PEER INTERACTIONS IN ACADEMIC CONTEXTS FOR ADOLESCENTS WITH DISABILITIES

A Three-Manuscript Dissertation Proposal

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ABSTRACT

Peer interactions have been found to be essential in children's social, cognitive, emotional, and language development which are critical aspects to an individual's quality of life. Within the classroom, peer interactions support access to opportunities for learning and advancement in content standards. Yet, existing research examining peer interactions, specifically among autistic children and adolescents, reflect lessened peer interactions in school settings. As such, the academic and social affordances of peer interactions in schools may not be fully realized for students with disabilities. The purpose of this three-article dissertation is to provide a holistic understanding of the role of peer interactions in accessing academic contexts for students with disabilities and explore how past, current, and future research on peer interactions influences how we educate students with disabilities. Specifically, this dissertation examines (a) inquiry-based science instruction, a pedagogy that relies heavily on academic conversations, (b) how students with intellectual and developmental disabilities are often supported socially at the secondary level, and (c) how autistic adolescents experience peer interactions in academic settings. Implications for research, policy, and practice are discussed.

Keywords: students with disabilities, social relationships, adolescents

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CHAPTER 1

Introduction

Executive Summary

Students with disabilities, especially students with intellectual and developmental disabilities (I/DD), often have fewer peer interactions in school compared to their peers without disabilities (e.g., Carter et al., 2005; Freeman et al., 2015; Locke et al., 2010; Raghavendra et al., 2012; Rosenthal et al., 2013; Rotheram-Fuller et al., 2010). This is unfortunate as many academic standards emphasize peer interactions through embedded speaking and listening skills (e.g., Common Core State Standards; Next Generation Science Standards) as social interactions facilitate knowledge construction (Bandura, 1977; Nystrand, 2006; O'Connor & Snow, 2018; Spies, 2016; Spies & Xu, 2018; Vygotsky, 1978; Zweers et al., 2019). Further, students with positive peer and teacher relationships are more likely to be engaged academically (Estell & Perdue, 2013; Perdue et al., 2009) and have higher levels of academic achievement (Wentzel, 2009) and social interactions with peers are strongly associated with adolescents' social-emotional, language, and cognitive development (e.g., Parker et al., 2006; Rubin et al., 2009). As such, the academic and social affordances of peer interactions in schools may not be fully realized for students with I/DD given the communal nature of the classroom.

Students with I/DD may experience particular difficulties with academic conversations which rely on social skills as well as content knowledge and academic language (Spies & Xu, 2018). Academic conversations are "sustained, intentional, back-and-forth exchanges about academic topics" (Spies & Xu, 2018, p. 23; Zwiers & Crawford, 2011) and are used throughout content areas such as in inquiry-based science learning and scientific argumentation, text-based discussions, and Socratic seminars. Academic conversations create opportunities for students to co-construct an understanding of academic content, expand their knowledge, and practice discipline-specific communication skills, leading to improved academic and linguistic outcomes.

The differences in social language and communication that many students with I/DD have may lead to exacerbated difficulty in accessing learning opportunities through academic conversations. This ultimately may decrease students' learning time and integration within the classroom learning community. Understanding how students with I/DD, in particular autistic students, experience social interactions during academic conversations is important in order to support these students in more fully accessing the classroom environment.

Extant research on social interactions among this population has predominantly explored this phenomenon through observations, social networks analysis, and interviews with peers, teachers, and caregivers (e.g., Chung et al., 2012; Freeman et al., 2015; Hestenes & Carroll, 2000; Locke et al., 2010; Odom et al., 2006; Taheri et al., 2016). This constrains our understanding of how students with I/DD, specifically autism, perceive peer interactions, and if they experience these interactions in the learning environment in the same way as discussed in current literature (e.g., Østvik et al., 2017). Given the importance of peer relationships in child development, accessing opportunities for learning, and overall quality of life, it becomes essential to understand how current literature explicates the role of peer interactions in learning, how students are supported through interventions, and how students with I/DD experience peer interactions in the classroom. Thus, this three-article dissertation aims to explore how past, current, and future research on peer interactions influences how we educate students with I/DD. Further, this study aims to provide educators, policymakers, and researchers a holistic understanding of the role of peer interactions in academic contexts in how autistic students access learning spaces.

Problem Statement

Peer interactions have been found to be essential in children's social, cognitive, emotional, and language development which are critical aspects to an individual's quality of life. Within the classroom, peer interactions support access to opportunities for learning and advancement in content standards. Yet, existing research examining peer interactions, specifically among autistic children and adolescents, reflect lessened peer interactions in school settings. Further research is warranted as the lack of peer interactions may indicate a decrease in students' learning time and integration within the classroom learning community. Thus, the academic and social affordances of peer interactions and inclusion in schools may not be fully realized for students I/DD.

Purpose of Study

The purpose of this three-article dissertation is to provide a holistic understanding of the role of peer interactions in academic contexts. Specifically, this dissertation examines (a) inquiry-based science instruction, a pedagogy that relies heavily on academic conversations, (b) how students with I/DD are often supported socially at the secondary level, and (c) how autistic adolescents experience peer interactions in academic settings. Ultimately, there is a need to understand the experiences of autistic students in classroom peer interactions so we may appropriately develop supportive interventions that are grounded in the perspectives of the students we are trying to support as well as grounded in a theoretical understanding of the role of conversations and dialogue in learning. Further, this study aims to explore how past, current, and future research on social interactions and social interventions influences how we educate students with I/DD.

Dissertation Proposal Format

This dissertation consists of three manuscripts, which are identified as chapters. The first manuscript examines research conducted in a focal content area, inquiry-based instruction in science, that requires peer interactions for students to engage in learning. The second manuscript examines the efficacy of direct peer-mediated social interventions at the secondary level. These interventions are frequently used in schools to support peer interactions, friendship development, and social inclusion for students with I/DD. The third manuscript explores autistic adolescents' lived experiences of social interactions with peers in academic learning contexts. Taken together, these manuscripts create a holistic reflection of what social interactions in academic settings (e.g., science inquiry) look like for adolescents with disabilities, with a particular focus on autistic adolescents.

Article 1

The first manuscript is a systematic and meta-analytic review of inquiry-based science interventions for students with disabilities. The purpose of the study was to analyze the current state of inquiry-based science intervention literature for students with disabilities and expand upon prior reviews with the inclusion of (a) current literature, (b) expansive research questions, (c) studies including inquiry-access interventions as well as inquiry-based instruction, (d) an effect size metric for single case design studies that is comparable to group design effect sizes, and (e) studies across disability types. The following research questions were asked:

(1) What are the intervention and participant characteristics of studies examining inquiry-based instruction for students with disabilities?

(2) What types of inquiry-based science interventions (e.g., open inquiry, guided inquiry) have been conducted with students with disabilities?

(3) What is the overall effect of inquiry-based science instruction on content learning for students with disabilities and does it vary across inquiry types?

Potential studies for inclusion were identified using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2020) process. I identified articles through three separate searches. First, articles were identified through a search in March 2020. The search was then replicated to update the potential pool of articles in March 2021. Also in March 2021, a grey literature search for published dissertations was conducted using the same search procedures. I used EBSCO*host* to search the entire electronic Education Resources Information Center (ERIC), Academic Search Complete, and PsycINFO databases using a Boolean search string. Equivalent subjects and related words search features were not used and the search was limited to studies published in English-language journals from 1980 onward.

The database searches provided a total of 2,097 results that underwent title and abstract screening. I screened the full text of 102 articles. A total of 24 articles met the inclusion criteria. Next, ancestral and forward searches of the articles meeting full inclusion criteria (n = 21) were conducted. I also conducted a search of references from related literature reviews and meta-analyses (n = 14). Potentially relevant articles were screened using the inclusion and exclusion criteria. This process produced five additional articles for consideration, one of which met criteria for full inclusion. This resulted in a total of 25 articles with 26 studies in the final review.

Data were then extracted and coded. I calculated effect sizes to estimate the common effect of inquiry-based interventions on student's acquisition of scientific content knowledge for group and SCD studies (Borenstein et al., 2009). I estimated the effect size for group studies using the standardized mean difference scaled to Hedges' g. I estimated ESs for SCD studies using the between-case standardized mean difference (BC-SMD; Hedges et al., 2013; Shadish et

al., 2014; Valentine et al., 2016) which is comparable to the group standardized mean difference (Shadish et al., 2014). Overall findings suggest that inquiry-based science instruction is effective in teaching SWD science content as well as developing proficiency in scientific practices and inquiry skills.

In the included studies, there was a notable absence of interventions supporting students with disabilities in the social communication aspects of science inquiry and cooperative learning. Academic conversations in content areas are a consistently used instructional component that require not only content knowledge, but also social communication and conversational skills. For students with disabilities, particularly students with I/DD, academic conversations may prove particularly challenging, thereby diminishing the academic and social affordances of school. A common approach to supporting the developing of social and communication skills are direct peer-mediated interventions. This became the impetus of the second study.

Article 2

The second manuscript is a systematic and meta-analytic review of direct peer-mediated interventions (DPMI) for students with intellectual and developmental disabilities (I/DD). The purpose of the review was to expand upon prior reviews in four ways. First, I focused the review on DPMI which have been shown to be more efficacious than other types of social peer-mediated interventions (Odom, 2019) that do not involve adult facilitation or peer training. Next, I only included studies at the secondary settings where the changing social landscape of adolescence necessitates additional and unique intervention considerations. Third, I included group and SCD studies, as well as gray literature (i.e., dissertations), to present a more holistic view of how DPMI have been examined. Finally, I employed meta-analytic techniques to evaluate the effects of DPMI on increasing the social and communication skills of secondary

students with I/DD, a need noted in Travers and Carter's (2021) recent review. Despite the frequency of DPMI being used in school settings (e.g., Brock & Huber, 2017; Travers & Carter, 2021), meta-analytic techniques to measure the effects of DPMI at the secondary level have not been applied. To this end, I asked:

(1) What are the intervention and participant characteristics of studies examining DPMI for secondary students with I/DD?

(2) What is the overall effect of DPMI in supporting the frequency of interactions between students with I/DD and their peers?

(3) Is the type of DPMI differentially associated with increases in interactions?

(4) Is the length and type of peer training associated with an increase in effectiveness of the DPMI on increasing the frequency of social interactions?

The literature search for the meta-analytic and systematic review was conducted using best practices (Cooper, 2016). Records were identified and screened using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2020) process. I conducted a systematic search using EBSCO*host* to search the Education Resources Information Center (ERIC), Academic Search Complete, and PsycINFO databases. Equivalent subjects and related words search features were not used and the search was limited to studies published in English-language journals. To identify published gray literature (i.e., dissertations), I used the same Boolean search terms in an abstract search in the ProQuest Dissertations & Theses Global database. This returned 1,319 articles after duplicates were removed that underwent title and abstract screening. I screened the full text of 105 articles. A total of 29 articles met the inclusion criteria. Next, ancestral and forward searches of the articles meeting full inclusion criteria were conducted. I also conducted a search of references from related literature reviews and meta-

analyses (n = 10). Potentially relevant articles were screened using the inclusion and exclusion criteria. This process produced four additional articles which met criteria for full inclusion. This resulted in a total of 33 studies in the final review.

After full text screening, the studies were dummy coded, and I calculated effect sizes to estimate the effect of DPMI on increasing social communication for students with I/DD for group and SCD studies (Borenstein et al., 2009). For group design studies, I used the standardized mean difference ES, scaled to Hedges' g to account for small study sample sizes (Hedges, 1981). For single-case design studies, I used the BC-SMD (Hedges et al., 2013; Shadish et al., 2014; Valentine et al., 2016). Overall findings suggest that DPMI are efficacious in increasing social interactions between students with I/DD and their peers.

Article 3

After completing the first systematic and meta-analytic review and beginning the second, it became evident there is a dearth of research in two pressing areas. First, there is a lack of research examining the role of social skills in accessing academic contexts through academic conversations. Second, there is a particular absence of research documenting the lived experiences of academic conversations for students with autism. This is unfortunate as autistic students often experience exacerbated difficulties in accessing the social community of a classroom. As such, the purpose of the final study was to explore the meaning autistic adolescents ascribe to social interactions and academic conversations in academic settings.

I situated the study in social constructivism with a critical disability interpretive lens (Creswell & Poth, 2018). I used hermeneutic phenomenology as it provides systematic structures to "uncover lived experiences" (van & Manen, 1990, p. 10) or "the world as we immediately experience it pre-reflectively rather than as we conceptualize, categorize, or reflect on it" (van

Manen, 2016, p. 9). Phenomenological researchers seek to explicate the essence of phenomena (Husserl, 1970) which is to "grasp the very nature of the thing" (van Manen, 1990, p. 193) by balancing idiographic descriptions of people's lived experiences with creating written reflections for others to connect with (Emery & Anderman, 2020). Ultimately, phenomenology aims to uncover insights into our everyday, shared experiences (van Manen, 2016). Hermeneutic phenomenology involves four recursive research activities (a) turning to the nature of lived experience, (b) investigating experience as we live it, (c) reflecting on essential themes, and (d) the art of writing and rewriting (Lauterbach, 2018; van Manen, 2016). In this process, the researcher and participants collaborate to explore and develop their understanding of the phenomenon through the empirical investigation and the writing process (Lauterbach, 2018).

For the study, I used purposeful, maximum variation sampling (Onwuegbuzie & Collins, 2007; Patton, 1990) to recruit participants until data saturation was reached. I first screened interested potential participants for the following criteria: (1) having a primary diagnosis of autism (per caregiver report), (2) not having a co-occurring intellectual disability, (3) being ages 14-22, and (4) included in general education content classrooms for at least 40% of the school day. Next, of the potential participants meeting full eligibility criteria, I purposefully selected maximum variation in gender. Participants were recruited from the Washington, D.C. metro area through local avenues such as online parent groups, advocacy organizations, service organizations, interest-based clubs, local libraries, mental healthcare providers, and social media.

During data analysis, I developed interpretive summaries detailing participants' experiences of peer interactions during academic conversations. Three themes were generated: (a) the role of the teacher, (b) navigating the interpersonal, and (c) relational trust. These three themes were connected in several important ways. First, the role the teacher played, and their

support, influenced how students navigated interpersonal aspects of group work, embraced each other's differences, and the level of relational trust that was developed between students. Next, how students did or did not embrace differences in interpersonal aspects of academic conversations and group learning influenced the degree to which relational trust was developed. Further, there appears to be a potential relationship between being open to differences in oneself and others, the opportunities that creates for interpersonal interactions, and the trust that develops where one can feel accepted and confident. Finally, embracing each other's differences in interpersonal interactions was a key aspect of working as classmates, but relational trust was essential in moving from classmates to friends. These all had implications for participants' engagement in class and their ability to benefit academically from peer interactions during learning.

Organization of the Remainder of the Study

Chapter Two consists of the first article, "Inquiry-Based Science Instruction for Students with Disabilities: A Systematic and Meta-Analytic Review." Chapter Three is the second article, "Direct Peer-Mediated Social Interventions for Secondary Students with Intellectual and Developmental Disabilities." In Chapter Four, the third and final article is presented, titled "Being Each Other's Keeper": Autistic Adolescents' Experiences of Peer Interactions During Learning".

CHAPTER II

Inquiry-Based Science Instruction for Students with Disabilities: A Systematic and Meta-Analytic Review

Abstract

Developing scientific literacy is necessary for students with disabilities (SWD) as it supports the ability to create solutions to real-world problems and understand current events, and it strengthens critical thinking, problem-solving, and complex communication skills. The purpose of this systematic review and meta-analysis was to evaluate extant literature on inquiry-based science interventions for students with disabilities (SWD) in service of developing scientific practices. We identified 26 studies in 22 articles and 3 dissertations for inclusion in this review. Effect size (ES) estimates demonstrate significant positive effects in both group (ES = 0.79; CI [0.41, 1.17]) and single case design studies (ES = 2.76; CI [1.93, 3.60]). Overall findings suggest that inquiry-based science instruction is effective in teaching SWD science content as well as developing proficiency in scientific practices and inquiry skills.

Keywords: exceptionalities, science instruction, learning strategies and direct instruction, meta-analysis

Introduction

The National Research Council (NRC) defines *scientific literacy* as "a greater knowledge and understanding of science subject matter" that "includes understanding the nature of science, the scientific enterprise, and the role of science in society and personal life" (NRC, 1996, p. 21). Developing scientific literacy is important because it allows individuals to understand current events (e.g., fracking, global warming, the COVID-19 global pandemic) and address these problems in the world (NRC, 2012). Further, scientific literacy affords opportunities to develop skills in critical thinking, problem solving, and complex communication (e.g., argumentation). Scientific literacy also has long-term implications for quality of life given the growing economic and occupational demand for science, technology, engineering, and mathematics (STEM) professions. Currently in the United States, it is estimated that STEM jobs will continue to grow rapidly by 8.0% between 2019 and 2029, as compared to 3.7% for all other occupations (Zilberman & Ice, 2021). Consequently, scientific literacy has been a major focus of education public policy for the last several decades (e.g., the American Association for the Advancement of Science' Project 2061: Science for All Americans [1990]; NRC's National Science Education Standards [1996]; No Child Left Behind [2002]).

Despite the importance of and emphasis on scientific literacy, students in the United States consistently demonstrate low performance on science achievement assessments (National Assessment of Educational Progress [NAEP], 2015). In 2019, only 36% of 4th-grade students, 35% of 8th-grade students, and 22% of 12th-grade students scored at or above the proficient level in science (NCES, 2021). Further, there was a marked discrepancy in performance between students with and without disabilities. Specifically, 15% of 4th-grade students with disabilities (SWD) scored at or above proficient compared to 39% of general education students, 13% of 8th

grade SWD scored at or above proficient compared to 38% of general education students, and 8% of 12th grade SWD scored at or above proficient compared to 24% of general education students (NCES, 2021). Given the educational and long-term implications for strong scientific literacy, addressing this gap between SWD and their peers is essential.

Science Education and Inquiry-Based Instruction

Students' poor science achievement may be associated with how science has historically been taught. Traditionally, science education has relied on didactic, teacher- and textbook-focused instruction with an emphasis on students acquiring a large volume of factual information and scientific vocabulary in isolation (e.g., Brigham et al., 2011; Scruggs & Mastropieri, 2007).This is unfortunate because students who do not engage in authentic scientific practices and process skills tend to view science as abstract and have an incomplete understanding of the process of scientific discovery, limiting their development of scientific literacy (National Academies of Sciences, Engineering, and Medicine, 2015).

SWD often struggled to acquire scientific content within these traditional instructional techniques, for several notable reasons. Primarily, students across disability categories frequently struggle with language. Difficulties with language have been attributed to many issues SWD experience in science (Scruggs & Mastropieri, 1993). Indeed, receptive and expressive language are needed to access classroom instruction and communicate learning. Language is also required to gain vocabulary knowledge, which is strongly associated with comprehension of high-level concepts (Kaldenberg et al., 2015). Further, SWD often experience difficulties in language-based academic domains such as reading and writing (e.g., Jenkins et al., 2003) which are necessary for accessing text-delivered instruction and for communicating knowledge. In addition to persistent language difficulties, some SWD experience challenges in information processing and

knowledge retention (e.g., Brigham et al., 2011) as well as information recall (e.g., Mercer & Mercer, 2005) which may further inhibit many SWD's ability to succeed in science using traditional methods. An overall lack of effective learning strategies exacerbates these difficulties (Scruggs & Mastropieri, 1993).

Within the last several decades, a substantial shift occurred in science education and what it means to *know* science (NGSS Lead States, 2013; NRC, 2007). During this time, general education science instruction shifted from more traditional instructional practices to inquiry-based methods (Scruggs & Mastropieri, 2007) where "learning science is an active process" (NRC, 1996, p. 20). In this approach to science education, the emphasis is placed on building proficiency in scientific practices. With inquiry-based methods, students master core concepts via the implementation of science inquiry skills. A high-quality and comprehensive science education affords students opportunities to actively acquire an in-depth understanding of content by developing underlying inquiry skills (NRC, 2007).

Inquiry has been described as "a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories" (NRC, 1996, p. 214). Across the science education community, the term inquiry has been applied and interpreted in varied ways (Anderson, 2002; Kang & Wallace, 2005; NGSS Lead States, 2013). Inquiry-based science instruction has become synonymous with terms such as *discovery learning*, *hands-on learning*, and *activity-based instruction* (Rizzo & Taylor, 2016). At its core, however, inquiry-based instruction can be considered a framework of practices where students are responsible for their learning through engaging in scientific exploration and

experiments to question, explain, and apply scientific understanding of the natural world (Bybee, 1989; Minner et al., 2010; NRC, 2007, 2012; Scruggs & Mastropieri, 2007).

Due in part to the varied way the science education community has interpreted the term *inquiry*, the NRC and a consortium of states developed the Next Generation Science Standards (NGSS; NGSS Lead States, 2013). Indeed, part of the intent of the standards is to "better specify what is meant by inquiry and the range of cognitive, social, and physical practices that it requires" (NGSS Lead States, 2013, p. 30). The NGSS stressed not only the learning of disciplinary core ideas, but also the necessity of students developing competency in the practices of science and engineering (NGSS Lead States, 2013). This focus on practices, rather than just content acquisition, reflects an emphasis on the idea that scientific inquiry requires both knowledge and skill working in tandem (NRC, 2012).

The NGSS outlined eight scientific practices that are needed for students to engaged in scientific inquiry (NGSS Lead States, 2013): (a) asking questions (in science) and defining problems (in engineering); (b) developing and using models; (c) planning and carrying out investigations; (d) analyzing and interpreting data; (e) using mathematics and computational thinking; (f) constructing explanations (science) and designing solutions (engineering); (g) engaging in argument from evidence; and (h) obtaining, evaluating, and communicating information (NGSS Lead States, 2013). By engaging in these practices, students are theorized to build, deepen, and apply their knowledge of the NGSS's disciplinary core concepts and cross-cutting practices (NGSS Lead States, 2013). Many SWD benefit from these practices being explicitly taught and modeled before being applied independently (Therrien et al., 2017).

Types of Inquiry-Based Science Instruction

Inquiry-based teaching has been conceptualized along a continuum with varying levels of teacher involvement and support as instruction gradually builds towards more nuanced scientific understanding and practices (Martin-Hansen, 2002; NRC, 2007). There are three general types of inquiry discussed within science education for students with disabilities literature. *Open*, also called full or pure inquiry, has minimal direct teacher instruction. Students are responsible for directing their learning and developing questions and hypotheses, conducting experiments, and communicating results (Martin-Hansen, 2002). Guided inquiry and structured inquiry combine inquiry-based instruction with elements of teacher support. In *guided inquiry*, teachers and students share responsibility within the inquiry cycle. Teachers provide more explicit instruction on the processes needed for scientific inquiry or background knowledge, rather than the focal content itself. Teachers may also provide additional guidance in the form of questioning and scaffolding of misconceptions. *Structured*, or *directed inquiry*, has the most teacher involvement and often includes elements of explicit instruction related to the focal content that fade over time (Therrien et al., 2017). In structured inquiry, the experiment or model-testing portion of the inquiry process is frequently a teacher-directed demonstration with less direct student involvement. For SWD, the use of guided or structured inquiry has shown promise as an effective instructional approach for science instruction as these students often require additional levels of support in order to access the learning environment and engage in the inquiry process (Scruggs & Mastropieri, 2007; Scruggs & Mastropieri, 1995; Therrien et al., 2017).

Previous Reviews

Scholars have included an investigation of the efficacy of inquiry-based instruction in science for SWD in several literature reviews and meta-analyses over the last decade. The preponderance of these prior reviews and meta-analyses have examined inquiry-based instruction

within the context of a broader review of science education intervention research for students with particular disabilities. Authors of these reviews included a review of inquiry-based interventions along with non-inquiry interventions such as mnemonics, graphic organizers, and peer-assisted learning. For example, Spooner et al. (2011) conducted a comprehensive literature review of interventions in science for students with significant developmental disabilities. The authors concluded students with severe developmental disabilities could be instructed in how to learn through structured (i.e., directed) inquiry. Similarly, Barnett et al. (2018) examined science education research for students with autism spectrum disorders (ASD), finding that students with ASD developed inquiry practices and learned science content when inquiry-based instruction was strengthened with direct instruction strategies such as supplementary text and scripted lessons. Additionally, two meta-analyses of science education for SWD have included inquiry-based instruction within a broader review of science interventions. Therrien et al.'s (2011) review of group design science education research for students with learning disabilities (LD) and Therrien et al.'s (2014) review of science education research for students with emotional and behavioral disorders (EBD) found structured inquiry produced medium to large effects (ES = 0.73 and 0.84, respectively) on learning science content.

