher meets participants in their natural setting to allow for behaviors and actions to be authentic to the problem of the study (Creswell, 2014). Talking to people and watching them behave naturally is a major component of qualitative research (Creswell, 2014).

The data in this study came from qualitative interviews with the principal and counselor at the school, and three teachers (one from each of the varying course designs – traditional versus problem-based and one teacher who taught both courses). The researcher contacted each participant of the study and scheduled a day and time for the interviews. All interviews were done via Google Meets. The researcher recorded the interviews and then transcribed them. The interviews were member checked for accuracy.

Data mining is an important aspect of qualitative case studies (Merriam, 1998). Data mining involves collecting any artifacts which may help the researcher frame the phenomenon in the study (Merriam, 1998). In this case study, the researcher collected master schedules from the year of the study as well the year before implementation of the new course designs, Algebra 1 January benchmark assessment data for the current year, January benchmark assessment data for the year prior to implementing the new course structures, course drop data, and the researcher's own historical observation artifacts. The artifacts allowed the researcher to note any discrepancies and articulate differences in before and after implementation as well as differences between the two courses.

Managing data. In conducting the method of inquiry for this case study, interviews with stakeholders were held. The interviews allowed the researcher to describe how the stakeholders perceived the implementation of the two different Algebra 1 courses which were offered. The researcher used one-on-one interviews to look for differences and commonalities between each of the participants responses. Member checking was used to ensure participants had the opportunity to change thoughts or enhance their thinking during an opportunity to reflect on the responses. The methodology of the study included a look into reasons why stakeholders decided to

restructure the district's ninth grade Algebra 1 program. Questions such as "Why did your school implement two different ways to teach Algebra 1?" and "How did offering students a choice between Algebra 1 courses differing only by instructional strategies influence a student's response to learning the content?" For more details regarding the interview questions and protocol, see Appendix A and B**.**

Recording data. Following the interviews, transcripts were created and common themes noted which gave the researcher an opportunity to further understand and describe stakeholder perceptions and outcomes of the new program. The analysis of interview transcripts included: identifying patterns and themes by counting frequencies within and comparing and contrasting the data (Miles, Huberman, & Saldaña, 2014). In addition to analyzing the perceptions of stakeholders, the researcher explored implications resulting from the implemented changes. School-wide, Algebra 1 achievement data from monthly benchmark assessments (before and after implementation), as well as course retention rates, and structures such as number of course offerings were explored.

Following the interviews, transcripts were provided to each of the participants to allow reflection on responses and any necessary changes to ensure the transcripts reflected the responses accurately. Participants' names were not collected for use in the study. The administrator, counselor, and each teacher participant completed an informed consent form (see Appendix D). Data collected for the study was kept confidential and was not shared or disseminated to a third party. Student achievement data was collected anonymously and disaggregated by students who were taking the traditional approach to Algebra 1 and those who were taking the problem-based approach, so implications

resulting from the implementation could be explored. All data was only used for the purposes of the study and was kept confidential.

Instrumentation

In qualitative case studies, the researcher is the key instrument as they examine data from multiple sources (Creswell, 2014; Merriam, 1998). The first type of instrument used in this study was an interview list of questions created by the researcher. The questions created were directly related to the research questions posed. Each interview protocol contained six questions. The details related questions and their alignment to research questions can be seen in Table 5.

Table 5

Interview Questions and Corresponding Research Questions

Item	Related Research Question
Why did your school implement two different ways to teach Algebra 1?	#1
How did offering students a choice between differing approaches to Algebra 1 influence a student's response to learning the content?	#2
How has the school and community responded to offering students a choice between instructional strategies?	#3
What other changes have you noticed since providing students a choice between Algebra 1 courses?	#4
How has the implementation affected you and your practice professionally?	#3, #4
Is there anything else on your mind which pertains to your school's decision to offer two Algebra 1 courses differing only in instructional strategies?	#1 thru #4

In addition to the interview data, this study also utilized quantitative data from the Algebra 1 End-of-Course exam for the three consecutive years prior to the year of the study. Specifically, the data collected was from the school years 2016 - 2017, 2017 -

2018, and 2018 - 2019. This data allowed the researcher to examine longitudinal Algebra 1 achievement since the school implemented the new Algebra 1 choice offering.

Summary

The purpose of this qualitative case study was to provide a descriptive analysis of the phenomenon of providing ninth grade students in one southwest Missouri school a choice between Algebra 1 courses which offered the same content but differing approaches to instruction. The theoretical framework used were Linton's (2011) Equity Framework, Vygotsky's (1978) Sociocultural Theory, and Dewey's (1916) Progressive Education theory, and provided the researcher not only a focus on equity, but on best practices related to instructional strategies, grounded in research as well. Interviews of participants, classroom observations, and data-mining helped the researcher gain an understanding of the phenomenon of the study. Overall, this chapter addressed the specifics of the study's methodology. Included in the chapter were research questions, hypotheses, selection and description of participants, design of the research, instrumentation used, and a description of the data analysis.

CHAPTER FOUR

ANALYSIS OF THE DATA

Introduction

The purpose of this qualitative case study was to explore the phenomenon incurred when a school district in southwest Missouri offered ninth grade Algebra 1 using two different instructional approaches – a traditional approach using worked examples delivered primarily through direct instruction and a problem-based approach delivered using varied instructional strategies and collaborative teaming. In order to understand the phenomenon, the researcher conducted interviews of a principal, counselor, and three teachers involved in implementing the new course structures and collected various related artifacts. In this school, students chose between a traditional approach to Algebra 1 using primarily direct instruction and modeling or a problem-based approach using collaborative teaming and real-world tasks. This chapter represents the participants' responses to interviews conducted to explore the choice design and the results following each design's implementation as well as the researcher's own professional opinions.

The design of the research was theoretically grounded using a combination of three different frameworks. The first, Linton's (2011) Equity Framework, allowed the researcher to define equitable practices resulting from each participants' perceptions of the new design structures. The other two theoretical frameworks allowed the researcher to base findings on learning theories. For the learning theories, the researcher used John Dewey's Progressive Education (1916) and Vygotsky's (1978) Sociocultural Theory. Both theories grounded the research in sound, pedagogical, best practices and allowed the

researcher to examine the phenomenon from both an equity lens as well as the lens of sound teaching practices.

Before the discussion of analyzing the data continues, it would be remiss to fail to convey the impact the COVID-19 pandemic had on this research project. The COVID-19 pandemic occurred simultaneously with the data collection and analysis timeline of the study. As the researcher was collecting data and conducting interviews, governments across the world were establishing stay at home orders causing schools, globally, to close their doors and convert to some form of distance learning for the last two months of classes. Since this study was largely designed to study stakeholder's perceptions of the new course designs and collect various artifacts related to the study, the project was allowed to go on as planned in a virtual setting. The results of the interviews and data mining are included in Chapter Four of the study and are as valid and reliable as they would have been without the pandemic. The study did, however, vary slightly concerning field observations due to the pandemic. The researcher had a unique opportunity to describe aspects of the design through her position as an instructional math coach in the district. As part of her responsibilities, she administered two classroom observations per teacher per year. The observations were not evaluative but rather a snapshot of the classroom to collect and document data concerning best practices and student participation during a full period observation. Due to the COVID-19 pandemic, the research committee for the study permitted professional notes and observations to be used in lieu of formal observations.

The analysis of data is divided into four sections. The first section describes the participants of the study. Participants included the principal in the building, a counselor,

and three teachers. The second section addresses methods for verification and the trustworthiness of the research. The third examines the results of patterns and themes surfacing from participant interviews, document mining, and observations with the last section addressesing the research questions.

The study was guided by the following central question: How was equity and accessibility addressed when a school district in southwest Missouri offered ninth grade students a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach? The following sub-questions helped frame the study:

1. Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?
2. How did offering students a choice between differing approaches to Algebra 1 influence a student's response to math?
3. How were implemented changes perceived by teachers, counselors, and administrators?
4. What were the results after implementing the new Algebra 1 course structures?

Participants

Interviews were conducted with five participants implementing the choice design at the school. Participants included the principal of the school, a counselor, and three teachers (P1; P2; P3; P4; P5). The principal was finishing his fifth year in that role. The counselor was one of two in the building and was primarily in charge of 8th grade advisement. The counselor had two master's degrees and 16 years of experience, thirteen as a counselor. The first teacher's teaching assignment included four sections of traditionally taught Algebra 1 and two sections of Honors Geometry using a problem-

based approach. The teacher held a master's degree with 23 years of experience, 15 of those years in the school district studied. The second teacher had 30 years of experience and had been with the district two of those years. This participant earned a bachelor's degree and was currently working on a master's degree. The teaching assignment of the second teacher included one Concepts of Algebra 1A course (the first class of a two-year Algebra course), two traditional Algebra 1 classes, and three sections of Algebra Investigations. The last teacher of the study was the problem-based teacher. This teacher had four years of experience with three of those at the district of the study. The teaching assignment for this participant included three Algebra Investigations classes, one Math Lab support class, and one section of Honors Geometry (also taught using a problem-based approach). The demographic breakdowns for the participants can be found in Table 6.

Table 6

Demographic Breakdown of Interview Participants

Participant	Years at Current Position	Professional Duties
Principal	5	Administration
Counselor	13	8th grade counselor
Teacher One	15	4 sections traditional Algebra 1 2 sections Honors Geometry
Teacher Two	3	1 section Concepts of Algebra 1A 2 sections traditional Algebra 1 3 sections Algebra Investigations
Teacher Three	3	3 sections Algebra Investigations 2 sections Algebra Math Lab 1 section Honors Geometry

Verification/Trustworthiness

The components of a qualitative case study are described as multi-method in focus and should involve a descriptive, informational, and natural approach to the subject of the study (Creswell & Creswell, 2018; Gay, Mills, & Arisian, 2009). In this study, the researcher described the phenomenon in its natural setting by using a qualitative analysis case study. Qualitative research describes personal experiences through interviews, observations, textual, and numerical data to understand the phenomena of the study (Creswell & Creswell, 2018; Gay et al., 2009; Merriam, 1998). The purpose of this qualitative case study was to describe the phenomenon leading up to the implementation of new course offerings, perceptions of participants experiencing the phenomenon, and the implications resulting from the phenomenon of one public school in southwest Missouri in attempt to increase rigor and access for ninth grade Algebra 1.

Establishing credibility and validity are one of the strengths of qualitative research (Creswell & Creswell, 2018). Researchers recommend use of multiple data collection approaches to describe findings (Creswell & Creswell, 2018). In doing so, the researcher is able to establish credibility and convince the reader the phenomenon was studied in depth and from multiple angles (Creswell & Creswell, 2018). This study used triangulation of data, member checking, peer debriefing, and clarifying bias to address trustworthiness, authenticity, and credibility.

Triangulation. Triangulation of data allowed the researcher to inspect evidence from three different sources of which were then used to better understand emerging themes. Data collection was achieved through interviews, observations, and document mining. Creswell and Creswell (2018) assert triangulation allows themes to converge

from several sources of data or from interviews of participants, thus, adding to the validity of the study (Creswell & Creswell, 2018).

To gain perspective of the stakeholders, the researcher conducted interviews with a principal, a counselor, and three teachers (one teaching the traditional approach to Algebra 1, one teaching the problem-based approach to Algebra 1, and one teaching both the traditional and problem-based courses). Interviews were conducted individually at a time convenient for each participant in a face-to-face meeting using Google Meet. Conducting interviews and cross-referencing responses allowed the researcher to identify common themes, as well as differences, which emerged among responses from the selected participants.

The researcher also collected data by obtaining documents relevant to the study. Documents were not subject to interruption of the phenomenon which oftentimes occurs by the presence of a researcher and were also not affected by the whims of the participants in the study (Merriam, 1998). Documents allow the researcher to supplement data collected from the interviews and observations. Artifacts included in the study were the school's master schedule, course drop data, and Algebra 1 End-of-Course data. The artifacts were collected from the school district's data officer and the Missouri Comprehensive Data System. The school's master schedule allowed the researcher to look at how the number of sections of the traditional Algebra 1 class differed before and after the study and helped the researcher identify the teaching assignments of the participants. Course drop data allowed the researcher to study how adding the choice course design affected retention rates in Algebra 1 and End-of-Course data was examined to compare the district's achievement scores from prior implementation.

To enhance the triangulation of data, the study's research committee approved the researcher to use her own classroom observation notes taken prior to the COVID19 pandemic. The modification was deemed valid as observation notes painted a picture of a typical classroom day in each of the different course types. The classroom observations were completed as an informative documentation of best practices observed as well as a frequency count of the opportunities for student participation during a ninety-minute classroom observation. The implementation of the classroom notes completed the researcher's triangulation of data.

