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Understanding Discourse of Co-Teachers in Middle School Mathematics Inclusive Classrooms

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UNDERSTANDING DISCOURSE OF CO-TEACHERS IN MIDDLE SCHOOL MATHEMATICS INCLUSIVE CLASSROOMS

by

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ABSTRACT

The researcher in this study investigated the verbal discourse moves of co-teachers in middle school mathematics classrooms to solicit students' mathematical thinking with a specific focus on students with disabilities. In this examination of two classrooms, students received high-level mathematics instruction from expertly trained co-teachers. A quantitative analysis of the video transcripts using a validated tool for coding teacher behaviors was used to examine the content and context of mathematical discourse in each of the classrooms. The researcher examined qualitative data using a critical discourse framework. Three themes emerged from the discourse analysis: (a) empowerment of co-teachers, (b) strategic use of scaffolding, and (c) cultivation of inclusive discourse with students with disabilities. The discourse analysis highlighted how each teacher's personal identities impacted a learning environment conducive to student participation and meaningful discourse.

Collectively, the results provide a view of how co-teachers use scaffolding within discourse to facilitate mathematical instruction. In addition, the outcomes provide a glimpse into the challenges of discourse and equity embedded within the complexities of institutional, epistemological, and social access to inclusive mathematics. The co-teachers in this study complemented one another as they worked across disciplines to educate all students equitably. Instead of operating from a deficit orientation, they worked collaboratively to remove the curriculum, environmental, and social barriers. Teaching with what appeared to be a mindset of assuming success rather than anticipating failure, the teams sought opportunities to provide access to what some deem is one of the most challenging concepts, mathematics.

Dedicated to my mom, Arletta Vance

for always believing I could, and for walking beside me to make sure I did.

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"Small steps may appear unimpressive, but don't be deceived. They are the means by which perspectives are subtly altered, mountains are gradually scaled, and lives are drastically changed." - Richelle E. Goodrich, *Making Wishes*

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LIST OF ACRONYMS

AERA	American Educational Research Association
CDA	Critical Discourse Analysis
CRA	Concrete Representational Abstract
DSE	Disability Studies in Education
DSME	Disability Studies in Mathematics Education
EQUIP	Equity Quantified in Participation
ESSA	Every Student Succeeds Act
GE	General Education
IDEIA	Individuals with Disabilities Education Improvement Act
NAEP	National Assessment of Educational Progress
NCLB	No Child Left Behind
NSSME	National Survey of Science and Mathematics Education
SE	Special Education
STEM	Science Technology Engineering and Math
WCD	Whole Class Discussions

CHAPTER ONE: INTRODUCTION

Overview

"Infinite diversity in infinite combinations…symbolizing the elements that create truth and beauty" - Commander Spock, Star Trek.

The diversity in 21st century classrooms avail new opportunities to improve the intellectual engagement, self-motivation, citizenship, and cultural engagement of students through designing diverse learning environments (Stroup et al., 2020). Academic skills like critical thinking, problem-solving, and writing become more refined through interactions with diverse peers (Hurst et al., 2013). These diverse environments today include, in addition to race and ethnicity, different religions, economic statuses, gender identities, language backgrounds, and disabilities. These shifts in learners reflect a change in the diversity of today's classrooms. The number of students in classrooms who live in culturally and linguistically different homes increased from 39% in 2001, to 48% in 2011 (U.S. Department of Education, 2014). In 2018, the number of students living in poverty in schools was 18% or approximately 12.6 million children (National Center for Education Statistics, 2020). In 2018–19, the number of students ages 3–21 who received special education services under the Individuals with Disabilities Education Act (IDEA) was 7.1 million, or 14% of all public-school students. Collectively, these demographics reflect a change in who is present in today's classrooms, but the outcomes for this range of learners is not equal, especially for students with disabilities.

According to the 2019 National Assessment of Educational Progress, 50% of 4th grade students with disabilities scored below basic proficiency in mathematics, compared to 18% of 4th graders without disabilities (a 32% difference). The national average of 8th graders was even more concerning, with 68% of students with disabilities scoring below basic proficiency in mathematics, while 14% of students without disabilities were below proficiency (a 54% difference). Evidenced by the current data, educational outcomes are not meeting the needs of this neurodiverse student population found in today's classrooms.

Problem Statement

Every single student, regardless of their learner variability profile, has the right to participate in rigorous academic instruction (Kim et al., 2021). According to the 2018 National Survey of Science and Mathematics Education (NSSME+) survey, 49% of elementary, 66% of middle grades, and 70% of high school teachers surveyed, either strongly agree or agree that "Students learn mathematics best in classes with students of similar abilities" (Banilower et al., 2018, p. 50). In other words, about half of the elementary teachers and the majority of middle and high school teachers believe the most effective approach to teaching and learning is to segregate students into separate tracks. The process of tracking commonly relegates students with disabilities to low-track mathematics, based on evaluative opinions, presuming their difficulties are a result of gaps in their mathematical knowledge (Tan & Thorius, 2018). The instructional approach in the lower tracks consistently focuses on the memorization of facts and procedures (rote performance), rather than developing a conceptual understanding of mathematics (Gutiérrez, 2017). In contrast, general education students are more often seen as mathematically capable, having an innate conceptual understanding, and excellent problem-solving skills (Tan et al., 2018). The decision to place students in remedial or advanced classes could determine their pathway to future courses and even access to many post-secondary options or career paths (Wai et al., 2010).

Purpose Statement

Improving science, technology, engineering, and mathematics (STEM) education for students with disabilities has been an ongoing priority for the Department of Education. Various efforts such as funding STEM projects and initiatives, implementing more rigorous standards, and changing the educational practices are a few ways the education system has attempted to ameliorate the persistent disparities that exist in the acquisition of mathematics between students with and without disabilities (Gersten et al., 2009). The impact these efforts have had, based on the 2018-2019 National Assessment of Educational Progress (NAEP) scores, have been insufficient. Thus, the purpose of this mixed methods study is (a) to examine the context of discourse with students with disabilities situated in a co-taught class by focusing on students' strengths rather than their deficits, (b) to understand how general and special education teachers use differing discourse practices to position students with disabilities as capable mathematicians, and (c) to add to the existing literature by describing how co-teachers use discourse to provide equitable access to meaningful mathematics in 7th and 8th grade classrooms. By closely examining the verbal discourse moves general and special education teachers use as co-teachers in middle school mathematics classrooms, the researcher examines the equity of participation of student with disabilities. This examination could help identify if students in inclusive co-taught settings have equal voices to their nondisabled peers in mathematical discourse.

Significance of the Study

Legislative changes have considerably influenced how academics and behaviors are addressed in society and public schools. The enactment of No Child Left Behind (NCLB, 2001), and more recently the Common Core State Standards Initiative (National Governors Association Center for Best Practices, & Council of Chief State School Officers, 2010), as well as the Every

Student Succeeds Act (ESSA, 2015), mandated more rigor and accountability for all students' success. Additionally, the reauthorization of the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) emphasized equal educational outcomes through rigorous assessments for students with disabilities. As a result, access to higher and more rigorous standards were provided for students with disabilities who today spend 80% or more of their school day in a general education setting (DeBrey et al., 2021). Classroom teachers also began serving more populations of culturally and linguistically diverse students, whose performance lagged behind that of their native English-speaking peers (August & Shanahan, 2006). Creating a pathway for a wider range of diverse learners being taught by highly qualified content teachers occurred in an attempt to address poverty, social inequity, and lack of access to quality education and to close the widening achievement gap among K-12 students (Strunk & McEachin, 2014).

As content teachers were pushed to work more mindfully and strategically to meet the diverse learning needs of all students, an increasing emphasis was placed on the process of including a special education teacher into the general education setting through a practice called co-teaching to enhance student learning outcomes (Knackendoffel et al., 2018). Despite the increase in the practice of co-teaching, a limited number of teacher education programs provided specific preparation on the co-teaching model (Faraclas, 2018). More often, general education and special education teachers followed a separate course of study and were expected to learn this practice as new teachers (Dieker & Murawski, 2003). Yet, how this model impacted learners access and outcomes is an area still emerging. Additional research focused on effective co-teaching for students with disabilities, in inclusive settings, is needed to determine if placement in such a setting provides equitable access to mathematical discourse (Miller et al., 2021).

Conceptual and Theoretical Frameworks

Individuals with disabilities strive to live and work in a culture where they are accepted and valued as individuals who offer meaningful contributions to the community at large. This study is grounded in Disability Studies in Education (DSE) (American Educational Research Association [AERA], 2017) framework under the premise that disability is a social-political-cultural issue, challenging inequalities and advocating for the full and meaningful participation of individuals with disabilities in education and society (Connor, et al., 2008; Gabel, 2005; Linton, 1998; Smith et al., 2009). The Model of Inclusive Schooling by Winzer and Mazurek (2012) anchors the study through the core element of social justice by providing equitable opportunities to learn. The theme of school transformation, identified by Winzer and Mazurek (2012), and further substantiated by others in the field over time (Villa & Thousand, 1996; 2005) explains how, when educators shift away from the traditional methods of teaching toward new instructional practices, a transformation takes place. In the transition, when both the Model of Inclusive Schooling and DSE are applied, the connection between the learning community discourse, and students' diverse backgrounds, experiences, and linguistic resources, as valuable assets, become more visible (Moschkovich, 2002).

Throughout this study, close attention is paid to teacher discourse to create opportunities for students with disabilities to engage in mathematical discourse at a level equal to their non-disabled peers. A convergent parallel mixed analysis design was followed (Creswell & Pablo-Clark, 2011) for data analysis. By utilizing a multi-layered approach, mixing the quantitative and qualitative data, the overall research findings are enhanced, allowing for a closer examination of the factors related to the discursive context, within these co-teaching classrooms. The rationale for this convergent parallel design, collecting both quantitative and qualitative data, is to provide an in-depth look at the nuances of the co-teaching practices allowing for equitable participation and access for students with disabilities, identify variables that may affect the phenomenon, and to clarify the socio-political processes that affect productivity and equitable discourse. The researcher poses the following research questions:

1. To what extent do general and special education teachers provide equitable participation opportunities, regardless of disability status, as measured by Equity Quantified in Participation (EQUIP; https://www.equip.ninja), in co-taught inclusive 7th and 8th grade mathematics classrooms?
2. What are the discourse patterns of general education and special education teachers in co-taught inclusive 7th and 8th grade mathematics classrooms for students with disabilities?

Operational Definitions

504 Plan: Shows the accommodations needed for a child who may have difficulties but does not qualify for special education services at that time.

Child with a Disability or also referred to as student with a disability: Defined by IDEA as follows: IDEA §300.8 (a) General. (1) Child with a disability means a child evaluated in accordance with §§300.304 through §§300.311 as having an intellectual disability, a hearing impairment (including deafness), a speech or language impairment, a visual impairment (including blindness), a serious emotional disturbance (referred to in this part as ‘‘emotional disturbance’’), an orthopedic impairment, autism, traumatic brain injury, another health impairment, a specific learning disability, deaf-blindness, or multiple disabilities, and who, by reason thereof, needs special education and related services.

Co-teaching: Co-teaching is an educational approach in which two teachers work in a coactive and coordinated fashion to jointly teach academically and behaviorally heterogeneous groups of students in an integrated setting (Bauwens et al., 1989).

Disability Studies in Education (DSE): The DSE promotes the understanding of disability from a social model perspective drawing on social, cultural, historical, discursive, philosophical, literary, aesthetic, artistic, and other traditions to challenge medical, scientific, and psychological models of disability as they relate to education (AERA, 2017).

Discourse and Mathematical Discourse: The terms “discourse” and “mathematical discourse” will be used interchangeably throughout this study. Discourse, in broad terms, is the way individuals communicate and share information through multiple means. The verbal discourse, or linguistics, refers to what is said. Nonverbal communication, including written interactions as well as gestures and body language are also forms of discourse. Mathematical Discourse refers to the ways students communicate their mathematical knowledge, form conjectures, and construct meanings, through verbal and nonverbal methods (Cobb et al., 1993; NCTM, 2000; Vygotsky, 1997).

Inclusion or Inclusive Education: Inclusive education refers to the placement of students with disabilities in mainstream settings, along with students who have not been identified as having a disability (Artiles et al., 2006). Inclusive education is a philosophy shared by a group of stakeholders who create a school environment, based on acceptance and belonging, within the school and the community (Salend, 2011).

Individualized Education Program (IEP): A program that shows the individual learning, behavioral, functional, or social needs of a child. A plan that details the support and services (such as speech therapy or multisensory reading instruction) a school will provide to meet the individual needs of a student with a disability who qualifies for special education.

CHAPTER TWO: LITERATURE REVIEW

Introduction

In this chapter, the author explores mathematics education for students with disabilities by examining relevant legislation and literature, summarizing the current status of special education, and discussing how co-teaching may provide students with disabilities equitable access to advanced levels of mathematics instruction. To be competitive members of tomorrow's workforce, students with disabilities will need to learn advanced STEM content, while possessing numerous soft skills, such as communication and collaboration (U.S. Chamber of Commerce, 2017). The author provides, in this chapter, a synthesis of what exists and what is emerging for students with disabilities in inclusive co-taught settings in mathematics.

Historical View

In this current era of educational reform, new legislative mandates have had a direct impact on the inclusion of students with disabilities in general education settings. The work toward equality and access for individuals with disabilities began long before laws were passed, largely because people with disabilities demanded and created those changes (Mackelprang & Salisgiver, 1996).

The disability rights movement has a long history of activism found among organizations by and for people with disabilities. In the 1930s, the League of the Physically Handicapped was organized to fight for employment during the Great Depression. In the 1940s, a group of psychiatric patients came together to form We Are Not Alone (Robbins, 1954), which supported patients in the transition from hospital to community. The Association for Retarded Children (ARC) was formed, and by 1960, ARC had tens of thousands of members, most of whom were parents dedicated to finding alternative forms of care and education for their children.

In 1973, the Rehabilitation Act was the first major law passed specifically to benefit individuals with disabilities. Ongoing advocacy and legal authorizations have continued to move the field of education, ever so slightly, toward equity and inclusion of students with disabilities.

The No Child Left Behind Act (NCLB), signed into law in 2002, widened the focus to encompass not just Title I schools, but the elementary and secondary education system, at large. Requirements for standards, assessments, accountability, and parental involvement are the pillars of this policy, providing both positive and negative effects for students who receive special education services. The Act mandated 95% of all students, including students with disabilities, be assessed equally, and shifted the responsibility of educating students with Individual Education Programs (IEPs) to include both a special education and general education teacher, equally (No Child Left Behind Act [NCLB], 2002). The regulations also mandated the requirement that special education teachers must become highly qualified, holding certifications in special education and a content subject area. The NCLB's goals were to hold all students to the same, challenging standards; close achievement gaps; and provide transparency and accountability for the proficiency and graduation rates of all students. However, the exclusive focus on tests, and disregard for other important measures of success, changed NCLB from an instrument of reform, into a barrier to reform, negatively impacting students with disabilities, low-income and minority students, and English learners (Duncan, 2013).

On December 3, 2004, the Individuals with Disabilities Education Act (IDEA) was once again reauthorized as the Individuals with Disabilities Education Improvement Act of 2004 (IDEIA, 2004). Revisions were based on the determination that the educational opportunities for students with disabilities were limited by “low expectations and an insufficient focus on applying replicable research on proven methods of teaching and learning" (IDEIA, 2004, §1400).

Therefore, significant changes to IDEA were made along with a close alignment to NCLB to allow students with disabilities full access to the general education curriculum in the general education setting, to, “meet developmental goals to the extent possible” (IDEIA, 2004, §1400).

In December 2015, the ESSA was passed, replacing the NCLB, bringing some of the most significant changes in special education policy in the past 40 years. For the first time, individual student’s needs and even student preferences were taken into consideration. High leverage practices (HLP; Mcleskey et al., 2017) using innovative strategies, personalized learning, and the Universal Design for Learning Framework became more widely used (Office of Elementary and Secondary Education, 2015).

Trending Toward Inclusive Education

Whether students with and without disabilities should be educated in the same classroom has been an ongoing discussion, as has the advocacy for students with disabilities to have equitable access to instruction in the least restrictive environment. The overall data shows a 50% increase in the number of students with disabilities included with nondisabled peers for the majority of the school day (National Center for Education Statistics, 2020). Students with disabilities, ages 6-21, who spend 80% or more of their school day in the general education setting, rose from 31.7% in 1988 to 62.2% in 2014. In the 2018-2019 school year, the NCES notes, 95% of students with disabilities, between the ages of 6 and 21, attended public school. Of these students, 13.3% joined the general education classroom for less than 40% of their school day, 18.3% spent between 40% and 79% of their time in general education, and 63.4% were included for 80% or more of their day. These findings reflect the shift in the educational settings for students with disabilities and a rising need to create more inclusive learning environments appropriate for all students (Cronis & Ellis, 2001; Shogren et al., 2015; Walther-Thomas et al., 1996). Inclusive practices were promoted as a benefit for all students, academically and socially. For example, in a comparison study, students who were classmates of students with significant disabilities achieved equivalent or higher test scores than those who were not in an inclusive setting (Salisbury et al., 1993). Students in inclusive settings also developed more positive attitudes towards peers with disabilities (California Research Institute, 1992); and they increased self-concept, social skills, and problem-solving skills for all students in inclusive settings (Peck et al., 1990; Salisbury et al., 1993).