Two reviews (i.e., Knight et al., 2020; Rizzo & Taylor, 2016) explicitly analyzed studies targeting scientific practices and inquiry-based instruction. Rizzo and Taylor (2016) used meta-analytic techniques to assess literature on inquiry-based instruction for SWD and concluded that science achievement for SWD improved when guided or structured inquiry-based instruction was used (PND range = 70.19%-96.13%; *g* range = 0.44-2.99). Knight and colleagues (2020) conducted a comprehensive review of the literature to determine evidence-based practices for teaching the eight NGSS scientific practices to students with ID and ASD. The authors

determined that students with intellectual disabilities and autism were able to increase their proficiency in scientific practices when provided appropriate scaffolding and supports such as multiple exemplar training, task analytic instruction, and time delay.

Although these reviews provide valuable insight into the effects of inquiry-based instruction for SWD, they are not without limitations. The majority of previous reviews restricted the inclusion criteria by student disability type (Barnett et al., 2018; Knight et al., 2020; Spooner et al., 2011; Taylor et al., 2020; Therrien et al., 2011; Therrien et al., 2014). These reviews provided important commentary about practices specific to certain categories of disabilities but did not examine the effects of inquiry-based instruction for SWD more generally. Further, Therrien et al. (2011) did not include studies that used single case designs (SCD), therefore not fully capturing the scope of research examining science education and inquiry-based instruction for students with LD. In the two meta-analyses that did include single case design studies (Taylor et al., 2020; Rizzo & Taylor, 2016), the authors used *Tau-U* and PND to estimate a study's effect size (ES), rather than a between-case-standardized mean difference (BC-SMD) ES. *Tau-U* and PND are not comparable to group design ESs, unlike the BC-SMD, limiting the conclusions that the authors could draw. Recently developed ES estimations in SCD enable researchers to compare SCD studies with group design studies (Hedges et al., 2013; Shadish et al., 2014; Valentine et al., 2016).

Purpose and Research Questions

The purpose of this systematic review and meta-analysis is to analyze the current state of the inquiry-based science intervention literature for *all* SWD and expand upon the knowledge gained from prior reviews with the inclusion of (a) current literature, (b) expansive research questions, (c) studies including inquiry-access interventions as well as inquiry-based instruction,

(d) an ES metric for SCD studies that is comparable to group design ESs, and (e) studies across disability types. Further, this study aims to identify corresponding implications for practice and future lines of research. To this end, we asked (a) What are the intervention and participant characteristics of studies examining inquiry-based instruction for SWD, (b) What types of inquiry-based science interventions (e.g., open inquiry, guided inquiry) have been conducted with SWD, and (c) What is the overall effect of inquiry-based science instruction on content learning for SWD and does it vary across inquiry types?

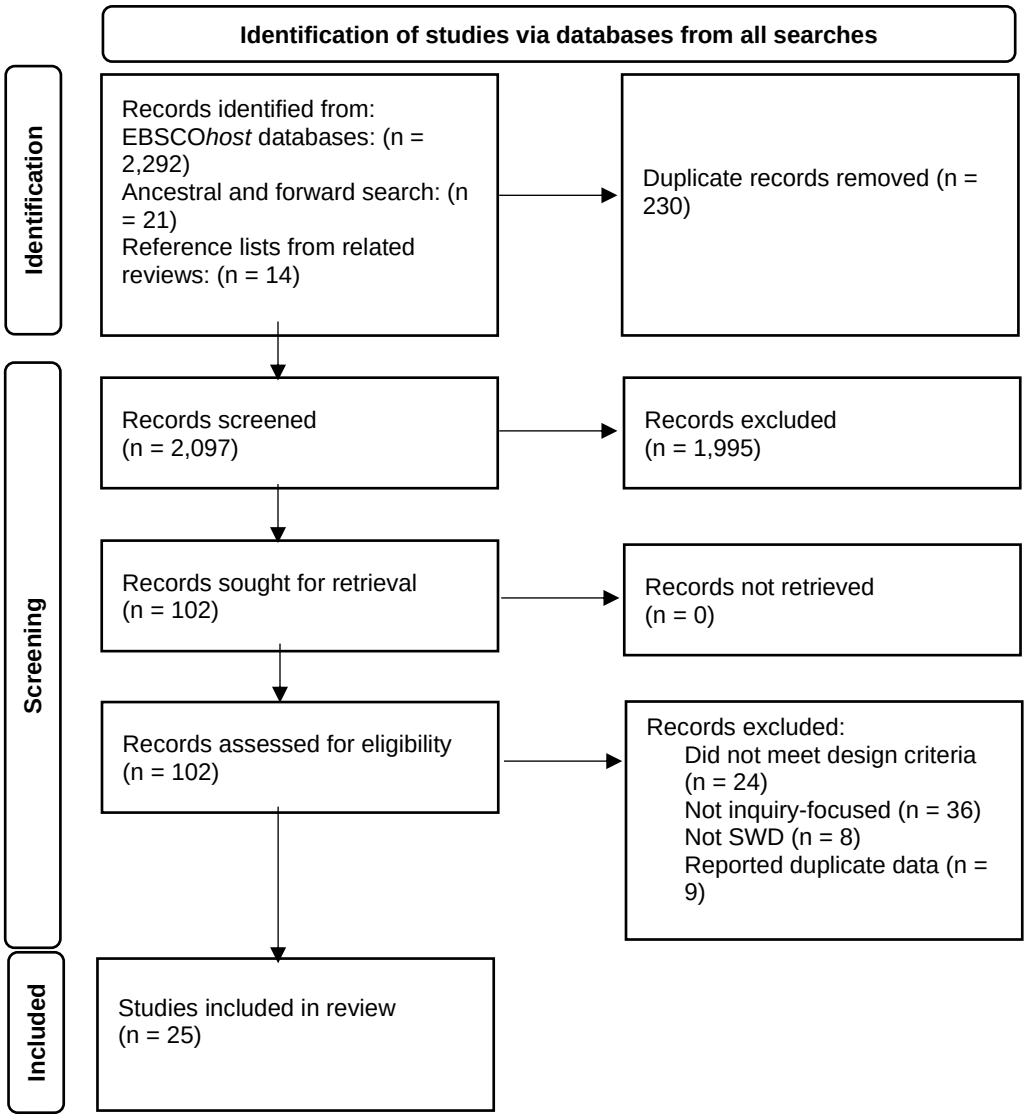
Method

We identified potential studies for inclusion and screened studies using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2020; Figure 1) process. Once identified, we examined studies for eligibility using the following a priori inclusion and exclusion criteria.

Inclusion and Exclusion Criteria

Studies first must have been published in a peer-reviewed, English-language, academic journal or as a dissertation between 1980 and 2021. We included only studies conducted using an experimental or quasi-experimental design that allowed for direct analysis of intervention outcomes. We included group and SCD studies but excluded studies utilizing a qualitative or case study design. Participants in the study must have included K12 school-age (5-21) students with a documented diagnosis of a cognitive disability that affects learning (i.e., autism spectrum disorder, emotional or behavioral disorder, intellectual disability, or learning disability). Studies that included SWD and students without disabilities were included if the study met all other

inclusion criteria. Additionally, interventions in studies needed to have been implemented in a school setting during academic instructional time. Studies focused on after school programs,



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Figure 1. PRISMA diagram

science camps, and enrichment programs occurring outside of the school day were excluded. Study interventions must have included a type of inquiry-based science instruction or instruction on a scientific practice within an inquiry-based lesson. For example, studies that had guided inquiry or scripted lessons within guided inquiry were included. Studies that taught science vocabulary outside of the context of an inquiry-based lesson were excluded. Finally, the study had to include a direct measure of science learning as the dependent outcome.

Search Procedures

Articles were identified through three distinct searches. First, articles were identified through the following search procedures in March 2020. The search was then replicated to update the potential pool of articles in March 2021. Also in March 2021, a grey literature search for published dissertations was conducted using the same search procedures. To search for peer-reviewed studies, we used EBSCO*host* to search the entire electronic Education Resources Information Center (ERIC), Academic Search Complete, and PsycINFO databases. Equivalent subjects and related words search features were not used and the search was limited to studies published in English-language journals from 1980 onward. We used a Boolean search of terms for inquiry-based instruction in science and disability categories (see Supplemental Materials 1) that were derived from Dobber et al.'s (2017) review of inquiry-based science educational research. To search for dissertations, ProQuest was utilized using the same search parameters. To identify any potential articles that had not been returned in the original search, we conducted an ancestral and forward search of all articles that met criteria for full inclusion and reviewed included articles in previous literature reviews and meta-analyses on science education for SWD (Barnett et al., 2018; Knight et al., 2020; Spooner et al., 2011; Taylor et al., 2020; Therrien et al., 2011; Therrien et al., 2014).

Screening of Articles

The initial search in March 2020 returned 2,031 articles, with a total of 1,801 unique articles after duplicates were removed (see Figure 1). Inclusion and exclusion criteria were applied in the title, abstract, and full-text screening. The first author trained the third author on applying the eligibility criteria to a subset of prospective articles (n = 250) until 90% agreement was achieved. All studies eligible for title and abstract screening were then double-coded. Interrater reliability (IRR) was 96% and all articles that were disagreed on were included for full text screening. All full-text articles (n = 87) were independently reviewed by the first author and third author for eligibility. IRR was 89% and disagreements were resolved through consensus.

Of the 87 articles that underwent full-text screening, 66 articles were excluded. A total of 24 articles were excluded because they did not meet the design criteria. We excluded an additional 32 studies because the intervention was not inquiry focused, but instead focused on developing other academic skills using science text (e.g., reading fluency using science passages), increasing access to the science classroom (e.g., video self-modeling of responding to questions), or targeted engineering content. Further, eight studies were excluded because they did not include SWD, and two final articles were excluded as they reported preliminary data from studies that were ultimately included.

Next, ancestral and forward searches of the articles meeting full inclusion criteria (n = 21) were conducted, as well as a search of the reference lists from related literature reviews and meta-analyses (n = 14). Potentially relevant articles were screened using the inclusion and exclusion criteria. This process produced five additional articles for consideration, one of which (Agran et al., 2009) met criteria for full inclusion.

The second search in March 2021 produced an additional 177 unique articles using the same search terms, criteria, and processes from March 2020-March 2021. We conducted this additional search to update the returned articles list as the initial search was over a year old. The first author screened all new titles and abstracts for potential inclusion. This did not yield any new articles for full-text screening or inclusion within the current review. The grey literature search for dissertations in March 2021 yielded 84 additional results using the same search terms, criteria, and processes. The first author screened the titles and abstracts of the returned dissertations. This resulted in 10 dissertations eligible for full-text screening. The first and third author each screened all 10 dissertations, with three meeting eligibility criteria for full inclusion. Of the seven excluded dissertations, three were excluded because they were duplicates of included peer-reviewed articles, two were excluded due to study design, one was excluded because the intervention focus was literacy in science, and a final study was excluded because the intervention did not occur with a school setting. IRR was 100%. Ultimately, we identified 25 from the three searches for inclusion in this review (see Supplemental Materials 2 for list of included studies).

Coding Procedures

Prior to data coding and analysis, articles were summarized narratively by the first and third authors with the second author providing independent validation of the narrative table (Table 1). Narrative data extraction included each article's number of participants, the participants' grade levels, participants' disability eligibility category, study design, a description of the intervention, the intervention location, and the type of dependent variable. Articles were then coded for the type of inquiry present in the intervention with operational definitions for inquiry types developed from Martin-Hansen (2002). For the purpose of this review, open inquiry was defined

as an intervention where students were responsible for developing questions and hypotheses, conducting experiments, and communicating results with teachers providing minimal guidance through questioning. Guided inquiry was defined as an intervention where teachers and students shared responsibility within the inquiry cycle. Teacher support was in the form of questioning and scaffolding of misconceptions. When direct or explicit instruction did occur, it was on scientific inquiry processes or background knowledge. Structured inquiry was defined similarly to guided inquiry, but in structured inquiry interventions, direct or explicit instruction was provided by the teacher related to the focal content or the experiment was a teacher demonstration without an opportunity for student experimentation. Finally, articles were coded as inquiry-access if inquiry instruction was a component of both the treatment and control or baseline conditions. In these studies, the intervention was additional support designed to increase access to learning benefits from inquiry-based instruction. Inquiry type was independently coded by the first and second author. Using a total-agreement formula (i.e., number of agreements divided by the number of agreements plus disagreements multiplied by 100), IRR was 92% for inquiry type. All discrepancies were discussed and resolved through consensus.

Finally, articles were dummy coded for ES calculations. Specifically, we coded (a) the study design (i.e., SCD, quasi-experimental, experimental), (b) the inquiry type (i.e., open inquiry, guided inquiry, structured inquiry, inquiry-access), (c) student grade (i.e., elementary, secondary), (d) the type of dependent measure (i.e., content-based, performance-based, standardized), (e) the interventionist (i.e., researcher, teacher), (f) the intervention location (i.e., general education, special education classroom, pull-out/resource room), and (g) disaggregation of outcome data for group design studies that included SWD and students without disabilities.

Article	Sample	Design	Intervention Description	Location	DV (ES, SE)
Open Inquiry					
Bay et al. (1992)	4th-6th grade[a]; 107 students; 16 SWD; 8 SWD in treatment; LD/EBD	G-R	Four semi-scripted instructional sessions lasting 40-60 minutes each. Lesson content was held constant between conditions. Discovery teaching (treatment) involved (a) hands-on materials, (b) class discussion of relationships between concepts, (c) conducting experiments, and (d) making and testing predictions.	PO	C (1.72, 0.81); P (0.95, 0.74)
Guided Inquiry					
Dionisio (2017)	6th-8th grade; 229 students; 41 SWD in treatment; MC	G-R	Three grade-level modules were used and treatment lasted 6-8 weeks with daily instruction. Treatment condition involved (a) teacher led exploration of concepts, (b) student-conducted experiments, (c) collecting, analyzing, and interpreting data and observations (d) making inferences (e) drawing conclusions, and (f) collaborating with peers.	GE	C (0.47, 0.22); S (-0.08, 0.22)
Jensen-Ruopp (2004)	10th graders; 134 students; 36 SWD in treatment; LD	G-R	Both conditions received the same science content in seven science lessons. Each lesson was a five-day unit taught for 45 minutes each day. Inquiry-based instruction (treatment) involved (a) a motivating question, (b) vocabulary word instruction and flashcards, and (c) opportunities for teacher-led demonstrations, extensions, reinforcements, and cooperative learning opportunities as needed.	GE	C (2.90, 0.25)
Lynch et al. (2007)	Middle school; 202 SWD; 103 SWD in treatment; MC	G-R	Three structured curriculum units were taught over 17 lessons. The Chemistry that Applies curriculum (treatment) is a student-centered, hands-on, phenomenon-based, guided inquiry curriculum involving students (a) making observations, (b) conducting laboratory experiments, (c) making and testing predictions, (d) building models, (e) observing, organizing, and interpreting data, and (f) discussion of findings.	GE	S (0.23, 0.14)
McCarthy (2005)	Junior high; 18 SWD; 9 SWD in treatment; EBD	G-R	Sixteen lessons were taught 3 days a week over 8 weeks. Treatment condition lessons involved (a) review of prior activities and concepts, (b) teacher-led demonstrations (c) students conducting teacher-guided experiments and practice, and (d) teacher-led discussion of observations and findings.	SE	C (2.889, 0.68); P (2.03, 0.56)
Scruggs et al. (1993)	7th-8th grade; 26 SWD; LD	G-C	Instruction on content was conducted in three, 45–60 minutes sessions over two weeks. Lessons in the activities-based condition (treatment) included (a) daily review, (b) small-group hands-on activities using Full Option Science System (FOSS) kits with teacher coaching, and (c) a whole-class discussion of the activities.	SE	C (0.46, 0.28)

Structured Inquiry					
Aydeniz et al. (2012)	4th-5th grade; 5 students; LD	SCD	Students were taught four units from The Electric Circuits KitBook with supporting activities. The Electric Circuits KitBook is a hands-on curriculum with lessons including (a) an overview of vocabulary, (b) teacher questioning of student's prior knowledge, (c) making connections between the content of the lesson and student's everyday life experiences with electricity, (d) explicit instruction of content and directions, and (e) teacher-led experiments.	PO	C (3.46, 0.68)
Browder et al. (2012)	Middle and high school; 37 SWD; 21 SWD in treatment; ASD/ID	G-R	A total of 20 lesson plans were implemented over four units. Inquiry instruction condition involved (a) use of an inquiry-based lesson, (b) supplemental instruction in science vocabulary, (c) hands-on materials to conduct experiments, (d) student response boards, and (e) teacher presented task analysis of inquiry steps.	SE	C (0.74, 0.34); P (-0.06, 0.33)
Courtade et al. (2010)	6th-8th grade; 8 students; ID	SCD	Teachers were trained in implementing inquiry-based science instruction. Teachers implemented a task analysis with students during inquiry lessons to increase teacher and student independent completion of inquiry skills. Lessons lasted 20-30 minutes and were taught to 2-6 students. Lessons included (a) student engagement with the materials, (b) connecting prior knowledge, (c) asking and answering questions, (d) investigating and describing relationships, (e) constructing explanations, and (f) reporting results.	SE	P (3.59, 0.52)
Eliot (2006)	High school; 38 students; all SWD; LD	G-C	Two science lesson units were taught to participants. Each unit was two class periods followed by a period of assessment. Treatments were applied sequentially. The constructivist, inquiry condition included (a) a hands-on learning task, (b) guided group discussions, (c) mini-lessons, (d) small group work, and (e) direct instruction as needed.	SE	C (0.25, 0.38); P (0.03, 0.40)
Jimenez et al. (2014)	3rd-4th grade; 3 students; ASD/ID	SCD	Students were instructed using three units of scripted lessons, then scripted lessons plus guided notes, from Early Science Curriculum, an inquiry-based science curriculum. Each unit had six lessons. Scripted lessons included (a) direct instruction of concepts, (b) a "wonder story", (c) constant time delay procedures, (d) making predictions, (e) discrimination training of key concepts, (f) teacher-led experiments with students, (g) making observations, (h) revisiting predictions, and (i) reporting of findings on KWHL chart.	SE	C (1.84, 0.51)
Mastropieri et al. (1998)	4th grade; 75 students; 5 SWD; 5 SWD in treatment; MC	G-NR	One unit on ecosystems was taught 3 times a week over 7 weeks. The activities-based (treatment) condition involved (a) curriculum and supplemental material that accommodated students with disabilities, (b) students collaborating to create an ecosystem and design experiments, (c) small group work, (d) making and testing predictions, and (e) individual activity booklets to record/draw observations and conclusions.	GE	C (0.70, 0.25)

Smith et al. (2013)	Elementary students; 3 students; ID/MD	SCD	Four units with seven lessons each from an inquiry-based science curriculum (i.e., Early Science). Curriculum includes a lesson script, task analysis, KWHL chart, science rules chart, "wonder stories", student report, and experiment materials. Lessons included (a) vocabulary instruction, (b), explicit instruction of concepts, and (c) opportunities for students to use inquiry skills like prediction and experimentation.	SE	C (1.39, 0.46)
Terrazas-Arellanes et al. (2018)	6^{th}-8^{th} grade; 2,303 students; 276 SWD; 197 in treatment; LD	G-R	Four interactive science learning units, each lasting 10-14 weeks, were tested across three years. Treatment condition used problem-based, culturally informed, interactive online science units. Units involved (a) daily instruction, (b) activation of background knowledge, (c) content enhanced eTexts, (d) comprehension questions or summaries, (e) teacher-guided discussions, (f) video tutorials, (g) interactive simulations and games, (h) data collection practice, (i) vocabulary instruction, (j) development of scientific thinking skills through hypothesizing and conducting inquiry investigations, (k) instructional games and virtual simulations, (l) corrective and explanatory feedback to address misconceptions, and (m) small group discussions.	GE	C (0.35, 0.12)
Inquiry Access					
Agran et al. (2006)	7^{th}-8^{th} grade; 3 students (1 included in analysis); ASD/ID	SCD	Used the Self-Determined Learning Model of Instruction (SDLMI) to promote student self-determination and student-directed learning skills. Student was trained in a 15-20 minute session using modeling, prompting, feedback, and multiple opportunities for practice. Student engaged in self-monitoring of a task analysis of the inquiry process.	GE	N/A[b]
Collins et al. (2017)	10^{th}-12^{th} grade; 4 students; ID	SCD	Instructor implemented simultaneous prompting of the task analysis focused on plant care with embedded science content. Participants received daily training trials on each step of the task analysis. Each training session included (a) a presentation of the task direction followed by an immediate prompt for the task step, (b) student completion of the step, (c) verbal praise, (d) non-targeted science content related to the task step, and (e) a visual connecting the task step and the science content.	PO	P (3.31, 0.46)
Dalton et al. (1997)	4^{th} grade; 172 students; 33 SWD; 14 SWD in treatment; LD	G-NR	Twelve hands-on science lessons lasting approximately 50 minutes each. The Supported Inquiry Science Method (SIS; treatment) involved (a) a focus on unifying concepts throughout lessons, (b) increased attention to misconceptions in student learning with increased teacher facilitated discussion to address and revise misconceptions, (c) peer collaboration, (d) students explicitly sharing predictions and outcomes, and (e) an emphasis on drawing to represent thinking.	GE	C (1.30, 0.38)

Jimenez et al. (2009)	6th-7th grade; 3 students; ID	SCD	Intervention included inquiry lessons with a science storybook and KWHL (What do I *K*now? *W*hat do I want to know? *How* can I find out? What did I *L*earn?) workbook for each concept. The science storybook and KWHL workbook guided students independently through the task analysis of the steps in the inquiry lesson and experiment. Lessons included (a) multiple exemplar training, (b) time delay, and (c) self-directed learning.	SE	P (6.38, 2.44)
Jimenez et al. (2012)	6th-7th grade; 5 students; ID	SCD	Intervention included peer-mediated embedded inquiry teaching sessions with response training using constant time delay. Lessons included (a) content reading from textbook, (b) teacher introduction of lesson using a KWHL chart, (c) teacher-led discussion and idea-generation regarding content, (d) developing plans for experiments, (e) cooperative learning groups to participate in online experiment or activity, (f) student reporting of data, and (g) teacher-led discussion.	GE	C (2.62, 0.88)
Knight et al. (2018)	1st-5th grade; 8 students; 4 classrooms; ASD/ID	SCD	Teachers used scripted and unscripted lesson plans for 4 units of study with 6 lessons each from the Early Science Curriculum. All lessons included (a) a teacher guide with scripted or unscripted lessons, (b) "wonder" stories, (c) vocabulary cards, (d) concept statement cards, and (e) the KWHL chart. Scripted lessons included verbatim teacher scripts while unscripted lessons included a task analysis of the lesson.	SE	C (1.53, 0.47)
Mastropieri et al. (2006)	8th grade; 213 students; 44 SWD; MC	G-R	One unit taught over 12 weeks involving hands-on laboratory experiments. Both conditions began with (a) a daily review, (b) presentation of new information through directed textbook instruction, (c) guided and independent practice, and (d) teacher led laboratory activities. Peer-assisted learning condition (treatment) included peer-mediated and differentiated science activities rather than worksheet time as the guided and independent practice.	GE	C (0.38, 0.14); S (0.30, 0.14)
McCleery & Tindal (1996)	6th grade; 57 students; 14 SWD; LD	G-NR	Study included three conditions- two treatment conditions and a control condition. Period A (treatment 1) and Period B (control) consisted of (a) a brief introduction of the topic, (b) a teacher-created experiment, (c) recording data, and (d) writing an explanation of their findings. Period A was provided explicit instruction during the assessment while Period B was not provided any explicit instruction. The Pull-away intervention (treatment 2) was provided to a subset of Period A students and included (a) explicit instruction using examples and nonexamples, (b) science inquiry rules, and (c) a task analysis of the steps of inquiry, and (d) guided hands-on practice. Period A and Period B received instruction for 6 weeks with 2–3 sessions of 90 minutes per week. The pull-away condition met five times over six weeks for 40-minute sessions.	PO	C (0.36, 0.45)

Miller et al. (2015)	High school; 3 students; ID	SCD	Students were trained in using a self-monitoring application with least-to-most prompting to engage within the steps of a science inquiry task analysis. The intervention consisted of at least four inquiry science lessons where students self-monitored their completion of the steps of the inquiry task analysis including (a) asking questions, (b) making and stating observations, (c) developing a hypothesis and plan for a solution, (d) conducting experiments, and (e) explaining results.	PO	P (1.99, 0.73)
Miller & Taber-Doughty (2014)	Middle school; 3 students; ID/MD	SCD	Students used a self-monitoring task analysis checklist with a least-to-most prompting system and science field notebooks during inquiry-based science lessons. The task analysis checklist of inquiry steps included (a) generating questions, (b) making observations, (c) conducting experiments, and (d) explaining the findings.	PO	P (11.49, 2.561)
Simpkins-McCrea et al. (2009)	5th grade; 61 students; 18 At-Risk and SWD; LD/At-Risk	G-C	Two units were each taught 4-5 times per week for 45-60 minutes over five weeks in a counterbalanced design. Differentiated condition (treatment) involved the addition of activities-based differentiated activities, matched to student performance level, to traditional instruction. Activities included small group work and worksheets with differentiated prompts.	GE	C (0.42, 0.33)

Note. DV = dependent variable; ASD = autism spectrum disorder; ID = intellectual disability; SCD = single case design; GE = general education; LD = learning disability; PO = pull-out; SWD = students with disabilities; EBD = emotional and behavioral disabilities; G-R = group design with random assignment; SE = special education; G-NR = group design with nonrandom assignment; MC = multicategorical disabilities; G-C = group crossover design; C = content; P = performance; S = standardized [a] Study was coded as elementary for purposes of ES calculation

[b] Study did not meet minimum requirements for ES calculation; Study is included in narrative analysis

Table 1. Narrative Description of Included Studies

Articles were dummy coded independently by the first and second author. Using a total-agreement formula (i.e., number of agreements divided by the number of agreements plus disagreements multiplied by 100), IRR was 97%. All discrepancies were discussed and resolved through consensus.