Member checking. Member checking ensured participants had the opportunity to change their thoughts or enhance their thinking while reflecting on their responses. To ensure accuracy of transcripts, the researcher recorded the interviews using an application called Otter. After the transcribing and data cleaning process, the researcher emailed the transcript to each participant and asked participants to ensure answers were accurate and complete thoughts were included. Participants were allowed to make changes by omitting, clarifying, or expounding their responses. All participants approved of the first draft of their transcribed interview; therefore, no changes were made.

Peer briefing. Creswell and Creswell (2018) assert peer debriefing enhances the accuracy of the study. Peer debriefing ensures the research will resonate with others and adds to the validity of the account (Creswell & Creswell, 2018). The peers consulted for the study included a committee of two university graduate education professors and a secondary education administrator. The purpose of the committee was to review research questions, framework, methodology, address bias, and review the data analysis related to the study. In the initial planning phase, the researcher's advisor reviewed the progress of

the first three chapters every two weeks. In this phase, the researcher honed in on the purpose of the study, the theoretical framework, the literature review, and the methodology. Upon approval, the advisor sought feedback from the remaining committee members. The committee gave feedback on narrowing the research questions, focusing the literature review toward the research questions, and clarifying how bias could have played a role in the research. The committee was a key factor in navigating how the COVID-19 pandemic, which occurred during the data collection phase of the project, might have altered or affected the outcome of the study.

Clarifying bias. Clarifying bias creates an open and honest narrative about the researcher's background related to the study and addresses how interpretation of the findings could have been influenced by the viewpoint of the researcher (Creswell & Creswell, 2018). In clarifying bias, it is important to note the researcher was employed by the school district used in the study. The researcher's position with the district was an instructional math coach whose responsibilities included embedding professional development related to improving student achievement in secondary mathematics. The researcher's duties included working with the participants in the study as well as the other secondary mathematics teachers not participating in the study. The researcher, however, was not a supervisor of the participants.

Addressing the researcher's role at the district, which may have influenced the study, adds to the trustworthiness of the study. In this case, the researcher did have a role in selecting the materials for the new, problem-based Algebra 1 course three years prior to the study. During that time, the district was noticing a large dropout rate in ninth grade Algebra 1, so it was the responsibility of the researcher to look for alternative methods

for delivering course content. It was through the researcher's own probing and groundwork, in conjunction with district and school administrators, which laid the foundation for implementing the new Algebra 1 course design. The positive feedback from teachers and students in the pilot group led the researcher to believe the new course might help the school address retention rates in Algebra 1.

The district began implementation of the investigative approach to Algebra 1 with a pilot group of 47 students during the 2017–2018 school year. The pilot group represented 19% of freshman enrolled in an Algebra 1 course during the 2017-2018 school year with the remaining Algebra 1 students (81%) enrolled in the traditional Algebra 1 course. At the time of the study, however, enrollment had a more leveled enrollment with 167 students enrolled in the investigative approach to Algebra 1 (56%) versus 131 (44%) students enrolled in the traditional approach. With the program leveling off to approximately half of the school's ninth graders enrolled in each course during the 2019–2020 school year, it allowed the researcher to study a phenomenon fairly well established in nature, thereby creating a more valid and reliable study.

Multiple theoretical perspectives. Multiple theoretical perspectives allowed the researcher to avoid channeling the research into one, predetermined theory. The researcher's initial belief was the changes made to the Algebra 1 courses were related to equity issues at the school as a response to ensuring all students had equitable access to rigorous course content. The question remained, however, was it really an equity issue or related to best practices in teaching? The researcher chose to look at the phenomenon with multiple vantage points by using a combination of three theoretical perspectives. The first was Linton's Equity Framework (2011) which stated equitable schools ensure

students have access to rigorous course curriculum, content is relevant to their lives, educators establish and maintain relationships with students, and the school holds all students accountable to high expectations. The next framework was John Dewey's theory of Progressive Education (2011) which identified learning happens through a series of purposeful experiences, shaping the way a child views the world. Dewey's theories support a hands-on approach to learning rather than a traditional direct instruction approach. Lastly, this study included Vygotsky's (1978) Sociocultural Theory. Vygotsky's theory (1978) asserted children learn best when collaborating and engaging in content meaningful to their lives. Vygotsky (1978) stressed the importance of learning by exchanging ideas with peers as this allows children to be active participants in the learning process. The combination of the three theories allowed the researcher a vantage point from multiple theoretical perspectives.

Data Analysis Procedures

Creswell (1998) states qualitative research comes from a tradition of inquiry. He refers to the process as an attempt to describe or conceptualize a problem to writing a narrative and not simply data collection, analysis, and report writing (Creswell, 1998). In order to write this narrative, the researcher used the Data Analysis Spiral suggested by Creswell (1998) to create a process moving in analytic circles rather than using a fixed linear approach.

In this approach, the researcher begins the process with data management by organizing the data into manageable files either by hand or by computer so the data can be easily located in a large database (Creswell, 1998). The process continues by immersing oneself in the details of the study by reading and rereading transcripts to get a

sense of the interviews as a whole while writing notes in the margins of key concepts, ideas, or phrases which stand out (Creswell, 1998). This process allows the researcher to develop themes related to the study and, according to Creswell (1998), represents the "heart of qualitative analysis" (p. 144).

Transcription and Data Cleaning. Interviews provided the researcher a unique opportunity to understand the phenomenon from the viewpoint of the participants involved. Specifically, the study included the comparison of interview responses between participants who have different perspectives. The participants in the study included three teachers (one who taught only the traditional course, one who taught both the traditional and problem-based course, and one who taught only the problem-based approach), a principal, and a counselor. Each participant was invited to participate and asked to digitally sign and return an informed consent. Once the consent was received, the researcher and participant agreed to conduct the interview via a Google Meet face-to-face interview at at time convenient for the participant. The details of the interview protocol are found in Appendix B.

The goal of the interview was to understand each stakeholder's perceptions of offering two approaches to ninth grade Algebra 1, differing only in instructional strategies. During the interview, the researcher recorded the responses of each participant using an application called Otter. Otter provided an audio of the interview as well as a rough version of the transcribed interview. To ensure accuracy of the transcripts, the researcher data cleaned the transcripts by reviewing audio and making edits to the transcripts as necessary so the transcripts were a direct reflection of each participant's thoughts and comments. Once the transcripts were clean, representing an accurate

accounts of the audio, the researcher sent each transcript back to the interviewee to review and check for accuracy, omissions, or clarifications.

Coding Transcripts. Following the interviews, the researcher read the transcripts and looked for general themes and ways to classify the data into categories. During this process, the researcher annotated transcripts while searching for general themes and other details helping to describe the thoughts of each participant. Each theme, insight, or descriptive detail suggesting equitable practices, research-based learning and theories, insightful perceptions of stakeholders was coded using the cardinal numbering system beginning at 1, 2, 3 and continuing to the end of the interview for each participant. The numbering system simply allowed the researcher to locate the note within the transcript easily when it was necessary to get a direct quote. The researcher repeated the same process two more times for each interview to ensure insights were coded accurately and were not inadvertently omitted.

Prior to the coding and transcribing process, the researcher designed interview questions to elicit information regarding stakeholder's perception of offering students a choice between two Algebra 1 courses , with each course differing only by instructional strategies offered. Curtis Linton's Equity Framework (2011), Dewey's Progressive Education (1916), and Vygotsky's Sociocultural Theory (1978) were the collective frameworks for the design of this study , so the researcher used six pre-determined themes to begin the organization process of categorizing data. Pre-determined themes aligned to the corresponding theory is found in Table 7.

Table 7

Predetermined Themes and Theory Alignment

Theme	Theory
Building relationships	Linton's Equity Framework (2011)
Relevant curriculum	Linton's Equity Framework (2011)
Rigorous curriculum	Linton's Equity Framework (2011)
High expectations	Linton's Equity Framework (2011)
Hands-on approach	Dewey's Progressive Education (1916)
Collaborative/social environment	Vygotsky's Sociocultural Theory (1978)

Once coding was completed, the researcher began to organize the data by using a spreadsheet to record notes and categorize the data into predetermined themes, subthemes, and research questions. In order for additional major themes to be included in the study, the theme needed to be mentioned multiple times by participants. The researcher also considered subthemes, which were related to major themes, but may or may not have been mentioned by multiple participants. Peer briefing was utilized following the coding and organizing process to allow for reflection and to ensure accuracy of the themes which emerged.

Document mining. Document mining allowed the researcher to continue the process of looking for themes alighning to the perceptions of stakeholders related to the study. To complete the process, the researcher contacted the district's data specialist. The data specialist was able to provide first semester course drop rate data for the 2016-2017 school which was the year prior to implementing the new course structures, first semester course drop rate for the 2019-2020 school year, and the master schedules for the 2016-2017 and 2019-2020 school years. The researcher collected Algebra 1 End-of-Course (EOC) data for the state and the school district for three school years beginning with the 2015–2016 school year and continuing to the 2018–2019 school year. EOC data was retrieved from the Missouri Comprehensive Data System. Algebra 1 EOC data for the

2016–2017 school year was not available on the website. Throughout the data mining process, the researcher compared data collected with the perceptions noted by participants to determine where connections existed.

Classroom observations. Due to the COVID-19 pandemic, the researcher was not able to visit classrooms to complete an official observation for the study. The committee for this project approved using the researcher's own observation artifacts collected during classroom observations during the fall of 2019. From these artifacts, the researcher was able to use documented accounts of research-based best practices as defined in *Principles to Actions* (NCTM, 2014a), as well as frequency counts for student opportunities to respond in class during the ninety-minute observation. The researcher used one observation from a traditional classroom and one observation from the problem-based classroom as artifacts for the purpose of the study.

Describing the Courses

Offering the same content using two different approaches is not typical in the same school setting. If a researcher wanted to study different approaches to teaching Algebra 1 content, one would normally need to look at multiple districts. The school district in this study, however, implementing two different approaches for the same course. As the researcher sought to explore each stakeholder's perception of offering two Algebra 1 classes differing only by instructional strategies, it became apparent the first goal should be to describe the two differing approaches. In this section, the researcher will compare and contrast the two course designs to offer a window into the two different classroom settings. In order to understand each type of course offered, the researcher sifted through interview data. Any word or phrase offering a glimpse into the classroom

through the eyes of the participant was noted. This viewpoint was gleaned from stakeholder's interview data and allowed the researcher to describe experiences students and teachers had when participating in one class type or the other.

Traditional Algebra 1. The traditional Algebra 1 class can be described as the course teachers had been teaching prior to implementing the two-course design. The primary mode of delivering content in the traditional Algebra 1 course was through a direct instruction approach. Students in traditional Algebra 1 take notes in a lecture-style setting, followed by homework problems typically emulating examples shown in class. Problems are presented primarily out of context and are typically routine in nature. Students are offered a rationale for the concepts but usually rely on memorization of step-by-step procedures demonstrated by the teacher. One participant (P5) described the presentation of material in the traditional class as a "huge deal." The participant (P5) mentioned, "I think they have to be very clear and it's a lot more on a teacher to make sure the way they presented the examples are broad enough to reach a bunch of students with different styles… and still reach the lowest level learners." Although direct instruction is the primary mode of delivery for the traditional approach to Algebra 1, three participants (P3; P4; P5) mentioned the strategies learned in the problem-based training were also incorporated into the traditional class as well or might be in the future. One participant (P4) noticed a difference in the type of engagement seen from the two varying course designs. The participant (P4) went on to claim once the teacher began implementing some of the instructional strategies from the problem-based class into the traditional Algebra 1 class, more engagement and participation started occurring. The

participant (P4) continued by stating, “students started turning in their work, responding to questions, and doing better
on assessments than what I had gotten from them earlier in the year.”

Problem-based Algebra 1. The school named the problem-based class Algebra Investigations to differentiate between the two courses. The course offering design was implemented three years prior to the study when the superintendent at the time approved a pilot of two sections of the new Algebra Investigations class. Combined, the two sections included 49 students. Three years later, during the year of the study, the school had 160 students enrolled in that Algebra Investigations course.

The problem-based class was described by participants (P4; P5) as addressing the same learning standards as the traditional approach but doing so from a real world, conceptual approach. Students in the class were typically presented a problem to grapple with prior to the teacher offering the most efficient algorithms and strategies for solving the problem. One participant (P4) described the process as “hands-on” where students collaborate on problems sharing strategies for solving and applying various approaches to solving the problems. Participants (P3; P4; P5) suggested the focus of the classes was on student-led conversation and teaming approaches. One participant (P5) described this method as “productive struggle” where students make sense of content to understand the “why.” The participant (P5) went on to say students in the problem-based classes get more interaction with the material and discover properties, algorithms, and patterns on their own. Every participant interviewed in the study (P1; P2; P3; P4; P5) suggested problem-based style of teaching diversifies learning and reaches more levels of learners. One participant (P5), specifically, mentioned allowing students to collaborate on

problems in their teams gives students more confidence to speak in class mainly because students ask questions to peers in a small group setting rather than raising their hand to ask questions to their teacher in front of the whole class. The type of embedded support, the participant mentioned (P5), gave the students confidence to participate in class and get their questions answered.