Equitable Opportunities to "Test"

For years, the learning gains of students with disabilities has been a critical focus of the U.S. Department of Education. The No Child Left Behind Act of 2002 brought forth policy changes, increased funding, targeted interventions, and changes in the curriculum. High reading and mathematics proficiency standards were established, requiring schools to annually assess at least 95% of students in grades 3-8 on grade level proficiency. The focus of testing was to close the achievement gaps between student groups historically at risk for low achievement, relative to the general student population, by 2014.

Progress evaluated through the establishment of adequate yearly progress (AYP) as created in the No Child Left Behind Act (2000) focused on students in 3rd through 8th grades, who attained grade-level proficiency in reading and mathematics. In addition to grade level achievement, states also evaluated AYP by the performance of disaggregated student groups, including student race/ethnicity; students living in poverty as indicated by receipt of free or reduced-price lunch at school; and students with disabilities, for whom adequate yearly progress remained low.

According to the 2019 NAEP data gathered, 50% of 4th graders with disabilities, and 68% of 8th graders with disabilities, scored below expectations in mathematics. Historically, students with disabilities have exhibited the largest achievement gap relative to the general student population, and of particular concern are students who tested below achievement in 3rd grade. Students with gaps in 3rd grade experienced even more difficulty as they progressed into middle and high school settings due to the exponential growth, they needed to meet grade-level proficiency (Schulte et al., 2016).

Conceptual Framework: Disability Studies in Education

These legislative actions promoting testing and growth are counterintuitive to a movement in the field of disability studies. The conceptual framework of Disability Studies in Education (DSE) draws from the social model of disability, developed in the 1970s and 1980s, by United Kingdom disability activists and sociologists. Scholars of both the social model and DSE theory reject the medical model of disability which holds a constricted, inadequate, and inaccurate conceptualization of disability (Abberley, 1987; Barnes et al., 1999; Connor et al., 2008; Gabel, 2005; Oliver, 1990/1996). The DSE has become a growing movement in educational research, theory, and practice through the establishment of a special interest group (SIG) of the American Educational Research Association (AERA) (AERA, 1999; Gabel, 2005). This AERA SIG under this framework embrace that biological differences exist; however, the unjust responses to these differences are criticized within the DSE movement. While individuals may have cognitive or physical differences, society's response to these differences are considered to be the actual disabilities. Instead of prescribing a cure or treatment, DSE postulates unjust social systems, such as testing or retention, perpetuate or exacerbate differences.

Disability Studies in Mathematics Education

Disability Studies in Mathematics Education (DSME) is a subfield of DSE. The DSME conceptual framework considers equitable access to mathematics education a matter of human rights. The DSME model emphasizes starting with a strengths approach and an open mind that multiple ways of "doing" are available in mathematics. Framing disability as an external component; part of the teaching, curricula, or environment; may guide more productive forms of research and advocacy (Tan & Kastberg, 2017). Recognizing students with disabilities as capable of constructing mathematical knowledge alongside their peers, while empowering them to become independent mathematical thinkers, pushes students with disabilities to attain the highest level of achievement instead of mediocre compliance (Tan & Kastberg, 2017).

The DSME conceptual framework is situated within the sociopolitical realm in mathematics education (Gutierrez, 2013) and based on the premise that disabilities should be understood in relation to social constructs and responses to differences, particularly focused on mathematics education. The DSME framework describes these barriers as issues of disability such as social constructions, stereotyped perceptions, discriminatory practices, and marginalization (Tan & Kastberg, 2017). Utilization of the DSME framework provides critical insights by examining how students with disabilities learn to do mathematics. The DSME, as a conceptual framework, provides researchers with a guide from a social justice stance.

Theoretical Framework: The Model of Inclusive Schooling

Paralleling the DSE and DSME movement for disability rights as a social justice movement is a push for more inclusive opportunities in school and society. Inclusive education has become a widespread focus of school reform with varying levels of implementation intensities all over the world. Inclusive education is implemented through strengthening the capacity of schools to educate all children, including traditionally excluded populations (United Nations Educational, Scientific and Cultural Organization, 2001, 2009). However, no formal definition of inclusive schooling has been adopted globally (De Beco, 2014). Inclusive education despite a clear definition is much more than legislation, policy, standards, assessment, or data. Inclusion is a culture that collectively accepts, without exception, humanity in all representations (Villa & Thousand, 2005).

The Model of Inclusive Schools is an international theory, developed by Winzer and Mazurek (2012), grounded in social justice, and based on the core philosophy that education is a fundamental human right. Ensuring students with disabilities receive equitable access to education extends the culture of inclusion to more people and experiences. A truly inclusive mindset needs to be an integral component at every opportunity in home, school, and community (Winzer & Mazurek, 2012).

Educator Expectancy Bias

Even if students are included, the perception of the teacher serving the student can impact outcomes, equity of participation, and access. Educator expectancy bias refers to predicting a future action based on stereotypes (Good & Brophy, 1970), and may contribute to a lack of educational opportunity for marginalized students (Fisher et al., 1981; Good & Brophy, 1970). Teachers who hold strong biases against students, based on their racial, class, gender, and family backgrounds (Cooper, 2001), can have a denigrating impact on students' self-esteem, motivation, and inclination to excel (Cochran-Smith, 1997, 2009; Oakes & Lipton, 1999). Further, the implicit, bias of teachers on students' intelligence, ability, and behavior can influence their ideologies, which are reflected in their instructional strategies and treatment of students (Cochran-Smith, 1997; Darder, 1991; Delpit, 1995; Oakes & Lipton, 1999).

Do Perceptions Matter?

Productive student-teacher relationships impact equity in mathematics classrooms (Bartell, 2011). Based on Bartell's (2011) research, positive student/teacher relationships are connected to positive feedback, and genuine interest in students' mathematical thinking. When caring and committed educators communicate their authentic understanding of their students and their students lived social realities, equitable learning opportunities are more likely (Boaler & Staples, 2008).

While mathematics education has placed a greater focus on sociocultural or socio-political research, much more research is needed. A comprehensive longitudinal outcome study by Ford and Russo (2016) shows students exiting special education continue to experience lower graduation rates, poorer postsecondary outcomes, and higher rates of unemployment and underemployment, when compared to nondisabled peers (National Longitudinal Transition Study-2, 2009).

Educator Bias

The results from a 2018 NSSME+ Survey reflect 49% of elementary, 66% of middle grades, and 70% of high school teachers either strongly agree or agree that "Students learn mathematics best in classes with students of similar abilities" (Banilower et al., 2018, p. 28). In other words, about half of the elementary teachers and the majority of middle and high school teachers believe the most effective approach to teaching and learning is to segregate students into separate tracks. The process of tracking commonly relegates students with disabilities to low-track mathematics, based on evaluative opinions, presuming their difficulties are a result of gaps in their mathematics knowledge (Tan & Thorius, 2018).

Growing concerns with the unfavorable post-secondary outcomes, for students who receive special education services, led to the establishment of a Presidential Commission, formed in 2002. The purpose of this commission was to issue recommendations to address the high rates of unemployment and underemployment and the low rates of participation in postsecondary education of students with disabilities. Developing ways to understand how educator bias may uniquely and adversely affect students from marginalized groups, with intersecting marginalized identities, specifically, at the intersection of race and disability, has and continues to be a critical focus for the field of education (Waitoller & Artilles, 2013)

Procedural vs Conceptual Instruction

Students with disabilities, who receive special education services in mathematics, often receive procedural-based mathematics instruction, relying on rote memorization rather than developing a conceptual understanding of mathematics (Gutiérrez, 2017). In contrast, general education students are more often seen as capable, with an innate conceptual understanding, and excellent problem-solving skills (Tan et al., 2018). Mathematics in general education, then, are more often delivered through an inquiry approach, which builds on students' conceptual knowledge (Akyuz & Stephan, 2020).

The philosophies, methods, and even the curriculum, in general and special education mathematics, are distinctly different (Little & Dieker, 2015). The instructional pedagogy, from a special education perspective, provides students with strategies, explicit instruction, and repetition to develop procedural competencies. Learning opportunities are explicitly designed by special education teachers to include the students' accommodations and academic needs (Johnson et al., 2019). The sensory and social needs of students also are taken into consideration. The goal of special education is to provide access to the educational curriculum while also meeting individual education program goals. The instructional placement for students in special education is delivered across a continuum of services, in the least restrictive environment, most appropriate to each student (IDEA, 2004).

When students with disabilities are granted the opportunity to participate in mathematics educational programs with non-disabled peers, the content instruction is typically provided by a general education teacher who has developed strong mathematical and pedagogical content knowledge (Scruggs et al., 2004; Pearl et al., 2012). Alternatively, students who receive special education services in mathematics are taught by a specialist with extensive preparation to meet the educational and legal nuances of individual education programs but may not have the expertise in mathematics instruction since many special education teachers work across grade levels and mathematical concepts (Shephard et al., 2020). Jackson and Neel (2006) found that students in general education classrooms spent significantly more time engaged in conceptual work in mathematics (61% observed time), while students in segregated special education settings at the same school spent far less time engaging in conceptual mathematics (19% of observed time). To illustrate this point, an assessment on K–6 mathematics computation and problem-solving content skills was given to 33 prospective special educators. The results showed a correlation between higher scores and conceptual teaching practices and lower scores related to procedural types of practices (Hinton et al., 2015). The authors conclude, “Participants’ lack of focus on conceptual knowledge may be due to their own lack of mathematics understanding and skill” (Hinton et al., 2015, p. 9). To mitigate gaps in content knowledge, numerous researchers (Griffin et al., 2009; Murphy & Marshall, 2015; Sheppard & Wieman, 2020;) recommend teacher preparation programs include more rigorous preparation in mathematics standards for special education teachers.

Current Co-Teacher Preparation Programs

Koh and Shin (2017) completed a comprehensive review of the literature to closely examine the current state of inclusive education practices in teacher preparation programs. A timespan of 30 years was selected, and 225 elementary teacher preparation programs, encompassing all 50 states, were examined with the purpose of gaining a better understanding of how new teachers were prepared for inclusive education. The findings identified that approximately 15% (34) of university programs did not require any special education courses, and approximately 62% (140) of university programs only required one introduction to special education course. A combination major of elementary and special education was available at 3% (7) of the programs.

Inquiry-Based-Approach vs Instructional Model

Inquiry-based instruction is a form of constructivist guided learning, in which students are presented with mathematical challenges (Hmelo-Silver et al., 2007). Students interact with new mathematical information by creating and analyzing conjectures, communicating, working collaboratively, and engaging in mathematical argument (Stonewater, 2005). This approach encourages students to combine standard mathematics with their own ideas to solve problems creatively. Students become active learners, constructing their knowledge of mathematics through exploration, discussion, and reflection (NCTM, 2000/2014). Students test and refine their individual ideas using a variety of tools. During whole-class discussion, students share ideas and clarify understandings, develop convincing arguments, and learn to see things from other students' point-of-views.

Conversely, the instructional model uses direct instruction, and is most prevalent in special education mathematic classes. This method is procedure-oriented with an emphasis on the recall of sequential steps and facts (NCTM 2000/2014). With some suggesting procedural knowledge could limit students' opportunities, many promote best practice used in conjunction with highly effective practices with targeted procedural models aligning with specific deficits (Rogers & Weiss, 2019; Berry & Powell, 2020).

Through the use of inquiry-based instructional methods, students have shown improvements in solving complex problems and their ability at applying mathematical knowledge in multiple environments. For example, students in a middle school, inquiry-based learning model scored higher on their standardized assessments than students using the traditional curriculum (Hmelo-Silver et al., 2007). Longitudinal studies have also shown that gains made in inquiry-based classrooms are more likely to last long periods of time, reduce achievement gaps, and help disadvantaged students find success (Hmelo-Silver et al., 2007).

Discourse in Mathematics

Educational researchers have provided several meanings for the terms discourse and discourse analysis (Goodwin & Duranti, 1992; Rampton, 2008; Rymes, 2009/2015).

> Discourse analysis is an eclectic set of theoretical and methodological approaches to the systematic study of discourse, language in use, notions of context and contextualization, questions of power, and increasingly discussed issues of embodiment, spatiality, virtuality, and complex ecologies shaping educational contexts. (Warriner & Anderson, 2017, p. 8)

When conducting an in-depth analysis, the "context" and "text" changes in and through interaction with outside influences, ideologies, policies, events, and practices. One of the greatest challenges in discourse analysis is finding the meanings, ideas, and purposes, communicated through the verbal or nonverbal messages, regardless of the analytic methodology selected.

The acquisition of mathematical discourse is often equated with mathematical competence (Schleppegrell, 2007) and how students develop the higher-level skills needed to engage in academic dialogue; acquisition of discourse is essential (Harper & De Jong, 2004; Kayi-Aydar, 2014; Khisty, 1995; Lambert & Sugita, 2016). Mathematical discourse is defined by the National Council of Teachers for Mathematics (NCTM, 2000) as communicating mathematical ideas clearly, coherently, and effectively to teachers, peers, and others. Educators are responsible for orchestrating effective high levels of mathematics discourse, establishing community expectations, posing different types of questions, and encouraging student-to-student discussion. Throughout the process, students develop fluency and competency in math (Celedón-Pattichis & Turner, 2012; Khisty & Chval, 2002).

Equitable Opportunities

Do all students receive the same opportunities to participate in high levels of discourse? To evaluate how meaningful opportunities to learn are distributed among all students, Reinholz and Shah (2018) offer three basic questions related to equity: (a) who participates, (b) what is the nature of that student's participation, and (c) what opportunities do teachers make available to support that participation? They found educator expectancy bias contributes to perceptions that students with disabilities cannot learn from or engage in discussion-based learning as a consequence of their disability (Lambert, 2015; Lambert & Tan, 2017; Reinholz & Shah, 2018). These deficit perspectives are more pronounced in the sequential progression of increasingly advanced courses requiring students to successfully complete prerequisites to be promoted. The opportunity for a student to progress to the next level is contingent on their ability to meet or exceed current expectations. This linear process can directly limit the opportunities students with disabilities have to participate in higher-level mathematics. However, with appropriate supports and scaffolding in place, students with disabilities can be fully engaged in mathematical discourse (de Araujo et al., 2018; Lambert & Sugita, 2016; Moschkovich, 2007; Pinnow & Chval, 2015; Turner et al., 2013; Xin et al., 2020). Given equitable opportunities to engage in discourse, students with disabilities can develop their ability to question, critique, and explain mathematics, which eventually leads to "doing mathematics," while also advancing their language acquisition (Lightbrown & Spada, 2013; Moschkovich, 2002; NCTM, 2014).

Co-Teaching

Although researchers recognize (Salend, 2011; Villa & Thousand, 2005) the benefits inclusion provides for students with disabilities, not all agree the general education setting is appropriate for students with specific disabilities (Solis et al., 2012). A survey of 498 early childhood teachers revealed a significant dichotomy in teachers' opinions on who should receive inclusive education. No more than one half of the respondents felt inclusion was appropriate for students identified as having an intellectual disability, physical disability, visual impairment, hearing impairment, autistic spectrum disorder, and attention-deficit hyperactivity disorder (Lee et al., 2015).

Despite this disparity in opinion, the practice of co-teaching as a way to support students with disabilities in the general education classroom is a common practice (Friend et al., 2010). In this model, a general education and a special education teacher work as a team to co-plan, co-instruct, and co-assess (Bauwens et al., 1989; Cook & Friend, 1991/1995; Dieker & Murawski 2003; Magiera et al., 2005; Scruggs et al., 2007). The model of co-teaching is considered a way to serve students with disabilities in the least restrictive environment.

The co-teaching model aligns with Bandura's (1989) Social Cognitive Theory that individuals exhibit plasticity; meaning they can change as a result of interactions with other people. In other words, growth and development are influenced by an individual's environment. As students interact with one another in rich social situations, such as co-taught settings, they develop interpersonal skills needed to complete new tasks (Vygotsky, 1997). Application of these theoretical views suggests that children learn best when they have the opportunity to collaborate in socially rich environments. Research on inclusion and co-teaching demonstrate that the general education classroom can provide a positive environment for frequent peer collaboration in a socially rich environment (Friend et al., 2010).