Effect Size Calculations and Analysis

We calculated ESs to estimate the common effect of inquiry-based interventions on student's acquisition of scientific content knowledge for group and SCD studies (Borenstein et al., 2009). Specific ES calculation procedures were used for group and SCD studies.

Standardized mean difference ESs for group design studies were calculated using Comprehensive Meta-Analysis Software (CMA; Version 3). When provided, treatment and control group posttest means and SDs were used to calculate ESs. When posttest means and SDs were not provided, *p*-values were used to calculate ESs. After standardized mean differences were calculated, each was scaled to Hedges' *g* to better account for small study sample sizes (Hedges, 1981).

We estimated ESs for SCD studies using the between-case standardized mean difference (BC-SMD; Hedges et al., 2013; Shadish et al., 2014; Valentine et al., 2016). Interpretation of BC-SMD estimates follow Cohen's (1988) guidelines. Using these guidelines, a BC-SMD < 0.20 indicates a small effect, and a BC-SMD > 0.80 indicates a large effect. This statistic has been identified as a robust ES that is consistent with the group standard mean difference (Shadish et al., 2015). When calculating the BC-SMD, there must be a minimum of three datum points in both the baseline and intervention phases and three cases within the study. Several included SCD studies utilized multiple baseline within participant designs, rather than multiple baseline across participant designs. In these instances, an ES was first calculated for each participant and then

aggregated for an overall study ES. Follow-up and generalization points were also excluded from analysis. All data extraction, cleaning, and evaluation was conducted by the first author.

To calculate the BC-SMD for each study, data from each SCD graph were extracted using WebPlotDigitizer (Version 4.4). Next, data were cleaned and assessed for accuracy against reported results in each study. Data were only adjusted if the outcome metric produced by a study's dependent measure was a whole number and the WebPlotDigitizer had extracted a non-whole number. For example, if a study's dependent measure assessed accuracy on a probe out of 10 possible points, and the WebPlotDigitizer had indicated that the point of the graph represented 9.78, the datum was adjusted to reflect the accurate datum of 10/10. IRR was then assessed by the second author for all cleaned data and agreement was 99%.

Cleaned data were then inputted into scdhlm, an open-source, web-based program (Pustejovsky et al., 2021). Session numbers were assigned to each case as the detrending variable. We used a Restricted Maximum Likelihood estimation method with random effects for both the baseline and treatment phases to estimate the ES. Computed scores from the scdhlm program were then uploaded into Comprehensive Meta-Analysis (CMA; Version 3). For studies that were within-subject SCDs (e.g., Aydeniz et al., 2012), individual ESs were inputted for each participant and then collapsed into an overall ES for each study. Finally, studies were grouped according to preidentified constructs (Table 2) in a random effects model.

When studies had more than one ES suitable to address a research question, estimates were calculated conservatively by averaging the ESs and SDs within study to ascertain an overall mean and SDs, with the assumption that outcome measures were likely highly correlated within studies (e.g., Browder et al., 2012). Liberal estimates (i.e., assuming no correlation between measures) were also calculated. There was only a marginal difference between conservative and

	Group designs		Single case designs	
Category designation	Mean ES (SE)	95% CI	BC-SMD (SE)	95% CI
Overall ES	0.79 (0.20)	[0.41, 1.17]	2.76 (0.43)	[1.93, 3.60]
Dependent measure				
Content	0.94 (0.22)	[0.51, 1.36]	2.02 (0.36)	[1.32, 2.72]
Performance-based	0.70 (0.48)	[-0.25, 1.64]	3.84 (0.75)	[2.37, 5.31]
Standardized	0.21 (0.10)	[0.02, 0.39]	—	—
Inquiry type				
Open inquiry	1.50 (0.54)[a]	[0.44, 2.56]	—	—
Guided inquiry	1.22 (0.47)	[0.35, 2.20]	—	—
Structured inquiry	0.39 (0.10)	[0.19, 0.59]	2.53 (0.57)	[1.40, 3.65]
Inquiry access	0.55 (0.21)	[0.14, 0.95]	3.18 (0.72)	[1.77, 4.60]
Study type				
Experimental	0.98 (0.29)	[0.41, 1.54]	—	—
Quasi-experimental	0.58 (0.15)	[0.29, 0.86]	—	—
Grade				
Elementary	0.86 (0.20)	[0.47, 1.25]	1.95 (0.41)	[1.16, 2.73]
Secondary	0.73 (0.25)	[0.25, 1.21]	3.54 (0.62)	[2.32, 4.75]
Interventionist				
Researcher	0.86 (0.53)	[-0.18, 1.90]	4.16 (1.32)	[1.57, 6.75]
Teacher	0.78 (0.21)	[0.37, 1.20]	2.46 (0.43)	[1.61, 3.30]
Intervention location				
General education	0.75 (0.24)	[0.28, 1.21]	2.62 (0.88)[b]	[0.90, 4.35]
Special education	0.91 (0.61)	[-0.28, 2.09]	2.24 (0.52)	[1.22, 3.27]
Pull-out	0.92 (0.43)	[0.08, 1.75]	3.65 (0.84)	[2.01, 5.29]
SWD disaggregated				
Yes	0.56 (0.15)	[0.26, 0.86]	—	—
No	0.96 (0.51)	[-0.05, 1.96]	—	—

Note. ES = effect size; SE = standard error; CI = confidence interval; BC-SMD = between case standardized mean difference; SWD = students with disabilities.

[a] Bay et al. (1992); This represents a single article, but two studies.

[b] This represents a single study.

Table 2. Effect Size Estimates

liberal estimates that resulted in no effect on interpretation. Therefore, only the conservative estimates are used in our subsequent analyses. The liberal estimates are reported at (OSF site blinded for review). Within each design type (group and SCD), we calculated weighted means and confidence intervals for categories (e.g., overall effect) of interest using Comprehensive Meta-Analysis (CMA; Version 3) to address our third research question.

Results

This systematic and meta-analytic review ultimately included 25 articles representing 26 studies. Bay et al. (1992) included two experimental conditions, one with students with learning disabilities (LD) and one with students with emotional/behavior disorder (EBD). One study, Agran et al. (2006), did not meet the minimum requirements for BC-SMD calculation. Therefore, the article is discussed narratively within research question one and two only. Descriptive information regarding each included article can be found in Table 1. Of the 25 included articles, 22 were published in peer-reviewed journals and three were published dissertations. Most of the included articles were published in the last two decades, with five articles published between 1980 and 2000 and 20 articles published between 2001 and 2021. There were 11 SCD studies and 15 group design studies. Because of the significant overall mean differences (ES= 1.08) in ESs magnitude between group and SCD studies, likely due to the different type of dependent variables used between the designs as well as the inherent nature of each design, we conducted separate analyses for group and SCD studies.

Research Question 1: Study and Participant Characteristics

Within the 25 included articles, there were a total of 3,718 participants. Group design studies accounted for 3,672 participants with 804 students with disabilities in treatment

conditions. SCD studies accounted for 46 participants, all with disabilities. Most studies (n = 17) included participants at the secondary level (i.e., Grades 6 through 12) with nine studies conducted at the elementary level. Studies included a range of participant disabilities, with studies focused on students with LD (n = 9) being the most common followed by ID (n = 5), severe disabilities (participants included students with ASD and students with ID; n = 4), multi-categorical disabilities (n = 4), EBD (n = 2), and ID and multiple disabilities (n = 2). Interventions were implemented across settings with 10 in inclusive general education classrooms, nine in self-contained special education classrooms, and seven in pull-out settings from either general education or special education classrooms. More interventions were implemented by teachers (n = 20) than by researchers (n = 6).

Research Question 2: Types of Inquiry-Based Science Interventions

Within the 25 included articles (see Table 1), only Bay et al. (1992) met the criteria for an open inquiry science intervention. In both experimental conditions in Bay et al., students were responsible for conducting experiments with hands-on materials, engaging in discussions regarding relationships between concepts, and making and testing predictions. There were five included articles that met the criteria for a guided inquiry science intervention (Dionisio, 2017; Jensen-Ruopp, 2004; Lynch et al., 2007; McCarthy, 2005; Scruggs et al., 1993). In these studies, students and interventionists shared responsibility within the inquiry cycle and interventions included some form of teacher guidance. Treatment conditions typically included (a) teacher guided exploration of background concepts; (b) student-conducted experiments with teacher coaching and supporting demonstrations as needed; (c) making and testing predictions; (d) observing, organizing, and interpreting data; and (e) discussion of findings.

Of the included articles, eight met the criteria for structured inquiry interventions (Aydeniz et al., 2006; Browder et al., 2012; Courtade et al., 2010; Eliot, 2006; Jimenez et al., 2014; Mastropieri et al., 1998; Smith et al., 2013; Terrazas-Arellanes et al., 2018). Structured inquiry interventions were similar to guided inquiry interventions, but interventionists provided direct or explicit instruction on the focal content, or the activity portion of the lesson was a teacher demonstration without student experimentation. Treatment conditions typically included (a) explicit instruction of content, (b) teacher coaching of the steps in the inquiry process, (c) teacher-led experiments, and (d) guided discussions of findings and predictions.

Finally, 11 articles met the criteria for inquiry-access interventions (Agran et al., 2006; Collins et al., 2017; Dalton et al., 1997; Jimenez et al., 2009; Jimenez et al., 2012; Knight et al., 2018; Mastropieri et al., 2006; McCleery & Tindal, 1999; Miller et al., 2015; Miller & Taber-Doughty, 2014; Simpkins et al., 2013). In inquiry-access interventions, inquiry instruction was a component of both the treatment and control conditions for group design studies, or treatment and baseline conditions for SCD studies. In these articles, the intervention was added supports intended to increase access to inquiry-based instruction as compared to stand-alone inquiry-based instruction. Inquiry-access interventions included (a) a peer-mediated Self-Determined Learning Model of Instruction (Agran et al., 2006); (b) task analyses of the steps in the inquiry process (Collins et al., 2017; McCleery & Tindal, 1996; Miller et al., 2015; Miller & Taber-Doughty, 2014); (c) the Supported Inquiry Science Method (Dalton et al., 1997); (d) workbooks with What I Know, What I Want to Know, How I Will Learn, and What I Learned (KWHL) graphic organizers, multiple exemplar training, time delay, peer-mediated learning, and self-directed learning (Jimenez et al., 2009; Jimenez et al., 2012); (e) scripted lessons for teachers

(Knight et al., 2018); (f) peer-assisted learning (Mastropieri et al., 2006); and (g) differentiated cooperative learning activities (Simpkins et al., 2013).

Research Question 3: Study Effects

Omnibus ESs were individually calculated for group and SCD studies to estimate the effect of inquiry-based interventions on the acquisition of science content knowledge (Borenstein et al., 2009). Results from all ES calculations are reported in Table 1. An ES was not calculated for Agran et al. (2006) as it did not provide three demonstrations of effects. Therefore, this study was omitted from analysis resulting in ESs calculated for 15 group and 10 SCD studies.

Individual study ESs for group studies ranged from 0.14 (SE = 0.39; Eliot, 2006) to 2.90 (SE = 0.25; Jensen-Ruopp, 2004). Individual study ESs for SCD studies ranged from 1.39 (SE = 0.46; Smith et al., 2013) to 11.49 (SE = 2.56; Miller & Taber-Doughty, 2014). We then estimated an omnibus ES for group and SCD studies using a random effects model. The group studies produced a large, combined ES of 0.79 (SE = 0.20, CI [0.41, 1.17]) and the omnibus ES for SCD studies was also large (BC-SMD = 2.76, SE = 0.43, CI [1.93, 3.60]) based on Cohen's (1988) recommended interpretations. The ES for Miller and Taber-Doughty (2014) was a notable outlier (ES = 11.49), therefore a second overall ES estimate was conducted omitting this study. This produced an ES of 2.52 (SE = 0.36, CI [1.82, 3.22]). As this did not change the overall interpretation, this study was included for the remainder of the analyses.

We then grouped studies by the intervention's inquiry type to explore if this contributed to variable effects. In group design studies, the largest effects were found for open (ES = 1.50; SE = 0.54; CI [0.44, 2.56]) and guided inquiry studies (ES = 1.22; SE = 0.47, CI [0.35, 2.20]). Structured inquiry studies produced a medium ES of 0.39 (SE = 0.10, CI [0.19, 0.59]). It is important to note when interpreting these ESs, however, that the ES for open inquiry represents a

single article, but two studies (Bay et al., 1992). Inquiry-access group design studies had a medium ES of 0.55 (SE = 0.21, CI [0.14, 0.95]). In SCD studies, structured inquiry studies had an ES of 2.53 (SE = 0.57, CI [1.40, 3.65]) and inquiry access studies had an ES of 3.18 (SE = 0.72, CI [1.77, 4.60]). There were no open or guided inquiry interventions within SCD studies.

A series of secondary analyses were then conducted to explore additional trends within the studies. Due to the small number of group and SCD studies trends in ESs were examined and ES findings should be interpreted judiciously. We first examined the effectiveness of interventions grouped by dependent measures. Intervention efficacy was measured by three types of dependent measures: content assessments, performance-based assessments, and standardized assessments. Content assessments solely measured acquisition of science content. Performance-based assessments measured students' ability to engage in the scientific inquiry process. Standardized assessments were state or district administered assessments or researcher-created assessments that had been validated (i.e., Lynch et al., 2007). Within group design studies, content assessments produced an ES of 0.94 (SE = 0.22, CI [0.51, 1.36]), performance-based assessments an ES of 0.70 (SE = 0.48, CI [-0.25, 1.64]), and standardized assessments an ES of 0.21 (SE = 0.10, CI [0.02, 0.39]). Within SCD studies, content assessments produced an ES of 2.02 (SE = 0.36, CI [1.32, 2.72]) and performance-based assessments an ES of 3.84 (SE = 0.75, CI [2.37, 5.31]). No standardized assessments were used in SCD studies. When grouped by grade, larger effects were found for studies conducted in elementary grades (ES = 0.856, SE = 0.2, CI [0.47, 1.25]) than in secondary grades (ES = 0.73, SE = 0.25, CI [0.25, 1.21]) in group studies. In SCD studies, however, larger effects were found in studies conducted at the secondary level (ES = 3.54, SE = 0.62, CI [2.32, 4.75]) compared to the elementary level (ES = 1.95, SE = 0.40, CI [1.16, 2.73]).

Discussion

The purpose of the current study was to examine the efficacy of inquiry-based interventions for SWD. Following systematic and comprehensive searches of peer-reviewed literature and dissertations, we ultimately included 25 articles representing 26 studies in the current review. The included studies assessed the efficacy of a variety of inquiry-based interventions including open inquiry, guided inquiry, structured inquiry, and inquiry-access interventions. Overall, large effects for group (ES = 0.79; SE = 0.20, CI [0.41, 1.17]) and SCD (BC-SMD = 2.76, SE = 0.43, CI [1.93, 3.60]) studies were observed suggesting that inquiry-based instruction in science is effective for SWD when additional supports are embedded. Additionally, we observed medium to large effects for inquiry-access studies in group (ES = 0.55, SE = 0.21, CI [0.14, 0.95]) and SCDs (ES = 3.18, SE = 0.72, CI [1.77, 4.60]), indicating the potential benefit of direct instruction in inquiry skills and scientific practices for SWD, especially for students with more significant disabilities.

Most studies examining inquiry-based interventions for SWD were conducted at the secondary level (n = 17 as compared to n = 9 for elementary) which limits the field's understanding of the effects of inquiry-based learning for elementary students. This is unfortunate as the NGSS include scientific practices and inquiry-skills within elementary science standards that build towards skills needed within secondary level standards. Of the included studies, most interventions were implemented by teachers. This is a strength of extant research indicating the potential for these science interventions to be implemented in the field. Within group design studies, ES estimates indicated that researcher-implemented interventions (ES = 0.86; SE = 0.53; CI [-0.18, 1.90]) and teacher-implemented interventions (ES = 0.78; SE = 0.21; CI [0.37, 1.20]) were similarly effective. Within SCDs, although both ES estimates were large,

researcher-implemented interventions (BC-SMD = 4.16; SE = 1.32; CI [1.57, 6.75]) produced much greater effects than teacher-implemented interventions (BC-SMD = 2.46; SE = 0.43; CI [1.61, 3.30]). These studies were mostly conducted in pull-out or self-contained special education classrooms. Comparatively, the group design studies were more frequently conducted in general education settings with larger student numbers.

There is a similar need for increased rigor in reporting methods for control and baseline conditions. In many studies, the limited reporting made it difficult to ascertain what students in these conditions were receiving compared to the treatment groups or condition. This is particularly important in business-as-usual conditions that may vary between research sites. Increased reporting would also support study replication efforts, a noted need within science education for SWD as well as special education more broadly (e.g., Makel et al., 2016). Sharing data and materials in alignment with Open Science practices (Cook et al., 2021) would support this effort and assist in greater transparency in treatment and business-as-usual conditions.

Types of Inquiry-Based Science Interventions and Study Effects

Overall, the omnibus ESs for both group and SCD studies were large, suggesting that inquiry-based interventions with embedded supports are effective at increasing science content knowledge for SWD. These findings are consistent with prior systematic literature reviews and meta-analyses (Barnett et al., 2018; Knight et al., 2020; Rizzo & Taylor, 2016; Spooner et al., 2011; Therrien et al., 2011; Therrien et al., 2014). The current systematic and meta-analytic review expands on this literature base, however, and contributes three unique findings regarding the efficacy of inquiry-based instruction on science learning for SWD.

First, in many historical discussions of inquiry-based learning, inquiry and content-focused explicit instruction have been discussed dichotomously as inverses (Scruggs &

Mastropieri, 2007). The current study contributes to extant literature by examining the efficacy of inquiry-based instruction separated by inquiry types, rather than grouping all forms of inquiry-based interventions together. In the current study, open (n = 2; ES = 1.50; SE = 0.54) and guided inquiry-based interventions (n = 5; ES = 1.27; SE = 0.47) in group design studies produced substantially larger effects on student learning than structured inquiry-based interventions (n = 4; ES = 0.39; SE = 0.10) did. Unfortunately, this finding is unable to be corroborated in the SCD studies included in this review as no SCD studies met the criteria for open or guided inquiry. This affirms the continued need for moving the discussion of science education for SWD from text-based and explicit instruction versus inquiry, to when certain types of inquiry are effective and what supports are necessary to make inquiry-based learning efficacious (Dalton et al., 1997).

When conceptualizing inquiry-based instruction, we posit it is more accurate to characterize inquiry-based learning and instruction as falling along a continuum, rather than opposing instructional strategies. On this continuum, different levels of openness of inquiry may be more or less appropriate for different learning aims and content depending on the learners. The continuum of inquiry-based instruction can be compared to an extensive gradual release model whereas students become more proficient and independent in scientific practices and inquiry skills, teacher supports can fade and students can benefit from more guided and open inquiry-based experiences. For SWD, this gradual release and shift towards openness may be particularly helpful given the complex skills involved in scientific inquiry. The NRC (2000; 2007; 2012) advocates for this and provides room within their standards and scientific practices for explicit instruction and structures to be embedded within inquiry-based teaching to support necessary knowledge development and guide students as needed.

Indeed, students need varied levels of openness in their inquiry learning to develop inquiry skills and scientific practices (NRC, 2000). Inquiry learning that is more open may better provide opportunities for students' cognitive development and growth in scientific reasoning. Yet, students often do not have all of the prerequisite skills and background knowledge to begin here (NRC, 2000). For example, students must first learn what types of questions can be investigated, the difference between evidence and opinion, how to engage in scientific argumentation, and how to craft a defendable and data-based explanation before they can fully benefit from more open inquiry (NRC, 2000).

Guided inquiry may be more beneficial for developing an understanding of certain science concepts (NRC, 2000). Ideally in guided inquiry, there is a balance between student self-direction and teacher involvement. When teachers are involved, it is to help students develop skills in data collection, form explanations, and communicate their findings and rationales in the context of the scientific knowledge they are working to construct (NRC, 2000). In other words, guided inquiry encourages students to become more active participants in constructing their own knowledge and in the learning process while teachers are providing guidance around misconceptions and opportunities for authentic practice.

This is distinctly different from structured inquiry where teachers provide more extensive instruction in the focal content and opportunities for self-directed are lessened. Rather, the hands-on opportunities within structured inquiry are either teacher demonstrations, or students following prescribed steps to reach a predetermined outcome. More structured inquiry assists in developing students' abilities to inquire (NRC, 2000). Structured inquiry may be a more beneficial model to employ when students are gaining proficiency in scientific practices or inquiry-based skills. It may also be a beneficial model if students require extensive background

knowledge development. However, as students become more independent in scientific practices and inquiry-related skills, it is likely beneficial to fade teacher involvement and gradually move towards a guided and eventually an open inquiry, model. In so doing, SWD can receive the individualized supports they need while moving towards proficiency in scientific inquiry which is necessary for scientific literacy and the long-term affordances it brings. Ultimately, providing students opportunities for robust and authentic experiences in science, as well as opportunities to develop the prerequisite knowledge and skills to support those authentic learning experiences, is critical to ensuring equity and access for all students. Over the progression of their science learning, students should be afforded opportunities to engage in inquiry across the continuum.

Second, this review contributes to the literature base through examination of studies testing inquiry-access interventions (n = 11). Studies were coded as inquiry-access if both treatment and control or baseline conditions included inquiry-based instruction. The interventions were added supports (e.g., peer-mediated learning, a task analysis, scripted lessons for teachers) designed to increase access for SWD to learning opportunities as well as independence in scientific practices and the inquiry process. Group design studies produced medium effects (ES = 0.55, SE = 0.21) and SCD studies produced very large effects (ES = 3.18, SE = 0.72). In conjunction with the previously noted effects of guided inquiry versus structured inquiry, it may be that as students become more independent in navigating the inquiry process, they are able to gain more from inquiry-based science instruction. This suggests the potential benefit of direct instruction in inquiry skills and scientific practices for SWD both separate and in tandem with science content, especially for students with more significant disabilities.

Finally, this review contributes to existing literature by analyzing the efficacy of inquiry-based science instruction on dependent measures assessing proximal science content acquisition,

distal science content acquisition through standardized measures, and acquisition of scientific practices and inquiry skills in performance-based assessments. In group design studies, inquiry-based instruction produced large effects for proximal content measures (ES = 0.94, SE = 0.22) and small effects for standardized content measures (e.g., end of year exams, ES = 0.21, SE = 0.10). For SWD, these small effects on standardized measures are still meaningful, and suggest that content gained through inquiry-based learning is sustained over time. In SCD studies, inquiry-based instruction produced large effects on proximal content measures (ES = 2.02, SE = 0.36). There were no standardized assessments used in the SCD studies and future research should consider including standardized measures as generalization and maintenance probes. Interestingly, group design studies produced medium effects for performance-based assessments (ES = 0.70, SE = 0.48) while SCD studies produced even larger effects for performance-based assessments (ES = 3.84, SE = 0.75) than on proximal content measures. Taken together, results suggest that inquiry-based instruction is effective for SWD in learning science content and scientific practices and inquiry skills with potential retention over time.