The teacher's role in the problem-based class is to facilitate instruction. Teachers are observed circulating the classroom, addressing student needs, and formatively asking questions as the teacher moves about the room. Two of the three teachers (P4; P5) suggested this type of interaction helped build relationships as teachers were able to have more conversations with students. Conversations are more difficult when teaching more traditionally (P5). One participant (P5) stated, "I think, for the most part, people have really enjoyed the interaction and relationships you need to build which are a lot different than in the traditional [class]."

Curriculum and state standards addressed were the same for both types of Algebra 1 courses and both courses gave students homework and summative assessments at the end of each unit. In addition, both classes utilized spiral review problems where students continually worked on a comprehensive set of problems, spanning the entire year. However, the scope, sequence, and pace were different in each type of class. One participant (P3) mentioned the difference between the scope, sequence, and pace between the two courses has been a problem for students wanting to switch classes. The participant (P3) believed aligning the scope, sequence, and pace would be an issue the school might need to address in the future.

It is important to note resources used for each type of class were different. The traditional class used primarily teacher-created resources. Two participants (P3; P4) eluded to the fact that Algebra 1 did not use a textbook but rather teacher-created guided notes and practice worksheets. Students were given daily quizzes and summative assessments to check for understanding. In the problem-based class, teachers used the *Algebra 1 Core Connections* series from College Preparatory Math (CPM) to assist with instruction (P4; P5). The resource helped the teachers use a more problem-based approach and assisted the teachers with suggested instructional strategies. Each teacher participant (P3; P4; P5) in the study completed eight days of training prior to using the new resources – four consecutive days at the end of the prior school year and four pullout days throughout the year (one every two months). CPM supported teachers during implementation by also sending a regional trainer who observed classes and offered feedback to each teacher. Four participants suggested the training made a big impact on the teacher's ability to deliver the new materials (P1; P3; P4; P5). One participant (P1) went on to say teachers appeared more open to investigation-based teaching – more so than before the implementation of the new choice design. One participant (P3) stated, "It's opened my eyes and reconnected me with the ways I've always wanted to teach certain things."

Training was an integral part in changing teacher mindsets as three participants (P3; P4; P5) mentioned teachers taught using a more traditional approach prior to implementing the Algebra 1 choice design structures. Participants (P3; P4; P5) admitted prior to implementing the new choice design, the teacher's primary mode of delivering content was through lecture and notetaking. Following the training, however, all teachers

were either implementing more collaborative teaming and a variety of instructional approaches or were planning to implement more of these types of strategies the following school year (P3; P4: P5). It is important to note, all teachers in the study participated in the problem-based training, including the teacher teaching only the traditional Algebra 1 class . The teacher teaching a traditional Algebra 1 course was also teaching a problem-based Geometry course. The problem-based Geometry course was also a new course in the district.

Research Questions

This study was guided by the following central question: How was equity and accessibility addressed when a school district in southwest Missouri offered ninth grade students a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach? In this section, the researcher provides data related to each of the sub-questions in the study. Data came from conducted interviews, collected artifacts, and the researcher's own observations.

As participants responded to the interview questions, the researcher made notes regarding the reasons for the change and any implications the responses contributed to Linton's Equity Framework (2011) or the learning theories of Dewey (1916) or Vygotsky (1978). The theories allowed the researcher to create the following predetermined themes: relationship with students, rigorous course curriculum, relevant content, high expectations for learning, hands on learning, and a collaborative/social environment. Findings from each research question were reported based on the theories, but also included any unrelated themes which emerged as well. Interviews, artifacts, and the researcher's own observation notes were used to collect information related to answering

the research questions. The researcher included the information under each research question subheading where appropriate.

Research Question 1. *Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?* The purpose of the research question was to explore each stakeholder's perceptions of difficulties existing prior to implementing the choice design of offering students two different approaches to Algebra 1. School districts do not usually implement new strategies, curriculum, or initiatives without trying to improve a current situation. Seeking answers to this question gave the researcher an understanding of what difficulties students, teachers, and the school as a whole were seeing thus, prompting implementation of the new course structures. The researcher explored this question with interview data and document analysis.

Interview data. The researcher included Research Question One as the first interview question for each participant (see Appendix A). When asking this question, the researcher looked for phrases or key words addressing the predetermined themes of the study. One word surfacing as a major theme was the word "different", which occurred 35 times over all of the interview questions combined. The word "different" was used in several diverse contexts. Participants used the word in phrases such as "different ways to teach Algebra 1" (P1; P2), "different directions we can reach our students" (P2), "it's being delivered differently" (P2), "different learning styles" (P1; P2; P3; P4; P5), "we need to do something different" (P2), "there could be a different or better way to reach students" (P3), "different levels of learners" (P5), and "different approaches" (P1; P5). Additionally, with this research question, the researcher identified learning style as a

subtheme. Learning style was mentioned 13 times, collectively, by all five participants (P1; P2; P3; P4; P5). Participants used phrases such as "addressing how they learn" (P3), "to address different learning styles" (P3), and "reach every kid's learning style" (P3). One participant claimed some students "get frustrated and give up" in the traditional approach to Algebra 1 (P2). By offering students a choice of how they want to learn Algebra 1 content, the school allows the student to consider their own type of learning style. One participant stated the choice design, "allows students to pursue their education through whichever avenue they prefer, whether it be one-on-one or with problem-based learning" (P4). All participants (P1; P2; P3; P4; P5) seemed to agree one approach would not allow all students to reach course content and differentiating by using two approaches to Algebra 1 course content allowed teachers to reach more students. The summary of the themes from Research Question One can be found in Table 8.

Table 8

Theme/Subthemes Related to Research Question 1 by Participant

Theme/Subtheme	Frequency	P	C	T1	T2	T3
Learning Style	13	2	1	5	2	3
Different	35	2	6	2	5	20

Further analysis of this interview question revealed quotes which helped describe participant's thoughts related to why the changes were implemented. For example, one participant stated the reason for the course changes was,

> We felt like there was a group of students that were, maybe, opting into the lower level or slower level that really needed to be in Algebra 1, but they needed a little support. In other words, those 'tween' students (P1).

Other participants (P2; P3; P4; P5) had views which were similar and felt like learning styles varied among different students. One participant (P2) believed the district wanted to meet the needs of all learners. The participant stated,

> I think that we should always be looking at different directions we can reach our students because we are learning more and more that not everybody learns the same. So, if we can make accommodations for each individual student, it's a win for everybody (P2).

Document analysis. To answer research question one with artifact data, the researcher looked for any documents offering a glimpse of existing issues prior to implementing the new course structures. The researcher was able to collect first semester course drop data as well as master schedule data from the 2016–2017 and 2019–2020 school years. The two school years represented the year prior to implementing the new course structures and the year of the study.

In examining first semester course drop data, the researcher noted during the 2016–2017 school year, 18 students dropped Algebra 1 first semester, all of whom transferred to the two-year Algebra class, Concepts of Algebra 1A. In comparison to 2019–2020 data, 15 students dropped traditional Algebra 1 first semester. Thirteen of the 15 students transferred to Algebra Investigations, one student did not replace the dropped course with a math course, and one student transferred to the first class of two-year approach to Algebra 1, Concepts of Algebra 1A. Three students dropped the Algebra Investigations course first semester. Two students enrolled in MOCAP – Launch (an online Algebra 1 course offered out of district) and one student dropped to the two-year

Algebra 1 class - Concepts of Algebra 1A. Details of these transfers can be found in Table 9.

Table 9

Algebra 1 First Semester Course Drop Data

School year	Course Dropped (Number of Students)	Course Added (Number of Students)
2016-2017	Algebra 1 (18)	Concepts of Algebra 1A (18)
2019-2020	Algebra Investigations (3)	MOCAP – Launch (2)
		Concepts of Algebra 1A (1)
	Algebra 1 (15)	Algebra Investigations (13)
		Concepts of Algebra 1A (1)
		Did not replace math class (1)

During the interviews, participants mentioned the reason the school began offering students a choice for the two courses was because the school believed students possessed different learning styles and not all students learned the same way (P1; P2; P3; P4; P5).

Participants did not mention Algebra 1 course retention rates in their responses to why the district chose to implement the new choice design approach to Algebra 1. In examining course retention rates, however, the researcher was able to explore more evidence related to the restructure. First, the researcher collected the first semester retention rates prior to implementing the choice design (2016-2017) and then the same retention rates from the first semester of the year of the study (2019-2020). In the year prior to implementing the new course design (2016-2017), the researcher found 18 students dropped the Algebra 1 class in favor of moving to a two-year Algebra 1 course (Concepts of Algebra 1A); however, in the year of the study, only three students dropped to the two-year approach. The findings represent an 83% decrease in the number of

students dropping Algebra 1 course content following implementation of the new choice design at the school.

Research Question Two *How did offering students a choice between differing approaches to Algebra 1 influence a student's response to math?* Understanding how the implemented choice design affected student's response to mathematics helped the researcher understand implications resulting from the new structures established at the school. Specifically, the researcher sought to understand how the two-course design influenced equity, accessibility, and a student's response to Algebra 1 as a whole. Interview data for this question was explored using two approaches. The first approach was identifying themes emerging from participant's direct response to interview question two only (see Appendix A). The researcher then examined interview responses to all questions by all participants, searching for themes related to understanding the student's response to mathematics.

Interview data. Similar to Research Question One, Research Question Two was also a direct interview question (see Appendix A). The theme occurring most frequently in response to this question was "choice" and variations of the word including "choose" and "chose." Participants (P1; P2; P3; P4; P5) mentioned this theme 12 times when responding to the related interview questions and 41 times when the researcher combined responses to all questions from all participants. One participant (P5), used the theme in phrases such as "I chose to take this class" on four separate occasions. Other phrases such as "students choose what way to approach a problem" (P5); "choice in how they engaged with content" (P5); and "the power to choose their class" (P3) emerged as well.

The intent of the study was to understand the phenomenon of offering students a choice between Algebra 1 classes, differing only by instructional strategies used during class. Quotes from participant interviews helped to understand the choice design. For example, two of the five participants (P1; P4), mentioned the community responded well to the choice design, but all five participants (P1; P2; P3; P4; P5) felt many parents still thought the new course design was a below grade level class. One participant (P1), stated the school measures community response by offering the class. Since there have been students choosing to take the class, the school knows there is community interest in providing options. Another participant (P4) claimed, no complaints regarding the new problem-based course, although one parent did ask why the problem-based students received so much homework. The participant explained,

> I think that if students have choices, that gives them the door to pursue [their] education with the avenue of one-on-one or direct instruction or I would like to pursue it with problem-based learning. It will help me extend my math skills and broaden my horizons per se (P4).

All participants (P1; P2; P3; P4; P5) seemed to appreciate students had a choice of how they wanted to take their Algebra 1 credit.

Another major theme of the study was the word "way" which occurred twelve times, collectively, by participants (P1; P2; P3; P4; P5) when asked how student's responded to math following the implementation of the choice design. When examining frequency across all questions and all participants, the word "way" occurred 48 times. In trying to understand the phenomenon, the researcher interpreted respondent's use of the phrase "way" to mean "a method." The word "way" might have referred to a teacher's

methods or student's methods. Phrases such as "two different ways to teach Algebra 1" (P1), "math can be learned in a different way" (P2); "the way they learned" (P2); "the way they plan the lesson" (P5); "a bunch of different ways instead of one teacher's way" (P5); "students choose the way the teacher does it or the way other people see it" (P5); and "same concepts just in a different way" (P2; P3; P5). The two major themes, broken down by participant, can be seen in Table 10.

Table 10

Theme/Subthemes Related to Research Question 2 by Participant

Theme	Frequency	P1	P2	P3	P4	P5
Choice/Choose/Chose	41	1	2	5	2	31
The way	48	3	3	7	9	26

In addition to looking at each participant's direct response to the question, the researcher also examined transcripts of all five respondents. The researcher looked for other themes related to a student's response to math which may have surfaced outside the direct question itself. In doing so, the researcher identified a student's math disposition as another major theme of the study. References from participants (P1; P2; P3; P4; P5) related to students' overall disposition toward mathematics surfaced 45 times during the study. These 45 references were broken down into three subthemes: math confidence, ownership and engagement, and a sense of enjoyment. The sense of enjoyment subtheme was broken down further to reflect comments related to teacher enjoyment and comments relating to student enjoyment.