A Team Approach to Mathematical Discourse

Recent trends in achievement on national and state assessments highlight the fact that learning mathematics is difficult for many students, including students with disabilities (National Assessment of Educational Progress [NAEP], 2017/2019). Mastering and applying complex mathematics concepts requires students to integrate and build upon a series of prerequisite skills, requiring students to use and understand the reasoning that underlies algorithms (Gersten et al., 2009; National Governors Association Center for Best Practices & Council of Chief State School Officers [NGA & CCSSO], 2010). Despite efforts to increase the rigor of mathematics instruction through teaching standards, students' mathematics performance remains stagnant, and achievement gaps persist (NAEP, 2017).

More students with disabilities are receiving the majority of their instruction in the general education classroom (DeBrey et al., 2021), and co-teaching is becoming a more common practice (Cook & McDuffie-Landrum, 2020; Solis et al., 2012). Unfortunately, these changes have not had the intended effect on closing the achievement gap, especially in mathematics. Walsh (2012) points to multiple factors, such as teacher expectancy, preparation in co-teaching, and the opportunities students with disabilities have to participate in rigorous mathematics.

Key Studies on Co-Taught Mathematics

The research on co-teaching, especially in mathematics, is relatively limited. A search using the terms "co-teaching, middle school, Math" solicitated five, key research articles. Each examines co-teaching from various angles, but all confirm co-teaching provides students with disabilities greater opportunities for developing conceptual and procedural understanding of mathematical concepts, ultimately enabling students to attain rigorous mathematical standards (King-Sears et al., 2015; King-Sears & Strogilos, 2015; Peltier & Vannest, 2018; Rimpola, 2014; Strogilos & King-Sears, 2019).

The concrete representational abstract (CRA) instructional framework, combined with explicit instruction, was presented by Peltier and Vannest (2018) as an empirically validated instructional method for students who are low performers in mathematics, particularly those with emotional behavioral disorders. The majority of the empirical research on the CRA framework has focused more on explicit instruction than a constructivist approach. However, this case study offers a glimpse into how co-teachers utilize this framework to introduce concepts and bridge lessons to explicitly show students how the concrete and abstract levels are related. Evidence of the CRA Framework's effectiveness at improving students' mathematical competencies has been observed across a variety of academic concepts such as place value (Bryant et al., 2008), addition and subtraction (Miller & Kaffar, 2011), multiplication and division (Flores et al., 2014), fractions (Butler et al., 2003), algebra (Watt et al., 2014), and problem-solving (Witzel et al., 2008). Improved student achievement is most likely to occur when the CRA Framework is implemented with fidelity (Peltier & Vannest, 2018).

In co-taught, inclusive classes, the general and special education teachers are both responsible for delivering effective lessons that address the needs of all students (Alper &

Ryndak, 1992; Bauwens et al., 1989; Murawski, 2009). The opportunity for co-teachers to collaborate is beneficial at every level. However, at the secondary level, co-teachers in mathematics consider collaborative planning time necessary (Mastropieri et al., 2005). Unfortunately, not all teams of co-teachers have scheduled time to plan together. In fact, fewer than 50% of the participants in one study were provided a scheduled collaborative planning time (Rimpola 2014). While co-teachers in Rimpola's (2014) study stated they were willing to meet with their co-teachers for planning, a lack of collaborative scheduled time remained a challenge. Teacher survey responses described how co-teachers coordinated their teaching. During scheduled weekly planning time, as recommended by Friend (2008), special and general educators collaboratively designed lessons, drew on one another's knowledge base, and determined strategies for teaching mathematical concepts to a diverse group of students. As noted by Rimpola (2014), the lack of collaborative planning time did not affect teacher efficacy.

In an interview study, middle school students, with and without disabilities, as well as their teachers, were asked about their experiences in co-taught classes (King-Sears & Strogilos, 2020). This study sought to explore self-efficacy, school belongingness, and co-teaching perspectives from middle school students and teachers in a mathematics co-taught classroom. Both students and teachers agreed that co-teaching provided extra help for all students. Beyond the academic support, positive interactions in the class benefit students' learning and social participation. The one teach, one observe model was reported to be the most common method of co-teaching (King-Sears & Strogilos, 2020). Interestingly, though, students did not view one teacher as subordinate to the other; students did express they would not like to learn with only one teacher because of the extra support available from two teachers (King-Sears & Strogilos, 2020). Researchers hypothesized that students with disabilities who spend more time in the general education setting feel a stronger sense of belonging (O'Rourke & Houghton, 2009; Wischnowski et al., 2004). According to McMahon et al. (2009), school belonging is the most important factor influencing elementary students' performance in language arts and self-efficacy. On the other hand, students with disabilities may feel as if they do not fit in; that the work is too difficult; or that they are competing against their peers, potentially causing them to feel disconnected from their school (Baird et al., 2009; Hampton & Mason, 2003).

Students with disabilities are spending more time in the general education classroom, prompting the development of new pedagogical approaches to teaching. One such model, used frequently in inclusive settings, is co-teaching. Although this model has shown to be a positive pedagogical practice with positive implications for students and teachers in the United States and internationally (King-Sears et al., 2014; Keefe & Moore, 2004), more research is needed to clearly define the roles and responsibilities of co-teachers. To date, the majority of co-teaching research has primarily investigated the perspectives and actions of teachers (Ashton, 2016; Stefanidis & Strogilos, 2015), the models of co-teaching, or the roles and responsibilities of co-teachers (King-Sears et al., 2014; Keefe & Moore, 2004).

In an interview study, King-Sears et al. (2014) investigated the co-teaching perspectives from middle school algebra co-teachers and their students with and without disabilities. Participants were asked to describe the roles of co-teachers, their perceptions about the academic impact of co-teaching on students' learning, and to explain the social outcomes of students in co-taught settings. The overall findings were that co-teaching had a positive impact on students' learning and social participation. Most students, with and without disabilities, in the current study, said they learned more in the algebra class with both the presence and active participation of two teachers in the same classroom. Interestingly, students also reflected that they learned best from both co-teachers or the special educator; whereas, few selected the general educator alone (King-Sears et al., 2014). Co-teaching is intended to promote learning for students with disabilities; yet the benefits afforded to all students is apparent (Cobb Morocco et al., 2002; Dieker, 2001; Fontana, 2005). When asked about parity, the value of support, and students' learning, varied responses were given, suggesting a need for more definitive data about how co-teaching impacts learning for students with and without disabilities.

Conclusion

The literature review provided a summary of the historical events, including the disability rights movement, and legislative impacts, leading to the current status quo in education. The transition from segregated schools, to more inclusive practices, shows progress has been made toward ensuring all students have equitable opportunities to learn. Both the DSE (conceptual framework) and the model of inclusive schooling (theoretical framework) were described. Five key articles on co-teaching were reviewed as a broad overview of how co-teaching and mathematical discourse have been investigated.

Empirical research on co-teaching is essential to gain a complete understanding of how effective general education and special education teachers orchestrate mathematical discourse in co-taught, secondary, inclusive mathematics classes, resulting in students with disabilities meeting or exceeding state standards. The researcher in this study explores co-teaching as a way to promote participatory access for students with disabilities in mathematics.

CHAPTER THREE: METHODOLOGY

Introduction

The researcher structures this mixed methods study on The Model of Inclusive Schooling by Winzer and Mazurek (2012) and filters the interpretations through the lens of the Disability Studies in Mathematics Education (DSME) framework (American Educational Research Association [AERA], 2017) to investigate the verbal discourse co-teachers use in a middle school mathematics classroom to solicit students' mathematical thinking, with a specific focus on students with disabilities. An explanation of the design, setting, procedure, data collection, and process of analyses are presented. The role of the researcher in relation to reflexivity also is discussed. The researcher concludes the chapter by describing how validity and reliability requirements were met.

Conceptual and Theoretical Frameworks

The current study was based on the Model of Inclusive Schooling and interpreted using a DSME framework. These analytical tools align with the issues of disability and education with a focus on social justice. Reflection on the meanings of disability, the substance of mathematics classrooms, and the nature of mathematics learners guided the researcher in data collection.

The Model of Inclusive Schooling, developed by Winzer and Mazurek (2012), is based on the core construct of social justice. This theoretical framework illustrates the components of an inclusive educational system. Winzer and Mazurek (2012) describe inclusion as a human right, contending individuals with disabilities want to participate in all aspects of their culture, including education.

Disability Studies in Mathematics Education (DSME) provides a conceptual lens to analyze the research, allowing the researcher to look through a lens of the strengths of students with disabilities in mathematics education. The DSME framework seeks to provide optimum learning for students with disabilities by positioning this population as capable learners. To extend this concept, DSME posits mathematical learning derives from discursive activity between teachers and students in a community of practice. Moreover, the authors of the framework assert students' diverse backgrounds, experiences, and linguistic resources are valuable assets to drawn upon in mathematics instruction (Moschkovich, 2002).

The Model of Inclusive Schooling is aligned with the tenets identified in DSE/DSME research. These inter-related frameworks provide critical insights to examine existing knowledge and guide future inquiries, such as equity and access of students with disabilities in inclusive co-taught settings.

Problem Statement

Mastering and applying complex mathematical concepts require students to integrate and build upon prerequisite skills, use algorithms, and understand the reasoning of those algorithms (Gersten et al., 2009; National Governors Association Center for Best Practices & Council of Chief State School Officers [NGA & CCSSO], 2010). Despite efforts to increase the rigor of mathematics instruction through teaching standards, students' mathematics performance remains stagnant, and achievement gaps persist (NAEP, 2017).

Significance of the Study

Recent trends in achievement on national and state assessments show students with disabilities are not attaining the same level of progress as their nondisabled peers (National Assessment of Educational Progress [NAEP], 2017). The research points to several important factors. For example, Murawski (2009) notes, teacher preparation programs offer limited co-teaching preparation. Because teacher preparation for content-based education and special education are grounded in different philosophies, fundamental differences and expertise are created and need to be addressed in preparation programs (Shin et al., 2016). Unintentional implicit bias, and low expectations of students with disabilities can impede opportunities to receive equitable access to grade level mathematics content (Cochran-Smith, 1997, 1999; Darder, 1991; Delpit, 1995; Oakes & Lipton, 1999). Research is needed on how co-teaching can be implemented most effectively with students who have been identified with specific disabilities, how to prepare new teachers in the practice of co-teaching, and how to find ways to deepen special educators' mathematical knowledge, while helping general education teachers increase their knowledge of accessibility and accommodations. The scope of this study is to explore the participation of students with disabilities in co-taught mathematics and how the two teachers, who were considered effective co-teaching teams, provide opportunities to develop these students' mathematical thinking in discourse rich instruction.

The purpose of this mixed methods study is to (a) reframe disability by focusing on students' resources rather than calling attention to their deficits, (b) understand how general and special education teachers use differing discourse practices to position students with disabilities as capable mathematicians, and (c) add to the existing literature by describing how co-teachers use effective discourse to provide equitable access to meaningful mathematics in 7th and 8th grade classrooms. Closely examining how effective co-teachers plan, implement, and scaffold instruction to support students as they engage in cognitively challenging mathematical work is the foundation of this mixed methods analysis.

Research Strategy: Appropriateness of Design

The researcher employed, for this study, a convergent parallel mixed analysis design. This process involved the researcher simultaneously conducting the quantitative and qualitative components of the research process (Creswell & Pablo-Clark, 2011). Although both elements are considered equivalent, the outcomes of each method were analyzed separately, and then interpreted together. By using a multi-layered approach, mixing the quantitative and qualitative data, the overall research findings were enhanced, allowing for a close examination of the factors related to the discursive context, within these co-teaching classrooms. Collecting both quantitative and qualitative data provided a more in-depth look at the nuances of the co-teaching practices, identifying variables that may influence the phenomenon, and clarifying the socio-political processes that affect productivity and equity discourse in inclusive classrooms.

Data Collection

Videotaped Sessions

The primary data sources were generated from videotaped observations of effective co-teaching in action, during the 2015-16 and 2016-17 school years. The sessions were prerecorded to be used for coaching and research. Permission was granted by the videographer to analyze the sessions as direct observations were limited during this time due to a pandemic. The classrooms selected for this study were 7th and 8th grade inclusive mathematics classes, taught by both a teacher certified in mathematics and a certified special education teacher. The complete corpus included videotaped classes, three from 7th grade and three from 8th grade, all occurring after a year of co-teaching together and extensive professional development and coaching by an expert in mathematics and co-teaching. All videos provided were reviewed by the researcher. Any sessions with 50% or more time spent in whole class discussion were included in the total sample. Of these, six sessions, three from each classroom were randomly selected for analysis.

Previously recorded observations and the corresponding transcriptions were used to generate descriptive statistics using a validated tool called the Equity Quantified in Participation

(EQUIP), as well as capture the didactic dialogue explored through critical discourse analysis (CDA) to determine themes and subthemes. The CDA provided the structure for interpreting the discourse practices of the co-teachers within the classroom context (Fairclough, 2003).

Research Questions

1. To what extent do general and special education teachers provide equitable participation opportunities, regardless of disability status, as measured by Equity Quantified in Participation, in co-taught, inclusive 7th and 8th grade mathematics classrooms?
2. What are the discourse patterns of general education and special education teachers in co-taught inclusive 7th and 8th grade mathematics classrooms for students with disabilities?

Setting

The data were collected via videotaped observations at a title I school, located in the Southeast region of the United States. The school serves students in grades 6-8 with the following demographics:

Table 1

School Demographics Compared to State Average

	Students Achieving Math Proficiency	Students Achieving Proficiency in Reading/ELA	Student/Teacher Ratio	Minority Enrollment
Student Population (n=1042)	25%	38%	15:1	51%
State Average	47%	46%	16:1	51%

Note. State average is from 2016-2017 school year.

Participants

Two co-taught, inclusive, mathematics classrooms, one 7th and one 8th grade, were purposely selected from a convenience sample of previously videotaped lessons, curated by national experts in mathematical discourse and co-teaching. Each class was led by both a mathematics educator and special education teacher. All educators featured in the videos were veteran educators, with three or more years of experience, who had received extensive professional development in cognitive coaching and in-the-moment content focused coaching, including modeling and co-teaching.

7th Grade Class Description

Ms. J (general education math teacher) and Ms. S (special education teacher) co-taught a 7th grade inclusion mathematics class for the second consecutive year. Ms. J was in her 26th year of teaching, 25 of which were in an inclusion setting. She has experience teaching 6th, 7th, and 8th grades. Ms. C held her undergraduate degree in nutrition and earned her master's in special education. She was entering her 5th year of teaching special education. The students in the 7th grade inclusive mathematics class represented diversity in race, backgrounds, cultures, and genders. In addition, 10 students were identified as having a learning disability, language impairment, or other health impairment. The video recordings used for this research were previously recorded, and the exact demographics of the participants were not able to be confirmed. Based on personal communication with the teachers, the general description of the students is accurate.

8th Grade Class Description

The general education mathematics teacher, Mr. C, was a 25-year National Board-Certified veteran teacher with an undergraduate degree in mathematics and a master's in middle school education. He has taught both 7th and 8th grade general education classes. The co-teacher, Ms. H., has been the special education teacher for 3 years.

The 8th grade inclusive mathematics class represented diversity in race, backgrounds, cultures, and genders. In addition, 21 out of 34 students were identified as having a learning disability, language impairment, or other health impairment, and one student was an English language learner. The video recordings used for this research were previously recorded, and the exact demographics of the participants were not able to be confirmed. Based on personal communication with the teachers, the general description of the students is accurate.

Study procedures

Institutional Review Board

The Institutional Review Board (IRB) gave exemption determination on December 8, 2020. See appendix A. All videotaped lessons, coding, and analyses were stored on password protected computers.

Instruments

Equity Quantified in Participation (EQUIP)

The EQUIP is a free, fully customizable web app, designed to capture classroom data in real-time, or to code video observations (Reinholz & Shah, 2018). The EQUIP was created through the National Science Foundation and the Spencer Foundation funding. Coding the video observations generated analytics, producing a three-part report: (a) overall summary of classroom participation, (b) summary of individual student participation, and (c) summary of group participation by each dimension. Various interactive analytics such as histograms were generated to support the discourse analysis.

Validity of EQUIP

The EQUIP application's validity was established by Reinholz and Shah (2018) by describing the seven original dimensions of the app, the levels at which they are coded, and connection to the relevant literature (Peter, 1981). Further, EQUIP pilot studies reflect consistencies with the research literature and existing classroom observation tools. See table 2, created by Reinholz and Shah (2018).