Considerations for Future Research

There are several considerations for future research. First, future research should include increased rigor in reporting participant demographic data so that it is clearer who the data represents. Although this is a need throughout educational research, the historical discrepancies in access to rigorous science instruction as well as poor science outcomes for students in historically marginalized groups (e.g., BIPOC students, women, SWD; National Center for Science and Engineering Statistics, 2021) makes accurate and thorough reporting of participant demographics especially salient in this domain. Second, future research should examine the efficacy of instruction in scientific practices and inquiry skills both separately and embedded

within inquiry-based learning through inquiry-access interventions. Third, future research should examine how to support SWD in accessing science instruction along the continuum of inquiry-based learning types through fading of supports. Longitudinal studies where SWD can experience a gradual release of supports along the inquiry continuum are also needed.

Within this review, there was a notable absence of studies targeting the underlying social, language, and behavioral skills necessary for students to participate in the scientific inquiry process. For example, inquiry-based learning requires students to engage in extensive peer collaboration and scientific discourse, work cooperatively with classmates, use sophisticated higher-order academic language, manage large amounts of materials and directions, and self-manage their behavior (e.g., Spies & Xu, 2018). These skills are required to fully participate and benefit from inquiry-based learning, and many SWD experience difficulties with them. Further research is also needed to identify the boundaries of inquiry-based science instruction, or for whom and under what conditions is inquiry-based science instruction effective and ineffective. Future studies should examine how to support these underlying social, language, and behavioral skills so that SWD may access the learning environment and process more robustly. Finally, given the number of SWD supported within general education classrooms (Hussar et al., 2020), future research examining opportunities for shared professional development special educators and general educators supporting SWD in inquiry-based learning is warranted.

Limitations

There are several limitations to consider within the current systematic and meta-analytic review. First, the limited information about control conditions limited our ability to compare and synthesize counterfactual instruction across studies and conduct a robust analysis of specific components within intervention packages. This is unfortunate as inquiry-based science

interventions often are multi-component and incorporate various elements of multiple instructional practices (e.g., direct instruction, use of visuals, peer-mediated learning). We did not examine specific components, but rather evaluated the complete intervention package. As such, it is unclear the specific role and efficacy of the individual components on science learning. Second, limited reporting of participant demographic data inhibited our ability to draw additional conclusions or examine trends across students to understand more fully who inquiry is effective for, and for whom it is not. Third, the current review contains a limited number of studies due to the limited research conducted in this area which prohibited the use of more sophisticated meta-analytic techniques. Fourth, many of the included group design studies included students without disabilities and did not disaggregate their findings. For some of these studies (e.g., Terrazas-Arellanes et al., 2018), most participants were not SWD, potentially affecting the ES.

Implications for Practice

Findings from this study have several implications for special and general educators who support SWD in science. First, SWD can benefit from *all* types of inquiry-learning experiences with supports. To develop their inquiry abilities, SWD need access to experiences that vary in openness. Inquiry-access skills can be taught within science lessons to build students' capacity in engaging in rigorous scientific inquiry skills. Guided and structured inquiry may best focus learning on the development of science concepts while allowing educators to fade their level of support. More open inquiry will afford the best opportunities for cognitive development and scientific reasoning. Students should have opportunities to participate in all types of inquiries during their science learning with an emphasis on increasing openness and fading supports as students gain independence and are able to take greater ownership of their learning.

Finally, along with supporting prerequisite academic skills and content knowledge needed to access inquiry learning experiences, educators should consider the addition of supports for the prerequisite social, language, and behavioral skills needed for inquiry-based learning. For example, managing materials, the data collection process, and the multiple steps needed for inquiry-based learning requires extensive executive functioning and behavior self-management skills. Additionally, scientific discourse and argumentation necessitates sophisticated higher-order academic language as well as nuanced social and conversational skills. This also included providing students clear social and behavioral expectations and guidelines when engaged in peer collaboration and science discourse in science inquiry.

Conclusion

Scientific literacy is essential for SWD as it supports their ability to understand current events, create solutions to real-world problems, and strengthen critical thinking, problem-solving, and complex communication skills. Further, with the continued demand for STEM professions, achieving strong scientific literacy has long-term life outcome implications for SWD. As this review suggests, SWD are capable of actively constructing knowledge about their world around them and engaging in inquiry-based science instruction across the inquiry continuum. In inquiry-based science instruction, SWD are able to develop scientific practices necessary for scientific literacy such as asking important questions, gathering data, brainstorming solutions to problems, articulating reasonable hypotheses, and observing consequences. SWD should have opportunities to participate in all types of inquiries in the course of their science learning with an emphasis on increasing openness and fading supports as students become more independent and are able to take greater ownership of their learning. Ultimately, the evidence for inquiry-based interventions for SWD is promising yet limited. Thus, we highly recommend that

the field extend and replicate extant literature on inquiry-based science instruction for SWD with particular attention given to inquiry-access interventions and supporting learning across the inquiry continuum.

Supplemental Materials 1

Boolean search string:

disabilit* OR autis* OR asperge* OR “emotional disorder” OR “emotional disturbance” OR “emotional disability” OR “emotional disabilities” OR “intellectual disability” OR “intellectual disabilities” OR “mental retardation” OR “cognitive disability” OR “cognitive disabilities” OR “developmental disability” OR “developmental disabilities” OR “learning disability” OR “learning disabilities” OR “learning difficulty” OR “learning difficulties” OR “reading difficulty” OR “reading difficulties” OR “reading disability” OR “reading disabilities” OR “behavior disorder” OR “behavior disability” OR “behavior disabilities” OR “behavioral disturbance” OR “exceptional children” OR “special education” OR “special needs”

AND

“Design based learning” OR “design based teaching” OR “dialogic inquiry” OR “guided inquiry” OR “Inquiry based instruction” OR “inquiry based learning” OR “inquiry based teaching” OR “inquiry classroom” OR “inquiry competence” OR “inquiry education” OR “inquiry learning” OR “inquiry teaching” OR PBL OR “problem based learning” OR “problem based teaching” OR “project based learning” OR “project based teaching” OR “guided inquiry” OR “structured inquiry” OR “open inquiry” OR “hands-on learning” OR “hands-on teaching” OR “activity based learning” OR “activity based teaching” OR “science inquiry” OR “inquiry-based” OR “inquiry based” OR “inquiry-oriented” OR “inquiry oriented”

CHAPTER III

Direct Peer-Mediated Social Interventions for Secondary Students with Intellectual and Developmental Disabilities

Abstract

Peer relationships and social interactions in the classroom are essential as they facilitate opportunities for learning and knowledge construction. Yet, the academic and social affordances of these peer interactions are not often fully realized for students with intellectual and developmental disabilities (I/DD) at the secondary level. Direct peer-mediated interventions (DPMI) are frequently used to support the development and quality of social interactions between students with I/DD and their peers. The purpose of this systematic review and meta-analysis was to evaluate extant literature on DPMI for secondary students with I/DD. We identified 29 studies and dissertations for inclusion in this review. Effect size (ES) estimates demonstrate significant positive effects in both group and single case design studies. Overall findings suggest that DPMI are efficacious in supporting social interactions and peer relationships between secondary students with I/DD and their peers.

Keywords: intellectual and developmental disabilities, social communication, social relationships, meta-analysis

Introduction

The communal nature of the classroom environment necessitates positive relationships with peers. Social interactions facilitate opportunities for learning and knowledge construction (Bandura, 1977; Nystrand, 2006; O'Connor & Snow, 2018; Spies, 2016; Spies & Xu, 2018; Vygotsky, 1978; Zweers et al., 2019) and academic standards emphasize embedded speaking and listening skills within content areas (e.g., Common Core State Standards; Next Generation Science Standards). Students who experience positive relationships with their peers and teachers are more likely to be academically engaged (Estell & Perdue, 2013; Perdue et al., 2009) and have higher levels of academic achievement (Wentzel, 2009). Further, peer relations and social skills are strongly associated with adolescents' social-emotional, language, and cognitive functioning (e.g., Parker et al., 2006; Rubin et al., 2009). For these reasons, students supported under the special education eligibility categories of autism, intellectual disability, and multiple disabilities (i.e., intellectual and developmental disabilities; I/DD) are frequently included within general education settings to foster normalized peer relationships, strengthen their social communication skills (e.g., Carter et al., 2014; Carter & Draper, 2010; Ryndak et al., 2013), and build community membership with their classmates (Schwartz, 2000; Staub et al., 1994).

Yet, the academic and social affordances of peer interactions are not often fully realized for students with I/DD. Differences in the social development of children with I/DD often result in challenges in social awareness, peer interactions, and overall communication (e.g., Kasari et al., 2011; Locke et al., 2017; Wagner et al., 2004). For many individuals with I/DD, these challenges lead to fewer friendships, higher rates of loneliness, and less social integration in their classroom or learning community (e.g., Chamberlain et al., 2007; Kasari et al., 2011; Kemp & Carter, 2006; Symes & Humphrey, 2010). Even when included, these students are often situated

at the periphery of peer networks that exist within their school and classrooms (e.g., Carter et al., 2008; Feldman et al., 2016; Kurth & Mastergeorge, 2012; Locke et al., 2010). This is rarely the result of a lack of motivation, as researchers consistently find that individuals with I/DD desire and seek friendships (Bottema-Beutel et al., 2016; Howard et al., 2006; Kapp et al., 2013; Rossetti, 2015; Sosnowy et al., 2019). Social differences and the skills needed to manage friendships, however, make it more challenging for students with I/DD to develop and maintain peer relationships (Rossetti, 2015). This may be compounded by their peers lacking the skills or support needed to be meaningful and reciprocal partners in these friendships (e.g., Shokoohi-Yekta & Hendrickson, 2010).

The quality and stability of peer relationships for students with I/DD often do not increase as these students age through adolescence (e.g., Boutot & Bryant, 2005; Chamberlain et al., 2007; Locke et al., 2010; Rosenthal et al., 2013; Rotheram-Fuller et al., 2010). Authors have reported in observational studies the infrequency or absence of interactions between students with I/DD and their neurotypical peers (e.g., Carter et al., 2005; Raghavendra et al., 2012). In addition to the disability-related social challenges that many students with I/DD experience, difficulty establishing and growing social connections at the secondary level may be exacerbated due to (a) shifting peer attitudes and expectations, (b) changing definitions of social success (Carter et al.,2014; Rubin et al., 2009), and (c) the increasing importance and nuance of conversations (Brown & Klute, 2003; Brown & Larson, 2009; Bukowski et al., 2018; Carter, 2017; Carter et al., 2014; Lynch et al., 2013).

The structure of schooling significantly shifts during the secondary years (Carter et al., 2014; Odom, 2019). Social interactions play a growing role in expectations for academic engagement and classroom participation (e.g., Lynch et al., 2013). Further, schools often

departmentalize by subject, causing peer networks to be spread throughout various classes, rather than remaining a nuclear group within a single classroom (Carter et al., 2014; Odom, 2019). Without attention to their classroom social connections, students with I/DD may not fully access academic and social learning opportunities in secondary classrooms. As such, targeted social interventions to support the peer relationships and networks of students with I/DD have vast implications for increasing students' social connectedness, access to their academic learning environment, and overall quality of life.

Direct Peer-Mediated Interventions

Peer-mediated interventions (PMI; Odom & Strain, 1984, Steinbrenner et al., 2020) are an empirically validated set of strategies that have demonstrated positive effects in supporting the development of social and communication behaviors for students with I/DD in service of fostering friendships and community membership (Steinbrenner et al., 2020). PMI are broadly defined and include myriad instructional techniques, but typically involve neurotypical peers who model or prompt interactions, or act as intervention implementers (Odom & Strain, 1984). For the purpose of this review, we used Wong and colleagues' (2015) definition that PMI involve, "teaching typically developing peers ways to interact with and help learners with ASD acquire new behavior, communication, and social skills by increasing social opportunities within natural environments" (p. 76).

Odom (2019) described three direct approaches to PMI (DPMI) particularly effective in promoting increases in social relationships, communication, and peer interactions: (a) peer initiation and response interventions, (b) peer-mediated social networks, and (c) peer support plans. In these direct approaches, adult facilitators teach strategies and skills to neurotypical peers needed to interact with and assist their peers with I/DD (Odom et al., 1985). These direct

approaches differ from other PMI in that they include adult facilitation and peer training. Adult facilitation and peer training are critical as extant literature has shown that proximity alone, without peer training, is not as efficacious (Odom; 2019; Odom et al., 1999) and that adult prompting and reinforcement in natural settings during peer training supports generalization and maintenance of social skills (DiSalvo & Oswald, 2002; Odom & Watts, 1991). Clearly defined implementation procedures and fidelity measures for practitioners and peers are also typically included (Katz & Girolametto, 2013).

Researchers have particularly advocated for PMIs at the secondary level (Carter, 2018; Travers & Carter, 2021). Utilizing peers as interventionists may increase access to intervention time for students with I/DD as DPMI can be embedded within other daily school activities and structures (Chan et al., 2009; Hemmeter, 2000; Trembath et al., 2009). Embedding DPMI into natural routines also potentially increases the likelihood of generalization as participating students have the opportunity to interact and practice communication and social skills with multiple partners across multiple settings (Carr & Darcy, 1990; Strain & Kohler, 1998). It has also been noted that DPMI frequently incorporate other evidence-based practices, potentially strengthening the efficacy of both practices than either in isolation (Kamps et al., 2017; Odom, 2019).

DPMIs leverage the social nature of the classroom and build a natural community for students with I/DD while actively teaching the communication and social skills needed to sustain it (Chan et al., 2009). DPMI serve as dual interventions, providing training and skill development to not only students with disabilities, but also their neurotypical peers. This supports the fostering of community membership and social relationships, as all members of the community, regardless of disability status, are given the tools and skills needed to communicate and interact in a

prosocial and inclusive manner. The training provided to peers within DPMI has been shown to be beneficial, with many studies demonstrating positive social and academic effects for peer implementers (e.g., Carter et al., 2011; Locke et al., 2012; McHale & Simeonson, 1980; Schaefer et al., 2016; Travers & Carter, 2021). For example, many peers report a deeper appreciation for diversity, greater commitment to inclusion, and improved attitudes towards their classmates with disabilities (Schaefer et al., 2016; Travers & Carter, 2021).

Types of Direct Peer-Mediated Interventions

Peer initiation and response interventions are one of the oldest forms of PMI (Goldstein & Wickstrom, 1986; Odom et al., 1985; Odom & Strain, 1986; Strain & Shores, 1977). In this approach, peers are taught discrete techniques in social communication for initiating, responding to, reinforcing, and sustaining interactions with students with I/DD (DiSalvo & Oswald, 2002; Odom, 2019). Adult facilitators frequently teach peers to provide social and verbal reinforcement to students with I/DD when they appropriately respond (DiSalvo & Oswald, 2002).

Peer-mediated social network interventions are cohesive social groups designed to integrate students with I/DD into social environments within the school (Carter et al., 2013). Unlike other more traditional PMI (i.e., peer initiation, peer proximity), peer network interventions focus on promoting friendships through positive interactions and shared activities, rather targeting discrete social or communication skills (e.g., Asmus et al., 2017; Carter et al., 2019; Haring & Breen, 1992; Odom, 2019). During weekly formal meetings, members of the peer network engage in mutually enjoyable shared activities, practice social and communication skills in a naturalistic environment, and plan informal social times to support skill generalization over time (Carter et al., 2013).

Peer support plans are an evidence-based practice where neurotypical peers are trained to increase the social interactions and participation of students with I/DD within general education academic contexts while students work alongside each other (Brock & Huber, 2017). Peer support plans combine the traditional social and communication focus of many PMI with the focus and intervention location of peer tutoring. As such, peer support plans typically contain goals and strategies that address the academic, classroom engagement, social, and communication needs of students with I/DD (Brock & Huber, 2017).

Study Purpose

The efficacy of DPMI for students with I/DD has been examined in several focused reviews and meta-analyses in the last decade, establishing all variations of DPMI as evidence-based practices for this population (e.g., Brock & Huber, 2017; Chang & Locke, 2016; Ezzamel & Bond, 2016; Hughes et al., 2012; Schaefer et al., 2016; Travers & Carter, 2021; Watkins et al., 2015). Within these reviews, authors have found that DPMI are effective at increasing social and communication skills and are conducive for implementation across the school-age years and within school settings. The effectiveness of DPMI for students with I/DD has also been studied in broader social skills intervention reviews, with outcomes supporting the use of PMI to increase social and communication skills (e.g., Carter et al., 2010; Kuntz & Carter, 2019; Steinbrenner et al., 2020; Walton & Ingersoll, 2012; Wong et al., 2015). Authors of these reviews have focused on descriptive analyses (e.g., Schaefer et al., 2016; Travers & Carter, 2021; Watkins et al., 2015), on one variation of PMI (e.g., Brock & Huber, 2017), or one type of research design (i.e., Chang & Locke, 2016).

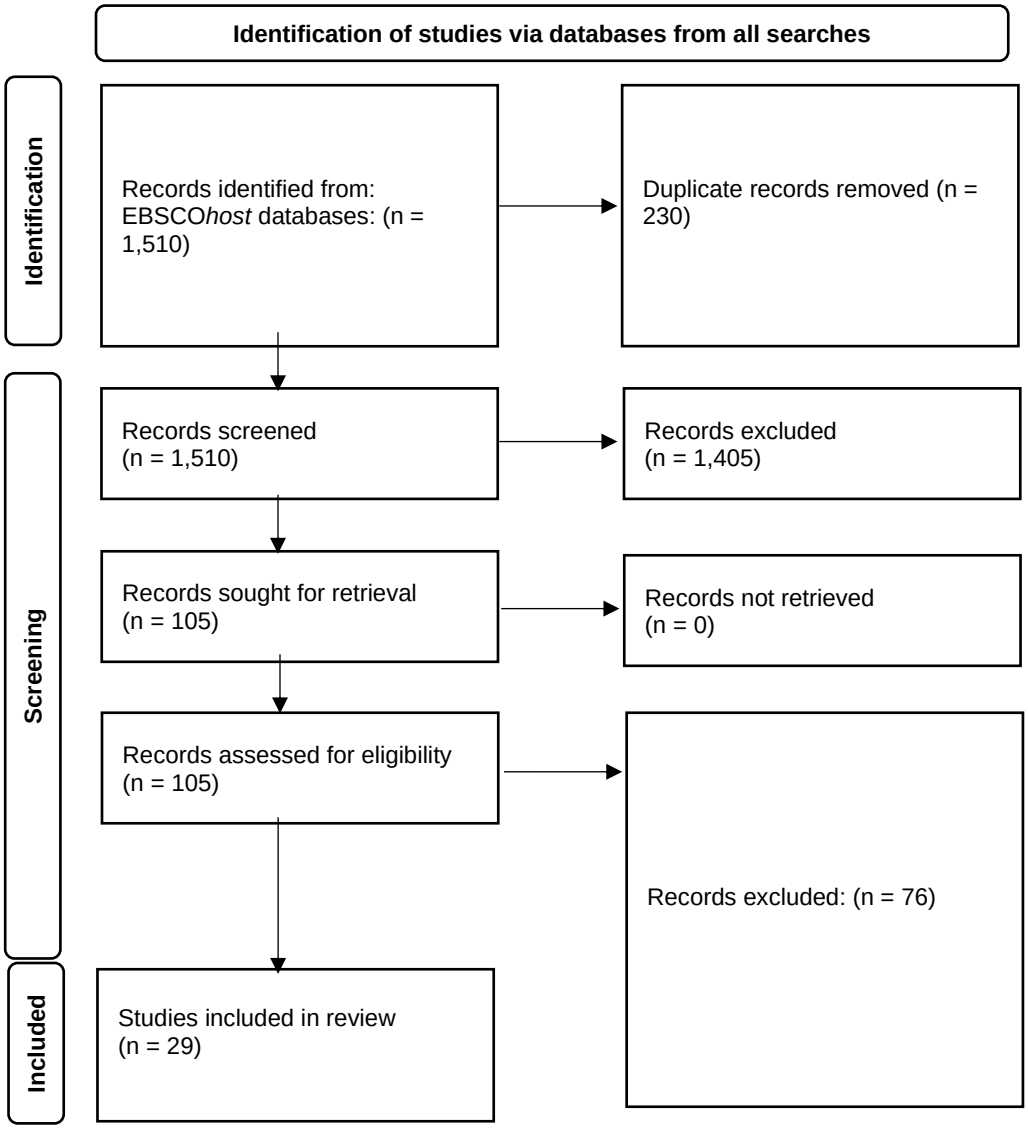
In this systematic and meta-analytic review, we aimed to expand upon these prior reviews in four ways. First, we focused this review on DPMI which have been shown to be more

efficacious than other types of social PMI (Odom, 2019) that do not involve adult facilitation or peer training. Second, we focused on secondary settings where the changing social landscape of adolescence necessitates additional and unique intervention considerations. Next, we included group and single case design (SCD) studies, as well as gray literature (i.e., dissertations), to present a more holistic view of how DPMI have been examined. Finally, we employed meta-analytic techniques to evaluate the effects of DPMI on increasing the social and communication skills of secondary students with I/DD, a need noted in Travers and Carter's (2021) recent review. Despite the frequency of DPMIs being used in school settings (e.g., Brock & Huber, 2017; Travers & Carter, 2021), meta-analytic techniques to measure the effects of DPMI at the secondary level have not been applied.

To this end, we asked (a) What are the intervention and participant characteristics of studies examining DPMI for secondary students with I/DD, (b) What is the overall effect of DPMI in supporting the frequency of interactions between students with I/DD and their peers, (c) Is the type of DPMI differentially associated with increases in interactions, and (d) Is the peer training provider and presence of on-going peer training and support associated with an increase in effectiveness of the DPMI on increasing the frequency of social interactions?

Method

We conducted this meta-analytic and systematic review using best practices to support a comprehensive search of peer-reviewed literature and published dissertations (Cooper, 2016). We identified and screened records using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Page et al., 2020; Figure 2). Once identified, we examined studies' eligibility for inclusion using the following a priori criteria.



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

Figure 2. PRISMA diagram

Inclusion and Exclusion Criteria

First, we included only studies published in peer-reviewed, English-language, academic journals or studies published as a dissertation between January 2000 and July 2021. Second, studies were required to have an experimental or quasi-experimental (e.g., single-group pre-post designs) design that allowed for direct analysis of intervention effects. This included both group design and SCD studies. We excluded qualitative research designs, case studies, SCDs with an AB or ABA designs, and correlational studies as the independent variable was not actively manipulated. Third, studies needed to include participants at the secondary level (i.e., grades 6 through 12 or ages 11-22) who were eligible for special education services under an I/DD (i.e., autism, intellectual disability, and multiple disabilities). Fourth, peer implementers within the study must have been neurotypical and also secondary students. When studies involved both students who met and did not meet these criteria (e.g., studies with elementary and secondary participants) and data had been disaggregated, only students who met full eligibility criteria were included in the analysis. We included group design studies that did not disaggregate but had a majority of students within the inclusion parameters.

Fifth, we only included studies where interventions were implemented within the school day in general education classrooms, special education classrooms, or pull-out settings. We excluded studies that were conducted outside of school settings such as in clinics, summer programs, theater programs, or virtual settings. Sixth, the study's independent variable must have been a DPMI (Odom, 2019) with the primary implementer being a neurotypical peer who had received training. Studies that solely utilized peers in proximity, without peer training or peers actively implementing a DPMI, were excluded. Students with I/DD and their neurotypical peers must have been grouped together and training must have been given to at least the neurotypical peer group. Studies where DPMI were part of a comprehensive treatment program were excluded

if they did not specifically discuss the peer training component and disaggregate the outcomes of the DPMI. If the study did disaggregate the outcomes of the DPMI, only the DPMI outcomes were included within the analysis. Finally, authors must have included at least one dependent measure directly assessing instances or rates of social communication or social interactions (e.g., communication bids and responses). Studies solely measuring academic outcomes, or academic related behaviors such as time on task or academic engagement were excluded.