The first subtheme, math confidence, occurred across all interviews 16 times. Common phrases mentioned included phrases such as "students gained confidence and deepened understanding" (P5) and "students taking the problem-based approach gained a

lot of confidence" (P5). One participant (P5) stated, "the amount of confidence I saw grow was incredible!" and other participants (P4; P5), believed the hands-on, problem-based approach, gave students confidence and a social boost by talking to people they may not have otherwise spoken to (P5).

The next subtheme, engagement and ownership, occurred throughout the interviews 19 times. In a problem-based class, students choose how they are going to respond (P4; P5) whereas, in the traditional Algebra 1 class the only choice for engagement is based on what the teacher plans for the day (P5) and usually involves taking notes and raising hands to ask a question (P5). According to participants, problem-based students have more opportunities to engage (P4; P5) and have to think more about the material to form their own ideas (P5). In a traditional class, however, ownership comes from being an advocate for themselves when acting on their own misconceptions (P5). Overall, participants seem to agree being allowed to choose between classes offering different instructional strategies makes a positive impact rather than forcing students to take a certain class (P1; P2; P3; P4; P5). The choice between two classes varying only by instructional strategies gives the students more buy-in and more control (P1; P2; P3; P4; P5).

The last subtheme which emerged was a sense of enjoyment and occurred ten times. Four of the ten reference teacher disposition and the other six were related to student disposition. Regarding teacher disposition, one participant stated, "I enjoy stating a problem and then facilitating the conversation" (P5), while another participant stated, "I enjoy being around students and the problem-based lessons allow this to happen more often" (P5). Participants eluded to the disposition of their students six times over the

course of the interviews. Phrases included “students seem to enjoy problem-based learning” (P5) and “the interaction helps students build relationships” (P5). One participant (P5) claimed,

> Sometimes, in a traditional course, students aren’t confident to ask a question out loud. In a PBL (problem-based course), students might just whisper it to a partner because they are supposed to talk, whereas they may not have had the confidence to raise their hand in front of the whole class (P5).

The same participant (P5) asserted the students choosing the traditional approach prefer to “have the material presented to them upfront” whereas another participant claimed if students did not prefer the traditional approach, at least now, the students have a choice (P5).

Observation data. Observation data allowed the researcher to explore a student’s response to mathematics through student and teacher interactions observed during a ninety-minute class for each of the traditional and the problem-based classroom. During the observations, the researcher looked for evidence related to the Mathematics Teaching Practices (NCTM, 2014a) as well as a frequency count of opportunities for students to respond during instruction through classroom discourse, asking a question, or answering a question. The Mathematics Teaching Practices (NCTM, 2014a) provide a set of standards defining best practices in mathematics education and offered the researcher an opportunity to gauge the quality of meaningful engagement students are offered during a class period. Opportunities to respond, rather, allowed the researcher to measure how frequent students engaged through active participation and meaningful responses to tasks presented during the lesson. Every time a student responded to a teacher or to another

student, the researcher tallied that as a response. If the entire class was allowed to respond to a prompt either via whiteboard, sharing with a partner, group work, etc., the researcher would automatically assign 30 opportunities to respond "points" for that particular activity.

To describe data collected during the two observations, the researcher compared and contrasted the two classes. In the problem-based class, the researcher noted evidence of seven out of eight Mathematics Teaching Practices (NCTM, 2014a) compared to four of eight observed in the traditional Algebra 1 class. The details of the observations, including which practices were observed can be found in Table 11.

Table 11

Comparison Chart of Observation Data Collected for Each Course Type

Mathematics Teaching Practice	Problem-Based Course	Traditional Course
Establishes mathematical goals to focus learning.	X	
Implements tasks that promote reasoning and problem solving.	X	X
Use and connect mathematical representations.	X	X
Facilitate meaningful mathematical discourse.	X	
Pose purposeful questions.	X	X
Build procedural fluency from conceptual understanding.	X	X
Support productive struggle in learning mathematics.	X	
Elicit and use evidence of student thinking.		

Concerning opportunities for students to respond, the researcher tallied 166 opportunities for students to respond in the Algebra Investigations course and twenty-three opportunities for students in the traditional Algebra 1 class. Data from the opportunities to respond can be found in Table 12.

Table 12

Observation Data: Student's Opportunities to Respond

Course	Frequency
Traditional Algebra 1	23
Algebra Investigations	166

It is important to note observations conducted were part of the researcher's own job duties within the district and were used for the study due to the COVID-19 pandemic occurring concurrently with the data collection and analysis phase of the study.

Research Question Three *How were implemented changes perceived by teachers, counselors, and administrators?* To answer this question, the researcher analyzed interview data from all participants line by line, looking for general themes occurring during the interview process. The process included comparing and contrasting participant responses, diagramming and connecting key words and phrases, as well as collecting quotes which seem to help interpret emerging themes. As listed in Table 7, the researcher identified several predetermined themes related to equity, using Linton's Equity Framework (2011), and the learning theories of John Dewey (1916) and Lev Vygotsky (1978), but other themes surfaced during this process as well. Perceptions of stakeholders are important to answering the main research question as it helped understand the issues present prior to implementation of the new course designs as well as the stakeholder's perceptions of the current reality and the process as a whole. Document analysis and observation data did not support this part of the study so was, therefore, not included under Research Question Three.

Interview data. Linton's Equity Framework (2011) helped the researcher look for themes related to equity. In his framework, Linton's (2011) explains equitable schools should focus on building relationships with students, rigorous curriculum, course content relevant to their lives, and high expectations for all students. Participants (P4; P5) referenced building relationships with their students eight times during the interview process. One participant stated, "I've learned over the years, that if I speak to a student and teach a student, and get to his level, I am pretty sure I can reach that student" (P4). Two participants (P4; P5) both referenced building relationships with students during their interviews. One (P5) suggested using collaborative instructional strategies and

circulating among the groups made it easier to build relationships with students because teachers were having more conversations than what usually occurs when teaching from the front of the room. When speaking of the Algebra 1 Investigations class, one participant stated,

> I think for the most part, people have really enjoyed [problem-based] and the interaction and relationships you need to build with students, which is a whole lot different in that situation than in traditional. In traditional, you don't really get to hear from the students that often. I think it's really cool (P5).

Linton (2011) asserted establishing a rigorous curriculum is essential for ensuring all students have equitable experiences in schools. Watering down course content or tracking students in courses below grade level only increases the achievement gap rather than seeking to reduce it (Burris, 2013; Chestnut et al., 2018; Linton, 2011). Four of the five participants (P1; P2; P3; P5) mentioned the problem-based curriculum was more rigorous than the traditional curriculum. Participants (P1; P2; P3; P4; P5) suggested offering students a choice between Algebra 1 classes differing only in instructional strategies allowed a greater number of students access to abstract Algebra 1 topics. Increasing rigor was mentioned nine times during the five interviews (P1; P2; P3; P4; P5). Understanding rigor as it relates to the two course designs is important as participants did not always use the word "rigor." Participants remarks each suggested increased rigor and included comments about pacing in the traditional class (P3), increased access to Algebra 1 content (P1; P2; P3; P5), and supporting students who struggle by using collaborative teaming strategies (P5). One participant stated, "The

problem-based approach is almost harder because the student has to actually engage and think more about the material and form ideas on their own" (T3).

One participant (P2) stated, "With math being such a foundational building block, and what you learn at that freshman level is so important as you move through your high school years, I think meeting those needs is a must for everybody". Two participants (P4; P5) reiterated this thought by implying the new course structures prepared students for high school and future courses. Participant P4 mentioned a problem-based approach in Algebra 1 will better prepare students for other types of instruction, even direct instruction, later on down the road. The participant (P4) explained group work and problem solving "...makes them confident and capable of doing [math] on their own." Two participants (P4; P5) felt the new problem-based class helped students in other areas besides just the content. One stating,

> I feel like the problem-based approach prepares them well for college and for life after high school too, because it teaches them that life, in general, is not cookie cutter. Not everyone is the same and no one makes choices the same way. There's a good chance no one has experienced it the exact same way as you and being able to have confidence to move forward [with a problem] even when something is not presented in the right way (P5).

Participants (P1; P2; P3; P4; P5) seemed to agree the pace of the traditional approach was faster when compared to the problem-based approach. One participant (P3) admitted,

> I don't know if that's better though. You know the saying, "a [curriculum] a mile long isn't as good as a mile deep" (P3).

The same participant (P3) believed, however, a more investigative approach needed to be brought back into the classroom, but felt "time has always been the biggest enemy" (P3). The participant (P3) explained, "We have to take 15-20 minutes of class time to try to get the students to discover something where we could have taken 5 minutes of class time to tell them where it comes from." The participant (P3) went on to explain the data was just not available to validate whether offering students a choice between Algebra 1 classes differing by instructional strategies was better or not. However, another participant (P2), did state the school's over all End-of-Course Exam scores had not decreased since implementing the new course structures.

Linton (2011) found equitable schools use course content which is relatable and relevant to student's life. During the interviews, participants (P3; P4; P5) referenced relevancy eight times. Participants used phrases like "discovery learning" (P5), "real world approach" (P5), and "preparation for life experiences" (P4; P5) which were perceptibly, related to relevancy. The researcher, however, also included in the count phrases such as "critical thinking" (P5) and "problem solving" (P3; P5) both of which imply real world approaches and soft skills. One participant (P5) stated,

> When the problem is a little bit different, they have to figure out a new way to do it that's not foreign to them and that happens in life. When they make a mistake and learn from it, they can say, 'Okay, I made a mistake, but I'm going to try something different.' That applies to life too (P5).

Higher expectations, however, does not automatically contribute to higher achievement (Boaler, 2016; NCTM, 2018; Tomlinson, 2018). Researchers also suggest embedded supports should be in the form of collaborative learning, a problem-based

curriculum, and extended time (Boaler, 2016; Cohen & Lotan, 2014; NCTM, 2018; Tomlinson, 2018). During the interview process, the researcher noted four instances participants mentioned embedded supports for struggling students (P1; P2; P3; P4; P5). In the Algebra Investigations course, students are supported through collaboration and teaming strategies. The school also offers an additional support class in the form of a Math Lab to give students extended time on topics if needed. The support class is optional and open to any student who wishes to enroll, but was ultimately created to support struggling students with the pace of the course and content. Linton's (2011) Equity Framework states equitable schools should offer rigorous courses but, must support the change a more rigorous course will require. Embedded supports are what sustain equitable schools (Linton, 2011).

Research Question Four. *What were the results after implementing the new Algebra 1 course structures?* Common questions after starting a new initiative is 'Did it work?' and 'So What?' The goal of Research Question Four was to explore changes which occurred following the district's implementation of offering ninth graders a choice between Algebra 1 courses differing only by instructional strategies. To answer Research Question Four, the researcher first examined interview transcripts, looking for common themes related to any significant changes surfacing following implementation. The researcher then searched through the master schedule data and achievement data to determine if changes existed in either of the data sets as well. The findings from each of the searches described in the following sections.

Interview data. Encouraging mathematics educators to change traditions grounded in years and years of practice is no easy task. Reeves (2009) stated two

common misconceptions among leaders is believing people like change and believing people like collaboration. Change in practice does not occur without a culture open to change (Reeves, 2009). Carol Dweck (2016) describes a person's disposition toward change as a "growth mindset" (p. 7). Dweck's (2016) "growth mindset" is the state of believing a person's basic qualities are things which can change through one's efforts. Contrary to a "growth mindset" (p. 7) is a "fixed mindset*"* (p. 6) which is the state of believing people are born with only a certain amount of intelligence. People with "fixed mindsets" (p. 6) are also change resistant (Dweck, 2016).

Understanding the theories allowed the researcher to identify key words or phrases which implied each stakeholder's willingness to change, a resistance to change, or difficulties with change. The researcher then identified what actually changed as a result of offering students a choice of Algebra 1 courses differing only by instructional strategies. In doing so, the researcher noted 58 instances where participants (P1; P2; P3; P4; P5) mentioned a reference to the change in course offerings or stakeholder's disposition toward the change. To analyze key words and phrases further, the stakeholder's disposition was broken down to a "fixed" (p. 6) or "growth mindset" (p. 7) and issues related to change resulted in the subtheme 'miscommunication.'

Of the 59 references regarding change (P1; P2; P3; P4; P5), the researcher noted 23 instances when participants (P2; P3; P4; P5) referenced an issue with communication of the new programs. Four of the five participants (P2; P3; P4; P5) mentioned there were still misconceptions about the choice offering. Students, parents, and other teachers in the building perceived the new Algebra Investigations class as the new, below grade level Algebra 1 class (P2; P3; P4; P5). One participant stated,

> [Parents] feel like the Investigations class is more of a lower-level class and trying to convince them it's not is very difficult. Just trying to get over that hurdle has been a big one (P2).