Table 2

Dimensions of EQUIP

Dimension	Levels	Core Literature
Discourse Type	Content Logistics	Driver et al., 2000; Michaels et al., 2010; Yackel & Cobb, 1996
Student Talk Length	21 or more words 5-20 words 1-4 words	Boyd & Rubin, 2002; Cazden, 2001; Engle & Conaant, 2002; Huffered-Ackles et al., 2004; Mehan, 1979; Michaels et al., 2010; NGA & CCSSO, 2010
Student Talk Type	Why How What Other	Braaten & Windschitl, 2011; Chi et al., 1994; Henningsen & Stein, 1997; Stein et al., 2008; Lombrozo, 2006
Teacher Solicitation Method	Random selection Called on NOT called on	Engle, 2012; Sadker et al., 2009; Tanner, 2013
Wait Time	More than 3 seconds Less than 3 seconds N/A	Rowe, 1986; Schoenfeld, 1988
Teacher Solicitation Type	Why How What Other N/A	Boyd & Rubin, 2002; Braaten & Windschitl, 2011; Chi et al., 1994; Henningsen & Stein, 1997
Explicit Evaluation	Yes No	Engle, 2012; Schoenfeld, 1988

Note. Table adapted from Reinholz & Shah (2018)

Coding Procedures

A class roster with pseudonyms and disability status were uploaded to the EQUIP app. No social markers, other than disability status, were collected. Only mathematical discourse in whole class discussions (WCD) were coded. Group work, side conversations, and other class talk were excluded.

The primary unit of analysis coded in EQUIP were participation sequences. A participation sequence is a string of uninterrupted talk by a student or teacher. A new participation sequence begins each time someone new speaks. While watching the video observations, the researcher divided the transcript into participation sequences, which were numbered and labeled with the speakers' pseudonym. This modified transcript was used to code each sequence along the assigned dimensions in EQUIP.

EQUIP Teacher Dimensions

- <u>*Solicitation Method*</u> – Anyone, Individual

  Teachers solicited participation from students in several ways: randomized calling (Tanner, 2013) planned solicitation, and student volunteers.

- <u>*Solicitation Type*</u> - Closed, Open, Open Plus

  The cognitive demand of a task can be modified by the level of questioning (Henningsen & Stein, 1997). Lower-level questioning reduces the cognitive demand, while encouraging students to think more deeply raises the cognitive demand (Boyd & Rubin, 2002). Teachers may also solicit student input by saying, "explain how you did number two." Danielson (2011) provided indicators for eliciting student thinking, such as higher-level questioning. Higher-level questions are defined as open-ended questions that allow students to use past experiences, prior knowledge, and previously learned content and relate it to newly learned content in order to create a well-thought-out answer (i.e., question statements that begin with "How", "What", or "Why"). Danielson (2011) advocates that after teachers are asked higher-level questions, they should provide students with sufficient time to think about their responses, reflect on the comments of their classmates, and deepen their understanding (Dieker et al., 2019).

- *Closed-ended questions* (CE): Content questions that have restricted parameters, expecting one possible response as its only acceptable answer, constrains a student's response, such as test questions, yes–no questions and forced choice questions.
- *Open-ended questions* (OE): Content questions to which a number of different answers would be acceptable; content questions that have no parameters and do not constrain student's response.
- *Open-ended plus questions* (OE+): Content questions that ask a student to extend, produce, or combine ideas to generate new ideas (related to Bloom's highest cognitive domain –creating) (Dieker et al., 2019).
- *Evaluation of Student Response* - Yes, No

EQUIP Student Dimensions

- *Talk Length* – number of words – Short (0-4), More (5-20), Extended (21+)
  The categories of 5–20 words and 21+ words roughly correspond to a single sentence and multiple sentences.
- *Talk Type* - Procedural, Conceptual, Other
  - *Procedural discourse response*: Student response that gives basic definitions, number combinations, with a focus on how to follow a step-by-step process to find solutions.
  - *Conceptual discourse response*: Student response that demonstrates understanding or explains the reasons why operations do or do not work to find solutions.
  - *Other discourse response*: Student response that is completely unrelated to mathematics.

The type of student talk is based on Braaten and Windschitl's (2011) approach to classifying verbal statements, which is closely related to Henningsen and Stein's (1997) framework for cognitive demand. Statements are classified in three levels: why statements, how statements, and what statements (Braaten & Windschitl, 2011).

Each video observation was "watched" to gain a high-level view of the lesson. Researcher Note: The researcher is blind, and only collected data on the audio content and professional transcriptions. No facial expressions, gestures, or other visual content was considered throughout the data collection or analysis. The terms "watched" and "observed" are used throughout this document, as the researcher, and blind community in general, do not substitute terms such as "listen" or "hear" for words with visual connotation.

Transcripts of each observation session were divided into participation sequences. A short excerpt shows how the transcript was organized into sequences along with the corresponding coding.

Inter-rater reliability

To establish interrater reliability, a mathematics professor with middle and high school teaching experience was recruited and trained to code the data, using the analytic framework. Following recommendations by Schlesinger and Jentsch (2016), prior to rating lesson in the data, raters practiced with sample lessons with the target of at least 80% point-by-point agreement. The researcher and rater independently coded an example transcript of participation sequences, using the classic mathematical discourse example of setting up chairs for a band concert. Any disagreements were discussed for clarity and consensus.

The EQUIP application was used to generate equity analytics by cross tabulating social markers within the five dimensions in EQUIP. The data were tabulated by grade level, across the three observation sessions and by comparing 7th and 8th grade outcomes. The results strengthened the discourse analyses through statistical representation.

The quantitative results were expressed as equity ratios, which are the ratio of actual participation to expected participation for a group of students along a particular dimension of classroom discourse. These ratios were expressed as greater than one, less than one, or equal to one. To determine an equity ratio, the actual participation, determined by classroom observation using EQUIP, was compared to the expected participation, the prediction based on a group's demographic representation in a classroom. For example, if 40% of students receive special education services, and if the actual participation from students with disabilities was 60% of the total participation, then the equity factor would be 1.5. This would indicate a disproportionately higher participation rate of students with disabilities compared to their demographic representation. If actual participation from students with disabilities was 30%, the equity factor would be 0.75—indicating disproportionately less participation. If actual participation was 40%, the equity factor would be 1.0, indicating proportional participation.

Critical Discourse Analysis (CDA)

The primary focus of CDA is the process of understanding and solving problems with any relevant theories or methods (Van Dijk, 2007). The use of CDA relies on a collection of techniques for the study of language use as a social and cultural practice (Fairclough, 2001). Procedures, techniques, and processes are all selected based on their relevance to the research purpose (Van Dijk, 1993). Examinations of interrelationships between power, ideology, and discourse are complex and multifaceted, Therefore, CDA must remain open to transdisciplinary research (Lazar, 2007).

A thematic approach to CDA provided the structure for interpreting the discourse taking place in the two, co-taught, inclusive classrooms (Fairclough, 2003). Rigorous and systematic reading of the transcripts, and listening to the audio files, established text familiarity. Further clarity was gained by hearing each participation sequence in context of the videotaped sessions because the meanings behind voice inflection, pauses in speech, and any emphasis placed on words of verbal discourse are not easily translated to written formats. The transcript of participation sequences in conjunction with the audio from the observation were used.

The audio dialogue was recorded through microphones worn by teachers. Most of the student talk during whole class discussion also was captured. A thematic analysis allowed the researcher to organize, describe, and interpret themes within the data (Braun & Clarke, 2006). Participation sequences were transcribed, and CDA was used to code and analyze themes form the transcripts. The researcher used inductive thematic analysis (Boyatzis, 1998), identifying themes that emerged from coding the discourse of the co-teachers and students during their VSR sessions.

The analysis consisted of coding the participation sequences gathered from transcripts of observations, using an inductive analytic process. As patterns emerged, a close analysis of meaning and relationships were considered.

Content Analysis

The videotaped sessions and outcomes of the study were validated by two, nationally recognized experts in the field. These experts reviewed these teachers' practices and validated they were both rich and aligned with best practices in mathematics and co-teaching. These videos were gathered from a previous research study aligned with best practices in co-teaching in mathematics. The experts who validated the content of these videos were a professor is a mathematics education who specializes in discourse analysis and prepares both general education and special education teachers to provide high levels of mathematics to students with and without disabilities; and a professor of special education, who is an expert in co-teaching and is a leader in national STEM education preparation programs.

Trustworthiness, Reliability, and Triangulation

Trustworthiness was established on Lincoln and Guba's (1985) definition of truth, value, applicability, consistency, and neutrality. Colleagues with expertise and experience in mathematics education and in discourse analysis were consulted throughout the process to ensure the researcher did not misunderstand the mathematical content, thereby misinterpreting the discourse. This process ensured the analyses were founded on reliable information. To provide trustworthiness and reliability of the coding, two doctoral students served as peer debriefers. After independently coding segments of each observation, discussions were held until consensus was reached. Triangulation was achieved using the videotaped sessions, debriefer coding and consensus, and the researcher's findings.

Positionality of the Researcher

Without some degree of reflexivity any research is blind and without purpose. (Flood, 1999: 35)

"*I don't need easy. I just need possible." - Bethany Hamilton*

A little bit about me. I am a Virgo; I love to solve puzzles, and I was diagnosed with Leber's Congenital Amaurosis (LCA) at two-years old. LCA is a condition that affects the retina, causing severe vision loss in children. What does this diagnosis mean to me? I am a strategic planner who loves to solve problems, and… I am blind. Frequently, people with disabilities are referred to as amazing or inspirational, simply by accomplishing something that would typically be considered "normal" for someone without a disability. Personally, I prefer to be complemented on my teaching, or recognized for an accomplishment, without the #AndShe’sBlind.

Growing up with a visual impairment was not too difficult; however, overcoming the myths and misconceptions of blindness was a greater challenge. At the time I entered kindergarten, parental rights were limited, and the common belief was children with disabilities could not learn. Therefore, students with disabilities were less often educated in the general education classroom, and when they were, effective techniques and materials were limited. Thankfully, my family and teachers anticipated success and treated me as though I would play, work, and succeed, just like anyone else. Although I was oblivious to the stereotypes and legal limitations, my parents understood, for me to be successful, I would need to have a strong educational foundation and maintain a positive mindset.

In school, I learned to be an avid braille reader, musician, and athlete. My parents and teachers encouraged me to try new things, never accepting the words, "I can't," as a reason not to try. When I began high school, I discovered just how hard my parents worked to protect me from society's doubts. Attending public school for my academic classes meant I had to advocate for what was routinely provided to other students. I learned to negotiate busy streets independently, to be assertive when I needed something, and to have high expectations for myself despite my vision loss. I learned to "think outside the box" and find solutions to everyday obstacles. These first lessons in determination have shaped my motto for life: “If the plan doesn’t work, change the plan, not the goal.”

During college and in my early career, I began to notice the varied societal perceptions of people with disabilities. Not just blindness, but anyone who did not fit neatly into the typical "box." Each organization promised an "equal opportunity," but the struggle to access that promise was real. At times, convincing people of my ability was just as difficult as acquiring accommodations. I continued to be a persistent advocate for equal access with the hope of increasing expectations and improving accessibility for people with disabilities.

My commitment and determination to increase equitable access to high-quality curricula and instruction in science, technology, engineering, and mathematics (STEM) for students with disabilities is partially due to my own educational experiences, and not to mention, my 14 years teaching in the public school system. My resolve to provide every student with a more inclusive, accessible education was strengthened during my time in graduate school. Each semester, when registering for new classes, inevitably, the conversation would lead to a suggestion that I should choose an alternative course that would be better suited for my disability, such as a text-based class instead of a course with lab requirements. Of course, I selected the course with the lab requirements.

"How will you perform the experiments?" "How will you observe the results?" These are valid questions, and ones I was able to answer because of my lived experiences as an individual with a disability. I had time tested, viable ways of successfully navigating an educational system designed for students who were not blind. Finding solutions to access information not otherwise accessible is an ongoing process. What is more difficult, though, is reassuring others that, with accommodations in place and creative problem solving, I can perform at a level equal to my sighted peers.

After graduation, I taught in an elementary public school for many, incredible years. I have taught students who are identified as having a disability, and some who are not. Whether blind, sighted, learning disabled, or typical, all are unique individuals with diverse gifts and challenges. I believe each one of them has great potential to become someone amazing in this world and finding ways to help them embrace their differences and overcome societal limitations has been a tremendous honor.

During my childhood, throughout my teaching career, and as a national advocate, my mission has been to challenge societal misconceptions about disabilities. I have always believed that things will not change by themselves; everyone in society has to be an active participant to affect positive change within society. Therefore, when I was recruited into the doctoral education program, I knew this would be an opportunity to speak up and influence the educational opportunities for students outside of my classroom.

My advocacy and determination skills were put to the test when I began the Ph.D. program. My first course, advanced statistics, had not been prepared with any accessibility features. The braille I requested 6 months prior had not arrived, and the statistical package was not screen reader friendly. The details of this ordeal are long and tedious, and probably familiar to most individuals who have had to overcome technical barriers. The outcome of the story, though, is after a year-and-a-half, multiple meetings, and far too many hours, I successfully completed the class. Although this process should not have occurred, positive outcomes prevailed. There was a definite improvement in the perception of individuals with disabilities in post-secondary settings. Additionally, stakeholders learned more about accessibility and how proactive measures are critical to student success. As someone with a disability and 14 years as a special education teacher, I am a strong proponent of Universal Design for Learning because of its proactive approach to inclusive design, offering potential for circumventing problems before they arise.

Although the intention is not to communicate low expectations to students, the reality is, implicit biases and stereotypes based on disability, socioeconomic status, and racial and/or ethnic identity do exist. These negative perceptions can impact learning and achievement, as well as student attitudes and motivations. Through collaborative efforts, everyone has the opportunity to disrupt and challenge the current narratives and develop new discourses with the potential to radically transform how science, technology, engineering, and mathematics education prepares all students, regardless of diverse ability, to become part of the next generation of the workforce.

I approach my research with enthusiasm for the chance to redefine how historically marginalized students are engaged in high quality, STEM education. My work has been further influenced by my time a National Science Foundation DRK-12 Cadre Scholar. The goal of this research is to have a direct influence on new teachers, showing how high expectations, innovative teaching, and sincere confidence in all children leads to success in mathematics.

Conclusion

This mixed methods study was composed around The Model of Inclusive Schooling by Winzer and Mazurek (2012). The interpretations were filtered through the lens of the DSME framework to understand how effective general education and special education teachers (determined by their preparation, outcomes in student learning, and expert preparation through both PD and coaching) orchestrate mathematical discourse in co-taught, secondary inclusive mathematics classes, resulting in students with disabilities meeting or exceeding state standards. In this chapter, the rationale for selecting a convergent parallel mixed analysis design was given. The process of coding, along with the design, setting, procedure, data collection, and analysis were also explained.

In the next section, the findings of both the quantitative and qualitative data are presented. The data analysis offers clarity into how educators, as a co-teaching unit, use verbal discourse to solicit students' mathematical thinking, regardless of disability. Videotaped classes and transcriptions captured the complexities found in co-taught, inclusive classrooms, resulting in descriptive statistical data and rich-thick descriptions of the discourse patterns.

CHAPTER FOUR: RESULTS

Introduction

The purpose of this study was to investigate the verbal discourse moves co-teachers use in middle school mathematics classrooms to solicit students' mathematical thinking. The specific focus of the study was on how the co-teachers' moves collectively elicited responses and provided opportunities for equity and access for students with disabilities. In this chapter, both quantitative and qualitative results are presented. The descriptive data provides a glimpse into who participates, and the type of participation taking place, in co-taught classrooms. Meanings derived from the critical discourse analysis (CDA) illuminated three themes: (a) empowerment of co-teachers, (b) strategic use of scaffolding, and (c) cultivation of inclusive discourse with students with disabilities. The collective results provide a view of how co-teachers use their combined expertise to facilitate mathematical discourse for students with disabilities. In addition, the outcomes provide a glimpse into the challenges of discourse and equity embedded within the complexities of institutional, epistemological, and social access to inclusive mathematics.

Scaffolding within Mathematical Discourse and Co-teaching

Understanding and explaining how discourse affects access and equity within the mathematical classroom has become an area of interest to mathematics education researchers, teacher educators, teachers, and policy makers (Walshaw & Anthony, 2008). Although each group of stakeholders may consider discourse from differing perspectives, i.e., linguistic, content specific, and socio-cultural lenses, all are focused on the challenges of access and achievement. Therefore, seeking clarity on how social, mathematical, cultural, and political aspects of classroom interactions impact students' future opportunities, especially in high-paying STEM related fields, is an important endeavor.

Equally important are the perceptions and practices of educators, particularly, their view on diversity as an asset, as well as their awareness of structural inequities as they perceive and design classroom discourse practices. To ensure students with disabilities receive equitable opportunities to engage in grade level mathematics instruction, co-teaching, as a service delivery model, is being used more frequently, intensifying the need for collaboratively designed classroom discourse. Co-teaching has been defined by Bauwens et al. (1989) as “an educational approach in which general and special educators work in a coactive and coordinated fashion to jointly teach academically and behaviorally heterogeneous groups of students in educationally integrated settings” (p. 18). The growth of the co-teaching model, and exploration into how co-teachers’ orchestrate effective mathematical discourse, encapsulates the scope of this study.