Systematic Search and Screening Procedures

To identify peer-reviewed literature, the first author conducted a systematic search using EBSCO*host* to search the Education Resources Information Center (ERIC), Academic Search Complete, and PsycINFO databases. Equivalent subjects and related words search features were not used and the search was limited to studies published in English-language journals. Boolean search terms ("peer support" OR peer-support OR "peer initiation" OR "peer tutoring" OR peer-tutoring OR "peer mediat*" OR peer-mediated OR "peer network" OR peer-network OR "peer delivered" OR peer-delivered OR "peer assist*" OR "peer direct*" OR "social network" AND "alternate assessment" OR "Asperge*" OR "autis*" OR "cognitive disabilit*" OR "cognitive impair*" OR "cognitively impaired" OR "complex communication needs" OR "developmental disabilit*" OR "intellectual disabilit*" OR "intellectual retardation" OR "mental retardation" OR "mild retardation" OR "multiple disabilit*" OR "profound disabilit*" OR "severe disabilit*" OR "significant disabilit*" OR "traumatic brain injury") were used within a full text search. To identify published gray literature (i.e., dissertations), the first author utilized the same Boolean search terms in an abstract search in the ProQuest Dissertations & Theses Global database. This returned 1,319 peer-reviewed articles and 191 dissertations after duplicates were removed.

Next, we used the inclusion and exclusion criteria in a title, abstract, and full-text screening process. The first author trained the second author in applying the inclusion and exclusion criteria to titles and abstracts on a subset of potential articles (n = 50) until 90% agreement was achieved. The second author then double coded an additional 20% of titles and abstracts. Intercoder reliability (ICR) was 94%, and consensus was reached through discussion on all disagreements. ICR was calculated using a total agreement formula (i.e., number of agreements divided by the number of agreements plus disagreements multiplied by 100). The first and second author then independently reviewed all full-text articles and dissertations that qualified for consideration (n = 105). ICR was 98%. Disagreements were resolved through discussion until consensus was reached.

Of the 105 articles and dissertations that underwent full-text screening, 76 articles were excluded. We excluded one article because it did not include students with I/DD, four articles because the effect size could not be calculated, two articles because there was not a direct assessment of social interactions in the study, two were not school based, four did not measure the efficacy of a DPMI against business as usual, three articles because peer behavior was the dependent variable of interest, and four articles because the article did not meet the design criteria. We further excluded six articles because there was no peer training, nine articles because they did not include a social dependent variable, and 36 articles as they were not at the secondary level. Finally, we excluded five dissertations as they were also returned as published journal articles. Ultimately, the systematic electronic search returned 29 articles for inclusion in this review.

To identify relevant literature that was not returned through the systematic electronic search, we conducted an ancestral search using the reference lists of included articles. We also

mined the reference lists of related literature reviews and meta-analyses (n = 10) that were returned during the electronic search or were previously known to the authors. Potentially relevant articles from the ancestral and prior reviews search (n = 14) underwent full text screening were considered for inclusion. This process added four articles, with a total of 33 articles or dissertations that met full inclusion criteria.

Data Coding and Extraction

We first narratively summarized articles that met the full inclusion criteria with independent validation of the narrative table by the fourth author (See Table 3). Narrative data extraction included each study's number of focal participants and peer implementers, the grade level(s) and demographics of the focal participants, the study design, the type of DPMI, the intervention location and session duration, the type of dependent variable, and the inclusion of generalization, maintenance, fidelity, and social validity measures.

Dummy Coding

We then dummy coded studies using an author-created coding manual (see Supplemental Materials 1 and OSF site masked). We created dummy codes based on prior reviews of DPMI as well as study variables hypothesized to affect study outcomes. Specifically, we coded three categories of variables: (a) study design and characteristics; (b) focal participant and peer characteristics; and (c) intervention and peer training characteristics. ICR was calculated using the total agreement formula after studies were coded and was 100%.

Study Design and Characteristics. We coded for study design, study characteristics, and study quality. Studies were coded as either SCD or group design. SCD studies were further coded categorically (e.g., reversal, withdrawal, multiple probe; Ledford & Gast, 2018) and group

designs were categorized as experimental or quasi-experimental. We also coded for the presence of generalization, maintenance, fidelity, and social validity measures.

Participant Characteristics. Next, we summarized the characteristics of the focal students with I/DD. For group and SCD studies, we only included studies that disaggregated by grade/age or that had a majority of participants within the eligible grade/age range. We coded demographic information for study participants including (a) grade level, (b) sex, (c) race/ethnicity, and (d) the student's primary special education eligibility category. We recorded each participant's special education eligibility category as reported by the study authors as (a) primarily ID, (b) primarily ASD, (c) both ID and ASD, or (d) multiple disabilities when they had a combination of two or more disabilities other than ID and ASD. Participants within single case design studies were coded separately, while participants within group design studies are reported in aggregate and as a range when appropriate. We also recorded the total number of eligible peer implementers within each study.

Intervention Characteristics and Procedures. We coded intervention components separately from the peer-training components. For intervention characteristics, we recorded (a) the type of DPMI and the dependent variables and measures within each study. For intervention procedural elements, we coded for (a) intervention location, (b) the frequency of intervention sessions, (c) intervention group size, and (d) the adult facilitator of the intervention. For the peer-training characteristics, we coded the peer-training provider and the presence or absence of follow-up support meetings led by the facilitator with the peer implementors.

Effect Size Calculations

Effect sizes (ES) were calculated to estimate the effect of DPMI on social interactions for secondary students with I/DD (Borenstein et al., 2009). We calculated ES indices that are

specific to group and SCD studies, but that are designed to be comparable. We analyzed group and SCD studies together and separately. Within the included studies, outcome data were presented in two ways. First, data were presented as separate instances of focal peer initiations and responses. Second, data were presented as a combined initiations and responses variable as total social interactions. If total interactions were presented, we calculated a single ES. If responses and bids were presented separately, we estimated two separate ES and then collapsed them into a single outcome variable of total social interactions.

Group Design Studies. For group design studies, we used the standardized mean difference ES, scaled to Hedges' *g* to account for small study sample sizes (Hedges, 1981). The ESs were calculated using the Comprehensive Meta-Analysis Software (CMA; Version 3). When provided, we used the treatment and control group posttest means and standard deviations (SD)s. When posttest means and SD were not provided, we used the p-values to calculate the ES.

SCD Studies. We used the between-case standardized mean difference (BC-SMD; Hedges et al., 2013; Shadish et al., 2014; Valentine et al., 2016) to estimate the magnitude of treatment effects for SCD studies. The BC-SMD is interpreted using Cohen's (1988) guidelines, where a BC-SMD < 0.20 indicates a small effect and a BC-SMD > 0.80 indicates a large effect. Shadish and colleagues (2015) identified the BC-SMD as a robust ES that is consistent with the group standardized mean difference. Barton and colleagues (2017) noted the BC-SMD makes the following assumptions:

> (a) the baseline is stable (e.g., no trend), (b) the intervention leads to an immediate change in level (e.g., no intervention-phase trend), (c) the intervention effect is constant across cases, (d) the outcome is normally distributed about case- and phase-specific mean

levels, and (e) deviations from mean levels follow a first order autoregressive process. (p. 375).

Potential autocorrelation, a likely event due to the nature of in SCD studies and repeated measurement of cases, is accounted for in the final assumption. To calculate the BC-SMD, studies must have a minimum of three datum points in both the baseline and intervention phases and three cases. Maintenance and generalization points were excluded from analysis.

The fourth author, a graduate assistant, extracted and cleaned all data after a training from the first author The fourth author extracted data from each SCD study using the WebPlotDigitizer (Version 4.4; Rohatgi, 2018), which has been used in prior reviews (e.g., Barton et al., 2017; Datchuk et al., 2021) and has been found to have high rates of reliability (r = 0.99; Drevon et al. 2017). Next, the first authored cleaned the data and assessed the extracted data for accuracy against reported results in each study. Data were only altered if the study's dependent measure was reported a whole number and the WebPlotDigitizer had extracted a non-whole number. We then inputted the cleaned data into scdhlm, an open-source, web-based program designed to calculate the BC-SMD estimate (Pustejovsky et al., 2021). For each study, we assigned session numbers to each case as the detrending variable and effect sizes were estimated using the Restricted Maximum Likelihood estimation method with random effects for both the baseline and treatment conditions. We then uploaded computed scores from the scdhlm program into the Comprehensive Meta-Analysis software (CMA; Version 3). ICR was calculated using a total agreement formula for all extracted data and was 97%.

Meta-Analysis

Of the SCD studies, five had more than one ES suitable to address research questions two, three, and four. In these studies, social interactions were either presented as separate

initiations and responses or the studies were multiple baseline within participants designs. Therefore, we assumed that the outcome measures were likely highly correlated within the studies (e.g., Huber et al., 2018) and we calculated estimates conservatively by averaging the ESs and SDs to produce an overall mean and SDs. We also calculated liberal estimates (i.e., assuming no correlation between measures) but the difference was marginal and had no effect on ES interpretations. As such, we only used the conservative estimates in our analyses. We used the Comprehensive Meta-Analysis (CMA; Version 3) to calculate weighted means and confidence intervals within each design type (group and SCD) to address the study effects research questions.

Results

We included 33 studies in this systematic and meta-analytic review. Descriptive information for each study can be found in Table 3. Of the 33 articles, seven were published dissertations and 26 were published in peer-reviewed journals. Most of the included articles were published in the last decade, with two articles published between 2000 and 2010 and 31 articles published between 2011 and 2021. Thirty-one articles utilized a SCD, and 2 articles utilized a group design. Of the 33 included studies, 13 were peer initiation or response interventions, nine were peer network interventions, and 11 were peer support interventions.

Research Question 1: Intervention and Participant Characteristics

Across studies, 207 students with developmental disabilities are represented in intervention conditions. Within peer initiation and response studies, 46 students with developmental disabilities (22% of total) were included as participants as well as 243 of their peers. Peer network interventions studies included 73 students with developmental disabilities (35% of total)

	Study Design	Participants	Intervention location; session location; session frequency	Intervention facilitator	Training provider	On-going peer support	G, M, F, SV
Peer Initiation and Response							
Hughes et al. (2000)	SCD	5 SWD; 71 peers; 1 peer/SWD	Classrooms and cafeteria; 5 minutes; daily	Research team	Research team	No	G, M, F, SV
Ogilvie (2008)	SCD	3 SWD; 3 peers; 1 peer/SWD	Academic and elective classrooms; class period; daily	School staff	Research team	Yes	G, M, F, SV
Hughes et al. (2011)	SCD	5 SWD; 48 peers; 11-16 peers/SWD	Elective classes and cafeteria; 5 minutes; daily	Research team	Research team	No	G, F, SV
Chung & Carter (2013)	SCD	2 SWD; 7 peers; 3-4 peers/SWD	Academic and elective classes; 20-50 minutes; 2-3 days/week	School staff	Research team	Yes	F, SV
Hughes, Bernstein et al. (2013)	SCD	6 SWD; 38 peers; 10-14 peers/SWD	Academic classes; 5 minutes; daily	Research team	Student	No	G, M, F, SV
Hughes, Harvey et al. (2013)	SCD	3 SWD; 3 peers; 1 peer/SWD	Elective classes; 90 minutes; daily	Research team	Research team	No	F, SV
Reilly et al. (2014)	SCD	3 SWD; 41 peers; 3-8 peers/SWD	Cafeteria; not reported; not reported	Research team	Research team	No	G, M, F, SV
Potter (2014)	SCD	3 SWD; 3 peers; 1 peer/SWD	Cafeteria; lunch period; daily	Research team	Research team	Yes	M, F, SV
Brain & Mirenda (2019)	SCD	3 SWD; 9 peers; 2-4 peers/SWD	Cafeteria; 30 minutes; daily	Research team	Research team	Yes	M, F, SV
MacFarland & Fisher (2019)	SCD	4 SWD; 7 peers; 1 peer/SWD	Classroom, school greenhouse, cafeteria; class period; daily	School staff	School staff	Yes	G
Barraza (2019)	SCD	3 SWD; 3 peers; 1-2 peers/SWD	Elective class; 50 minutes; daily	School staff	School staff with research team support	Yes	G, M, F, SV

Mahoney (2019)	SCD	3 SWD; 8 peers; 2-3 peers/SWD	Academic classes; 50 minutes; daily	Research team	Research team	Yes	F, SV
Ackerman et al. (2020)	SCD	4 SWD; 2 peers; 1 peer/SWD	Academic classes; 10 minutes; not reported	Research team	Research team	Yes	M, F, SV
Peer Network							
Leinert (2013)	SCD	3 SWD; 11 peers; 3-4 peers/SWD	Cafeteria; 30 minutes; daily	Research team	Research team	Yes	M, F, SV
Hochman et al. (2015)	SCD	4 SWD; 11 peers; 1-3 peers/SWD	Cafeteria; 30 minutes; 2-3 days/week	School staff	School staff with research team support	Yes	G, F, SV
Bambara et al. (2016)	SCD	3 SWD; 9 peers; 2-4 peers/SWD	Cafeteria; 30 minutes; 3-4 days/week	Research team	Research team	Yes	F, SV
Asmus et al. (2017)	Group	47 SWD; 192 peers; 3-6 peers/SWD	Cafeteria; varied; varied	School staff	School staff	Yes	G, M, F, SV
Sreckovic et al. (2017)	SCD	3 SWD; 14 peers; 3-6 peers/SWD	Conference room or empty classroom; 25-30 minutes; 2 days/week	Research team	Research team	Yes	G, M, F, SV
Bambara et al. (2018)	SCD	4 SWD; 16 peers; 4 peers/SWD	Cafeteria; 30 minutes; 3-4 days/week	Research team	Research team	Yes	G, F, SV
Herbert et al. (2020)	SCD	3 SWD; 13 peers; 3-5 peers/SWD	Cafeteria 30 minutes; weekly	Research team	Research team	Yes	F, SV
Thomas (2020)	SCD	3 SWD; 12 peers; 2 peers/SWD	Cafeteria or study hall; 10 minutes; 3-4 days/week	Research team	Research team	Yes	G, F, SV
Thomas & Bambara (2020)	SCD	3 SWD; 7 peers; 2-3 peers/SWD	Cafeteria; 10 minutes; 3-4 days/week	Research team	Research team	No	G, F, SV
Peer Support							

Carter et al. (2007)	SCD	4 SWD; 4 peers; 1 peer/SWD	Academic classes (3) and elective class (1); class period; daily	Researcher team	Research team	Yes	F
Carter et al. (2011)	SCD	3 SWD; 6 peers; 1-3 peers/SWD	Elective classes; class period; daily	School staff	Research team	Yes	SV
Brock et al. (2016)	SCD	4 SWD; 10 peers; 2-3 peers/SWD	Elective classes; class period; daily	School staff	School staff with research team support	Yes	G; F; SV
Brock & Carter (2016)	SCD	4 SWD; 11 peers; 2-3 peers/SWD	Academic classes; class period; daily	School staff	School staff with research team support	Yes	F; SV
Carter et al. (2016)	Group	51 SWD; 106 peers; not reported	Academic classes; class period, daily	School staff	School staff	Yes	G, M, F, SV
Athamanah (2017)	SCD	5 SWD; 5 peers; 1 peer/SWD	Work-based learning settings; not reported; not reported	None	Research team	No	G, F, SV
Biggs et al. (2017)	SCD	4 SWD; 8 peers; 2 peers/SWD	Academic classes; class period; multiple times a week	School staff	School staff with research team support	Yes	G; F; SV
Carter et al. (2017)	SCD	4 SWD; 13 peers; 1-6 peers/SWD	Academic classes (3) and elective class (1); class period; daily	School staff with research team support	Research team	Yes	F; SV
Huber et al. (2018)	SCD	3 SWD; 8 peers; 2-3 peers/SWD	Academic classes; class period; daily	School staff	School staff with research team support	Yes	F; SV
Schaefer et al. (2018)	SCD	3 SWD; 6 peers; 2 peers/SWD	Academic classes; class period; daily	School staff	Research team	Yes	G; F; SV
Athamanah & Cushing (2019)	SCD	3 SWD; 3 peers; 1 peer/SWD	Work-based learning settings; average 45 minutes; multiple times a week	School staff	Research team	No	F

Note. SCD = single case design; SWD = students with disabilities; G = generalization; m = Maintenance; F = fidelity; SV = social validity

Table 3. Narrative Table of Studies

and 285 peers; peer support intervention studies included 88 students (43% of total) with developmental disabilities and 180 peers. Across the 33 studies, 65 of the students with developmental disabilities were female while 142 students were male. Study participants were majority White (*n* = 121) followed by African American or Black participants (*n* = 35), Hispanic (*n* = 18) Asian or Asian American/Canadian (*n* = 9), multi-racial (*n* = 7), and Native American or Alaskan (*n* = 2). Authors did not report racial demographics for 15 participants. The majority of participants with developmental disabilities were at the high school level (*n* = 178) with significantly fewer at the middle school, or junior high school, level (*n* = 29). Of the 207 total participants with developmental disabilities across the corpus of studies, 87 had a primary diagnosis of autism spectrum disorder, 80 had a primary diagnosis of an intellectual disability, 34 had a primary diagnosis of co-occurring ASD and ID, and 6 had a primary diagnosis of multiple disabilities or another developmental disability that was not ASD or ID. A detailed depiction of participant demographic information by intervention type is presented in Table 4.

Across the 33 included studies, DPMI were implemented in a wide array of settings including academic content classes, elective classes, the cafeteria, study halls and home rooms, and work-based learning settings. Of the 33 studies, 18 were researcher-implemented interventions and 15 were school staff-implemented. However, of the 15 school staff-implemented interventions, nine were peer support plans. The overwhelming majority of peer initiation and response interventions and peer network interventions were researcher-implemented. Peer training was provided primarily by researchers (*n* = 24 studies) with only nine studies including peer training provided by school staff. Of the 33 included studies, 25 studies included on-going peer training and support provided by the intervention facilitator and eight did not include additional peer support after the initial training was complete.

Demographic	Initiation and Response	Peer Network	Peer Support
Total Participants	*N* = 46	*N* = 73	*N = 88*
Sex			
Male	33	53	56
Female	13	20	32
Race/Ethnicity			
White	18	47	56
African American or Black	11	10	14
Asian	4	1	4
Hispanic	6	12	0
Multi-racial	1	3	3
Native American or Alaskan	0	0	2
Not Reported	6	0	9
Grade Level			
Middle School	11	3	15
High School	35	70	73
Primary Eligibility Category			
ASD	23	36	28
ID	8	23	49
ASD & ID	15	9	10
MD or DD	0	5	1

Note. ASD = autism spectrum disorder; ID = intellectual disability; MD = multiple disabilities other than ASD and ID; DD = developmental disability other than ASD or ID.

Table 4. Participant Demographic Information

Research Question 2, 3, and 4: Study Effects

To answer research question 2, we calculated individual omnibus effect sizes for group and SCD studies to estimate the effect of DPMI on increasing social interactions between students with I/DDs and their peers (Borenstein et al., 2009). ESs for group design studies should be interpreted cautiously as they represent only two studies. Table 5 presents results for all ES calculations. Individual study ESs for SCD studies ranged from 0.01 (SE = 0.16; Barraza, 2019) to 44.86 (SE = 7.90, Hughes et al., 2011). Individual study ESs for group studies ranged from 0.42 (SE = 7.12, Carter et al., 2016) to 1.39 (SE = 0.36, Asmus et al., 2017). We then estimated an omnibus ES for group and SCD studies using a random effects model. The SCD studies produced a large, combined ES of 2.04 (SE = 0.28, CI [1.50, 2.58]) and the group studies produced a large, combined ES of 1.39 (SE = 0.36, CI [0.68, 2.09]). These ES are both considered large based on Cohen's (1988) recommended interpretations. The ES for Hughes et al. (2011) was a notable outlier (ES = 44.86, SE = 7.90), therefore a second overall ES estimate was conducted omitting this study. This produced an ES of 1.97 (SE = 0.26, CI [1.46, 2.47]). Because including this study did not meaningfully change the overall interpretation of the magnitude of the ES, we included this study for the remainder of the analyses. Overall, DPMI are effective in increasing social interactions between students with I/DDs and their peers across school settings. To answer research question 3, we grouped studies by the type of DPMI. In SCD studies, all types of DPMI produced large effects, however, peer network (ES = 2.25, SE= 0.52, CI [1.24, 3.27]) and peer support plans (ES = 2.31, SE = 0.23, CI, [1.86, 2.75]) produced notably larger effects than peer initiation and response interventions (ES = 1.51, SE = 0.41, CI [0.71, 2.31]). In group design studies, there was a notable difference between the ES of Asmus et al. (2017), a peer network intervention (ES = 1.39, SE = 0.36, CI [0.68, 2.09]), which is considered

	Group designs		Single case designs	
Category designation	Mean ES (SE)	95% CI	BC-SMD (SE)	95% CI
Overall ES	1.39 (0.36)[a]	[0.68, 2.09]	2.04 (0.28)	[1.50, 2.58]
Type of DPMI				
Peer Network	1.39 (0.36)[b]	[0.68, 2.09]	2.25 (0.52)	[1.24, 3.27]
Peer Support	0.42 (7.12)[c]	[-13.54, 14.38]	2.31 (0.23)	[1.86, 2.75]
Peer Initiation/Response	—	—	1.51 (0.41)	[0.71, 2.31]
Grade				
Middle	—	—	2.16 (0.41)	[1.37, 2.96]
High	1.39 (0.36)[a]	[0.68, 2.09]	1.99 (0.34)	[1.32, 2.65]
Intervention Grouping Size				
1 peer/SWD	—	[]	1.38 (0.32)	[0.76, 2.00]
2-5 peers/SWD	0.42 (7.12)[c]	[-13.54, 14.38]	2.19 (0.38)	[1.44, 2.94]
6+ peers/SWD	1.39 (0.36)[b]	[0.68, 2.09]	4.13 (1.45)	[1.29, 6.98]
Intervention Location				
Academic Classes	0.42 (7.12)[c]	[-13.54, 14.38]	2.14 (0.36)	[1.43, 2.85]
Non-academic	1.39 (0.36)[b]	[0.68, 2.09]	1.98 (0.42)	[1.16, 2.79]
Frequency of Intervention				
Daily	0.42 (7.12)[c]	[-13.54, 14.38]	2.15 (0.39)	[1.39, 2.91]
Multiple times/week	1.39 (0.36)[b]	[0.68, 2.09]	2.37 (0.45)	[1.49, 3.24]
Not Reported	—	—	0.56 (0.39)	[-0.20, 1.32]
Adult Facilitator				
Research Staff	—	—	2.05 (0.40)	[1.28, 2.83]
School Staff	1.39 (0.36)[a]	[0.68, 2.09]	2.07 (0.42)	[1.26, 2.89]
Peer Training Provider				
Research Staff	—	—	1.93 (0.29)	[1.36, 2.50]
School Staff	1.39 (0.36)[a]	[0.68, 2.09]	2.50 (0.77)	[1.00, 4.01]
On-going Peer Support				
Yes	1.39 (0.36)[a]	[0.68, 2.09]	2.86 (0.81)	[1.27, 4.44]
No	—	—	1.89 (0.29)	[1.33, 2.45]

Note. ES = effect size; SE = standard error; CI = confidence interval; BC-SMD = between case standardized mean difference; DPMI = direct peer-mediated intervention; SWD = students with disabilities.

[a] This represents two studies, Asmus et al., (2017) and Carter et al., (2016)
[b] This represents a single study (Asmus et al., 2017)
[c] This represents a single study (Carter et al., 2016)

Table 5. Effect Size Estimates

large and the ES of the peer support intervention in Carter et al. (2016) which produced a medium ES of 0.42 (SE = 7.12, CI [-13.54, 14.38]). Additional secondary analyses were conducted to explore further patterns within the studies. We first examined the effectives of DPMI grouped by grade. Within SCD studies, DPMI were similarly effective at both the middle (ES = 2.16, SE 0.41, CI [1.37, 2.96]) and high school levels (ES = 1.99, SE = 0.34, CI [1.32, 2.65]). There were no group design studies at the middle school level, but the studies at the high school level produced an ES of 1.39 (SE = 0.36, CI [0.68, 2.09]). When SCD studies were grouped by intervention group size, although all produced large effects, groups of 6 or more peers produced much larger effects (ES = 4.13, SE = 1.45, CI [1.29, 6.98]) compared to groups of two to five peers (ES = 2.19, SE = 0.38, CI [1.44, 2.94]) and dyads (ES = 1.38, SE = 0.32, CI [0.76, 2.00]). For group design studies, groups of two to five peers produced an ES of 0.42 (SE = 7.12, CI [-13.54, 14.38]) and groups of six or more peers produced an ES of 1.39 (SE = 0.36, CI [0.68, 2.09]). When SCD studies were combined by intervention location, DPMI had similar effects in academic classes (ES = 2.14, SE = 0.36, CI [1.43, 2.85]) and non-academic spaces (e.g., cafeteria, elective classes, etc., ES = 1.98, SE = 0.42, CI [1.16, 2.79]). In the group design studies, there was a notable difference between Carter et al. (2016) which produced a medium ES of 0.42 (SE = 7.12, CI [-13.54, 14.38]) in academic classes compared to Asmus et al. (2017) which produced a large ES of 1.39 (SE = 0.36, CI [0.68, 2.09]), in non-academic classes.