Another participant (P4) said many questions came during open house night. Parents wanted to know how students would benefit from the problem-based class (P4). Ultimately, many parents, students, and other teachers in the building think the traditional Algebra is the more challenging class not realizing the content learned in both courses is the same (P4).

For true change to occur, mindsets must change (Dweck, 2016; Reeves, 2009). Mindset was another strong subtheme related to the results. Out of the 22 references (P1; P3; P4; P5) to the stakeholder's disposition toward the new course changes, 14 implied a "growth mindset" (p. 7) and 8 implied a "fixed mindset" (p. 6). Mindset references can be broken down further and categorized by teacher, principal, counselor, parent, and student. The detail of these breakdowns can be seen in Table 13.

Table 13

Mindset References Broken Down by Stakeholder

	Student	Teacher	Parent	Principal	Counselor	Total
Growth Mindset	9	4	1	0	0	14
Fixed Mindset	0	4	1	3	0	8

Overall, mindsets toward the implemented changes seemed positive even though every teacher participant in the study self-assessed their own teaching style as a traditional, lecture style, before the implemented changes. One participant (P4) described their prior style by stating,

> I was the one standing in the front of the room with an old roll projector and a Vis-à-vis pen. I had a spray bottle to wipe down my projector. My hands would get all blue! You know, I was *that* teacher! Students taking notes, one doodling, one falling asleep, …looking forward into today's problem-based classroom, now I get engagement! We did the whip-a-round, the gallery walk, we stand up, reciprocal teaching, play until the music stops, high fives, somebody fist bump, what slope-intercept form means, where do we start, and where do we end (P4)?

Teaching this way didn't come naturally for teachers at first. One participant (P4) explained a sense of nervousness when first teaching the new problem-based Algebra Investigations course. When describing the transition to the problem-based approach, the participant stated,

> Speaking from a teacher that had a total fear of it and could not sleep in [thinking about] out how I'm going to teach this, and [I'm a] teacher who's experienced, and then it only took me two weeks to say, 'Hey, this is great!' (P4).

Collaboration among teachers teaching the course as well as the training the teachers received seemed to be an essential part of the change. Three participants (P3; P4; P5) mentioned collaboration between teachers had been helpful in learning how to teach differently. One participant (P3) stated, "Being thrown into it, it was nice to have colleagues on our team to help each other." Three participants (P3; P4; P5) mentioned training was helpful in learning new teaching strategies. Teachers in the district completed four consecutive days of training at the end of the school year prior to implementing the new classes, and then were pulled out of the classroom for four more days during the first year of implementation. According to one participant (P3),

"Trainings made me more comfortable to add these strategies to my traditional course as well which I have always wanted to do." Two of the participants (P3; P5) mentioned an interest in incorporating the strategies into their traditional class or might do so the next school year. One participant (P4) stated,

> Teachers teaching problem-based learning are also learning from their students and are surprised when a student approaches a problem differently than the teacher anticipated. When students find something or see something that I didn't, I think that grows me even more as a teacher (P5).

The observation of one participant (P1) was recognizing an overall change in the teachers. The participant stated,

> I think there is an openness to [problem-based teaching] now. I just don't think they [the teachers] always know how to teach that or how it translates to other classes (P1).

The participant (P1) continued by stating the training and new course designs had opened more doors for teachers in regard to their repertoire of teaching strategies. The participant (P1) also believed the choice design increased accessibility and allowed more students to be successful in Algebra 1.

Document Analysis. Linton's (2011) Equity Framework includes setting high expectations for students and encouraging students to reach the expectations. During the interviews, the researcher counted 11 instances of participants (P1; P2; P3; P4; P5) implying the new course structures set higher expectations for students than when the school only offered a traditional approach to Algebra 1. One participant (P1) suggested the reason for adding the new course to the school's list of courses was due to increasing

numbers of students enrolling in the two-year Algebra 1 approach. The participant (P1) stated,

> We felt there was a group of students that were opting into the lower level or slower level that really needed to be in Algebra 1, but they needed a little support, in other words, those 'between' students (P1).

Another participant (P3) suggested one of the by-products of the new course design was reduced numbers of students in the two-year approach to Algebra 1. The researcher was able to support the claims of both participants when collecting the schedule artifacts. Before implementing the new course designs, the school district enrolled 111 students in six sections of Concepts of Algebra 1A (the first half of Algebra 1 taught in one year) and during the year of the study reduced the numbers to 56 students enrolled in three sections of Concepts of Algebra 1A. Table 14 shows the breakdown.

Table 14

Concepts of Algebra 1A Master Schedule Data Before Implementation vs Current

School year	Number of sections	Number of students
2016 - 2017	6	111
2019 - 2020	3	56

Further document analysis included examining Algebra 1 End-of-Course (EOC) data from the year prior to the implementation of the new course structures to the year before the study. The data included the school years of 2015–2016, 2017–2018, and 2018–2019 (the data from the school year 2016–2017 was not available on the website). Algebra 1 EOC data was retrieved from the *Missouri Comprehensive Data System* website. The researcher also included state data as a frame of reference for the school's

EOC data. Table 15 displays the percentage of students who received a score of advanced or proficient for each of the years studied.

Table 15

Percent of Students who Achieved an 'Advanced' or 'Proficient' on the Algebra I EOC

School Year	School Percentage	State Percentage	School/State Ratio
2015 - 2016	83.6	65.8	1.27
2016 - 2017	data not available		
2017 - 2018	61.6	46.9	1.31
2018 - 2019	60.6	45.3	1.34

As a frame of reference, the school piloted the first year of the choice design during the 2016–2017 school year when data was not retrievable on the state's website. The researcher, however, also pulled data from the year before the first year of implementation. For example, in 2015–2016, 65.8% of the students in the state received a score of advanced or proficient on the Algebra 1 assessment, compared to 83.6% at the school of the study. In order to compare the change over the three school years, the ratio of school to state percentage is also displayed. The ratio can be interpreted as the percent of students receiving advanced or proficient at the school for every one percent of students who received advanced or proficient in the state. In the school year 2015–2016, the ratio was 1.27. The interpretation of this ratio represents for every 1.27 percent of students in the school earning advanced or proficient on the Algebra EOC, there is one percent of the students in the state that are the same.

Summary

Chapter Four of the study presented the data analysis and included a description of participants as well as a breakdown of themes emerging from interview transcripts, document artifacts, and the researcher's own observation notes. The analysis was broken

down by research question to help tie the data to each of the research questions of the study. Overall, participants seemed to support the new changes and believed addressing equity issues and Algebra 1 retention rates was more about supporting student learning styles rather than believing some students are just incapable of learning mathematics. The study found multiple instances where offering students a choice in how they learned Algebra 1 course content transitioned to more equitable approaches. Using Linton's (2011) Equity Framework as the theory base for the study, the researcher was able to identify improved opportunities for relationship building, instances of access to more rigorous Algebra 1 content, and increased opportunities to offer content relevant to lives of students'. Perceptions of the participants proved invaluable to exploring this phenomenon and offered a unique perspective describing the course choice offering for students.

Chapter Five brings together the findings, offers conclusions, and the researcher's recommendations moving forward. In addition, Chapter Five includes the researcher's own professional opinions based on a combination of findings from the literature review and of the findings gleaned from the data collected from the participants at the site of the study. Chapter Five also includes a discussion of findings, implications for educators in the field, and suggestions for future studies.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The intent of this study was to explore stakeholder's perceptions of offering ninth grade students a choice in earning their Algebra 1 credit. Students in the southwest Missouri school used for the study could choose from either a traditional Algebra 1 class with a focus on teacher-led modeling and direct instruction or a problem-based Algebra 1 class which used a combination of real-world tasks and collaborative teaming to develop a conceptual understanding. Participants in the study included one principal, one counselor, and three teachers assigned to teach the varying approaches of Algebra 1.

The framework of the study was a combination of theories from the work of Curtis Linton (2011) and his Equity Framework, Lev Vygotsky (1978) and his Sociocultural Theory, and John Dewey's (1916) theory of Progressive Education. The theories offered a collective framework for equitable schools and research-based learning theories. The combination of the three theories allowed the researcher to view the phenomenon from perspectives tying together equitable practices and sound pedagogy.

The following central question guided the study: How was equity and accessibility addressed when a school district in southwest Missouri offered ninth grade students a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach? The following sub-questions helped frame the study:

1. Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?

2. How did offering students a choice between differing approaches to Algebra 1 influence a student's response to learning the content?
3. How were implemented changes perceived by teachers, counselors, and administrators?
4. What were the results after implementing the new Algebra 1 course structures?

The study took place at a school district in southwest Missouri. The purpose of the study was to explore stakeholder's perceptions of offering ninth grade Algebra 1 students a choice between two differing instructional approaches. One approach was referred to as the "traditional" approach and delivered primarily through direct instruction. The other approach, called Algebra Investigations, incorporated a problem-based approach and was delivered primarily through problem-solving, collaborative teaming, and the teacher acting as facilitator. Both classes offered the same course objectives and were scheduled to take the same End-of-Course (EOC) exam at the end of the school year.

Chapter Five includes conclusions of the study and the researcher's recommendations moving forward. Implications for practitioners in the field are also addressed. Specifically, Chapter Five includes limitations, a summary of methods, the results and outcomes, a discussion of findings, implications for educators, and suggestions for further research.

Limitations

One might argue when addressing and reporting on systems which may or may not pose equity issues, bias of the researcher, as well as the participants, must be

acknowledged as a limiting factor of the study. The limitations of the study included bias on the part of the researcher, as well as the participants, when defining what constitutes as more accessible or more equitable. In order to understand stakeholder's perceptions, the researcher assumed participant's were honest and offered complete thoughts when responding to interview questions. In addressing this limitation, the researcher used one-on-one interviews, allowing participants to speak openly without judgement from peers and also used probing questions to extend each participant's thinking further. Participants responded to interview questions using their own experiences and viewpoints. The researcher assumed bias was present as stakeholder's reflected on and responded to interview in order to address issues of equity.

Researcher bias was also a limitation of the study. Acknowledging the possibility of implicit bias when discussing issues of equity is important as it may have influenced the lens of the researcher. It is important to disclose the researcher was an instructional coach at the school at the time of the study but was not an evaluator or supervisor of the participants in the study. By performing a thorough review of literature, the researcher was able to gain an objective viewpoint of what the profession deems as equitable practices in mathematics instruction. Using the literature review and theoretical framework, the researcher was able to reduce the possibility of allowing pre-conceived notions or the researcher's own preferences to affect outcomes. It is important, nevertheless, to acknowledge limitations could exist due to the researcher's own deep beliefs that equity issues in mathematics education actually do exist and must be addressed.

Summary of Methods

The components of a qualitative case study are described as multi-method in focus and should involve a descriptive, informational, and natural approach to the subject of the study (Creswell & Creswell, 2018; Gay, Mills, & Arisian, 2009). In this study, the researcher described the phenomenon in its natural setting by using a qualitative analysis case study. Qualitative research describes personal experiences through interviews, observations, textual, and numerical data to understand the phenomena of the study (Creswell & Creswell, 2018; Gay et al., 2009; Merriam, 1998). The purpose of this qualitative case study was to describe the phenomenon leading up to the implementation of new course offerings, perceptions of participants experiencing the phenomenon, and the implications resulting when students were offered a choice between traditional Algebra 1 or Algebra 1 using a problem-based approach. This study described the process, structures, and outcomes of one public school in southwest Missouri in an attempt to increase rigor and access to ninth grade Algebra 1 courses.

Triangulation of data. Triangulation of data allows a researcher to inspect evidence from three different sources and increases trustworthiness, authenticity, and credibility of a study (Creswell & Creswell, 2018). In this study, the researcher utilized interviews, observations, and document mining to collect data and justify themes which emerged. To gain the perspectives of the stakeholders, the researcher conducted interviews with a principal, a counselor, and three teachers. Conducting interviews and cross-referencing responses allowed the researcher to identify common themes emerging from the participant responses. Member checking ensured the participants had the opportunity to change thoughts or add to their thinking.

In addition to interviews, the researcher also used observation data to get a deepened perspective of the similarities and differences of the two courses offered. Due to the COVID-19 pandemic occurring simultaneously with the data collection and analysis phase of the study, the committee advising the study approved using the researcher's own observation notes from the semester prior to substitute for observations intended during the pandemic. The researcher's observation notes resulted in data related to NCTM's defined Mathematics Teaching Practices (NCTM, 2014a) and student data in the form of frequency of opportunities to respond to the teacher or another student during a ninety-minute observation.