Fairclough's (2003) Critical Discourse Analysis (CDA), which is an interdisciplinary approach for viewing the discourse of language as a form of social practice, was the framework for the qualitative analysis in this research. The data analyses specifically examined two co-teaching teams’ discursive interactions with learners in 7^{th} and 8^{th} grade inclusive classrooms, closely examining the teacher-student dialogue in relation to power, identity, and assumptions. Both teams included a mathematics teacher and a special education teacher. All educators in the video analyses were veteran educators (3 or more years of experience), who had received extensive professional development in cognitive coaching and in-the-moment content-focused coaching, including modeling. The PD occurred over the course of a year and was part of an earlier research study. The PD reflected what is considered best practice consisting of sustained content presented over the course of the year along with sustained and just-in-time classroom-based coaching.

Social Context

The researcher in the analysis of the derived data grounded her thinking in the classroom as a learning context in which a great deal of social interaction takes place through lessons, drills, group discussions and dialogues (Pica, 1987). Classroom interaction, according to Tsui (2001), refers to “the interaction between the teacher and learners and amongst the learners, in the classroom” (p. 120). The interactions within these two classrooms differed in the lesson design, communication style, and the co-teaching models. Both, however, strived to provide all students with equitable opportunities to engage in high levels of mathematics discourse. Collectively, the teachers held high expectations for students with and without disabilities, presuming every student would progress in their mathematical thinking. To this end, structure and safety measures were imbedded into the development of classroom communities. The collective approach, by the grade level teams, was to establish a classroom dialogue providing just the right amount of scaffolding for students to extend their thinking beyond memorizing and repeating patterns (Barnes, 1976; Kumaravadivelu, 1993; Schunk, 2004).

Data sources and analysis

Videotaped observations, transcripts of classroom observations, supplemented by the researcher’s notes, provided the source of data for analysis in this study. In collecting the data, classroom observations were audiotaped via a remote microphone worn by the teacher, capturing most of the verbal interactions. A total of six observations, three from each grade level co-taught team, were analyzed. These videos were gathered over a two-week period in the fall following a year of professional development in cognitive coaching and co-teaching. Three videos from each team were randomly selected from the available sessions. Quantitative and qualitative data were collected simultaneously. The statistical and contextual data were analyzed separately and converged for final interpretation.

Data Analysis

Quantitative Data

Video observations of inclusive 7th and 8th grade mathematics classrooms were coded using Equity Quantified in Participation (EQUIP) to identify how co-teachers solicited participation, what type of questions were asked to engage students in mathematical discourse, and whether teachers evaluated the accuracy of students’ responses. The EQUIP tool also was used to capture the type of student discourse, procedural or conceptual statements; and length of time students talked: 0-4 words (short), 5-20 words (more), and 21+ words (expanded). The quantitative data were used to answer research question 1: To what extent do general and special education teachers provide equitable participation opportunities, regardless of disability status, as measured by Equity Quantified in Participation, in co-taught inclusive 7th and 8th grade mathematics classrooms? The EQUIP tool provides Equity Analytics (EA), which involves identifying and analyzing patterns of equity and inequity in classroom discourse. The researcher used EA to pinpoint patterns in student participation and the opportunities made available for students to participate in classroom discourse. Reinholts and Shaw (2018) designed EQUIP based on the following question: “To what extent does the actual distribution of resources align or diverge from the distribution predicted based on demographic representation?” For the purposes of this study, the EA was determined by the number of participation sequences contributed by students with disabilities over the actual number of total participation sequences by students. The EA was calculated for 7th and 8th grades to determine if students with disabilities had equitable opportunities to participate in whole class discussions.

Teachers by Dimension

To capture quantitative data on teacher discourse, three dimensions, (variables) were entered into the EQUIP app: the solicitation method (whole group or individual), type of solicitation (closed, open, or open+), and evaluation of students' mathematical responses (yes or no). Table 3 provides a summary of these dimensions based on combined totals of all observations in each grade.

Table 3

Teacher Discourse Dimension Totals by Grade

	Solicitation Method		Solicitation Type			Evaluation		
Grade	Any	Indiv.	Closed	Open	Open Plus	Yes	No	Total
7th	177 (66.5%)	89 (33.5%)	147 (55.3%)	92 (34.6%)	27 (10.2%)	74 (27.8%)	192 (72.2%)	266 (100%)
8th	132 (46.3%)	153 (53.7%)	145 (50.9%)	123 (43.2%)	17 (6.0%)	36 (12.6%)	249 (87.4%)	285 (100%)

Table 3 presents an overview of the teacher discourse for each grade level. The data accounts for the participation contributions given by the co-teaching teams, not as individuals. The 7th grade team contributed 266 sequences. Of those, 66.5 (177) were solicitations directed toward anyone in the class, and 33.5% (89) were solicitations directed to individual students. The most frequently used solicitation type were closed-ended, 55.3% (147); followed by 34.6% (92) open-ended; and 10.2% (27), open plus. Of the teachers' 266 discourse sequences, 27.8% (74), explicitly evaluated student responses for accuracy, and 72.2% (192) did not evaluate for accuracy.

In the 8th grade classroom, co-teachers had 285 contributions. Of those, 46.3% (132) were solicitations to anyone and 53.7 % (153) were solicitations to individual students. Similar to 7th grade, closed-ended solicitations were used most often at 50.9% (145), followed by 43.2 % (123) open-ended solicitations and 6.0% (17) open plus. The 8th grade teachers evaluated student responses for accuracy at 12.6% (36), and they did not evaluate student responses for accuracy 87.4% (249) of the time.

Students by Dimension (with and without disabilities)

The student level of analysis in EQUIP was used to determine the length of students' responses (0-4; 5-20; 21+) and the discourse type of responses (conceptual, procedural, other). Table 4 provides a summary of these dimensions within each co-taught grade level, summarized by students with and students without disabilities' data. Table 4 represents the combined data from the six observations, three in each classroom. The number of participation sequences are shown for each grade level, and further delineated by the number of students with and without disabilities, the length of students' responses (0-4; 5-20; 21+), and the discourse type of responses (conceptual, procedural, other).

Table 4

Student Discourse by Grade

Grade	Total Students	Count Participation Sequences	Disability Status	Student Count	Talk Length: Short (0-4)	Talk Length: More (5-20)	Talk Length: Extended (20 Plus)	Talk Type: P	Talk Type: C	Talk Type: O
7th	20	108	SWD	10	32 (55.2%)	18 (56.2%)	8 (44.4%)	44 (61.1%)	8 (36.4%)	6 (42.9%)
			W/O	10	26 (44.8%)	14 (43.8%)	10 (56.6%)	28 (38.9%)	14 (64.6%)	8 (57.1%)
				Totals:	58 (53.7%)	32 (29.6%)	18 (16.7%)	72 (66.7%)	22 (20.4%)	14 (13.0%)
8th	34	154	SWD	21	39 (60.0%)	41 (57.7%)	7 (38.9%)	53 (58.9%)	20 (54.1%)	14 (51.9%)
			WO	13	26 (40.0%)	30 (42.3%)	11 (61.1%)	37 (41.1%)	17 (45.9%)	13 (47.1%)
				Totals:	65 (42.2%)	71 (46.1%)	18 (11.7%)	90 (58.4%)	37 (24.0%)	27 (17.5%)

Note: SWD=student with disability; W/O=without; P=procedural; C=conceptual; O=other

As seen in Table 4, the 7th grade classroom had a total of 20 students. Ten students had identified disabilities and 10 students were without an identified disability. Of the 108 student contributions, 53.7% (58) were from students with disabilities and 46.3% (50) were from students without disabilities. The 8th grade class had a total of 34 students: twenty-one students with disabilities and 13 students without any identified disability. Of the 154 student contributions, 56.5% (87) were from students with disabilities and 43.5% (67) were from students without disabilities. Both the 7th grade classroom and the 8th grade classroom had more contributions from students with disabilities than students without disabilities.

In terms of talk length, 53.7% (58) of responses were short, 29.6% (32) were more, and 16.7% (18) were extended. In the 7th grade classroom, short and more responses were greater from students with disabilities. Thirty-two of 58 (55.2%) short responses, and 18 of the 32 (56.2%) more responses were from students with disabilities. Students without disabilities had more responses that fell into the extended category with 10 of 18 from students without disabilities. In the 8th grade classroom, 42.2% (65) of responses were short, 46.1% (71) were more, and 11.7% (18) were extended. Similar to the 7th grade classroom, short and more responses were greater from students with disabilities. Thirty-nine of 65 or 60% short responses, and 41 of 71 or 57.7% more responses were from students with disabilities. Also consistent with the 7th grade classroom, students without disabilities had a greater number of contributions in the extended category with 11 of 18 or 61.1% being from students without disabilities.

In terms of talk type, procedural responses made up more than 50% of the contributions in both grade levels. In 7th grade, the procedural contributions were 66.7% (72) of the responses. In the 8th grade classroom, the procedural contributions were 58.4% (90) of the responses. The conceptual talk type made up the second greatest number of responses in both classrooms with

20.4% (22) conceptual responses in 7^{th} grade and 24.0% (37) in 8^{th} grade. Thirteen percent (14) of student contributions fell in the other talk type category for 7^{th} grade and 17.5% (27) student contributions fell in the other talk type category for 8^{th} grade.

In 7^{th} grade, the students with disabilities mostly responded in the procedural talk type with 44 of 72 (61.1%) contributions in this category, 8 of 22 (36.4%) contributions in conceptual and 6 of 14 (42.8%) in other. In 8^{th} grade, however, students with disabilities had a greater number of responses in all categories than students without disabilities. In 8^{th} grade, students with disabilities talk type consisted of 53 of 90 (58.9%) contributions in procedural, 20 of 37 (54%) in conceptual, and 14 of 27 (51.9%) in other.

Mathematics Discourse Equity Ratio

EQUIP analytics provided the ratio of actual participation to expected participation of students with and without disabilities in each classroom. Equity ratios are reported as greater than, less than, or equal to one. The closer to one, the more equitable the participation as per the validation procedures by the author of the EQUIP tool. Figure 1 displays the equity ratio of student talk length by disability status in the 7^{th} grade classroom as a bar chart reported from EQUIP. Figure 2 shows a bar chart of the equity ratio of student talk type by disability status in the 7^{th} grade classroom. Figure 3 displays the equity ratio of student talk length by disability status in the 8^{th} grade classroom as reported from EQUIP. Figure 4 shows a bar chart of the equity ratio of student talk type by disability status in the 8^{th} grade classroom.

Figure 1 shows that the equity ratio for talk length for students, with and without disabilities, consistently falls between 0.9 and 1.2 in all talk length categories. Specifically, equity ratio for talk length for students with disabilities in the 7^{th} Grade was 1.1 for short, 1.2 for more, and 0.9 for extended. The equity ratio for talk length for students without disabilities in 7th Grade was 0.9 for short, 0.9 for more, and 1.2 for extended.

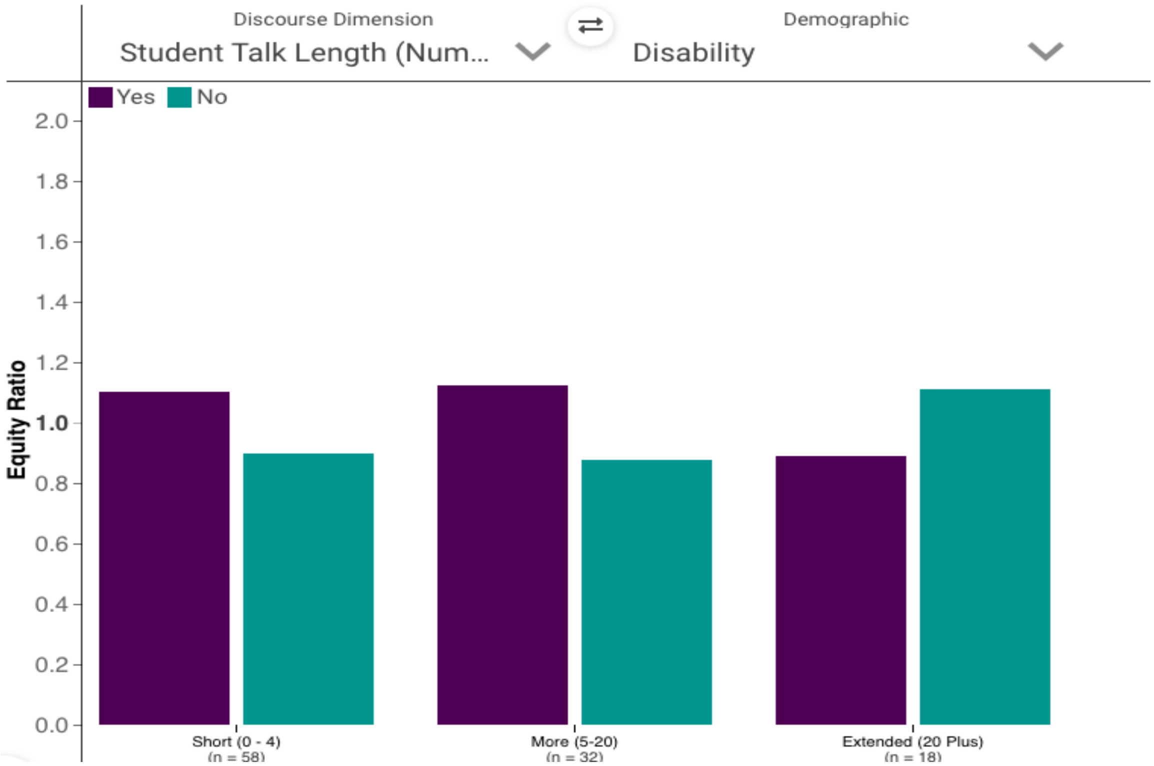

Figure 1. 7th Grade Equity Ratio for Talk Length

Figure 2 shows the equity ratio for talk type for students with and without disabilities consistently falling between 0.8 and 1.2 in all talk type categories. Specifically, equity ratio for talk type for students with disabilities in the 7th grade was 1.2 for procedural, 0.8 for conceptual, and 0.9 for other. The equity ratio for talk type for students without disabilities in 7th Grade was 0.8 for procedural, 1.2 for conceptual, and 1.2 for other.

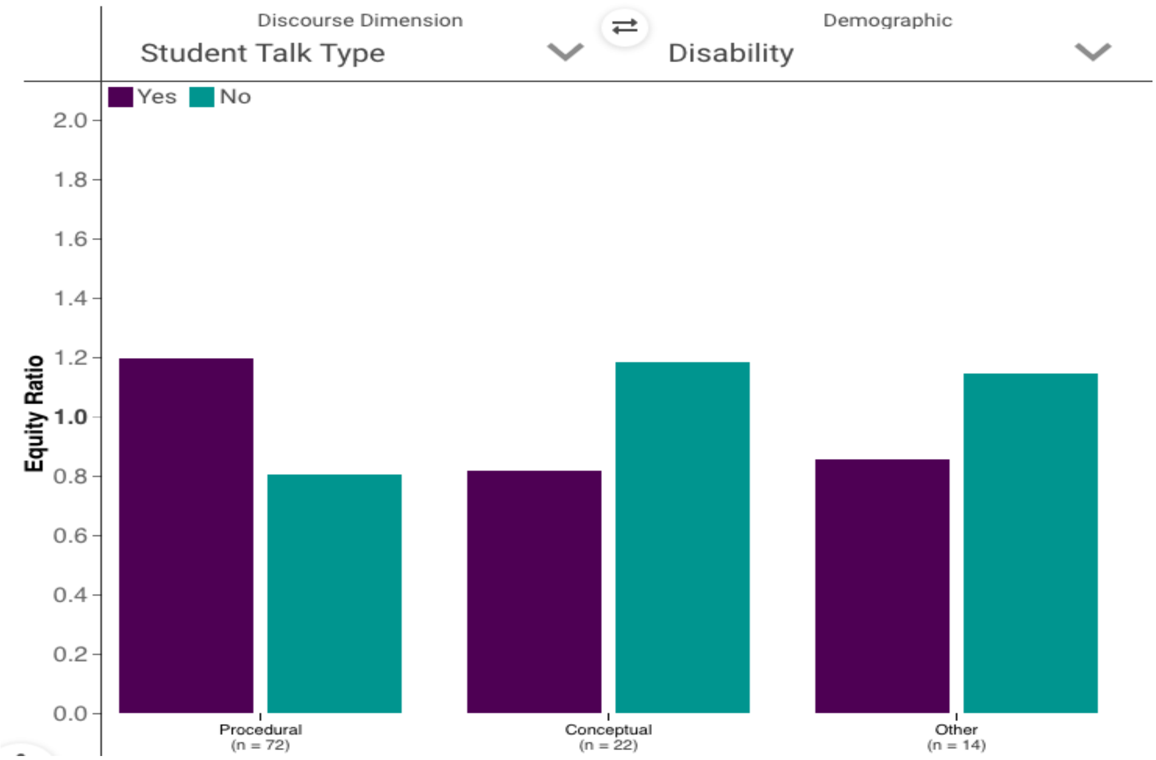

Figure 2. 7th Grade Equity Ratio for Talk Type

Figure 3 shows that the equity ratio for talk length for students with and without disabilities consistently fell between 0.9 and 1.2 in the short and more talk length categories but varied significantly in the extended category. Specifically, equity ratio for talk length for students with disabilities in the 8th Grade was 1.0 for short, 0.9 for more, and 0.6 for extended. The equity ratio for talk length for students without disabilities in 8th Grade was 1.1 for short, 1.2 for more, and 1.7 for extended.