Next, we grouped studies by the frequency of the intervention. SCD studies where DPMI were implemented daily (ES = 2.15, SE = 0.39, CI [1.39, 2.91]) had similar effects to DPMI that were implemented several times per week, but not daily (ES = 2.37, SE = 0.45, CI [1.49, 3.24]). Notably, SCD studies that did not report the frequency of the intervention produced much smaller effects (ES = 0.56, SE = 0.39, CI [-0.20, 1.32]). In the group design studies, there was a

difference between Carter et al. (2016) which produced a medium ES of 0.42 (SE = 7.12, CI [-13.54, 14.38]) in daily implementation compared to Asmus et al. (2017) which produced a large ES of 1.39 (SE = 0.36, CI [0.68, 2.09]), and implemented peer networks several times a week. Within SCD studies, the adult facilitator of the DPMI produced similar effects for research staff (ES = 2.05, SE = 0.40, CI [1.28, 2.83]) and school staff (ES = 2.07, SE = 0.42, CI [1.26, 2.89]). All group design studies were implemented by school staff and produced an ES of 1.39 (SE = 0.36, CI [0.68, 2.09]). When grouped by the peer training providers, SCD were similarly effective for both researcher-provided (ES = 1.93, SE = 0.29, CI [1.36, 2.50]) and school staff-provided (ES = 2.50. SE = 0.77, CI [1.00, 4.01]). All peer training sessions in group design studies were implemented by school staff and produced an ES of 1.39 (SE = 0.36, CI [0.68, 2.09]). Finally, we analyzed study effects grouped by whether peers received on-going coaching and support by DPMI facilitators. While SCD studies produced large effects for both the presence and absence of on-going support, studies where peers received coaching produced a notably higher effect (ES = 2.86, SE = 0.81, CI [1.27, 4.44]) than studies where peers did not receive on-going coaching beyond initial training (ES = 1.89, SE = 0.29, CI [1.33, 2.45]). All group design studies included on-going peer support and produced an ES of 1.39 (SE = 0.36, CI [0.68, 2.09]).

Discussion

Social communication skills play a critical role in supporting social integration and community membership for students in secondary settings and aid students in accessing both the content of instruction as well as the classroom context. Yet many students with I/DD experience difficulty in developing these skills (Kasari et al., 2011; Locke et al., 2017; Wagner et al., 2004) and often operate on the fringes of classroom social networks (e.g., Chamberlain et al., 2007;

Kasari et al., 2011; Kemp & Carter, 2006; Symes & Humphrey, 2010). Establishing social communication skills through interventions in a meaningful and naturalistic manner that establish a natural community of practice remains a challenge for researchers and educators alike. Thus, the purpose of this review was to systematically analyze the effects of DPMI as defined by Odom (2019) on increasing social interactions for secondary students with I/DD and their peers.

We identified a total of 33 studies evaluating the efficacy of three types of DPMI (i.e., peer initiation and response interventions, peer support interventions, and peer network interventions) for secondary students with I/DD. Across these 33 studies, sufficient meta-analytic evidence exists suggesting DPMI are an effective intervention at increasing social interactions between students with I/DD and their peers at the secondary level. This finding makes an important contribution to the literature examining the efficacy of PMI and aligns with prior narrative literature reviews (e.g., Brock & Huber, 2017; Chang & Locke, 2016; Ezzamel & Bond, 2016; Hughes et al., 2012; Schaefer et al., 2016; Steinbrenner et al., 2020; Travers & Carter, 2021; Watkins et al., 2015). Here, we note several important insights from this finding and provide implications for researchers and practitioners.

First, there were notable demographic discrepancies in the study participants, as critiqued in broader literature examining evidence-based practices for students with I/DD, and autism in particular (e.g., West et al., 2016). Study participants were overwhelmingly White (n = 121; 58%) and male (n = 142; 69%). An additional 15 participants did not have racial demographics reported. Participants at the middle school level were noticeably absent and 86% of participants were at the high school level. Further, of the 207 total participants with I/DD across the included studies, 87 had a primary diagnosis of autism spectrum disorder and 80 had a primary diagnosis

of an intellectual disability with only 34 participants having a primary diagnosis of co-occurring ASD and ID, and 6 having a primary diagnosis of multiple disabilities or another developmental disability that was not ASD or ID. This implies that students with more complex support needs may not be fully represented in the literature examining the efficacy of DPMI on social communication skills.

Next, this review presents a need for increased transparency when discussing intervention details such as location, session frequency, and intervention session length. Most studies provided brief descriptions of intervention settings and several studies did not report critical intervention components such as the session length and the intervention frequency. This increased transparency is not only important for more robustly understanding the intervention but is also critical for replication efforts. Similarly, this review highlights a need for increased rigor in reporting methods for control and baseline conditions. Limited reporting made it challenging to determine what students in these conditions were receiving compared to intervention groups. This is important as many students with I/DD receive some form of social skills or communication support. Increased reporting of baseline and control conditions would help contextualize who was included in the intervention and how much support participants in the comparison conditions were receiving.

Additionally, large effects for group (ES = 1.39; SE = 0.36, CI [0.68, 2.09]) and SCD (ES = 2.04, SE = 028, CI [1.50, 2.58]) studies were observed suggesting that DPMI are effective at increasing social interactions in a wide array of school-based settings for secondary students with I/DD. Within SCD studies, peer network (ES = 2.25, SE = 0.52, CI [1.24, 3.27]) and peer support plans (ES = 2.31; SE = 0.23, CI [1.86, 2.75) produced similar effects, but peer initiation and response interventions produced a noticeably smaller effect (ES = 1.51, SE = 0.41, CI [0.71,

2.31) albeit still a large ES. Within group design studies, there were no peer initiation and response studies, but there was a marked difference between the ES of the peer network study (Asmus et al., 2017; ES = 1.39, SE = 0.36, CI [0.68, 2.09]) and the peer support study (Carter et al., 2016; ES = 0.42, SE = 7.12, CI [-13.54, 14.38]). This suggests that these three interventions are effective in increasing social interactions for students with I/DD and their peers, but there may be differential effects depending on the DPMI that is implemented.

Further, there was a noteworthy difference in group size and the effects of the DPMI on increasing social interactions. This is expected as larger groups would provide students with disabilities more opportunities to interact with more students. Interestingly, there were similar effects for SCD studies in both academic (ES = 2.14, SE = 0.36, CI [1.43, 2.85]) and non-academic (ES = 1.98, SE = 0.42, CI [1.16, 2.79]) spaces (e.g., cafeteria, elective classes), but there was a substantial difference between the group design study in an academic classroom (Carter et al., 2016; ES = 0.42, SE = 7.12, CI [-13.54, 14.38]) and the group design study in a non-academic space (Asmus et al., 2017; ES = 1.39, SE = 0.36, CI [0.68, 2.09]).

Importantly, there were similar effects for SCD studies that were researcher-facilitated (ES = 2.05; SE = 0.40, CI [1.28, 2.83]) and school staff-facilitated interventions (ES = 2.07, SE = 0.42, CI [1.26, 2.89]), indicating this is potentially an intervention that is scalable and has high fidelity of implementation and is socially and ecologically valid for teachers. Similarly, there were marginal differences between SCD studies that had researcher-provided peer training (ES = 1.93, SE = 0.29, CI [1.36, 2.50]) and school staff-provided peer training (ES = 2.50, SE = 0.77, CI [1.00, 4.01]). Finally, although large effects were produced for SCD studies that included on-going peer support and studies that did not, there is a marked difference between the effects of on-going peer support (ES = 2.86, SE = 0.81, CI [1.27, 4.44]) and an absence of on-going peer

support (ES = 1.89, SE = 0.29, CI [1.33, 2.45]). In the group design studies, peers were provided on-going support, and this was associated with a large effect size (ES = 1.39, SE = 0.36, CI [0.68, 2.09]. However, comparisons cannot be made as all group studies included on-going peer support.

Limitations

There are three primary limitations within the current systematic and meta-analytic review to consider. First, the vast majority of studies included in this meta-analytic review are SCD studies which are arguably weaker compared to group design studies. This limits our ability to draw more robust causal conclusions about the efficacy of DPMI in supporting the social communication and interactions skills of students with I/DD. Second, we focused on a subset of PMIs. Third, we only included studies that were conducted with secondary students with I/DD. Additional insights might be gained by expanding this focus in future reviews. Finally, studies included in this review overwhelmingly represent White, male students with I/DD.

Implications for Practice

This meta-analytic and systematic review has several implications for practice in school settings. All three types of DPMI that involve peer training and adult facilitation are effective practices for encouraging social interactions between students with I/DD and their peers. School professionals should consider incorporating these interventions into a broader plan for inclusion of students with I/DD. When implementing these practices, peer and focal student training should be explicit and systematic as it appears that systematic training and ongoing support to peers is essential for successful implementation of DPMI. (Bambara et al., 2018). Educators may also consider how DPMI may evolve and build off each other. For example, when supporting

initial development of social communication or conversational skills, teachers may consider beginning with a peer initiation and response intervention. But as both students with disabilities and their peers build skills, teachers may consider shifting towards peer networks or peer support arrangements to support the development of more authentic friendships.

When training components of these interventions are implemented by paraprofessionals or peers, teachers should work closely with paraprofessionals and students implementing DPMI to ensure fidelity of implementation and provide feedback. Further, teachers should be mindful to train and teach neurotypical peers about inclusion, embracing difference and diversity, and a wide range of communication styles and preferences. Supporting neurotypical peers' growth and capacity for meaningful social interactions is just as essential as supporting the growth and capacity of students with disabilities. This is important for equity as well as in helping students feel comfortable within the intervention. It is additionally important to align intervention strategies with targeted intervention goals as increasing peer conversation to encourage interaction is not enough; to produce change in specific conversation skills, DPMI must include explicit intervention strategies designed to elicit targeted outcomes (Bambara et al., 2016; Bambara et al., 2018; Thiemann & Goldstein, 2004).

Finally, educators should be careful to support self-determination and agency when including students with disabilities in these interventions with an eye towards equity. Including student choice in goal setting, training, and implementation of the intervention can help ensure that these interventions do not inadvertently create a sense of otherness or become misaligned with the valued outcomes of the student.

Directions for Future Research

This meta-analytic and systematic review highlighted several directions for future research. First, there were sizeable demographic discrepancies among participants. Studies in this review represent primarily White, male students with I/DD. It is essential that more representative samples are recruited for future studies. Second, only nine of the 33 studies included participants at the middle school level. More research is needed to examine the efficacy of DPMI with this age group as well as examine the social and ecological validity of these interventions with school staff. Third, only two of the included studies were group design studies. Additional consideration should be made in scaling up SCD studies to larger, fully powered group studies using rigorous research designs such as randomized control trials. Similarly, attention should be given to systematically replicating extant research on DPMI to contextualize the intervention's efficacy more fully.

Fifth, additional research is needed to examine the potential differential effects between different DPMI. This would further our understanding of what DPMI is best suited for different social and communication goals. Sixth, future research should consider how DPMI can be differentiated to meet the different goals of individual students and acknowledge the agency and self-determination of the participants. Further, few studies examined longitudinal generalization and maintenance outcomes. This affects our ability to discuss the degree to which these studies truly support the social communication and interaction skills of students with I/DD over time. Finally, it is unclear the extent to which these interventions build meaningful and reciprocal friendships. Future studies should include additional measures or methodologies to determine the extent to which friendships are developed.

CHAPTER IV

"Being Each Other's Keeper": Autistic Adolescents' Experiences of Peer Interactions During Learning

Abstract

Many autistic students at the secondary level experience difficulties with social aspects of the classroom, despite desiring and seeking friendships. Autistic students may experience particular difficulty with peer interactions in academic conversations which rely on social skills, discipline-specific communication and conversational skills, and academic talk. Importantly, academic conversations create opportunities for students to co-construct an understanding of academic content, expand content knowledge, and practice discipline-specific communication skills. The differences in social language and communication that autistic individuals have may lead to exacerbated difficulty in accessing learning opportunities through academic conversations and cooperative learning activities, ultimately decreasing students' learning time, integration within the classroom learning community, and the academic and social affordances of inclusion. I used hermeneutic phenomenological methods to explore autistic adolescents' lived experiences of peer interactions in academic contexts at the secondary level. Three themes were generated: (a) the role of the teacher, (b) navigating the interpersonal, and (c) relational trust.

Introduction

Students served in special education under autism spectrum disorder are increasingly included in general education settings. In 2018, 40% of these students were educated in general education settings for over 80% of their school day (NCES, 2021). Inclusion in general education is purported to provide these students access to grade level academic content and opportunities to develop socially with their peers (e.g., Carter et al., 2014; Carter & Draper, 2010; Ryndak et al., 2013). Indeed, "the social relations of schools are not just a mechanism for production but are a valued outcome in their own right" (Bryk & Schneider, 2002, p. 19). Opportunities to develop skills in social interactions and build relationships with peers is critical, as students who report positive relationships within their classroom community are more likely to be academically engaged and have higher levels of achievement (Estell & Perdue, 2013; Perdue et al., 2009; Wentzel, 2009). This is particularly salient for students at the secondary level where peer interactions play an increasingly important role in classroom expectations for academic engagement and classroom participation (e.g., Lynch et al., 2013).

Yet, many autistic students at the secondary level experience difficulties with social aspects of the classroom, potentially minimizing the academic and social benefits of inclusion. Autistic individuals differ in their social development leading to difficulties in reciprocating or initiating social interactions, perseveration on high-interest topics, and challenges in interpreting figurative language. These developmental differences have implications for autistic individuals' social awareness, frequency of peer interactions, and overall communication patterns (e.g., Kasari et al., 2011; Locke et al., 2017; Wagner et al., 2004). For many autistic students, these challenges result in fewer friendships, elevated rates of loneliness, and less social integration in their learning community (e.g., Chamberlain et al., 2007; Kasari et al., 2011; Kemp & Carter,

2006; Symes & Humphrey, 2010). Indeed, many researchers have found autistic students have smaller social networks, interact less frequently compared to their peers, and are less integrated within their classroom community, even when physically included (e.g., Chamberlain et al., 2007; Kasari et al., 2011; Kemp & Carter, 2006; Locke et al., 2010).

Peer-Mediated Interventions

To address concerns regarding autistic students' inclusion in social groups and the classroom community, researchers and educators have often utilized direct peer-mediated interventions (DPMI; Travers & Carter, 2021; Wilson et al., in progress). DPMI are a set of evidence-based practices that have demonstrated efficacy in supporting autistic students' development of social and communication behaviors (Steinbrenner et al., 2020) and researchers have especially encouraged the use of DPMIs at the secondary level (Carter, 2018; Travers & Carter, 2021). Typically, DPMI involve adult facilitators supporting neurotypical peers in modeling or prompting interactions, or implementing intervention plans (Odom & Strain, 1984). There are three types of DPMI that are particularly efficacious in supporting the development of social relationships, peer interactions, and communication skills: (a) peer initiation and response interventions, (b) peer-mediated social networks, and (c) peer support plans (Odom, 2019). Although DPMI have demonstrated efficacy in improving social interactions and peer relationships for autistic students, these interventions have been primarily implemented during non-academic portions of the school day (Travers & Carter, 2021; Wilson et al., in progress). Yet, the communal nature of the classroom necessitates peer interactions within academic learning time, such as in cooperative learning structures. Even peer support plans, which involve peers providing social, academic, and behavioral supports to their classmates with disabilities, still often focus on social and academic supports separately. A critical missing component of

these interventions is the integration of social communication skills within academic learning time. In research and practice more broadly, social skills are often taught in isolation and not in relation discipline-specific communication and conversational skills.

Academic Conversations

Attention to the development of discipline-specific communication and conversational skills for autistic students is warranted because communication and collaboration are essential skills in the workforce today (Partnership for 21st Century Learning, 2016). In the classroom, many national content standards such as the Common Core State Standards (CCSS; Council of Chief State School Officers, 2010) and the Next Generation Science Standards (NGSS; NGSS Lead States, 2013) reflect this by including rigorous standalone and embedded speaking and listening standards. These standards necessitate peer interactions and developing skills in academic talk that aid in learning and knowledge construction (Bandura, 1977; O'Connor & Snow, 2018; Nystrand, 2006; Spies, 2016; Spies & Xu, 2018; Vygotsky, 1978; Zweers et al., 2019). Proficiency in academic talk, or the language used in teaching and learning, is critical as it allows students to work collaboratively and develop an understanding of content and communicate their knowledge and ideas (van Kleeck, 2014). Academic oral language proficiency has been associated with academic success (van Kleeck, 2014).

Autistic students may experience particular difficulty with peer interactions in academic conversations which rely on social skills, discipline-specific communication and conversational skills, and academic talk (Spies & Xu, 2018). Academic conversations are "sustained, intentional, back-and-forth exchanges about academic topics" (Spies & Xu, 2018, p. 23; Zwiers & Crawford, 2011) that "allow students to closely examine, scrutinize, critique, validate, and share the ideas being discussed" (Zwiers & Crawford, 2011, p. 15). Academic conversations

create opportunities for students to co-construct an understanding of academic content, expand content knowledge, and practice discipline-specific communication skills, leading to improved academic and linguistic outcomes (e.g., van Kleeck, 2014; Zwiers & Crawford, 2011). The differences in social language and communication that autistic individuals have may lead to exacerbated difficulty in accessing learning opportunities through academic conversations and cooperative learning activities. This ultimately may decrease students' learning time and integration within the classroom learning community. Understanding how autistic students experience social interactions during academic learning is important in order to support these students more robustly in fully accessing the classroom environment.

Purpose

Extant research on autistic students' peer interactions in classrooms has predominantly been conducted through observations, social networks analysis, and interviews with peers, teachers, and caregivers (e.g., Chung, et al., 2012; Freeman et al., 2015; Hestenes & Carroll, 2000; Locke et al., 2010; Odom et al., 2006; Taheri et al., 2016). Further, extant research has almost exclusively focused on peer interactions in non-academic settings where friendship has been the construct of interest. This limits our understanding of how autistic students perceive peer interactions during academic learning, and if they experience these interactions in the learning environment in the same way as discussed in current literature (e.g., Østvik et al., 2017). Because little work has been done in this area, it is important to first explore the lived experiences of autistic students. Further research is warranted as the lack of peer interactions may indicate a decrease in students' integration within the classroom learning community as well as their instructional time. Thus, the academic and social affordances of peer interactions and inclusion in schools may not be fully realized for autistic students. Ultimately, there is a need to

understand the experiences of autistic students in classroom peer interactions so we can appropriately develop supportive interventions that are grounded in the perspectives of the students we are trying to support (Pellicano et al., 2018) as well as grounded in a theoretical understanding of the role of conversations and dialogue in learning. Therefore, the purpose of this study was to explore the meaning autistic adolescents ascribe to the experience of peer interactions in academic settings during learning.

Interpretive Framework

This study is situated in social constructivism with a critical disability interpretive lens (Creswell & Poth, 2018). Social constructivist scholars seek to interpret the subjective meanings of experiences as they are negotiated through interactions and social and historical contexts (Creswell & Poth, 2018; Crotty, 1998; Lincoln & Guba, 2000). A critical disability interpretive lens (Creswell, 2009; Creswell & Poth, 2018; Mertens, 2003; 2009; 2019) is also appropriate as it positions disability as a dimension of human diversity and adds disability-specific context to social constructivist interpretations. Further, a critical disability lens assumes the meaning of disability is socially constructed and is grounded in societal and historical interpretations and understandings of disability. This framework and lens are well aligned with my epistemological orientation and the philosophical underpinnings of phenomenology and phenomenological interviewing (Creswell & Poth, 2018, Denzin & Lincoln, 2017; Mertens, 2019).

Social constructivism with a critical disability lens informed this study in several ways. First, they informed the development and positioning of the research question within broader extant literature. This study aimed to explore the social nature of learning as well as how roles and meanings in social interactions are constructed for autistic adolescents. Second, language plays a fundamental role in hermeneutic phenomenology as language is socially constructed

(Aldiabat & Le Navenec, 2001), and is how individuals communicate the meaning they attribute to objects (van Manen, 2016). Third, a social constructivist with a critical disability interpretive lens informed the way we communicated with the participants during the data collection process and how the data is reported. These were done in a way that is cognizant of the social and communication support needs of autistic individuals, the power differential between participant and researcher, and historical dialogue surrounding disability and social interactions for autistic individuals.

Method

We used hermeneutic phenomenology to conduct this study because it provides systematic structures to "uncover lived experiences" (van & Manen, 1990, p. 10) or "the world as we immediately experience it pre-reflectively rather than as we conceptualize, categorize, or reflect on it" (van Manen, 2016, p. 9). In other words, phenomenologists examine the meaning people attribute to their interactions with a phenomenon (Crotty, 1998). Scholars engaged in phenomenological research seek to explicate the essence of phenomena (Husserl, 1970) which is to "grasp the very nature of the thing" (van Manen, 1990, p. 193). In this, phenomenological researchers balance idiographic descriptions of people's lived experiences while generating opportunities for others to connect with the final narrative text (Emery & Anderman, 2020). Ultimately, phenomenology aims to uncover insights into our everyday, shared experiences (van Manen, 2016). Hermeneutic phenomenology is interpretive, rather than descriptive such as in existential and transcendental phenomenology. In it, researchers work in tandem with participants to explore how a person makes meaning of a phenomenon to cultivate deep understandings of it. The emphasis is on interpreting the meaning of their lived experience (van Manen, 1990, 2016). Hermeneutic phenomenology is particularly appropriate for examining

phenomena that are collectively shared, yet uniquely experienced (van Manen, 2016). Friendship, social interactions, and feelings of belonging are inherently outward facing, but personally felt, and universally desired.

Researcher Subjectivity

In hermeneutic phenomenology, understanding the researcher's lived experiences and subjectivity are particularly important as researchers and participants work together to co-construct the meaning of the phenomenon (Dibley et al., 2020). The first author identifies as a White female who has worked with autistic students and their families for over 10 years. Like the participants of this study, the first author has a disability (i.e., dysgraphia, a writing-based form of dyslexia) and identifies as neurodiverse. She has faced many of the same social exclusions and barriers to success based on disability stereotypes that the participants may have experienced. The first author often felt excluded from group and social-based learning opportunities, not due to academic knowledge, but due to social ramifications of disability. These experiences informed her practice as a special education teacher and as a researcher and they supported building rapport with participants as well as in exploring nuances of the focal phenomenon.

The second author identifies as a white, non-disabled male who has worked with autistic students for almost 10 years. As a former special education teacher, the second author is aware of many challenges that secondary students with autism face in educational contexts, but he acknowledges that he lacks an understanding of their lived experiences.

Together, we believe social skill instruction is important for both students with and without disabilities, and that many teachers require additional supports and resources to effectively address social skills, especially at the secondary level. We also believes that autistic

students should have more opportunities to interact with peers and develop meaningful and reciprocal friendships. Our scholarship is motivated by our past experiences working with autistic students in the classroom.

Participants and Recruitment

We used purposeful, maximum variation sampling (Onwuegbuzie & Collins, 2007; Patton, 1990) to recruit participants until we reached data saturation. The first author screened interested potential participants for the following criteria: (1) having a primary diagnosis of autism (per caregiver report), (2) not having a co-occurring intellectual disability, (3) being ages 14-22, and (4) included in general education content classrooms for at least 40% of the school day. Next, of the potential participants meeting full eligibility criteria, we purposefully selected maximum variation in gender until data saturation was reached. Participants were recruited from the Washington, D.C. metro area through local avenues such as online parent groups, advocacy organizations, service organizations, interest-based clubs, local libraries, mental healthcare providers, and social media.