Document mining was also utilized as the researcher collected artifacts related to the study. Documents collected included first semester course drop data for the Algebra 1 courses, Algebra 1 End-of-Course data, and master schedule data from the year of the study as well as from the year prior to implementation of the new course designs. Document mining completed the triangulation of data for the study.

Results/Outcomes of the Study

The study had one central question and four related sub-questions. All four sub-questions revealed one or more major themes. The rationale for the research questions was to explore a gap in literature involving unique solutions to a chronic issue related to mathematics achievement. Mathematics achievement, in and of itself, is historically well-researched. New curriculums and new strategies are proposed, studied, and then practiced in the field. Mathematics educators continue to look for the golden nugget when it comes to mathematics for all students. The school district in this study offered a unique solution to an age-old problem as they incorporated a multi-faceted approach to learning Algebra

1 content. The researcher chose to explore the decisions leading to, perceptions of stakeholders, and outcomes resulting from the unique approach to teaching Algebra 1 to ninth graders.

In order to frame the study and ensure it was grounded in research, the researcher used Linton's (2011) Equity Framework, as well as the learning theories of Vygotsky (1978) and John Dewey (1916) as the theoretical frameworks for the study. Using multiple frameworks allowed the researcher to explore the phenomenon with an equity lens but also with the lens of improving instruction for all students through best practices. The triangulation of data included five participant interviews, classroom observations, and document analysis of EOC data, course retention data, and data retrieved from an analysis of the school's master schedule. From this analysis, the researcher was able to fill a gap in research related to improving Algebra 1 instruction from not only a best practices lens, but from an equity lens as well. The school district used in the study offered a unique perspective in providing students two different approaches to Algebra 1 in an attempt to improve retention rates and student achievement. The researcher was able to draw conclusions from the unique phenomenon and make implications for mathematics education as well as recommendations for future studies.

Research Question One. Research Question One was *Why did the school offer students a choice between two different instructional approaches to Algebra 1 course content?* From this research question, the researcher concluded the school offered different approaches because the school believed offering two approaches allowed instructional strategies to match student learning styles. Every participant in the study mentioned, or alluded to, a student's learning style in response to this question.

Participants believed some students did not fare well in a lecture-style format and were more inclined to learn through hands-on, investigative approaches. Dewey's (1916) Progressive Learning Theory supported the school's decision as the theory asserts students learn by experiencing new content and relating it to previous content. Participants each agreed some students need a conceptual approach to understanding course content and benefit from a more research-based approach to learning mathematics. Specifically, participants stated students benefit from collaborating on real-world problems to learn abstract math topics and participants all agreed some students learn better using a conceptual instructional approach rather than an approach using primarily direct-instruction. Subsequently, Vygotsky's (1978) work found students learn through meaningful social interactions with other students. Vygotskty (1978) believed students learn as they interact and communicate with others making connections to each other's experiences related to new content. Additionally, Linton's (2011) Equity Framework asserts schools ensure a more equitable experience by engaging students in rigorous course content relevant to their lives. Teaching mathematics with meaning is related to a large body of literature which attests to improved access to Algebra 1 through relevant course content (Albanese & Mitchell, 1993; Boaler, 2002c; Linton, 2011; Sigurdson & Olson, 1992).

To support more rigorous mathematics, participants stated the problem-based Algebra 1 students worked in collaborative environments. Participants mentioned allowing students to work in teams offered embedded supports for struggling students as well as students who were not confident math learners. A large body of literature supports collaborative learning environments as well. For example, Vygotsky's (1978)

Sociocultural Learning Theory identified students learn best when they draw from the experiences of others in a collaborative environment. Recent literature affirms Vygotsky's (1978) theory, relating student discourse as an effective method, helping students solidify understandings by making connections to previous knowledge (Cohen & Lotan, 2014; Keedy & Drmacich, 1994). In using a problem-based approach, combined with collaborative teaming strategies, participants believed they were reaching more students than with lecture-type classes alone. The newly learned teaching strategies had an impact on traditional classes as well as participants stated teachers were incorporating a more diverse collection of teaching strategies into the traditional Algebra 1 course. In other words, direct instruction in the traditional classrooms seemed to include more student discourse and student collaboration than what was previously used. Furthermore, participants expressed the new teaching strategies helped some students feel confident in mathematics, resulting in a positive impact on course retention rates. Current literature supports the Linton's (2011) Equity Framework recognizing improving student's self-confidence in mathematics through relevant material and diversifying instructional strategies supports learning rigorous course content (Beilock, 2014; Bernard, 2016; Maloney et al., 2015).

In addition to interview data, course retention analysis revealed data related to why the school district needed a change. The researcher revealed prior to implementing new course structures, during the 2016–2017 school year, 18 students dropped first semester Algebra 1 in favor of a two-year approach. In the year of the study (2019–2020), however, only three students transferred to first semester Algebra 1 course content in favor of a two-year approach class. The data revealed an 83% reduction in the number

of students opting for the two-year approach to Algebra 1 following the implementation of the new course structures. Course retention data clearly confirmed, prior to implementing the new course structures, students were, indeed, struggling with Algebra 1 course content. The researcher, however, was not expecting participants to suggest the reason for student's struggle was because of a difference in learning style. Rather, the researcher assumed participants would have a "fixed mindset" (Dweck, 2016) believing some students are inherently not 'math people' or perhaps lack of success in Algebra 1 was because students were just lazy and did not want to do the work. The researcher's assumption, however, was incorrect. Participants believed some students just learn differently and must be taught differently to understand abstract course content. Addressing student's learning style and improving course retention rates were the primary reasons the school chose to implement the new course structures.

Research Question Two. Research Question Two was *How did offering students a choice between differing approaches to Algebra 1 influence a student's response to math?* In exploring data related to Research Question Two, the researcher noted several themes associated with the influence a choice offering had on student's response to math, both through interview data as well as the researcher's own observation notes. Collectively, an analysis revealed themes centered around student choice and educator choice. Specifically, choice related to how students learn, instructional methods chosen by teachers, and how problems were solved. The theme of choice was supplemented by a theme related to a student's overall disposition toward learning math.

Overall, it was noted students liked and appreciated the opportunity to choose how they learn Algebra 1. Participants agreed choice gave students ownership, buy in,

and helped students engage in the content. Research supports the findings claiming a student's disposition toward a topic has a positive influence on achievement and learning of the topic (Dweck, 2016; Dunleavy, 2018; Richard & Nillas, 2017; Samuels, 2020). Participants believed, however, student buy-in and positive attitudes in the classroom was largely due to allowing the students to choose how they learned Algebra 1. Participants mentioned the school gauged community and student interest by counting initial enrollment numbers. If students were signing up for the new investigative course, then it was apparent there was an interest in offering the class. Participants did seem to agree, though, some students just preferred to learn from a more direct approach rather than an investigative approach. Believing students have a learning style or preference of teaching strategies might explain why the traditional approach to Algebra 1 was still offered at the school.

Another key word which emerged related to Research Question 2 was the word "method." Participants mentioned some form of the word 48 times over the course of all the interviews combined. The researcher found both students and teachers were allowed to choose problem-solving methods and teaching methods more often than before implementing the new choice design. Not only could students choose how they took Algebra 1, but in the problem-based class students were not required to use a pre-determined algorithm or procedure for solving problems. Students were, instead, allowed to explore all strategies and choose the strategy which made sense. Research on problem-based learning suggests productive struggle and working on tasks relevant to students lives, help students make connections among typically abstract topics (Muhammad, 2015; Patton et al., 2016; Tomlinson, 2018). Teachers, in both classes, were allowed to choose

how content was delivered. However, in the problem-based course approach, teachers seemed to use a more abundant and varied set of instructional strategies than strategies used in the traditional approach. The researcher believes it was the varied approach to teaching the content which allowed more students to pass Algebra 1. Research supports implementing varied approaches and finds students perform better when allowed to choose visual and tactile strategies when engaging in mathematics (Richard & Nillas, 2017). Using a variety of teaching strategies, as well as using heterogeneous grouping, allows opportunities for embedded support systems in a class normally thought of as very abstract. Heterogeneous grouping offers struggling students, as well as stronger math students, opportunities for growth. In heterogeneous classes, struggling students benefit from conversations with students who understand content sooner and stronger students benefit from articulating mathematics to their peers; thereby solidifying understandings of all students in the classroom , rather than just the mathematically inclined students (Cohen & Lotan, 2014). It is the combination of decreased tracking and increased instructional strategies which seemed to have the biggest impact on student's response to mathematics at this school (Burris, 2013; Burris & Welner, 2005; Linton, 2011).

The last major theme of Research Question Two was a student's math disposition. Research supports math disposition and its effect on a student's intention to drop out (Alivernini & Lucidi, 2011). Alivernini & Lucidi (2011) stated self-efficacy and self-determined motivation were both indicators of a student's academic performance and intention to drop out of school. In this study, the researcher found instances of improved math disposition and categorized the themes into math confidence, math engagement and ownership, and math enjoyment. According to participants, the problem-based math

course increased student's math confidence by using small, collaborative groups focused on rigorous problems relevant to student lives. Participants claimed students had more buy-in, not only in choosing the math course which matched their learning style, but also in choosing how to engage with and solve complex math problems (Dweck, 2016; Dunleavy, 2018; Samuels, 2020). Teachers, as well, seemed satisfied with the new teaching strategies and were incorporating more diverse strategies into classroom lessons. Every teacher in the study indicated an increase in the number of instructional strategies used beyond relying primarily on a traditional, direct-instruction approach including the teacher teaching the traditional Algebra 1 course. Overall, the findings of the study identified the new teaching strategies made math more enjoyable for both teachers and students.

The researcher attributed the increased instances of using a variety of instructional strategies to the intense, sustained, professional development received over the course of the year. The school in this study devoted one week of professional development prior to implementing the new course structures and supported the new learning with four follow-up professional development days throughout the year. In addition, teachers were supported with embedded instructional coaching and a classroom observation by a professional in the field. Researchers find professional development is critical to the implementation of new programs and should be a process occurring over time; and thus, not an isolated event (Bonner, 2019; Foster, 2017; Hackett, 2019)

Classroom observations supported these findings as well. Linton's (2011) Equity Framework states fostering good relationships between students and teachers is imperative in supporting an equitable approach to academics. Relationship building was

evident in both the interviews and the observation data. Participants mentioned conversations were easier with students in the problem-based classroom since the teachers were out in the classroom more. Relationship building was also evident during the researcher's classroom observation. Out of NCTM's eight mathematical teaching practices, seven were noted in the problem-based classroom observations compared to observing only four of eight practices in the traditional classroom (see Table 11). In addition, the researcher noted 166 opportunities for students to respond to the teacher during the problem-based classroom observation compared to only 23 opportunities in the traditional classroom.

Research Question Three Research Question Three was *How were implemented changes perceived by teachers, counselors, and administrators?* This research question revealed three major themes: building relationships with students, ensuring rigorous course content, and implications beyond the classroom. Most participants agreed the new problem-based curriculum helped teachers establish relationships with students as the teachers were circulating around the classroom having conversations with students more in the problem-based rather than primarily at the front of the classroom as in the traditional approach. In addition, using a variety of instructional strategies allowed for more conversation between students and teachers as well as among students themselves. Vygotsky (1978) claims conversations and connections allow students to build understanding about the world around them and are critical to learning. Linton (2011) agrees but also believes the conversations help build relationships in the classroom an element of equitable instruction. In this study, collaboration and conversation among peers and between teachers/students in the problem-based class seemed to foster

connections and trust relationships more so than in the traditional classroom. Furthermore, literature also suggests even off task conversations help build relationships necessary to encourage truly productive, collaborative, and effective group work (Cohen & Lotan, 2014).

In addition to building relationships, participants mentioned on multiple occasions, the problem-based course was more difficult than the traditional course. Students in problem-based course are required to think through non-procedural problems prior to being taught the algorithm. The non-procedural types of problems are often referred to as group-worthy tasks and are used to build conceptual understanding and relevancy of the upcoming algorithmic procedure. Linton (2011) stated equitable schools hold students to high expectations and ensure access to rigorous course curriculum for all students. Unfortunately, a more rigorous curriculum often equates to tracking students into slower paced, below grade level courses. Proponents of tracking claim students have an irreversible gap in their education, which is so large, no amount of instruction can ever fill the gap (Delpit, 2012; Hanushek et al., 2019; Harry & Klinger, 2006; Horn, 2006). On the contrary, a large amount of literature, however, identifies what actually improves student achievement is raising expectations for children and keeping students in classes with their peers (Delpit, 2012; Hanushek et al., 2019; Harry & Klinger, 2006; Horn, 2006). The school district in this study had improved course retention rates in Algebra 1 following implementation of the new course structures. It was clear the school in the study had a positive impact on the number of students passing Algebra 1 which, in turn, increased rigor for a greater number of students.