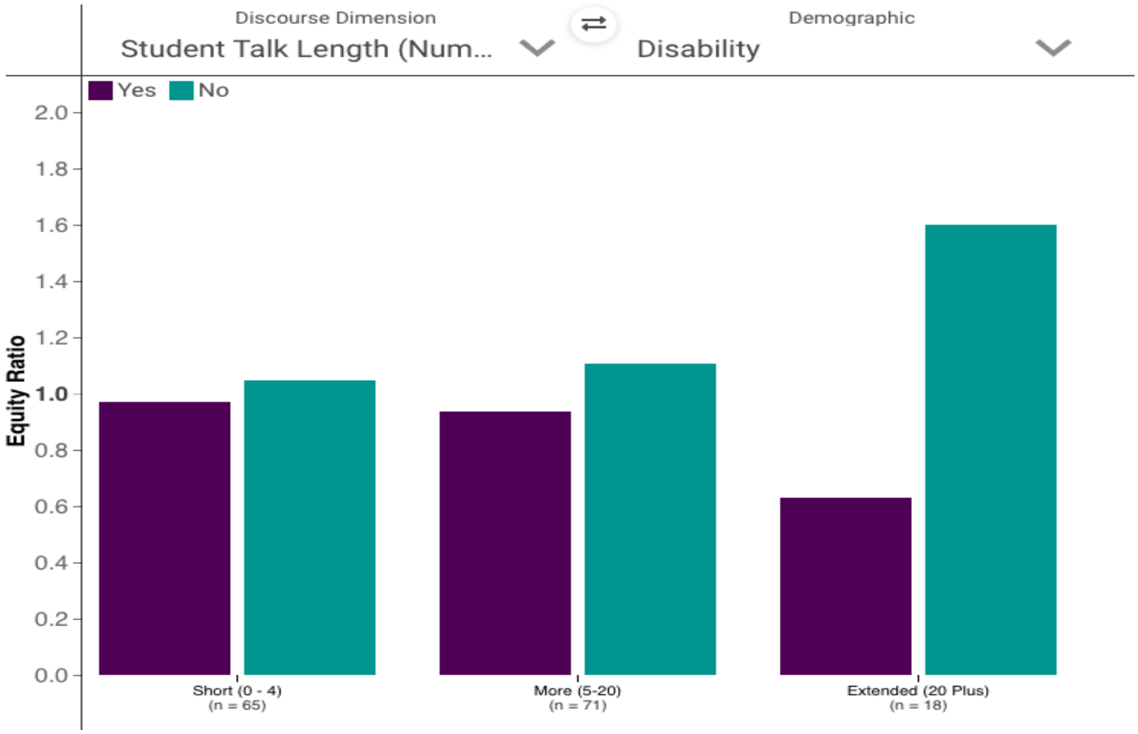

Figure 3. 8th Grade Equity Ratio for Talk Length

Figure 4 shows that the equity ratio for talk type for students with and without disabilities fell between 0.8 and 1.3 in all talk type categories. Specifically, equity ratio for talk type for students with disabilities in the 8th Grade was 0.9 for procedural, 0.8. for conceptual, and 0.8 for other. The equity ratio for talk type for students without disabilities in 8th Grade was 1.1 for procedural, 1.2 for conceptual, and 1.3 for other.

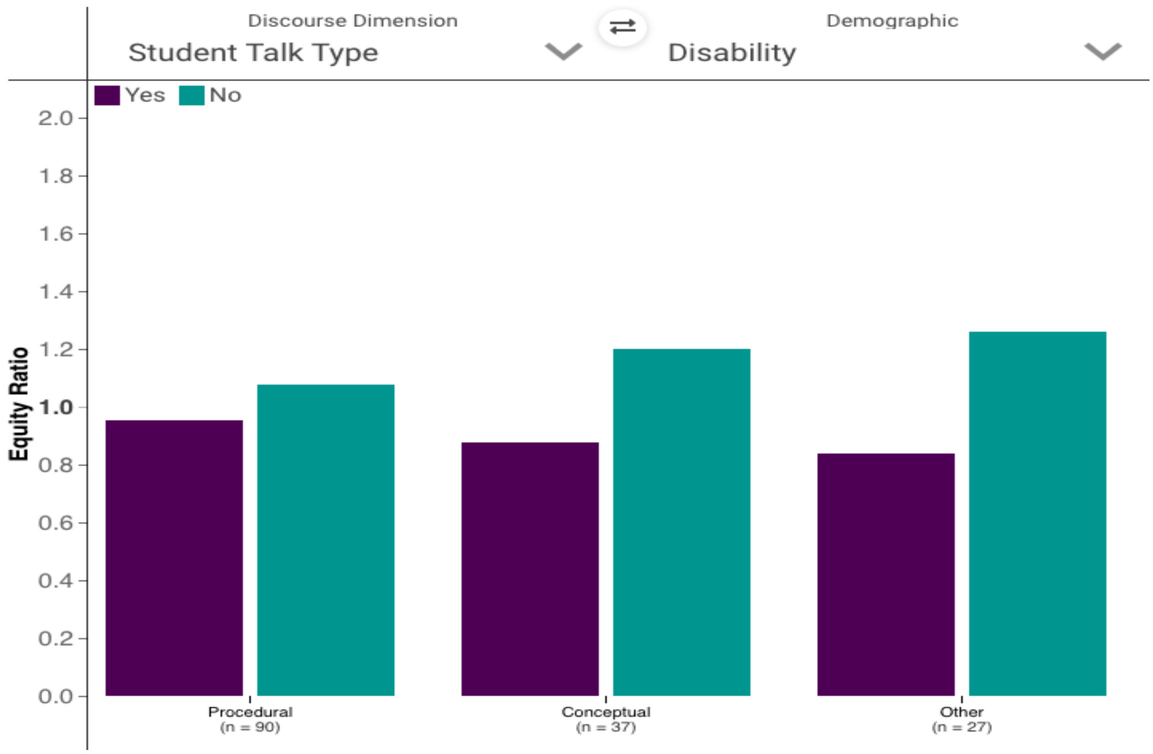

Figure 4. 8th Grade Equity Ratio for Talk Type

Inter-Rater Reliability for Data Collection

Interrater reliability followed recommendations by Schlesinger and Jentsch (2016). Point-by-point total agreement of at least 80% was used as an adequate measure of agreement. The researcher and assistant coded one observational session by each grade level. The 7th grade observation from September 20th resulted in an 84.48% exact-point agreement, and the 8th grade observation from December 3rd resulted in a 95.34% exact-point agreement.

Qualitative Data Analyses of Three Themes

Transcripts of classroom observations and field notes were first analyzed by examining the teachers' question and response patterns. These patterns often were a series of questions and responses rather than a single exchange. The video tape recordings were consulted to capture discourse nuances like tone, voice inflection, and wait time, not easily translated into a written format.

A thematic analysis process was used to identify and analyze patterns of themes within the transcribed verbal discourse (Braun & Clarke 2006), inclusive of the use of CDA noted by Mullet (2018), and described in detail by Lincoln and Guba (1985) of using the adequacy of data and the adequacy of interpretation (Morrow, 2005). The researcher immersed herself in the data through repeated forays into the manuscripts generated from the collected samples of discourse until clearly articulated themes emerged (Mullet, 2018). During initial coding, 11 categories were identified. Subsidiary patterns, based on the teachers' responses, were noted, and linked patterns were then categorized into themes based on the nature and focus of the discourse. After multiple reiterations, three overarching themes emerged. These themes aligned with promoting student discourse by: (a) empowerment of co-teachers, (b) strategic use of scaffolding, and (c) cultivation of inclusive dialogue with students with disabilities.

Once the themes were identified and assigned to units of data through the CDA framework, these themes were analyzed to identify the extent students with disabilities were involved in the interactions. Although students' comments were difficult to discern because only the teacher was wearing a microphone, student equity clearly emerged from the EQUIP data, and further, the CDA of themes in Table 5 show the co-teachers created a social context for meaningful discourse for students with disabilities. These levels of analyses aligned with research question 2: What are the discourse patterns of general education and special education teachers in co-taught inclusive 7th and 8th grade mathematics classrooms for students with disabilities? The top three themes and their descriptions are shown in Table 5.

Table 5

Discourse Themes

Theme	Sub-themes	Description
Empowerment of co-teachers	Self-identity	How teachers' positionalities provided access for students with disabilities to participate.
Strategic use of scaffolding	Phases of questions within instruction Developing mathematicians through discourse Class response implications	Use of solicitation types to provide equitable learning opportunities.
Cultivation of inclusive dialogue with students with disabilities	Hesitation and presence Richness of contributions Assumptions	How co-teachers created a classroom culture to encourage participation of students with disabilities

A rich, thick description of the co-teaching practices of each team is provided with examples that demonstrate the collective themes in Table 5. The researcher provides specific examples of each theme to expand on how these teams provided equity and access for students with disabilities within mathematical discourse.

7th Grade Team

During the majority of the observational period, the 7th grade teachers used a one teach, one assist model. Occasionally, the teachers rotated roles or team taught, giving the perception of a highly collaborative team. This audio component captures Ms. J's confidence as she engages with the students to elicit discourse from all learners. Her momentum is fast paced, and she captures student interest. Ms. S can occasionally be heard leading the class, but most often, she can be heard interacting with students during group/individual work.

The following example was taken from the 7th grade proportional reasoning unit where students ponder a description of a dream about aliens searching for food. This example reflects all three themes identified in Table 5. Students were given a rule that one food bar was needed to feed three aliens to avoid being attacked. The excerpt comes from a whole class discussion on organizing data.

Ms. J: Okay, so if you forget what's happening in my nightmare, up at the top, you see a little bar that has three little alien heads and then a food bar in it? Okay, that's our rule. So, you have three questions on the front, the first situation is I want you to figure out, is there enough food to stop that group of aliens? Number two, is there enough food to stop the second group, and then the third question, if that third group is chasing me, how many food bars am I gonna have to throw back at them to keep them away from me?

Ms. J's solicitation to participate was extended to anyone. The pattern of discourse was presented using closed questions, while maintaining the appropriate level of rigor for the task. Additional scaffolding was given in the form of a reminder to students about the rule with a verbal reference to the picture. The discourse, in this short monologue, illustrates how scaffolding increased the opportunities for participation. This example also shows parity within the team. While it is quite possible Ms. J thought to include the visual reminder of the rule for answering the questions, just as possible was that Ms. S made suggestions to improve access. This developing parity and learning to present mathematics in ways that empowers all learners to achieve success in math is much more than a simple agreement to co-teach (Sherwood & Barger-Anderson, 2008).

The dialogue continues with an excerpt featuring Diane, a general education student.

Ms. J: Remember, if you see something that someone did that you really like, feel free to add it to your paper. Umm and I wanna start with Diane, she did something cool with a picture, and a lot of you did something similar. So Diane, go ahead and talk to people about what you did and what all those words and circles mean.

Diane: Okay, so I went and circled three, and then I put that those would equal one, that would be the first one, second one, third one, and then just goes on from there (inaudible).

Ms. J: So how many total bars would we need?

Diane: Five.

Ms. J: So, what was the significance of Diane circling three aliens? Why did you circle three?

Diane: You said in your dream, one bar could feed three aliens. So, I circled three because you said that in your dream, one bar could

feed three aliens.

Diane provides both procedural and conceptual responses describing her process; however, her only reasoning refers back to the original problem. This is a correct, succinct answer. Yet, the lack of independent thought could be interpreted as not having conceptual understanding. Together, the co-teachers empower one another to consider, listen to, and use student thinking to inform instructional decisions from different points of view. The identity of the mathematics educator and special education professional strengthened the overall instructional approach, lesson design, and progress monitoring of all students.

Evaluating student understanding requires teachers to have a depth of understanding in how students learn mathematics, as well as knowledge on implementing appropriate scaffolding, accommodations, and modifications, to ensure equitable access. For many students, verbal expression comes naturally. However, for others, public speaking is difficult. Therefore, the 7th grade co-teachers put several measures in place, like raising your hand, to maximize participation.

The discourse continues with students sharing additional strategies for organizing data. In particular, the points made by John, Dalton, and Kendra, are significant. The contributions made by these students were unsolicited, and their explanations of their strategies included both procedural elements, as well as the rationale to support their thinking. Further, John, Dalton, and Kendra, all participated more often than other students, despite having a disability.

Ms. J: Very good. One bar feeds three, so we needed groups of three aliens. Very good, Diane. I love your picture. Okay, so now, I want to go to Amy. Alright, Amy, I love how she labeled. So, can you talk everybody through your division problem?

Amy: (inaudible)15 group of aliens and I think divide it by three (inaudible)

John: It's a ratio.

Ms. J: It's a ratio?

John: Ratio.

Ms. J: I thought a ratio was like a fraction or the little colon... So, what do you mean?

John: I did 15 aliens and then like... And then the total of bars is like three.

Ms. J: Oh, okay, so if we think about it, 15 aliens to five bars. Is that a ratio? Yeah. Is it also a rate? Yesterday, we talked about rates. What was important about a rate? Does anybody remember? Yes?

Dalton: It keeps going at a... It keeps growing at a certain pace...

Ms. J: Okay, yeah, that's where we're going with this. But remember, a rate... Our units are different. So, we're talking about two totally different things. What do you think about how Amy labeled her numbers? Does that help make it clear?

Ms. J: Can somebody... I want you to talk at your tables, and I want you... Your conversation to be about, how is Amy's division problem like Diane's picture? How is Diane's picture and Amy's equation, how are they similar? You've got one minute, talk at your tables. How are those similar?

Ms. J: Alright, so who can make a connection between that division statement and that picture? What were some of the things that you said at your groups?

John: They’re sort of both doing division.

Ms. J: Okay, so how? Like how would you explain that to maybe a sixth grader or a fifth grader, or maybe somebody that's just struggling to follow along? Alright, Kendra, give it a whirl.

Kendra: There umm... They both had the 15 aliens, and they did it in different ways though. They came back to the (inaudible) the same way because she divided it through groups (inaudible).

Ms. J: Okay. Let's go back to the first part of what Kendra said. She said they both started with 15 aliens. When you looked at that picture, what's the first thing you probably had to do? Count those aliens. And how many are there?

Class Response: 15.

Ms. J: 15. So I would imagine that Amy got her 15 by counting. Alright, then what did both of them do? Diane, physically on the picture and Amy, with a math problem, what did they do then?

Class Response: They divided.

Ms. J: They divided into groups of...

Class Response: Three.

Ms. J: Three. Does everybody see the groups of three? And so then how many total bars did we need?

Kendra: Five.

Ms. J: Very good. Do you see the connection? Alright, now I wanna go to Rock because he did a multiplication problem and I saw a couple of others, so talk to me about how... Why you multiplied?

Rock: Because I saw umm there was three right here and then five, so I did three times five is 15, 'cause that's how much there were total. And then there was one bar equals three aliens, so I did 15 divided by three is five.

Ms. J: Oh, so you had to divide after you multiplied. Okay. Did anybody else multiply? Alright, does yours kinda... Does your reasoning kinda go along with Rock?

Dalton: Uh. No.

Ms. J: No? So, what were you thinking when you were thinking multiplication?

Dalton: Well, I counted from the middle, which was five and then I counted the left side, which was also five, and so what I've, (inaudible) with my reasoning, I came with five... I went to multiples of five, and then I looked at the prob... I looked at the (inaudible) and I saw three, so a multiple of five would... That has a... That uses a three, but in that (inaudible).

Ms. J: Oh, I don't know if you guys could hear everything Dalton was saying. To kinda go along with Rock's, he's started thinking about multiples of three and he saw columns of five. Does that help you?

Ms. J: Alright. So, does everybody have a strategy? We had using the picture, we had division, we have multiplication. Everybody good with the strategy?

The co-teaching model aligned with this example of discourse offers consistency of teacher presence, creating ongoing opportunities for all students to construct knowledge and express themselves. Both teachers identified their role and orchestrated opportunities for classroom discourse inclusive of classroom wide choral responses with the intention of providing equitable opportunities to all students.