Data Collection and Analysis

Hermeneutic phenomenology involves the dynamic interplay between four concurrent data collection and analysis activities (a) turning to the nature of lived experience, (b) investigating experience as we live it, (c) reflecting on essential themes, and (d) the art of writing and rewriting (Lauterbach, 2018; van Manen, 2016). In this process, the researcher and participants collaborate to explore and develop their understanding of the phenomenon through the empirical investigation and the writing process (Lauterbach, 2018). The four concurrent research activities are elaborated upon in the following sections.

The Nature of Lived Experiences

The first research activity is turning to the nature of the lived experience (van Manen, 1990; 2016). There are two purposes of this: (a) developing a pertinent research question and (b) identifying and recording the authors' prior perceptions and experiences of a phenomenon. To develop a pertinent research question, I (the first author) explored relevant literature and consulted an autistic adult who was not a study participant. I also informally consulted with two researchers who examine social interactions of individuals with I/DD. The literature review and consultations indicates the research question was appropriate, timely, and meaningful for autistic adolescents, educators, and researchers.

The second purpose intends to reduce researcher bias through epoché (van Manen, 1990; 2016). Although hermeneutic phenomenologists assume that their prior experiences and understandings cannot be fully set aside or bracketed as the researcher is the main analytic tool, engaging in epoché supported our efforts to privilege the experiences of participants over our own (Wertz et al., 2011). This process involved explicating our own assumptions and pre-understandings of the phenomenon of interest by proactively and continuously setting aside theories, hypotheses, measuring instruments, and prior research (van Manen, 2016; Wertz et al., 2011). To engage in epoché for the purpose of this study, I (the first author) kept a reflective journal during all data collection and analytic stages. During the interviews, I recorded my own thoughts about the phenomenon that are tied to the experiences participants shared. Before analyzing the data, I reviewed and bracketed my prior experiences, knowledge, and perceptions of the phenomenon through reflective journaling and discussions with the second author. This supported our efforts to set aside our own interpretations of the participants' experiences and instead privilege their interpretations.

Investigating Experience as We Live it

This second research activity is investigating experience as we live it (van Manen, 1984; 2016). Here, the researcher explores a phenomenon by drawing on personal and participant experiences through interviewing (van Manen, 1990). In hermeneutic phenomenological interviewing, researchers aim to develop a deep understanding of the phenomenon through a co-constructed conversation with participants of the experience's meaning (van Manen, 2016). This conversational interviewing differs from other forms of phenomenological interviewing in that it is semi-structured and both researcher and participant contribute as active collaborators (Lauterbach, 2018; van Manen, 2016). Participant memories and reflections are used in semi-structured interviews to support participants in revisiting their experiences (Crotty, 1998).

For each participant, I (the first author) sent rapport-building emails prior to beginning data collection. These rapport-building emails were back-and-forth exchanges that allowed for more natural conversation to occur during the interviews. I used my experiences as a student with a learning disability and special educator to build rapport. I then conducted two interviews over a video-conferencing platform with each participant. Two interviews with each participant was deemed sufficient due to recurring themes that supported data saturation. Interviews lasted between twenty and forty minutes. The purpose of the first interview was to explore the participants' pre-reflective understandings of social interactions within academic learning opportunities (e.g., lab activities, cooperative learning groups, class-wide discussions). This interview included questions about how participants experience social interactions, friendship, and social interventions. I used individualized follow-up questions and prompts based on participant responses. The second semi-structured interview included questions related to the same topics that arose from readings of the first interview. I, the first author, wrote reflective

field notes after each interview, reflecting on emerging constructs and themes. All interviews were recorded and transcribed verbatim. In addition to the two interviews, participants were also asked to reflect on their experiences via written narratives to elicit additional reflections that might occur after the interviews. This gathering of interview transcripts, narratives, and field notes provides multiple sources of textual data and supported a 'multi-level text' (Cohen et al., 2000).

After concluding the interviews, we consulted phenomenological literature to reorient myself to how phenomenological philosophers describe experience. We consulted Merleau-Ponty (1948; 1962), Gadamer (1960; 2003), Heidegger (1927; 1962), and van Manen (1990; 2016). As we grounded this study in a social constructivist interpretative framework with a disability theoretical lens, we also consulted relevant literature examining the lived social experiences of individuals with autism. Finally, we examined literature on relational trust in school social interactions (Bryk & Schneider, 2002) as trust was a consistent construct participants described in their interviews.

Reflecting on Essential Themes

The third research activity is reflecting on essential themes through reduction and thematic analysis (van Manen, 1984; 2016). We used van Manen's (1984; 2016) and Dibley and colleagues' (2020) approaches to reduction and thematic analysis to analyze the transcribed interviews, narrative reflections, and field notes. Phenomenological reduction is an iterative coding process in which researchers aim to understand the essential components of participants' experiences (van Manen, 1990; 2016). In this process, the authors conducted a line-by-line analysis of each transcript to develop inductive codes. We discussed individual codes in consensus-building data meetings and refined the inductive codes. Next, we identified prevalent

themes in the participants' experiences. We then selected the themes that related to the research question and grouped the inductive codes by theme. For example, inductive codes of "mutual support", "compatibility", "vulnerability", and "reciprocity" were all grouped into the larger theme of "relational trust". We subsequently identified statements corresponding to these themes from the transcripts. Then, we reordered and combined the statements to form a linguistic transformation of how each individual participant conceptualized peer interactions in academic settings during learning.

Hermeneutic Phenomenological Writing

The final research activity is hermeneutic phenomenological writing (van Manen, 1984; 2016). This data analytic stage is an iterative process of reading, reflective writing, and interpretation (Gadamer, 1989; van Manen, 1990; 2016). We first read the linguistic transformations as well as the original interview transcripts. Based on this reading, we chose exemplary quotes that most accurately reflected the experiences of the participants. We then connected participant's words to our interpretation of their words, thereby creating an interpretive summary of the adolescents' lived experiences. This writing process was used to reflect carefully on the data (van Manen, 1990). We further used reflective journaling and consensus-building data meetings to support brainstorming, writing, and revising interpretations of the data (Heidegger, 1927; 1962). Finally, we collaborated with participants and a peer debriefer, an autistic adult, to receive feedback on the draft of the interpretation and revise based on feedback.

Rigor, Credibility, and Trustworthiness

We used several measures to increase the rigor, credibility, and trustworthiness of this study (Brantlinger et al., 2005; Trainor & Graue, 2014). First, prior to data analysis, we wrote

reflexivity statements. Next, we engaged in epoché to the extent that is appropriate for hermeneutic phenomenology. Reflective journaling and memo writing were also used during the data analysis process as an on-going effort. Epoché was particularly important during this study given historical discourse regarding social interactions and autistic individuals. Third, data collection involved multiple, extensive interviews designed to access deeper perspectives of the participants (Lauterbach, 2018). Fourth, we adopted open science practices (Cook et al., 2021) throughout the course of the study to enhance the transparency of the study process. We preregistered the study (Author, blinded) and made data and analytic materials as well as the full audit trail open on an Open Science Framework (OSF) site. Further, we used analyst triangulation (i.e., multiple coders) to address potential biases related to having the principal investigator as the sole interviewer (Patton, 2002). Finally, we used a peer debriefer and member checking during the writing process to enhance the trustworthiness of data collection and analytic stages (van Manen, 1990). These measures were aligned epistemologically with my methodology (Dibley et al., 2020; van Manen, 2016), a component of study rigor (Trainor & Graue, 2014).

Findings

Through data analysis, we developed interpretive summaries detailing participants' experiences of peer interactions during academic learning. Three themes were generated: (a) the role of the teacher, (b) navigating the interpersonal, and (c) relational trust. In the following sections, we first provide descriptions of each adolescent at the time of the study based on self-report. Then, we describe each participant's lived experience of peer interactions during academic conversations such as in small group learning structures. The lived experiences of

participants are presented thematically, to highlight the similarities and differences in participants' experiences.

Ana

Ana was an 18-year-old, English-speaking, African American woman in the 12th grade at the time of this study. She identifies as an autistic person and chooses to disclose her diagnosis to others. She reports that she receives mental health and emotional support in school. Ana describes working with her peers as aiding in her understanding of classroom instruction.

The Role of the Teacher

Ana frequently discussed the role of the teacher in supporting peer interactions during learning, especially in small group time. Her teacher provides structure to the groups, monitors what is happening, and assigns a group leader. For example, Ana shared, "Whenever we're in group work, she will want a lot of accountability from the group leader, so you don't want to be on the wrong side being reported negative". It seems that the structure of the group work (e.g., assigning roles or group leaders) led to increased accountability with the teacher but also accountability between peers. Group structure is an important consideration for teachers as they ensure that groups not only complete the required task, but they learn to navigate social situations together and learn to care and be accountable for one another. The teacher also directly supports Ana by:

> At times she notices that I have also some challenges, so she'll be there, like monitoring everything. I think she understands that also people are different…And she has her own way of getting to know if I understood something.

When Ana has been mistreated in groups in the past, the teacher intervened and responded positively. Ana learned that she could count on the teacher to stand up for her. Ana shared:

> I remember one time there was this case that I reported that I was getting mistreated by some group mates. And the teacher had to like call all the parents of the other students. Like I kind of felt like she responded positively because I was the one suffering. At least I knew that there's justice. People should not feel like they're entitled to better treatment than others. And whatever they choose to do, know that they have consequences.

While Ana has not directly worked with her teacher on making friends and interacting with her peers, Ana described numerous ways the teacher supported the social ecology of the classroom by monitoring students, holding students accountable, and making sure that students treated each other fairly. Yet, in addition to the support the teacher provides, it seems that students must also desire to improve relationships and make friends if improvement is to occur. As Ana said, it was ultimately up to her to trust her peers and be positive about working with them. She described this as being "it's up to me, it's my own initiative."

Navigating the Interpersonal

Ana consistently reflected on the changes she has had to make herself to navigate interpersonal aspects of working with her peers. This has been a process that has occurred over time and through personal growth in learning to embrace differences in her peers, and in herself. She stated:

> Initially, when I would go into group work, I really found it very hard to be in groups. Because I kind of thought it would overwhelm me. Now, with time… all those techniques for groupwork work very often. And I had to adjust which took a long time.

Ana self-advocated to her teacher in helping her navigate interpersonal relationships with her peers in class. She recognized that even teachers have limits in their ability to support her growth and that she would need to rely on peers, especially for social and emotional support. Ana

eventually “made friends out of these groups.” She describes the process of personally recognizing that groupwork would be a part of her educational experience as “it kind of felt like this was going to happen for a long time so like, I had to like, if you can’t beat them, then you have to join them, so that's what I did.” Ana feels that she adapted to navigate interpersonal relationships, rather than a perception that her peers also changed.

Over time and with repeated opportunities to interact, Ana has learned to see value in working with her peers. Now, “It doesn't feel overwhelming, it feels like the best thing. Like other students are the second teachers in my class.” Interactions also allowed Ana to recognize commonalities and shared experiences with her peers. Instead of feeling different, Ana began to recognize similarities and feel like she belonged with her peers and could be one of them. She described this realization as:

> Even other students are coming to me with some problems so it's not me alone. Like, I’m not having like unique problems, the problems that we share around that cut across everyone only that it will be at different times.

Ana understands the reciprocal nature of relationships and interactions with her peers. She realized the nature of helping relationships and that she was expected to also support her friends and classmates as they were supporting her. They were accountable to each other and able to support each other in the areas they needed help in. For Ana, this was important as she tends to “lose concentration very easily; I drift away quite easily…at times, I might end up forgetting some things. So, the ease of group work is that we keep on reminding each other from time to time. She feels that:

> it takes a lot of time for a person to adjust, the person who's not used to group work. But it's really amazing to get to appreciate other people. And doing what you would want to be done to you, you know, and supporting each other.

Ana demonstrated grit and a growth mindset when dealing with social situations at school. She "realized that every experience is a learning experience only that, in the initial stages, it will not really feel like things are working out but later on, they will actually work out." She allowed herself the time it took to learn how to work with her peers while also being "positive about it" and recognizing that "everything is solvable". Navigating interpersonal relationships with her peers has opened the possibility of deeper relationships with the peers she works with. She realized that the more "frequent we were put in groups, the more I got to adjust and the more I realized actually I need friends." Through the process of these interpersonal interactions, Ana shared that "It's amazing. I feel like my social life has really improved, and many people are really trying to get friendly with me". Through navigating interpersonal interactions with her peers during learning, Ana has made friends out of her groupmates and peers.

Relational Trust

For Ana, developing relational trust was the result of opportunities to interact with her peers in group work and recognizing the value of peers in a small-group context. It seems that navigating these complex social situations together, in small groups, was a precursor to trust and eventual friendship. Once trust had been established, Ana benefitted academically, socially, and emotionally and stated that she was more comfortable, confident, able to ask questions, and better concentrate in academic settings. For Ana, trust in her groupmates is reciprocal, and is "having people believe in you and giving them your secrets, and helping them, and helping you when you need to be helped."

Because of this trust, group work and peer interactions have shifted from overwhelming to fun and appreciated. Ana attributes this to "because I've developed trust from them. I've learned that its easier when you are working as a group. And every problem that I have has gotten solved like almost every problem in the group work sessions." Trust also developed because of repeated interactions and opportunities to engage with her peers during learning: "Over and over again, you are put in groups, so it wasn't changing. We used to meet very often, so it was, it was just because of the situation". Solving problems together and being able to rely on one another were integral to the trust that Ana feels has been built between herself and her classmates when interacting together during learning. She has not only navigated academic problems with her peers, but also emotional problems. The support she has received for navigating emotional problems has helped shift the nature of her relationship with her peers:

> In terms of emotional problems is, at times I will be in a period of, of a lot of sadness, a lot of anger. And then, when I feel like I have people to talk to like it acts as a distraction, a distraction point to me. So, I would like to have someone around to be there for me, by talking to me…. Mostly they like being there for me in terms of class work, and also in terms of general friendship.

Trust between her and her peers has also influenced how Ana learns when working with her peers during academic time. In becoming comfortable with her peers, Ana felt empowered to ask questions, receive help, and build relationships:

> By being with friends around, they kind of make me feel very comfortable around them, especially when in group work and so that boosts even my concentration and…working in groups, like groups where I have friends…I feel like I'm able to ask questions, I'm able

> to interact with other students who are not yet my friends and get some make friends from that and also able to increase my social skills.

Overall, developing trust and relationships with her peers have been instrumental in helping Ana feel engaged in class and receiving support and help in school. Ana finds working with her peers and peer interactions as "something that helps in everything like in understanding, in increasing concentration, and increasing like friendship, if you want that."

Norah

Norah was a 21-year-old, English-speaking, Black woman in the 12th grade at the time of this study. She identifies as an autistic person and chooses to disclose her diagnosis to select people. She identifies supports in school as helping her build self-esteem while living with autism. Norah reports that she tries her best to socialize and sees friendship and peer interactions as a means to reduce stress.

The Role of the Teacher

Norah highlighted the role of the teacher in making peer interactions during learning successful for her and her peers. Her teacher monitors the group discussions and makes sure each student gets to share. Additionally, her teacher works as an advocate for Norah, helping provide space for her to perform her best and participate with her peers. For Norah:

> Teachers ask you to share out your ideas and possibly whatever you're discussing with the group discussion. And it just makes it fair, they make sure that each and every person able to present within their group, so in that in that way I'm able to present social communication well…if you are not given an opportunity, they will see that everyone have already presented, so why should I not present my ideas on to that group.

However, Norah does wish that her teachers helped her self-advocate more when working with her peers. She wished teachers could "be in a position to address and give out information about autism" so that her peers understood her more fully. Ultimately, her teacher helps create a classroom environment and climate that feels fair where students trust that it is safe to share with each other. They give students "a comfortable platform where you can share your ideas out."

Navigating the Interpersonal

Norah has experienced both positive and negative aspects of navigating interpersonal relationships with her peers while collaborating with them during learning. Similar to several other participants, Norah attributed many of her difficulties in navigating interpersonal relationships to her autism. Interestingly, she explains that these challenges stem from both her fear of being judged because she is autistic, as well as her challenges with social communication. Norah described this as:

> I can say it's never been easy, because, as a person living with autism there is so many difficulties when you're doing the communication, and also the social interaction with other people, so you will realize that during social interaction, you're not feeling comfortable interacting because not everyone will like the way you are, or like our motives and person. And you'll realize, not everyone is happy about your state and having the state of autism it's not easy, because we also get to lack that social communication skills.

Although communication and social skills impact Norah's ability to navigate interpersonal relationships, it seems that peer acceptance is a necessary precursor to interacting comfortably and effectively with her peers. Not only is Norah keenly aware of how her peers perceive her, but she also has the self-awareness to recognize how her disability impacts her ability to

communicate with her peers. Norah views herself as “lacking in those social interaction skills and maybe you're not able to communicate so well with other people. So, it makes it so hard to be able to explain yourself and also express what your emotions are.” This influences how Norah is able to communicate the academic and affective aspects of working with her peers during learning.

Norah consistently expressed a desire for her peers to understand her and embrace her differences when collaborating with them. She wants her peers to give her an opportunity to show her strengths and who she is as a person. Although it may seem like Norah does not desire to interact with peers because of her social challenges and anxiety, Norah wishes “they could know that I really love interacting with people so much, I wish they could know that I really love showing off, like giving out the best to the community.” However, the social communication difficulties Norah experiences often leads to fear and anxiety about being misunderstood when working with peers she does not know or does not trust. Further, she feels uncomfortable at times interacting because she knows not everyone will like who she is and understand her motives. Norah described being anxious about being judged and the impact that anxiety has on her participation in class as:

> It is so hard, because sometimes you had something in mind that you wanted to share, but because there is that fear inside you, you're not in a position to share it out and like it gets so difficult so maybe you are emotional and maybe you can’t share anything with them. And then you fear being judged, because these people are strangers to you, so you don't know what your outcome is, how you talked, how they will react to that, so you fear being judged…. what I fear most is like what are they thinking about what I’m talking about, what will be their reaction be about what I just spoke about? The ideas that I

> shared will they take it, will they take it positively, or will it be a negative impact on to them? So, it usually worries me so much not knowing what feedback they have on their mind.

For Norah, it seems that most of her social anxiety stems from worrying if peers who are unfamiliar with her communication style and disability will accept her as an individual and respond positively to what she says. This sometimes leads her to not participate fully academically and benefit from peer interactions during learning. Furthermore, not being able to personally participate can lead to classroom discussions to be boring and sources of stress and fear. For example, Norah reported her difficulties in social communication as making:

> The group discussion so boring because you can only maybe listen to what other people are saying and you cannot participate personally, so it makes so much, a person to have so much stress, because you don't want to say something that maybe would offend the other people or you, your fear to express yourself because you don't have that confidence.

Norah's fear of being judged by her peers and the worry that they will not embrace her differences reduces her engagement in class and leads to not feeling confident. However, Norah believes that embracing difference is not enough, peers should also become educated about individuals with disabilities in order to better understand and accept them as individuals. She thinks her peers "should be educated, you know it that they treat every person with autism or any other disability. The peers should know that every other person is a human being. A human being, who is supposed to be understood."

However, Norah has also experienced positive interpersonal relationships with her peers when she feels they are open to her and her differences. When other students "can be in a position to support the social interaction and have positive peer relationships among the

people…It makes it so much easier for them to be able to interact with each other." For Norah, navigating interpersonal relationships with her peers involves opportunities to interact and develop relationships, her own social communication skills set, and the willingness of her peers to interact positively with her. Although navigating interpersonal relationships is challenging when peers are unfamiliar, given time and opportunities, Norah becomes more confident and trusting in these situations. She feels "confident when there is a group of people who are used to me, like friends that we hang out so much, I feel confident with them." For Norah, her friends support her as allies and serve as a bridge to interacting with unfamiliar students. Her friends "try as much as possible to make that interaction possible." She said during discussions, "they try to elaborate on what I was trying to explain on to the other people" and that it "becomes easier when you have someone who is standing by your side and is able to take everything that you are going through personally and be able to explain it and is understanding you every day." There is a sense of advocacy among Norah and her friends when working together in class. If someone does not understand her, her friends step in and help clarify to other peers. She said, "they stick up for you and help other people understand you". Her friends help other peers understand who Norah is as an individual.

Relational Trust

Importantly, Norah has also learned to embrace her own differences by watching how other peers have been accepted in her classroom community. This has changed how Norah interacts with her peers during learning as well as changed how Norah views her own agency. She describes this process as:

> Not something that you're taught, it's just something that you are supposed to observe because at times, you might see that if other people can stand up and be confident, now

> you ask yourself like such a question like, “why should they not do this?” It is very important if you have the courage and if you're willing, you'll be in a position to be able to practice. And when you practice it makes things perfect.

Seeing her peers accept each other when sharing and interacting has helped Norah trust that she would also be accepted, and her differences would be embraced. She said:

> When you see your peers are also standing up, and maybe sharing their views on something, you will get the confidence because you're given the morale. They show you like a way like you're supposed to stand up and be confident. So, when they show you by example, you are also in a position to be able to express the same to them.

This has supported Norah in feeling that working with her friends in class, or people she has a relationship with, to be much more successful. There is a sense of trust between her and her friends who stand with her and who have embraced her differences. This has led Norah to feel more comfortable and confident in working with her peers, which has been important for Norah academically and socially. Norah has found that working with her peers has helped her by putting her:

> In a position to be able to broaden and also make your skills so much better, and you also gain that confidence and when you have the confidence to be able to present when it comes to things like education.

Because Norah and her peers were given opportunities to understand and embrace each other, trust was established. Once trust was established in the group, Norah was more confident and comfortable in her learning, reciprocal supports were implemented between Norah and her peers, and her academic and social abilities were broadened. Although interacting with her peers can sometimes be difficult for her, Norah views it as:

> A good thing, because when you try to interact with your peers, you have the opportunity to express yourself and to interact for sharing. So, it gives you that courage to be able to talk and also have the development of getting that confidence.

This has led Norah to value the reciprocal nature of shared trust in interpersonal relationships with her peers as a good thing where differences are embraced because:

> You are going to be in a position to share my experiences with them. They also share their experiences with you, and you will be in a position to learn more from each person because it is believed that every person has their own perspective of what's right, and when you interact with people you get to know about their life…and with that you're going to be in a position where you're going to be comfortable with each other.

Melissa

Melissa was an 18-year-old, English-speaking. Black woman in the 12th grade at the time of this study. She identifies as a person with autism and chooses to disclose her diagnosis to others. She reports receiving counseling, academic, and relationship supports in school.

The Role of the Teacher

Melissa's teacher acted in a regulatory role when students worked together during learning. Melissa shared that her teacher "mostly advocates for small groups and that's something I really like because she knows, once the groups are bigger it gets it gets out of control, even for her." This is important for Melissa as she prefers to work with a few of her peers during learning, rather than work with a larger group. In knowing Melissa's needs, her teacher has helped her be more successful in the classroom. Melissa reflected on this saying:

> Personally, for me, I feel like when I was working in a small group, it was more productive, and goal oriented as compared to when I was working in a bigger group. For

> me, I have phobia of many people, I fear crowds, I don't like being so much exposed and that's just me and I get anxiety like a lot of anxiety from just anything.

Her teacher also helps students navigate interpersonal and academic differences. She is "there to like guide us in terms of whether we are having problems. And, for example, it's a groupwork presentation, she'll be part of it, making sure she'll be encouraging us to like work on certain strengths." For Melissa, the structure of the group work and teacher accountability improved her learning experience and allowed her to create connections with her peers and navigate the challenges of the classroom. Melissa further described the teacher's role in how students navigated interpersonal aspects of working collaboratively saying:

> The motivation from teachers is very important, of which at times it's not all that pronounced. Like it should be in the curriculum, like there should be a teacher's role in playing, for like, a role played by the teacher to ensure that the peer-to-peer support works.

Melissa would like, however, more opportunities to consult with the teacher, provide feedback on how the peer work is functioning, and receive additional support. This way, her teacher could "be up to date with what am I thinking, are there any challenges, are there any fights in the group because there could be." She further wishes her teachers would dedicate more time to building relationships with students and set aside time to "catch up with students so that students don't feel like its only classwork" and "they should know each other, like every student more like deeper". Melissa views this as important as, in her perspective, the teacher wants students to be there to "be each other's keeper" and be "there to help each other…mainly for her its academic-wise, but she also wants people to have a good relationship, she doesn't want people to get into arguments every time". Her teacher "also puts us in different groups at different times, just for

the sake of getting that friendship grew in the class". The teacher further holds each group accountable by monitoring group progress and allowing all students to participate, but students also play an important role in making group work successful by caring about and holding each other accountable as well. Melissa described her teacher as working to build relational trust among students by not only helping students academically work together successfully, but also socially and emotionally.