The last theme related to Research Question Three had implications extending beyond the classroom. Participants agreed the problem-solving course offered more than just course content. The course offered critical-thinking skills related to problem-solving; invoked math confidence and developed student's collaboration and cooperation skills. The literature review supports this conclusion as a growing number of professionals in the field attest to the mere fact improving mathematics education goes beyond making sure all students have access to rigorous course content (Boaler, 2016; Symons et al., 2016). Symons et al. (2016) believe mathematics agency is a result of a series of micro events. The micro events allow scaffolding of concepts and build confidence along each step in the process; thereby, building not only understanding, but also a sense of self efficacy. According to Symons et al, (2016) the self efficacy lasts throughout the course and well into the student's future endeavors.

Research Question Four. Research Question Four was *What were the results after implementing the new Algebra 1 course structures?* Analysis of this research question revealed several different themes. Related to the change, the researcher explored comments which revealed a "growth mindset" versus a "fixed mindset" to determine the organization's overall attitude toward the change (Dweck, 2016). Literature on this topic revealed mindset plays an important role in determining a person's ability to persevere in learning new course content (Coyle, 2016; Dweck, 2016). The analysis in this study revealed an overall "growth mindset" to "fixed mindset" ratio of 7:4, revealing the organization accepted the new course structures (see Table 13). The school, however, struggled to communicate the new choice design to parents, students, and other teachers in the building. Linton (2011) states it is easy for society to blame demographics,

backgrounds, socioeconomic status, or race as the cause for underachievement in mathematics and asserts some educators perceive they have done all they can do for students and can do no more. Dweck (2016), however, reminds the profession not only do students need to believe in their unlimited potential, but educators must do so as well. The literature review revealed high-achieving students with a low-socioeconomic background had a 50% chance of being placed in an upper-level mathematics class (Burris, 2013). Mindsets were still an issue for the school in this study regarding other teachers in the building as well as from parents. Almost all of the participants mentioned the new Algebra Investigations course was perceived to others as the new below grade level math class despite efforts to communicate the course's equivalence to traditional Algebra 1.

In addition to mindsets, teachers seemed more prepared to add a variety of instructional strategies to their classes. An unintended outcome found during the study was, not only were teachers using the newly learned instructional strategies in the Algebra Investigations course, but were incorporating some of the strategies into their traditional classes as well. One teacher stated how they wish they knew twenty years ago what they know now. Through an extensive review of literature, the researcher revealed a large emphasis must be spent on professional development for teachers if catalyzing change in mathematics education is the true vision of a school (NCTM, 2014a). Anderson et al. (2018), asserted, however, professional development should shift from how to teach mathematics to ideas about who can achieve. The researcher of this study concurs and believes without a true vision of what equitable mathematics instruction looks like and a strong commitment from mathematics leaders toward this end, long-lasting change will

not occur. With so many initiatives schools implement, unless a clear vision and dedicated commitment are present, efforts will just become another fad or trick to get students to jump through hoops. In this school, however, teachers expressed the district had a commitment to professional development. Professional development, along with collaboration among peers, was what helped teachers learn new strategies and teach a diverse group of students. Diversifying instruction was evident with the lower retention rates following the implementation of the new course designs. With continued collaboration amongst teacher peers, including eight days of training, the teachers felt more comfortable meeting the needs of a diverse group of learners. Through the training, the teachers learned how to embed formative assessments into daily instruction and address student misconceptions in real time. The immediate feedback helped meet students at their current level of understanding and provided opportunities for teachers to move student's learning forward instantly rather than waiting for a formal assessment to address deficiencies. The researcher attributes the changes back to the teacher's "growth mindset", positive attitudes, acceptance that some students just learn differently, and the urgency to keep students in grade-level course content (Dweck, 2016).

Discussion

Tracking students into below grade-level classes dates as far back as the Progressive Era of the 1920s when industrialization and an influx of immigration collided (Burris, 2013). During the time of the Progressive Era , Americans wanted their children to take college-preparatory classes and believed immigrants would slow classes down due to their lack of English-speaking abilities (Burris, 2013). People believed schools should create differentiated curriculum to meet the needs of a diverse society (Burris,

2013). The belief ultimately evolved to tracking based on a merit system and the idea academic ability was the deciding factor as to which track a student would be assigned (Burris, 2013).

By the 1970s, researchers were beginning to question the common practice of tracking students in mathematics and educators began noticing how a student's own self-awareness of being placed in below grade-level classes affected their mindset toward learning as well as behavior during class (Burris, 2013). Students called themselves the 'dumb class' and teachers were finding the classes hard to manage. Behavior management issues were attributed to student's awareness of being labeled 'dumb' and unable to learn mathematics at the same pace as their peers. This, combined with being surrounded by other students of the same mindset, was causing classes to become hard to teach and difficult to manage.

Unfortunately, the practice of tracking students in slower-paced course paths still exists in schools across America (Bieda & Staples, 2020). Schools seem to do whatever it takes to help students pass classes. Typical strategies include, but are not limited to, placing students into programs using self-led software, partial content courses, and 'testing out' of a class just to name a few. Research spanning many years reveals, it is not the content itself is not what is causing students difficulty, but rather how the content is taught and delivered is the real issue (Balka et al., 2010; Burris, 2013; Delpit, 2012) . In other words, the way mathematics is traditionally taught is largely to blame for student failures. Bieda & Staples (2020) believe mathematics educators can create a more equitable approach to mathematics learning through engaging students in mathematics justification. According to Bieda & Staples (2020), mathematics justification is a process

which requires synthesizing mathematical concepts, then justifying those concepts through reasoning, and then explaining why an answer makes sense. The findings of Bieda & Staple's (2020) study paralleled this research. In using a problem-based approach with collaborative teaming, the school district provided opportunities for students to justify their reasoning and make sense of mathematics through conversation and rigorous tasks. Conversation leads to understanding abstract topics through reasoning and creates a more level playing field for all mathematics students by doing two things: (1) providing access and (2) developing mathematical agency (Bieda & Staples, 2020; Boaler, 2016; Vygotsky, 1978). The teachers in the school used for this study learned, through intense professional development, how to facilitate student conversations toward a lesson goal and use strategies to support student agency and identity. Creating a culture of learning where students are supported and encouraged to try and fail as a normal part of the learning process is what helped the school decrease the number of students opting into the two-year approach to Algebra 1.

True mathematics understanding can certainly be possible for all students when educators and their leaders begin to address equity issues in mathematics education. Addressing equity issues includes discontinuing practices allowing students to receive mathematics credit for simply 'checking a box'. Linton's (2011) Equity Framework calls for holding students accountable to high expectations, not just in mathematics, but in all areas. Unfortunately, leaders at all levels are either unaware of how to stop tracking students, are afraid to buck the system, or have too many responsibilities to take the time needed to make true change occur. Mindsets must also change. Old traditions of tracking students is a difficult pattern to change. Some educators believe all students do not need

strong backgrounds in mathematics to be successful in future endeavors. The reasearcher of this study argues if educators keep teaching mathematics as a system of memorizing routine procedures out of context, then most of the mathematics taught beyond eighth grade will be truly unessential and in doing so society's belief a 'math person' truly will be fulfilled. If the fundamental way in which mathematics is delivered and taught will change to reflect essential, life-enhancing skills such as critical thinking, problem solving, collaboration, and looking for patterns, not only can equitable instruction be achieved, but an argument for all students to complete an Algebra 2 course before graduation becomes more feasible.

Overall, participants in the study liked the choice design approach to meet the needs of all their learners and appreciated the new repertoire of instructional strategies. When designing the researcher assumed teachers would favor one approach over the other and seek to persuade their administration to drop one of the courses. The researcher did not expect teachers to embed newly learned teaching strategies into their traditional courses as well. The training the teachers received seemed to have an effect which was immediately useful in classrooms and provided a glimmer of longevity and sustainability. The learned strategies may have changed the way many of the teachers traditionally viewed best practices. Although most teachers seemed to prefer teaching the problem-based class over traditional direct-instruction, all participants agreed offering both classes was what was best for students. Participants believed offering students a choice between two Algebra 1 courses differing only by instructional strategies helped students buy-in to Algebra 1 and resulted in greater achievement overall.

This study fills a gap in research which lacks case studies directly related to addressing equity issues in mathematics. The multi-method approach implemented by the school used in the study offered a unique solution to address Algebra 1 retention issues. The school's unique solution to equity issues in Algebra 1 filled a gap in research by allowing the researcher to study stakeholder's perceptions of providing student choice between two course designs of Algebra 1. The study, however, was limited to one school in southwest Missouri. In this school, equity was addressed, not by implementing new programs school wide, but by offering students a choice between the old and the new courses. The study took place over a one-year time span and included teachers and students participating in ninth grade Algebra 1. The year of the study offered challenges created by the COVID-19 pandemic. However, the COVID-19 pandemic did not disrupt interviews, but did disrupt the researcher's ability to have conversations with students taking the courses.

Overall, insights from the participants were informative and provided enlightening perspectives which were helpful in painting the picture of the phenomenon. In exploring the school and in describing the school's answer to addressing equity, the study offers possible transfer to other schools considering accessibility and achievement issues in their own mathematics classes. Replicating and improving structures created in one district can improve practices for many other districts around the state as well as the country.

Implications

Research is pivotal in improving practice and achievement, but for education, is a complex science; often difficult to replicate and get into the hands of practitioners in the

field. The findings in this study are consistent with the three corresponding theoretical frameworks of the study, but does have implications for addressing equity as first and foremost. Linton's (2011) Equity Framework consists of four major categories stakeholders can use as a guide when addressing equitable structures at their schools. According to Linton (2011), schools need to incorporate rigorous and relevant course content as well as ensure a focus on building strong relationships and setting high expectations for students.

The school in this study used a choice design approach to Algebra 1 content in an attempt to reach more students. Increasing rigor, making the content relevant, emphasizing relationships through more conversation and interaction with the teacher, and setting high expectations for students were all pieces comprising the school's choice design approach. The reason for the new design was to reduce the number of students struggling with Algebra 1 course content by offering two approaches to instruction rather than one. For smaller school districts, replicating the method of reduced tracking and increased rigor for students might be difficult due to limited budgets and resources. For larger districts implementation may be difficult due to the sheer number of course offerings required to make the model work. The school district in this study did not completely eliminate tracking students, but essentially added another course to the school's course catalog of offerings. When calls for detracking courses come from researchers and professionals in the field, a choice design is not exactly what the profession is seeking. Essentially, however, most districts will either choose one approach over the other, which is why the school in this study was worthy of exploring. Critics of offering students a choice approach might claim the school has created another

instance of 'separate but equal' which society has worked hard to eliminate. Critics could argue when speaking ethically, a more equitable approach to school mathematics should not be viewed as a choice but rather a moral obligation. Thus, it seems counterintuitive to offer any version of a traditional course which has historically been know to cause large amounts of dropouts and failures. The profession would suggest the more equitable choice is the only choice.

Choosing only one approach, however, has its challenges as well. If districts ignore equity issues and continue to offer traditional Algebra 1 courses taught using memorization of routine tasks out of context, schools risk retaining students who think more conceptually. Essentially, not teaching to the learning needs of students closes doors of opportunity for students who may be more conceptual learners. If the district transitions to a completely problem-based Algebra 1 curriculum, then the district will offer courses unfamiliar to the community, and teachers, and the district potentially risks losing the buy-in necessary to make the course work. This researcher asserts, however, doing nothing and ignoring the issue of equity altogether is the last thing educators must do. Any attempt at creating equitable structures in school mathematics is an improvement over instruction grounded in traditionally unequitable approaches. Bohlman and Deal suggest a continuous improvement cycle is the only way to ensure change and Linton (2011) reminds that equity issues will never completely be eliminated. This research study helps to fill the gap related to defining and modeling what equitable mathematics looks like and how equitable practices can be achieved.

Ultimately, this study offers findings which can immediately impact course offerings in high school mathematics classes. Course planning must be done so with

careful collaboration, research, and thoughtful planning of its stakeholders. This researcher claims without mindsets geared toward a continuous improvement cycle and administration leading and facilitating the change, mathematics grounded in years and years of unequitable practices will continue. Linton (2011) states the culture of a school grounded in high expectations for students creates equitable experiences. When a student in equitable schools fail, then everyone fails (Linton, 2011). Adults in school buildings take responsibility for a student's failures.