8th Grade Team

The 8th grade co-teachers mainly used a one teach, one assist structure. The audio component of the observations features Mr. C's verbal discourse, as he guided the mathematical discussion with a focus on content standards. This example reflects all three themes identified in Table 5. Although Ms. H.'s support is less frequently heard, the positive impact of her assistance is evidenced by the uninterrupted whole class mathematical discussion taking place, such as in the following excerpt from the launch of a new unit on slope and writing linear equations. The teachers open class with a time-lapse video showing a cruise ship being built one floor at a time, on top of each other, followed by a whole class discussion on the reasoning behind the "how and "why" this particular construction process was used.

Mr. C: How would you describe how they built that ship? You know, what did you... What did you see them doing? Alright. Gail?

Gail: Umm, I said they were kind of building it like how you would use Legos.

Mr. C: Alright, stop right there. They build it like Legos. We all like Legos at one... So, I want somebody else to explain like I see people nodding their head. So, what she means by, it's like Legos? Gary?

Gary: They kinda fit together perfectly.

Mr. C: All fit together perfectly. I wouldn't want to be on a ship that didn't fit together perfectly, right? Would you? Mmm, probably pretty bad. Umm, but you know... Brian, what did you say?

Brian: I said they were like puzzle pieces that were built separately and…

Ms. H: They were built separately and then put together? Why do you think they built them separately and then put together?

Brian: Because that'd be too much for like the one, one area. With all the different spots, like pieces in the same spot.

Mr. C: Louis, what did you say?

Louis: Umm, they, they put the boxes in a different place and then they put them to be together.

Mr. C: And then Andy, I'll come to you, 'cause you like, i-in my mind, you and what I saw Janet write down, pretty much summed up what I... What did you say?

Andy: I said piece by piece, floor by floor.

Mr. C: He said piece by piece, floor by floor. And that's really what you said, they built it a section at a time, a floor at a time. And if you noticed those big, you know, sections... Guys, those were rooms that they built on the floor, uh, on the ground.

The co-teachers solicited individual student participation by asking open-ended questions. Response lengths were in the more (5 – 20 words) range and provided procedures and basic conceptual knowledge. Of the five students who contributed to the dialogue, three were students with disabilities. The contributions made by Brian, Gary, and Louis demonstrate how students with disabilities use mathematical thinking to contribute meaningfully to the classroom discourse, given equitable participation.

The math unit continues under the premise that students work for a construction company building skyscrapers, one floor built on the previous. Students are presented with various problems showing a time lapse of the building construction progress over several weeks. For example, a skyscraper may have four floors after one week of work, eight floors after two weeks, and 12 floors after three weeks of work. Each picture would show a straight line (like an x-axis) with a 1, 2, and 3 underneath it. Above the 1 would be four short, thin rectangles stacked atop each other to show that the skyscraper is four floors tall. Then next skyscraper above the 2 would be eight rectangles tall, and the 3rd shape above the line would have 12 rectangles stacked. The goal is for students to find an equation that would predict how tall the skyscraper is after *w* weeks of work.

The following mathematical discussion between Mr. C and Brian begins in a typical questioning pattern: question, answer, and evaluate. Mr. C initiates the dialogue with an open-ended question. However, instead of evaluating Brian's answer as correct or incorrect, he allows the student responses to guide the subsequent questions. Once Mr. C has confirmed Brian's understanding of the concept, he increases the cognitive level (scaffolding) by pressing Brian to support his reasoning for using a particular procedure.

Mr. C: Now Brian threw up something that I didn't expect. He got an equation up there. So, explain your way.

Brian: I did five weeks plus the original, gives you fifty-six. Which is five weeks plus twelve, which is the original.

Mr. C: Why five weeks?

Brian: Because it says five weeks on the paper, after five weeks what is the final?

Mr. C: How would you change- it said eleven weeks, not five weeks. How would you change your equation then?

Brian: Eleven W plus twelve equals fifty-six.

Brian provided reasoning as to why he used a particular method to solve the problem which verified that he used the entire question to make a procedural decision, rather than basing the method on the number 5 exclusively. The teacher's solicitation method was open-ended, resulting in a procedural based response. When pressed, Brian was able to describe the procedure he would use given a different set of numbers. His explanation does not demonstrate a conceptual understanding, but he was the only student, who wrote the solution as an equation.

The 8th grade team employed a variety of discursive moves to help students continuously develop as mathematical thinkers. Asking students to explain their thinking, comparing different methods, and providing evidence to support claims were all noted components of the discourse observed in the 8th grade classroom. The 8th grade students also were stretched in their thinking beyond mathematics by challenging them to incorporate new vocabulary into their explanations.

Both the 7th and 8th grade co-teaching teams were focused on using effective methods for engaging their class in mathematical discourse. They appeared to use role identity to determine the best moves for soliciting student responses. The co-teachers developed structure and routines based on their particular student needs. They acknowledged student participation without judgement on the quality of student input. This is not to say student answers were never evaluated, only that evaluative statements were made strategically. Individual teacher personalities, relationship with students, and established norms, are all factors considered throughout this discourse analysis.

Theme 1. Empowerment of Co-Teachers

The classroom environment and the discourse statements observed and analyzed were products of the collective identities of the students and how the two teachers' backgrounds blended to impact student equity and access for discourse. The following are the perceptions of the researcher and may not be the exact identities of the educators.

Self-Identity

Throughout the observations, all four teachers used positionality to increase discourse and provide access and opportunity for dialogue by students with disabilities. The following excerpt shows how co-teachers positioned and supported one another based on their individual roles. The following excerpt, from the unit on proportional reasoning, exhibits the connection of teacher identity providing opportunities to participate. This example shows contrast between hesitancy-unsureness and confidence-positivity to empower both teachers to engage and ensure accurate and meaningful discourse by a student with a disability.

Ms. J: Okay. Um, David, tell me why it's so important, like the way that he drew his - His picture is very organized. What's the importance of that organization? Do you- Do you have an idea?

David: (inaudible)

Ms. J to Ms. S: "I might not have asked that nicely, and, I think you know where I'm going with this, so if you can ask it better?"

The general education teacher is quick to hesitate, but quickly empowers her co-teacher (special educator) to ensure David, a student with a disability, has the chance for a voice in the classroom.

Ms. S: Why is it important the way he put together his circles and his food bars? Like, how does that help you understand that 12 food bars will feed 36 aliens?

David: (inaudible)

Ms. S: Okay. So, he was saying that the rule shows that three aliens will eat one food bar, right? What if he just drew aliens? - - Like he drew 36 aliens, but they're all spread out all over his page? How does this help you more than aliens all over the place?

David: (inaudible)

Ms. S: Okay so it's easier to maybe match up the aliens with blue bars? Okay.

The special education teacher employed her special education identity and expertise to provide David with an equitable opportunity to engage in the mathematics discourse. Essentially, she asked the same question as her co-teacher; however, the special education teacher’s delivery provided scaffolding and reassurance for David to participate. Even without an inaudible response from David, the special education teacher continued the dialogue with a tone that implied confidence in David, and her expectation that he would successfully learn. During the observations, additional teacher self-identities examples emerged as a theme. Such as this example, the special education teacher described herself in videos as “not as good in mathematics” while noting the need to ensure the identity of the mathematics teacher was respected to provide reach, clear, and accurate dialogue in mathematics for students with disabilities. For example on the 7th grade team the special education teacher stated:

“Can you say it one more time?”

“Sorry, you guys are really throwing me for a loop today”

“Oh, is there another one? Don’t confuse me!”

In another example from Mr. C’s 8th grade class, he shares his thoughts on the previous unit. In this example, Mr. C’s is the expert in mathematics. He uses his positionality to encourage students who may be struggling in math by explaining that sometimes learning math can be difficult, and even if we don’t do as well as we hoped, we just move on, and keep doing our best.

“What we did first, and I'm going to be real honest with you, that unit we just taught, even for me, is a difficult unit to understand, it was really difficult, it's what... Like I... In my mind, it's probably the hardest unit we teach all year, so maybe we didn't do as well as we thought.”

Overall, the self-identity of the teachers in their respective roles lifted up the students who were struggling. Collectively, both teams provided equal access and equity of voice through the use of their identities as co-teachers with unique expertise.

Theme 2. Strategic Use of Scaffolding

Teachers used a variety of discursive moves to help students continuously develop as mathematicians. Asking students to explain their thinking, comparing different methods, and providing evidence to support claims were all components of the 8^{th} grade discourse.

Mr. C: Are we ok to talk about Rose’s method? Can we call it that? I like that. So- So, can I verbalize- Help me, because I don’t want to put words in your mouth because this is your method. Rose, put words to it because I- I did write your method back up with your formula so- within the first problem, we did the plus two because that was the initial building, now we said that, right? So, Rose’s even got the plus five because that’s what we started with. That was- That was week zero, that was the initial building, right? So Rose, will you tell me why you did W times two? Because that’s the part we didn’t verbalize in the method, right? What- So say it again.

Mr. C: Okay, all right, so- How many people got that? But all right, so here's the other part, here's the other part we make mistakes. We make mistakes when we- Plus 22, there's nothing wrong with that math, your processing is spot on. It's the little things that we like to try- When they write those test questions, that's what they do to you.

Theme 3. Cultivating Inclusive Discourse

The type of classroom discourse observed across these two classes appeared to be partially attributed to how the co-teaching teams developed structure and safety within the classroom communities. Characteristics of the discourse patterns evolved naturally for each group, yet, still promoted students' mathematical thinking and learning. Although the teachers guided the discussion, they did not control the outcome. The mathematical interpretations, conjectures, and explanations were contributions made by students.

The standard set for students is "your best." This statement is not evaluative. Instead, this statement tells students that learning is hard work, and to achieve personal potential, they have to put in the work. The ongoing dialogue communicates sincere belief, that given the right support, all students can contribute meaningfully to mathematical discourse.

Students were sometimes reluctant to share their thinking, and this behavior seemed to be the case in both classrooms. The collective approach, by the grade level teams, was to foster a classroom dialogue with just the right scaffolding for students to extend their thinking beyond memorizing and repeating patterns. To ensure learning opportunities were accessible to every student, alternative modes of communication were made available. As students gained confidence in their understanding of the concept, the level of math talk increased. An example of the promotion of dialogue and support for communication is provided.

Ms. J: Alright, does that make sense? One bar is gonna feed three of those aliens, so she just made groups of three and assigned a bar to each one of them. Who had a strategy similar to Diane's? Raise your hand high if you had a strategy similar to Diane's.

For other students, verbal expression was a strength and the teachers appeared to build upon students' strengths. Rich descriptions of student work and comments were regularly part of the 7^{th} and 8^{th} grade co-taught discussions.

Mr. C: Look at Karen's way. (inaudible). Connect Karen's method to what MK did? Can you connect Karen to MK?

Mr. C: So, Rae. Can you connect the two?

Rae: Yeah.

Mr. C: Alright, how would you connect them?

Rae: So, as soon as I saw Karen's way I pictured it in my head, like, I saw, oh, like the number of each week above each four, and that's what kind of… That's kind of how I pictured it with MK, too. Like one four, two four, three four- And then with the- and then the number of floors would come up with the table with what MK did at the bottom.

Mr. C: So, I wanna use this word "Superimpose." Like, can I put sort of Karen's method with MK's method?

Class Response: Yes.

Mr. C: Okay. Mekkhi, talk about yours and they're gonna talk. I see you got something else.

Mekkhi: Alright, so, what I did was I took eleven times four because since there's eleven weeks and they're building four- four floors each week, I did that and I got forty four. And then I did forty-four plus twelve because they started on week zero and there's already twelve floors so I did forty-four plus twelve equals fifty-six.

Mr. C: So, look at Gail's. I want you to turn and talk- Gail's looks a lot like Mekkhi's right? She's got some addition; she's got some multiplication. But she ain't got the same numbers.

Mekkhi's got forty-four. They both end up with fifty-six, right? But what is she doing different than Miekkhi? Turn and talk, thirty seconds. Go.

Mr. C is tuned in to the individual learning process of each student. From the discourse taking place, student explanations are vital to the lesson moving forward. Had this lesson been taught in a traditional lecture format, the rigor of the mathematics may have been diminished. However, Mr. C anticipated student success and proceeded with a whole class discussion. the rich contributions made by several students, (much of which came from students with a disability) appeared to extend student thinking. At the start of the exchange, the questioning seemed simple. Yet, as the discussion progressed, the concept was expanded.

When Mr. C asked questions, his main focus was to explore how students arrived at their answers. He focused more on students' thinking, and their various solution strategies; less on the correct answer. Additionally, when students explained their answers, all students benefited from hearing multiple ways to think about and solve problems. This appeared to increase access for students to engage in grade level content with their peers.

The assumptions, and stereotypical impressions are one of the greatest barriers students with disabilities face in trying to access equitable education. As the vignettes illustrate, students can meet the challenges of a rich mathematics curriculum when given the opportunity. The positive constructivist mindset was evident across the teams. Instead of telling students how to think about and solve math problems, teachers employed measures to build on students' ideas to stimulate further thought (Martino & Maher, 1999). The assumption observed was that all students meaningfully contributed to the productive classroom discourse. The expectations were not lowered, and with the collaborative co-teaching teams, students' ideas were encouraged, valued, and used to shape instruction. The standard set for students is "your best," as seen in this final example. This dialogue with the students was not an evaluative statement. Instead, this statement tells students that learning is hard work, and to achieve personal potential, they have to put in the work.

Mr. C: And when I say what we're gonna do, I'm talking Math 1, Math 2, and Math 3. So, when we talk about doing the work and the homework and everything, guys, it is imperative that you do your best. Remember what we said, best is standard. If you're not doing your best, you're not living up to what we need to live up to, everybody understand? Alright…

Collective Analysis of the Data

Both the quantitative and qualitative data presented in this chapter present only a snapshot of what classrooms might look like if all students were regarded as mathematics doers and thinkers and capable of mathematical knowledge construction. The overall findings show that co-teachers were empowered to use their role identity to impact learning while strategically using scaffolding to elicit confidence in student with disabilities to participate in a discourse rich inclusive setting. The EQUIP data shows that the level of participation and dialogue were close to equal with students with disabilities using less longer phrases in their discussion and being asked more procedural than conceptual statements at times. This initial research leads to future discussion and potential research on finding the right balance across the different preparation of these two fields.

CHAPTER FIVE: DISCUSSION

Introduction

The purpose of this study was to determine how middle school co-teaching teams engage students with disabilities in mathematical discourse. Using the EQUIP and transcripts from video analysis, the researcher used both quantitative and qualitative analyses to investigate the context and content of mathematical discourse. Using a critical discourse analysis, (CDA) the verbal discourse was coded into one of three themes: (a) empowerment of co-teachers, (b) strategic use of scaffolding, and (c) cultivation of inclusive dialogue with students with disabilities. This mixed-methods approach was aligned to each research question and outcomes provided in this chapter. The researcher begins with a discussion of mathematical discourse and co-teaching.

The data from EQUIP shows co-teachers, across teams, solicited student participation from the class as a whole and connected with individual students in mathematical discourse. The teams asked a variety of question types, including open plus, to engage learners and to elicit and advance their thinking. The researcher noted, in personal observations, that both teams used rigorous questions aligned with recommendations from the NCTM (2014). The level of discourse and the promotion of conversation throughout video examples provided both spiraling and scaffolding of dialogue to create a positive learning environment.

7th grade Co-Taught Team

The co-teachers worked in tandem to provide equitable opportunities to all students. As they worked together, they used their individual strengths and positions to support one another throughout the teaching process. Parity was strong within the team, which was observed in both their sidebar conversations, and smooth transitions as they took turns leading the instruction. The EQUIP data shows the solicitation methods and types used by the 7th grade team provided equitable opportunities for students with disabilities to participate in mathematical discourse at or equal to their peers. This finding was further substantiated from the qualitative themes that emerged.

8th Grade Co-Taught Team

The co-teachers facilitated the engagement and opportunities for mathematical discourse to all students. The EQUIP data reveals that the solicitation methods and types were distributed equitably, showing students with disabilities participating in mathematical discourse near or equal to their peers. This team consistently used a one teach, one assist model, but also showed parity in their flow and communication during instruction. The discourse was equally open in the responses elicited, and the team of teachers as noted in the examples that emerged from the qualitative analysis allowed students to come to their own conclusions in their answers. The two teachers built upon, progressed, regressed, and scaffolded their discourse as needed.

Positive classroom discourse was observed throughout the study, across both grade levels. Each group developed a discourse style unique to their classroom, while maintaining their combined commitment toward inclusive practices that promoted students' mathematical thinking and learning. A general observation, based on the verbal discourse, was that students' confidence in their ability to communicate their understanding, improved. Students with disabilities became less hesitant and more willing to share their thinking, including mathematical interpretations, conjectures, and explanations.