Fortunately, the field's knowledge base related to equitable practices in mathematics education has deepened, but cannot be put into practice until practioners implement equitable practices and such practice becomes the new normal. The researcher suggests schools invest in intense and ongoing professional development for teachers. Such professional development can be achieved through intentional and focused trainings as well as embedding the professional development in the form of onsite job coaching. Professional development should include a vast overhaul of current, traditional structures. First and foremost, math educators must have access to quality, problem-based curriculum so teachers can spend time and focus on what students know and can do and less time on creating instructional materials. Training should, more importantly, include developing a teacher's capacity for facilitating collaborative groups toward specific instructional goals, while using a plethora of instructional strategies meet the needs of a diverse population. As educator's implement the new strategies, follow-up trainings on a variety of formative assessement techniques embedded into daily instruction, become an essential component when monitoring what student's know and can do. Using formative assessment technique does not become another way to track students but is used to guide

the instructor's thinking as the teacher moves their class forward. In classrooms implementing formative assessment practices, the teachers become learners as they seek to understand their students through conversations and observations. Circulating the classroom becomes essential as teachers are not simply available to answer student's questions, but rather seek to ask the questions instead. Teachers in equitable classroom use information gleened from students to clear up misconceptions on the spot rather than waiting for a summative assessment to learn what students did not know. Equitable instruction involves teachers having conversations with collaborative groups as well as individual students. The conversations between the teacher and student vary widely as the instructor meets the learners where they are at and then moves their understanding forward. Instructors in equitable classrooms do not hold value in getting all students to a random set proficiency level, but rather embrace success at all levels. Teachers in equitable classrooms work to build the student's mathematical agency and identity which leads to an increase to a student's self-efficacy.

Curriculum choice in diverse classrooms is always first and foremost. Marzano (2010) believes schools must prioritize curriculum to ensure the curriculum is guaranteed and viable. Equitable schools ensure students have equal access to course materials and high quality instruction. Teachers who resist implementing equitable structures in their classrooms must be addressed personally. However, teachers can only be held accountable when leaders are clear about expectations and clearly define what equitable instruction looks and feels like in today's schools. Equitable teaching must become non-negotiable in schools. Leaders must also be aware teaching for equity does not come naturally to some educators. Learning how to teach to a diverse population takes training

and practice and can only be achieved with a district committed to growing not only students but teachers as well. Although it is imperative to choose curriculum marterial and resources to develop a stong and cohesive conceptual design approach, the real issue and importance is how the content is delivered rather than what is being delivered. In order to meet the learning needs of a diverse group of students, teachers must incorporate a diverse repertoire of instructional strategies deemphasizing the 'sit and get' approach to learning. In schools deciding such strategies are non negotiable and no longer consider equitable instruction a choice but a professional responsibility, then improvements in student achievement will soon follow. Students of varying race, language, gender, socioeconomic, and ability backgrounds experience mathematics differently and and such differences must be addressed at the school level (Aguirre et al., 2017).

As with any study, limitations cannot be avoided. Although the findings of this study seem to offer a favorable approach to addressing equity issues in mathematics education, it does so from the lens of only one school district in southwest Missouri whose demographics include an abundance of ability and socioeconomic diversity but lacks racial diversity. Studying only one school's approach causes a limited scope. It would further enhance the findings if more school districts were offering the school's choice design for Algebra 1 and could, therefore, be included in the findings. It is also important to note, despite the seemingly positive outcomes of the study, the researcher is not necessarily suggesting a school district consider offering a choice design approach within their buildings. One might argue it seems counter-intuitive, to some degree, in regard to detracking mathematics, to offer a solution which essentially still segregates

learners into two different classes; especially when struggling students will more than likely choose, or be coached to take, one approach over the other.

This study does, however, offer teachers and administrators an approach which may or may not have been considered traditionally. Additionally,the course design does seemingly offer students an opportunity to learn abstract topics of Algebra 1 at a more successful rate. The findings in this study demonstrate equity issues in mathematics can be addressed and changes can be implemented ,allowing more students access to grade level content. Furthermore, addressing equity issues can be done without a culture shock to the community as well. Implementing the new choice design for students taking Algebra 1 demontrated positive outcomes from administrators counselors, teachers, and students in the school. Implications for other school districts to follow are great and should be done so with careful consideration to current structures within their own school settings.

Suggestions for Future Research

This study offers many avenues for future research. In order to make true change occur, the profession must continue to make strides studying innovative attempts toward a more equitable future. Accepting the status quo and being afraid to think differently, only offers stagnate situations grounded in comfort for the adults in the organization (Reeves, 2009). Bolman and Deal (2008) call this a *stagnate bureaucracy*. In other words, "A predictable and placid environment has lulled everyone to sleep and top management is slavishly committed to old ways" (p. 90). Continued research, however, offers districts information which can be applied directly or modified to meet the needs of the district and prevent situations grounded in tradition.

This study failed to completely address how educator mindsets related to change affected the outcomes of the study. It would be interesting to further investigate how mindsets affect educators' views and the success or failure of implementing a problem-based curriculum. Many attempts to overhaul mathematics programs have existed and many attempts have failed. It is this researcher's opinion more initiatives toward change would be successful with the right attitude toward the change. Overall, the educators in this study were excited about the new course offerings and worked hard to implement what was learned in their trainings. It is very probable the teacher's attitude toward new approaches made the implementation of the new structures successful. Exploring educator mindsets, as it relates to mathematics education, would add to the research base from a vantage point rarely explored.

Another topic for research would be examining how intense teacher trainings affected the overall success of the program. Many districts implement new initiatives and spend very little time, if any, training teachers on the new programs. The district in this study offered teachers a total of eight days of in-house training related to teaching a more diverse group of students. Teachers were offered more than two dozen new instructional strategies and spent time reading research related to developing and encouraging mathematical minds. This type of intense training, oftentimes,goes unchecked with new initiatives and could be the source of failure if omitted. Tracking mathematics students by ability level is so deeply embedded in years of tradition, it would be worthy of study to determine the constructs, like professional development, which must be in place so teachers are equipped to handle a more heterogeneous group of students.

Lastly, the researcher suggests longitudinal studies following typically underachieving mathematics students through high school and post high school to observe and compare their educational and career paths of the future be administered. Comparing educational futures of students taking a problem-based Algebra 1 course, students taking traditional ninth grade Algebra 1, and students offered the two-year approach would add to the research base in determining if detracking Algebra 1 is truly a realistic idea or it if has any lasting effects on students' post high school education or career paths.

Conclusion

Ultimately, the goal of the study was to explore how equity was addressed at the school by offering students a choice between Algebra 1 classes differing by instructional strategies. One could say the question was answered by looking at course retention rates alone. When 83% fewer students dropped first semester Algebra 1 after implementing the new choice design, it can be concluded more students have access to and are being successful in grade-level Algebra 1 course content following the implementation of the new choice design approach. This study shed a light on alternative teaching methods and the effect alternative methods can have on student outcomes. Alternative teaching methods should be considered by any practitioner searching for a method to reduce tracking by engaging and supporting struggling math learners in heterogeneous classes. Few school districts are specifically addressing equity issues related to mathematics and case studies describing this phenomenon are difficult to find. This study fills a gap in literature which includes a unique approach to equity issues related to mathematics

achievement. The study described a school addressing the needs of more learners by creating a unique equitable approach to Algebra 1 instruction.

In reviewing current research related to mathematics learning and understanding, researchers now believe it is not only Algebra 1 content proving difficult for some students, rather, how the content is taught. Some students simply need to build understanding from the ground up. Using algorithms and memorization of routine problems out of context is not purposeful without basic number sense and conceptual understanding. Linton (2011) believed content must be relevant to meet the needs of all learners. Dewey (1916) believed students must experience content relevant to their lives and Vygotsky (1978) believed students build understanding from connections and conversations they have along the way. The school district in this study was making progress toward these goals despite how difficult change and mindsets are to overcome.

In conclusion, for lasting equitable structures to exist in mathematics classrooms, students must have access to high quality instruction, rigorous and relevant course content, collaborative groups providing embedded supports, and educators who incorporate strategies which build student's mathematical agency and identity in the classroom. Student's believing they are capable doers of mathematics is critical to their success in mathematics.

Leading true change, however, is difficult. It is especially difficult without leaders driving the change. Reeves (2009) stated, mottoes proclaiming a "culture of equity" are fraudulent when essential interventions to improve student performance are sacrificed on the altar of traditional schedules and the convenience of adults (p. 37). Leaders need to lead with moral imperatives rather than authoritative mandates (Reeves, 2009). Equitable

practices should drive every decision. Leaders must ask, How can we meet the needs of every learner? and What policies exist in our building which close doors for kids? Questions such as these are difficult when grounded in tradition spanning years, even decades. When a school addresses equity issues, they address achievement issues also. Equity issues are resolved when schools have equity conversations and ensure access to courses offer opportunities for students to learn to think critically and solve real world problems.

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Appendix A

Principal/Counselor/Teacher Interview Questions

1) Why did your school implement two different ways to teach Algebra 1?
2) How does offering students a choice between differing approaches to Algebra 1 influence a student's response to Algebra 1?
3) How has the school and community responded to offering students a choice between instructional strategies?
4) What other changes have you noticed since providing students a choice between Algebra 1 courses?
5) How has the implementation affected you and your practice professionally?
6) Is there anything else on your mind which pertains to your school's decision to offer two Algebra 1 courses differing only in instructional strategies?

Appendix B

Principal/Counselor/Teacher Interview Protocol and Non-Disclosure Statement

Introduction

Thank you for meeting me here today. My name is Kim Spence and I am working toward completing my doctoral degree in educational leadership from Southwest Baptist University. This research has been reviewed by the SBU Research Board. By participating in this research, you have the opportunity to add to the research base related to improved student achievement in ninth grade Algebra 1 course content. Today I'm going to ask you a few questions related to your perceptions of offering ninth graders at this school a choice between traditional Algebra 1 and a problem-based approach to Algebra 1.

Informed Consent

Participation in this interview process is completely voluntary. You may end this interview at any time. The consent form for this interview was emailed to you, which you digitally signed and returned to me so, first, I would like to thank you for that. I would like to also make sure you understand I will not be using your name in my dissertation and your information will be kept strictly confidential. I will be recording and transcribing this interview for research purposes and will provide the entire transcript to you for your review.

Purpose of the Study

The purpose of my study is to look for patterns and themes related to stakeholders' perceptions of offering students a choice between traditional Algebra 1 and a problem-based Algebra 1. I'd like to know your personal feelings and thoughts related

to your experiences with this choice offering course design. My overall goal is to study a school district's attempt to increase access to Algebra 1 course content. Do you have any questions about the study or the informed consent process?

Interview Questions

If you are ready, we will begin the interview. Please feel free to stop me if you need to.

1) Why did your school implement two different ways to teach Algebra 1?
2) How does offering students a choice between differing approaches to Algebra 1 influence a student's response to Algebra 1?
3) How has the school and community responded to offering students a choice between instructional strategies?
4) What other changes have you noticed since providing students a choice between Algebra 1 courses?
5) How has the implementation affected you and your practice professionally?
6) Is there anything else on your mind which pertains to your school's decision to offer two Algebra 1 courses differing only in instructional strategies?

Concluding the Interview

Thank you, again, for agreeing to participate in this study. I will be transcribing your responses and will email you the transcript when it is complete. If you read through the transcript and would like to add to or clarify any of your answers, you may contact me by email at firemath5@gmail.com. If you have any questions or concerns about the study in general, please don't hesitate to contact me as well. Thank you again and I'm very grateful you have shared your experiences with me today!

Appendix C

Principal, Counselor, and Teacher Informed Consent

Hello!

You have been invited to participate in my interview case study to analyze your perceptions of offering students a choice between differing approaches to Algebra 1 course content at your school. This research has been approved by the Southwest Baptist University Research Review Board. You may contact Duke Jones, Ph.D., Chair, Research Review Board at RRB@SBUniv.edu for any questions or concerns you may have related to this research. By participating in this research, you have the opportunity to add to the research base related to improved student achievement in ninth grade Algebra 1 course content.

In this interview, you will be asked questions about your perceptions with the choice design. The interview will last approximately 15 minutes.

Your participation in this study is completely voluntary and there are no foreseeable risks associated with this research. However, if you feel uncomfortable answering any of the questions, you can withdraw from the interview or decline to answer at any point.

It is very important that I learn your opinions. Your responses will be completely confidential. Your information will be coded and your name will not be used. If you have any questions about the interview or your responses to the questions, you may contact Kim Spence by email at xxxxxxxx@gmail.com.

In order to participate in this interview, you must sign an informed consent. This is required. If you agree to allow me to use your interview responses for research purposes, please sign below.

_____

Signature of Participant Date

_____

Signature of Researcher Date