Theoretical Framework

The data were examined under the disability studies in education (DSE) premise that disability should be understood in relation to social constructs and responses to differences. In schools, responses often result in social exclusion and oppression. By analyzing the classroom discourse through a DSE lens, disabling responses to those differences can be understood, providing critical insights into the existing knowledge and to guide future inquiries.

The model of inclusive schooling, (Winzer & Mazurek, 2017) is based on the central theme of equity within schools, and specifically within the general education setting. On one hand, disability is characterized as simply another identity representation such as culture, gender, ethnicity, language, and social class, overlooking the uniqueness of disability. On the other hand, diversity advocates seek equitable treatment. The complicated dialogue surrounding social justice and equitable opportunities are systemic, and significant at the local, institutional, and societal levels. Therefore, the discourse taking place in classrooms is only a small part of the dialogue. The discourse taking place in mathematics classrooms is ultimately shaped by the experiences, backgrounds, and beliefs of the individual participants. Using the inclusive model to guide the discourse analysis provides a multi-level perspective to identify and discuss some of the systemic barriers to inclusive education. In this study, the focus is centered on equity and access, but further investigation could continue with a shift toward the additional elements of the inclusive model, to provide a more comprehensive analysis.

When viewing data through these theoretical frameworks, The DSE framework aligns with the findings that when a second teacher is in the room, they can make contributions to overall classroom discourse and engagement for students with disabilities creating an inclusive and equitable learning environment. These frameworks, supported by the quantitative analysis from the EQUIP, show that when students have higher level content challenges from a content expert and the ability to contribute to the discourse with scaffolding from the special education teacher, the outcome is access to mathematics. This study grounded in mathematics was not about this content area, but how these two teams of teachers collectively created an inclusive model of equity and social justice in access to content and equity by students being actively engaged in discourse near equal to their nondisabled peers. The EQUIP data shows that when given the chance, students with disabilities can engage in mathematics discourse dialogue and that this dialogue does promote mathematical understandings.

The observations of the 7th and 8th grade classrooms demonstrated how two classrooms can differ broadly in co-teaching structures, positionalities of the teachers, and the communication styles, while also reflecting similar techniques of facilitating students' engagement in classroom discourse. According to the socio-cultural theory, "learning arises not through interaction, but in interaction" (Ellis, 2000, p. 209). During classroom interaction, teachers and learners jointly constructed context-specific classroom discourse, which has been acknowledged as an important element for learning. Educational researchers have used Critical Discourse Analysis to explore connections between educational practices and social contexts; for example, CDA has been used to examine relationships between teaching, learning and curricula, students' identities across time and context (Tamatea et al., 2008), cultural representations in textbooks (de los Heros, 2009), and the influence of teachers' ideological perspectives on their teaching practice (Llewellyn, 2009). In this study, CDA was used to closely examine the ways in which co-teachers collectively used language as a means of increasing opportunities for students to learn mathematics.

Identity development of co-teachers

During classroom interactions, teachers and learners jointly constructed context-specific classroom discourse, which has been acknowledged as an important element for learning. Both teachers used scaffolded questioning to increase opportunities for all students to learn mathematics.

Strategic use of scaffolding

Different foundational theories underly mathematics education and mathematics in special education. Research in special education is rooted in behaviorism and experimental psychology, which aligns with the use of direct, procedural instruction (Osgood, 2008; Woodward, 2004). Mathematics educational research is based on constructivist and sociocultural theories of learning, which tends to recommend an inquiry approach to mathematical learning (Boyd & Bargerhuff, 2009; van Garderen et al., 2009). The traditional teacher preparation program may not have provided these teachers an understanding in different pedagogical recommendations on best practices, which could pose challenges for co-teachers when collaborating. The observations of both teams did reveal mutual respect. On several occasions, teachers consulted one another regarding the moves needed to set up, organize, and manage the whole class discussion to give every student access to the content. The examples provided in chapter 4 show a common observation of the two teachers integrating their disciplinary expertise. These teachers used multiple methods regarding the types of questioning they would ask, the most appropriate teaching approaches for different mathematical concepts, and in determining who was most qualified to teach students with disabilities. The EQUIP data shows when these teachers used different solicitation methods, solicitation types, and strategic determinations to evaluate students' responses for students with disabilities to participate. The data shows various methods used were more likely to engage students with disabilities in extended mathematical discourse, covering both procedural and conceptual information, comparable to nondisabled peers.

Cultivation of inclusive discourse

Across both classrooms, the context and the content were notable in the structure these teams used and their engagement with students. Although the approaches by each team were different, both produced similar results in engaging and extending opportunities for students with disabilities. The EQUIP data further substantiates this theme. These teachers used a positive approach to students with disabilities to create a culture of inclusion and expectations of competence in mathematics. Access before assumption needs to be the future for all individuals with disabilities; the consistent themes of access and student learning of mathematics were prevalent for both teams from the data analysis.

Empowerment of co-teachers

General education teachers who work with students with disabilities in their classroom need to be empowered to use their collective experiences and knowledge to direct student learning. The process of directing content learning is very complex for special education, considering their own potential content knowledge and the complexity of the range of disabilities. Nevertheless, both teachers need to be empowered to use best practices in mathematics instruction as well as in special education. Combining these disciplines through co-teaching collectively can help teachers meet students where they are and connect and support one another in both the context and content provided to ensure equitable access for learners.

Strategic use of scaffolding

Research on scaffolding in discourse has been present in special education or general education literature but has not blended as much across disciplines. The EQUIP provides a glimpse of scaffolding dialogue in discourse, and shows variation in methods of questioning that allowed students to participate and contribute as members of the discourse. Instead of looking at scaffolding as a bridge, discourse in a co-taught classroom provided organic access from the start. This shows how fields can complement each other to educate all students more equitably.

Cultivating mathematical discourse

Across both classrooms, the context and the content of mathematics discourse were notable in the structures teachers used to engage all students. Although the two teams approached their roles as co-teachers differently (one had more equality and parity while the other used more of a one-lead, one-support role) both produced similar results in engagement and extending opportunities for equity and access for students with disabilities. The EQUIP data further substantiates this theme of equity by students with disabilities being at or near the level of participation in classroom discussions. What was not ascertained is if individual students' voices were equal; however, collectively, students with disabilities participated, verbally, at or near the amount and length as students without disabilities. The difference in approaches of the two teachers was clear in that Mr. C, in the 8th grade classroom, wrote on the board more often and followed a similar pattern of instruction repeatedly. In the 7th grade class, the two teachers had more fluid roles, and one teachers' identity was not as patterned or predictable.

Discussion of Findings Related to the Literature

Inclusive Education

The overall data shows a 50% increase in the number of students with disabilities, included with nondisabled peers, for the majority of the school day (National Center for Education Statistics, 2020). In this study, students with disabilities were clearly included and benefitted through their contributions, academically and socially. Beginning with NCLB (2002), students with disabilities have been expected to test at the same level as their nondisabled peers, and schools have been held accountable for their progress. Yet, even with this expectation, the level of instruction provided in more restrictive settings has not always aligned with the rigor, expectations, or outcomes expected on state and local assessments, especially in mathematics. As noted in the 2019 NEAP, scores were less than 50% for 4th graders or less than 68% for 8th graders with disabilities, yet what is not accounted for is where and from whom they received their mathematics instruction. In this study, examining two co-taught classrooms from the lens of the researcher's expertise and that of two national experts on co-teaching in mathematics, students received high level instruction and accommodations in discourse. Yet, how their affordance of an inclusive setting rich in discourse impacted students with disabilities' learning gains individually and collectively is clearly an area of future research.

Perceptions Matter

Bartell (2010) noted productive student-teacher relationships impact equity in mathematics classrooms. In this study, the relationship the co-teachers had with each other and the students appeared to create an environment where students actively engaged and took risks to participate in mathematical discourse. Teachers openly showed their own vulnerabilities in making mistakes, acknowledging their own errors, and embracing the perception that mathematical learning was not about right answers but about understanding the underlying assumptions. Students' discourse was longer, on average, than their nondisabled peers, showing they understood the perception that getting it right was not the outcome of mathematics but was about the process of learning and understanding the mathematics. The teachers showed they had confidence in their learners and embraced the rich diversity of the classroom. Listening to the whole class discussion, voices of students with and without disabilities could not be discerned as the dialogue, risk and output were not differentiated. What was clear, was the dialogue and how voices of students with disabilities were included.

Procedural vs Conceptual Instruction

Students with disabilities, who receive special education services in math, often receive procedural-based mathematics instruction, relying on rote memorization rather than developing a conceptual understanding of mathematics (Gutiérrez, 2017). Jackson and Neel (2006) found that students in general education classrooms spent significantly more time engaged in conceptual work in mathematics (61% observed time), while students in segregated special education settings at the same school spent far less time engaging in conceptual mathematics (19% of observed time). The balance or close to balance of these two types of approaches, through questioning given to students with disabilities, were found as outcomes of this study. An interesting finding was that more conceptual statements were made to students without disabilities in both classes, but with such a limited sample size, further research is needed to consider how to investigate the impact of these differences on student learning, and if they exist across a larger sample of co-teaching teams.

The discussion about which teaching practices promote the intellectual, social, and emotional growth of every student has been ongoing within the realms of mathematics and special education for years. According to mathematics researchers, students learn higher level math through open-ended, probing discourse, than talk that is directive and has dichotomous responses (Forman & Ansell, 2001; Lampert, 2001; Moyer & Milewicz, 2002; National Council of Teachers of Mathematics [NCTM], 1991, 2000; Simon & Schifter, 1991). Recently, greater concerns about equitable access to significant mathematics instruction have been raised, questioning whether implicit instruction is effective for all students (Ball et al., 2005; Lubienski, 2000). The researcher in this study cannot provide any definite answers but did find further information to consider in this line of inquiry.

Researchers in mathematics education have just begun to explore what this middle ground might look like. In particular, Boaler (2002) suggests some practices may put some students at a disadvantage, while providing valuable learning opportunities to others. As such, she recommends continued research into teaching practices that incorporate verbal discourse and problem-solving with close attention to equitable access much like occurred in this study.

Future of Co-Teaching Preparation

According to the 37th Annual Report to Congress (U.S. Department of Education, 2015a) more than 90% of students with disabilities receive part of their education in the general education classroom. To meet the needs of a diverse student population, co-teaching, as an instructional model, has increased (Cook et al., 2011; Dieker & Murawski, 2003; Magiera & Zigmond, 2005). The ongoing discussion around best practices to teach students with disabilities highlights a common concern regarding the preparation of educators to meet the diverse educational needs of students with disabilities. Of particular concern has been on preparing general education teachers to effectively facilitate inclusive education (Allday et al., 2013; Harvey et al., 2010; Smith et al., 2012; Thompkins & Deloney, 1995). Unfortunately, the level of content knowledge required of special education teachers is also unacceptable and may not be sufficient for students to successfully achieve learning gains (Ploessl & Rock, 2014; Pugach, et al., 2011). The collaborative nature of co-teaching integrates the general educator's content knowledge with the special educator's expertise in providing adaptations and modifications across content areas in the general education setting, as outlined by the students with disabilities individualized education program (IEP; Department of Education, 2004).

The number of professional development programs focused on preparing co-teachers are limited. Koh and Shin (2017) closely examined the present state of inclusive education practice and current teacher preparation programs. The findings identified approximately 15% (34) of university programs did not require any special education courses, and approximately 62% (140) university programs only required one introduction to special education course. The option to major in elementary and special education was available at 3% (7) of the programs reviewed (Koh & Shin, 2017). Discourse, co-teaching, and special education knowledge enhance teaching and learning in general education. Combined degrees give students access, as evidenced through discourse analysis.

Summary of Findings

The outcomes of this mixed-methods study resulted in findings that concur with research in the field and extend thinking in the use of the EQUIP to examine equity and further investigate the qualitative themes that emerged. The discursive interactions provided in the text give brief examples of collaborative communication, showing how students with disabilities, when given equitable access to mathematics content, did engage in the mathematical discourse of these two co-teaching teams.

Quantitatively, the data suggest no hard and fast rules exist for establishing classroom routines, processes, or teaching practices to ensure all students master every benchmark. Moreover, the outcomes of this study indicate a need to further investigate if a hybrid approach (direct instruction and inquiry-based learning) similar to that used by these two teams to teach mathematics is the right approach for optimal learning gains. Varying question types (closed, open, open plus) also were determined to be a factor in how co-teachers engaged students in productive discourse, leaving another area for further investigation.

Three primary themes persisted throughout the study relevant to the overall understanding of co-teaching mathematics to middle school students with and without disabilities. Empowerment of co-teachers revealed the range of positionalities educators assign to themselves and their co-teacher to engage every student in productive mathematical discourse. The lessons, beyond the quantitative factors described, demonstrated how both teams built confidence in their students through strategic use of scaffolding in discourse versus direct instruction. The problems presented were grade level appropriate, and the variation of questioning patterns elevated students' mathematical thinking. The cultivation of inclusive discourse was a powerful theme to find within these two, distinctly different classrooms. As the teachers went about their usual tasks associated with teaching and learning, the treatment of students with disabilities felt genuine. The message heard in the discourse was that students with disabilities were and are capable of learning mathematics. Demonstrating mathematical understanding can be assessed using multiple methods. The discourse used by both 7th and 8th grade teachers, throughout the study, communicated a strong desire to provide equitable opportunities for all students to learn.

Conclusion

The purpose of the study was to understand how co-teachers use discourse to provide equitable access to grade level mathematics in their middle school, inclusive classrooms. Beyond the descriptions of talk and the analysis of themes, the researcher's intention was to challenge the field of education to ethnocentrically consider that the ideas about what is right, true, or possible, might be wrong. Until the fields of special education and mathematics decide how to collectively challenge their perceived limits of human potential in mathematical thinking for students with disabilities, then both fields are trapped, with little opportunity to change and grow.

School systems across the country are engaging in educational reform that demands higher educational standards and results for students with disabilities, which could be seen as positive. Mathematics education has received a large share of this attention due to the need for schools to produce more quantitatively literate citizens. No longer can schools allow students with disabilities to “miss out” on learning advanced mathematics, leaving students underprepared for the technological society in which they will live and work. The purpose of this research was to remind both fields of the urgent need to relinquish the use of the medical model, which includes teaching students with disabilities by prescribing treatments students must undergo to be fixed, calling treatments targeted interventions to remediate deficits. Instead, as reflected by both teams in the study, we must “reimagine” how to provide students with equitable access to mathematics education and to realize disability as part of human identity. Additionally, education should support social justice for students with disabilities by providing access to meaningful curriculum in mathematics. Education for students with disabilities is no longer simply an issue of effectiveness, measured in the short-term; it is about equal rights. It is time for the field of education to realize the need to explore the reconstruction of students with disabilities in both access to spaces and pedagogy. The adoption of a DSME lens affords both mathematics education and special education a chance to address a critical dimension, taken-for-granted by assumptions and marginalizing practices, in mathematics education involving individuals with disabilities. The DSME model and AERA practice groups supporting this model strive for more productive and liberating forms of educational research in mathematics for and with individuals with disabilities. Future research and practice should focus on identifying and supporting mathematical disabilities more broadly, across multiple dimensions (e.g., student, teacher, classroom, curriculum) of teaching and learning, rather than a singular focus on individuals. Individuals with disabilities are the experts, and their perspectives should be privileged in the area of disability and learning. It is that of an ableist mindset to assume that students with disabilities cannot think conceptually or cannot benefit from an engaging and rigorous inquiry curriculum. The field of education, in general, with true synergy between special education and mathematics education, as shown by these teachers, must expect success and engagement of students with disabilities in authentic and relevant instruction for students with disabilities to construct identities as mathematical thinkers and doers.

Inclusion is a culture that collectively accepts, without exception, humanity in all representations (Villa & Thousand, 2005). As a blind, disabled, individual, educator, researcher, and colleague, I challenge each and every one of us, to stop “considering” “examining” “investigating” and “researching” how to ensure students receive equitable access, and instead, take action by reimagining students with disabilities as capable. Only then, will we truly achieve inclusion.

APPENDIX: IRB APPROVAL

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

EXEMPTION DETERMINATION

December 8, 2020

Dear Amanda Lannan:

On 12/8/2020, the IRB determined the following submission to be human subjects research that is exempt from regulation:

Type of Review:	Initial Study, Category 4
Title:	Disrupting Inequities Through Mathematical Discourse: A Convergent Parallel Mixed Analysis
Investigator:	Amanda Lannan
IRB ID:	STUDY00002556
Funding:	None
Grant ID:	None
Documents Reviewed:	• Disrupting Inequities HRP-251- FORM - Faculty Advisor Scientific-Scholarly Review (1).pdf, Category: Faculty Research Approval; • Disrupting Inequities Through Mathematical Discourse: A Convergent Parallel Mixed Analysis, Category: IRB Protocol;

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

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