Navigating the Interpersonal

For Melissa, learning to navigate interpersonal relationships with her peers during learning was a process. Initially, there were "times when you're used to not being in a certain group, at times it makes you to have to adjust so that adjusting is very tough". Similar to other participants, Melissa is more comfortable and confident with peers she is familiar with and can trust. However, group work can still be challenging when working with peers "with a negative attitude" or when a group feels unfocused. Melissa values the growth learning with her peers brings and wants "to have an aim and a goal at the end of the group that I have learned at least something, like I'm not coming out of that group the way I was".

Time has allowed Melissa to learn to navigate the social aspects of peer interactions during learning. In Melissa's experience, now learning with her peers in small groups is "quite fulfilling. I find it fun. I find at times like I can use that platform to get help from my fellow colleagues, my fellow classmates". This is in part due to the peers she works with. Melissa said they:

> Cooperate very well, they are friendly, at times we get into some sort of arguments, but all the same, we don't get to have a grudge throughout, we get resolve issues, and we

> actually don't take anything for granted in those groups. We value friendship and also value class work.

Collaboration is sometimes hard, and can sometimes lead to conflict, but it also allows Melissa and her peers a safe space where they can practice and work on important social skills such as resolving conflicts or disagreements. It seems, however, that the students must share a similar goal and be willing to navigate the interpersonal aspects of group work together. For Melissa's peers, they work together to resolve issues and they value both the friendship and achievement that comes from working collaboratively. This supports Melissa in feeling like she can get help from her peers when she needs it. It also seems that at times, group work can be empowering for Melissa as it provides space for her to self-advocate in a way that feels comfortable for her. She:

> Is being able not shy away from having to address a challenge that I'm getting. Like if it's a math problem, I'm not going to keep quiet over it, at least, let me just speak it out and get help from it.

In navigating interpersonal interactions, peers need to embrace diversity, learn to appreciate peers who are different, and value each other's strengths. When discussing what she wants from her peers, Melissa shared that she wants:

> To have people who appreciate you, who love you for who you are, who are not going to judge you, who are going to help you. So, adjusting to this new group and getting to understand each other is also a very big challenge and milestone that you have to achieve.

Melissa further wants them to understand that people are different and talented in different ways. She wants what she is good at to be valued and appreciated. She noted the reciprocal nature of working collaboratively and wants her peers to:

> Understand that people different. And people are very talented in different ways. I may not be good at math and may be good in English and maybe do good in anything else, or maybe poetry or something. And that's something for me to appreciate and know that it's something that you have to be accommodative of each other and be ready to work with each other, like in a teamwork set.

Melissa has learned that she does not need to be best friends with everyone and that she does not need to be popular but developing relationships with other peers who appreciate and value her for her strengths, and having beginning levels of trust, makes it much easier and comfortable to learn. Ultimately, she said it is your "perspective of a person and which group, you find yourself in" that makes navigating interpersonal relationships with her peers during learning more or less successful.

Relational Trust

Working with her peers is now a fulfilling aspect of Melissa's learning. Melissa has worked hard to become good at working with her peers. With time and opportunities to interact, she has found that she has been able to develop a bond with her classmates. This has allowed her to feel comfortable and not shy away from issues she is having or when she doesn't understand something:

> The more you get to interact in a smaller group, it feels like you get to make a bond with the people in that small circle, like a small circle works for me, and I feel like anytime I have an issue, I will not shy away or pretend that I know something when I don't.

When describing the trust that she has developed in working with her peers, Melissa reflected:

> Trust is knowing that if I give out information that I consider very true that to me is that it is going to remain that way, if at all, I wanted it that way. And trust is also getting to have

> a lot of people around me and people who are going to understand me and who are not going to judge me, and who are always going to be there to help when I have to be helped.

This trust has also been instrumental in helping Melissa develop her social skills and a sense of community she did not have previously with her classmates. For Melissa, she feels "like it's amazing, it has made me develop a social aspect. I feel like growing up, I was kind of isolated and, besides, I had very few people to see when growing up. So actually, the social aspect is being improved on".

Further, by working with her peers during learning, Melissa has not only benefitted academically, socially, and emotionally, but she had developed long term friends. She says she was able to:

> Make friends long term friends. I'm able to trust others. I'm able to know that teamwork also is very effective and appreciated, what others have to offer and not judge and also be knowing that I am also a person who is of value to others.

Melissa has not only developed relationships with her peers, but her self-perception has also changed. She now views herself as an active, valued, and contributing member of her classroom community. In Melissa's experience, the reciprocal nature of group work and working with peers has been pivotal in her learning academically and socially. She has learned the goal of peer interactions during learning is not for one student to solely help another, but for all students in the group to contribute and to learn to value the bi-directional and diverse contributions of others.

Sadie

Sadie was a 19-year-old, English-speaking, Black woman in the 12th grade at the time of this study. She identifies as a person with autism and chooses to disclose her diagnosis to others. She reports that she receives academic, emotional, and social support in school. Sadie identifies collaborating with peers as helpful in building confidence and understanding of academic content.

The Role of the Teacher

Sadie discussed the role of her teacher in setting up groups for success. In Sadie's perspective, "the teacher should be the one making up the groups. And she should be the moderator of the groups and she should be willing to listen to any complaints that come from the groups." Sadie wishes that her teacher engaged more and was more of an advocate for the students when working with peers is not functioning well. For example, Sadie said "they should be more accommodative of any complaints that come to them like they should not rubbish them, they should be willing to engage more." This has affected Sadie's participation and engagement in the class in the past when:

> For example, times when you are the soft-spoken person in that group set up and tell the teacher that this group is not for you. You don't feel like you're compatible, the teacher should also be able to address that without delays, because at times you could be in a certain group, you're not comfortable you're lagging behind in class.

From Sadie's perspective, the teacher should also be creating a safe space in the classroom for students to work and learn from each other. She wished that there was "a class setting for morals…morals for like one to be an upright person, like specifically for that, not only mathematics." Sadie highlighted the important role her teacher plays in helping students successfully socially and emotionally interact during academic learning.

Navigating the Interpersonal

Sadie highlighted the reciprocal nature of the interpersonal dynamics in working with her peers. She also expressed her desire to find friends who love, understand, and support her as an individual. She views the reciprocal nature as essential and wants peers who "support the morals that I have, you are their good friends the same way I expect myself to be to you," and wants them "to know that I'm a person who loves people around me. I want to be understood, I want to be having friends who are really supportive, and I would be willing to do that too." She wants group members to "just be friendly, be kind because you don't know what everyone is undergoing in that moment." Additionally, through working with her peers during learning, she feels "like it was really something that was very important for me because I learned the aspect of teamwork, and I don't know, some way group work makes you gain confidence."

Sadie has benefitted both socially and academically from group work, but it seems that these gains are also contingent on the personalities of and compatibility with her peers. For Sadie, interacting with her peers during learning is a good experience when she is "in the right setup of people who are very good to you…the right constant of people in terms of the personality matches mine. And people who are willing to help, that is really important." However, Sadie also expressed that working with her peers is challenging when working with:

> Those people who are full of pride or someone who's already judgmental. Like, for example, if you want to talk about something, and if you want like expose yourself like you're not understanding, a certain topic, the person's like 'this is so easy', not knowing that one's strengths can be weaknesses, one's weaknesses could be my strengths, so I like that kind of relationship where one can appreciate each other.

For Sadie, when her peers do not embrace each other's strengths and weaknesses, this affects her ability to learn through interacting with her peers:

> It may feel like you're getting frustrated, like people don't understand you…Like, for example, you may not be in a position to talk in the group, so you feel like you're not even comfortable at the end of the day, your contribution doesn't matter because possibly people are already judging you so at times you could feel really isolated, even in the group setup.

When peers judge or do not embrace students who are different, not only does this impact learning and lead to frustration, but it can lead to isolation and social separation from peers. Sadie further reflected how things outside of class or emotions not related to the class setup can make group work hard:

> Like, for example, I would be very sad out of something that is affecting me, that is something that is not related to class setup. So, when I go in this group, I usually want people who are supportive, people who are kind, who know how to help me.

In Sadie's experience, help "looks like not judging me, it looks like being counted as a friend, and it looks like, being able to help me in terms of classwork if I'm having challenges." For Sadie, working with her peers involves not only classwork, but also interpersonal relationships where conflict can be resolved. For example, when her peers "are going so fast, I'll talk it out, and in a kind way, so that it feels like they are also not like put in awkward positions of conflict." As other participants have reflected, although group work sometimes leads to disagreement, it also provides an opportunity for students to safely navigate and resolve conflict, a skill that often requires real-life experience to develop.

Sadie shared that learning to navigate interpersonal dynamics between her and her peers took time and is a process that involved getting to know who her peers are as individuals. For example, Sadie described this as "if you are not friends, I get to understand you I get to know what you like, like aside from classwork, what you like, what you don't like, what's fun about your life." Sadie acknowledged that this can be hard to accomplish "because it's an act that I'm trying to learn over time and I have appreciated that it won't take like immediately…but, with patience with yourself, you can manage."

Although Sadie had negative experiences interacting with peers in the past, she learned that friendship and social compatibility are skills that can be improved over time. However, Sadie is also clear that these changes are not always easy and that you must be your own "greatest motivator", believe in yourself, and recognize that "no one is perfect". It seems that having a growth mindset can be immensely beneficial for students who are struggling socially. Although poor social interactions with peers can be extremely challenging, recognizing that "friendship doesn't happen automatically", as well as having "patience" and learning to "take risks" can be beneficial for struggling students.

When working with her peers that do embrace each other's differences, Sadie doesn't feel bad when she makes mistakes in front of her group. This has developed "over time, you like see that it's not even me alone who is making mistakes, anyone else can make a mistake…I realized that everyone has the strengths and weaknesses, you have to be very accommodating. By interacting with her peers during group work, Sadie realized that she is not alone in making mistakes and that everyone has areas where they need to improve. Now Sadie does not:

> Feel bad when I make mistakes in front of my group because either way if you laugh no problem, I have like developed a kind of attitude, whereby you have to be strong…over time, I realized, you must first be your greatest motivator.

Sadie further recognizes the importance of working with her peers during learning and the help they provide each other:

> At times, you have to like blend in, and also be accommodated. Like, for example, it could be in a group of people, whereby their weaknesses are quite minimal than yours. Some would be the fast learners, I will not take that negatively, I'll just want to let them help me…. because most of the time when I realize a certain student has a certain strength, I want her to help me.

In Sadie's experience, everyone has their strengths and weaknesses, and everyone has to be accommodating and be accommodated. She wants her peers that she interacts with during learning to learn "to accommodate each other, no one can be like you and then I don't expect anyone else to be like me, everyone is unique only that you have to be compatible." Regardless of ability, and each individuals personal strengths, it seems that embracing differences and accommodating those who are different are the main prerequisites for successful group work. However, Sadie has also learned that some peers will not accept you regardless of your ability. Sadie explains learning this important lesson when she said:

> Not everyone will accept you the way you are, no matter how good you are, but don't take it negatively just work on yourself and possibly pray that it also it also works for them like the able to change attitudes and remain patient with yourself.

Relational Trust

In Sadie's experience, trust is an integral part to working with her peers during learning and is developed over time and with opportunities to interact:

> Trust in groups is something that you gain, like trust once you're in that group, like it's a lesson you come to learn later on…I cannot be in a certain group and say 'people do not judge me', I have to learn from the experience of being in the group set up, I cannot learn about it before.

Sadie further reflected that "patience and confidence and trust is earned" between her peers and her. For Sadie, "the more you're talking in a group setting with other students, the more you are getting to know each other, the more you're able to gauge who your friends are then it gives you a sense of trust." Sadie and her peers needed multiple opportunities over time to positively interact to develop confidence and trust in each other.

Working with her peers is much harder for Sadie when there is not trust or a sense of acceptance, "when I'm not conversant with the people in the group, like if I'm put in a group of people who are not even my friends, who are mean to me before even in that group setup." Sadie further reflected on negative feelings that have stemmed from working with peers who are unfamiliar to her or who have been mean to her in the past: "it's very hard to keep relationships…that, of course, bit of awkwardness, and fear and intimidation." However, Sadie experiences success when working with peers where there is trust. This has led some classroom peers to become Sadie's friends. When working with peers she trusts, she views her strengths as being:

> Able to not feel shy. So, my confidence, I work on it. Second, I'm able to talk to each person like we have a relationship, together, we are both friends and also groupmates and also besides classwork we are able to share our stories outside class.

This has led to a sense of safety and belonging where Sadie can be her whole self, and share things from outside the classroom in her interactions with her peers:

> It means that you're, you're in an environment where you feel safe like maybe it's something that is that just happened to you about family just anything so you feel like you could share with friends.

This trust has not only been important to how Sadie has grown academically when working with her peers, but it has also been important to her overall social development. Working with her peers during academic learning has helped her become more confident socially, and it has helped her open up, make more connections and relationships with others, and recognize the value of friends in her life. Sadie explained:

> They helped me in developing that character that out like, initially, I think I was more of an introvert but nowadays, I am pretty much an extrovert, it has helped me develop storytelling techniques and it's made me also perform well in class.

These experiences have also been informative to Sadie about what she needs outside of school and after graduation. Sadie reflected:

> It kind of feels like you're learning to trust people, you're learning to make friends, your also learning to accommodate others, and you're also learning to know that you cannot live by your own, even after class, like ahead of that class, in life you also need people.

Beau

Beau was a 19-year-old, English-speaking, Black man in the 12th grade at the time of this study. He identifies as an autistic person and chooses to disclose his diagnosis to others. Beau reports that he receives assistance in school through peer support.

The Role of the Teacher

Beau's teacher has been instrumental in helping him navigate interpersonal relationships and interactions with his peers at school as well as stretching outside his comfort zone. When discussing his teacher, Beau says the best thing his teachers do is maximize his strengths and understand the person that he is. Knowing and understanding each student's strengths and weaknesses allow Beau's teachers to intentionally and successfully configure cooperative learning groups in the classroom. His teachers make sure the group:

> Is composed of people of different strengths. We have people who really work well in class and people who are not that good. And then everyone has to participate in tasks and so even the poorest of all of them will have to take part.

Beau further identifies his teacher as

> A person who is not biased and stuff like that, and so they understand if a person is weak with presentation, they'd kind of understand and not pin them to the wall and you know, try to break them at it. So, they are somebody who understands your strengths and your weaknesses and is ready to work and help you improve.

Developing a trusting relationship with his teacher has required Beau to self-advocate. He has worked with his teacher to make interacting with his peers during learning successful for him. Beau prefers to work with his friends who he feels understand him and his needs and value his strengths in group work. Beau reflected on when he first began to advocate for himself to his teacher to work with peers, he feels understand him:

> It was quite hard for my teacher to allow at first. Because the teacher wants it some way, according to what the plan is, but usually, when you become adamant about it, and then you quite push it through because you understand, it is something that is going to help you in the long term, you know the teacher has no option but to accept what you say. So,

> it's something that I had to push it myself… I was a person who was very outspoken about it and made sure it was working for me and not against me.

Part of the reason why Beau has been so successful self-advocating for his needs has been his own self-awareness of what he needed to be successful. Having a good understanding of his own needs allowed Beau to ask for specific changes and supports from his teachers when engaging in peer work. As Beau and his teachers have developed a relationship, Beau now feels that his teachers are an ally to him because they have a better understanding of his needs and how they can support his learning in the classroom. Beau describes this as:

> The best I think the teacher does that helps me is they maximize on my strengths…teachers have made me ambassadors of groups that have students who have the same issues, and so you feel like you're there to get empowered… they've tried to understand me…after me advocating for myself, they took a side with me, and they understood my issues.

Beau's teachers have also been important in helping Beau develop new communication and interaction skills. In Beau's perspective, they balance his strengths with his areas for growth and help push him to develop further. They:

> Are the types of people who would push you to do the best trying to interact with others, they won't let you hide a lot. So, they understand that these things are your fears, but they want the best for you, and so they want to push you out there, to do whatever you want to do even if you're afraid.

By understanding Beau's needs, providing necessary supports, and always holding high expectations for Beau, his teachers have helped him to have successful social interactions and navigate challenging situations with peers and his own emotions. His teachers:

> Understand the person that I am and the condition that I have. They helped me navigate through the bad days. Sometimes you come to school, and you don't feel like it. Or sometimes you interact with people who remind you of who you are, so they play a key role in trying to help you navigate through that.

When other students have been unkind to Beau, his teachers have helped Beau understand "you can't change the fact that they're having a bad day. We can't change their opinions. Accepting that helps you move through; you understand it's not a 'you' problem it's a 'them' problem." Ultimately, Beau trusts his teachers to know him, support him, and push him to grow when it comes to interacting with his peers during learning.

Navigating the Interpersonal

Beau's experiences of navigating interpersonal aspects of working with his peers has been different from how his peers have experienced it. He attributes this to his autism, having a speech impediment, and his peers not being able to understand or accept his differences:

> My normal day to day interactions with my peers in a classroom setting is quite different compared to how other students interact with their peers. For me, it is really with my condition. With time, you get to think it's normal because you get used to it. But at first, really when I was a new student, it used to be quite difficult because people don't quite understand your condition.

Similar to other participants, working with unfamiliar peers can be challenging. When Beau was first a new student, it was difficult for him to be understood by his peers when interacting during learning because they did not understand his autism. He often had to explain himself to his peers. With time, however, he made friends who act as advocates for him and ease the challenge of interacting with unfamiliar peers:

> Who like are tied to me and so when we get to these situations, they try to explain this to the other students on my behalf, but again now, when we are having like group work or something I tend to have like few friends who were used to me, and so, in that way I don't have to explain much. But first it used to be, you know something quite difficult for me.

Beau's friends act as advocates when navigating interpersonal relationships with new and unfamiliar peers. Beau and his friends help explain Beau's autism to other students who are unfamiliar with it:

> The only difficulty I have is when I have to go outside of a setting, and I have to interact with new students or new groups of people, you know, in different institutions, different lessons, when I'm away from my close group. I have difficulties because they cannot relate to what I go through and sometimes I even feel shy to explain myself to them because this is something you're not supposed to be judged, but sometimes you get harsher treatment. You know, sometimes people might think it's evil or you're a cursed person, or it's demonic or something of the sort, by it's just a medical condition, but you try to help them understand.

Beau has to navigate explaining or advocating for himself so that others who are unfamiliar with him will understand and not judge him. For Beau,

> It helps when you have people who understand you around you. So, you don't have to do much explaining. When I go to different settings, say I am different institutions or I'm a different setting say even a church or something, it's quite difficult because you have to try to explain yourself if you can because not everybody quite understands what you're going through.

Beau consistently expressed a desire for the peers he works with during learning to understand him. He wants to be seen like everyone else, and not given special attention due to his disability when interacting with his peers. At the same time, he also wants his peers to know he understands if they do not like him. He does not expect everyone he works with to be his friend, but he expects to be treated with respect and dignity, like anyone else in the classroom. For Beau, he wishes his peers:

> Knew that I am not my issues, and I am not my form of disabilities, I am really more than this. I'd really also want to make friends like everybody else…I'd want them to know that I understand them and understand it's okay to not like somebody like me. Because we also all have choices and so they should not feel bad when they don't like a person like me because also I do not like everybody else. And so, I need to be treated normally too. I don't want to be given special attention…I'd love to be basically a normal person.

In Beau's experience, learning this has taken time as "you don't fly on the first day". At first, working with his peers was difficult because they did not understand his autism. They:

> Used to have trouble working together because they didn't understand about my situation… people couldn't understand the situation. And so, we were given tasks that you couldn't accomplish, given duties to do and you're not quite familiar with them, and all that, and so, in time, they got to understand the situation and we you know we've worked out a way forward with it.

Now, Beau feels the peers he interacts with during learning "work well with each other" because with "time I got to be at ease with them and understand their side. And I made myself easily understood by them". Beau attributes this to knowing and choosing to value each other's strengths and supporting each other's areas of weakness. Although participants often discussed

how they felt more comfortable with peers over time, it seems that peers without disabilities also require time and opportunities to learn how to navigate interpersonal relationships with autistic peers as well. Beau and his peers also navigate the interpersonal aspects of working together through a strengths model:

> I think is it's the fact that we understand each other's strengths and weaknesses and so we dwell on each other's strengths. So, when we have a task, we make sure everybody works at the places where they can do their best at, as compared to where someone works in the weak points and everything so it's kind of hard when you start with, so we tend to dwell on each other's strengths…These are things like my friends know about me and when there are activities of the sort that I like, they support me. And if the activity is something that I don't like, they would also support me not to be involved with it and somebody else will do it.

For Beau, navigating interpersonal interactions during learning has also broadened his perspective about life outside of the classroom and may better prepare him for his transition to adult life:

> I think it gives me a perspective about what society is about. If I wasn't like interacting with my peers, most of the time I'll have a foul view society and everything, and so I think it gives me like a small micro view of how the world works and how society and you know it prepares me for the future.

Navigating the interpersonal aspects of collaborative leaning has also taught Beau to be more accepting of his own differences and the differences of others:

> Everybody is different. Just like in the outside world, everybody has a different view, and so with the interactions we come to realize that not everybody thinks like you and everybody's entitled to their opinions and so you learn to cope with such a world.

Over time, interactions with others has allowed both students with and without disabilities to be more understanding of each other. For Beau, he:

> Used to be rigid about it at first. I tended to press people you know, to take my views and everything of that kind, but with time, I became easy with it. I sort of accepted people's views and understand that everyone was entitled to what they had to say.

Relational Trust

Beau has developed strong friendships with a deep sense of trust with some of the peers he has worked with during learning. This has allowed him to feel comfortable and valued when working with them during class where he "doesn't feel alone". Further, Beau's friends have made space for Beau to be fully himself:

> The best thing about my friends, is they have not personalized it. They don't make it look like it's something out of the norm, you know, they've made me very comfortable with who I am. And they've accepted who I am. I'm good enough, they embrace the strengths that I have instead of people magnifying the weaknesses. They embrace the strengths that you have, so you also feel some kind of way that your normal when you interact with them.

This has been important for Beau as he has also experienced the opposite where some peers "just want to magnify your weaknesses and feeling bad about yourself". However, his friends have helped explain that his autism is:

> Not like a problem, he chose to have. It's just something that happened, and you know you can't be vilified for it, and a lot of my friends, because they made me very comfortable, and they've understood that it's not my choice to have this thing.

When working with other students during learning, Beau desires “to work my best to be just a normal human being, like them”.

Although Beau has felt very positive feelings interacting with friends who know and understand him, Beau has also experienced the opposite: doubt and mistrust. These feelings impacted him socially, emotionally, and academically and sometimes prevented him from feeling comfortable enough to come to school. He was afraid of how people might judge him and not accept him due to aspects of his autism, “sometimes I did not attend school the days that I felt like something was going to happen, because I was afraid of people knowing some side of me. I wouldn't know how to react to it”. However, Beau has now developed a sense of safety and trust with his peers where he feels comfortable being vulnerable and receiving support. Now, he has “been real upset at school and everything of the sort, I am still comfortable, because I know they are people I can trust, and you know they'll take care of me”.

In Beau’s experience, trust has been foundational to feeling successful when working with his peers during learning. Beau described this as being able to trust that:

> Trust is you can trust that they respond to, to whatever you have to say in the way you you'd expect them to, and they still hold you the same regards as they used to, even before you know, knowing about these things, and so I think, for me, that was the main issue with trust.

Now for Beau, there is a sense of safety in his collaboration with peers that involves reciprocal trust:

> Emotionally, I think, for me it feels like it's a kind of a safe space now. Compared to how it was. It's a group is that, for my case, it's a set of people we've worked for like months or a few years, and so you get comfortable with them. You tend to share more, you feel at home, they're friendly, it's engaging. It feels like something you'd want to have a now as compared to how it felt first, when we were new to each other, and we didn't have any background information about each other. We didn't know each other's preferences and all that, so it was kind of weird at first, but with time we got used to each other and for now, it feels like a safe space.

Anderson

Anderson was a 19-year-old, English-speaking, Black man in the 12th grade at the time of this study. He identifies as a person with autism and discloses his diagnosis to certain people. Anderson reports receiving classroom and testing accommodations and assistance from his teacher. Anderson enjoys the company his peers provide in small group learning time and states that it boosts his morale. Additionally, his peers help him revise the classroom content when working in small groups.

The Role of the Teacher

Anderson's teachers have been instrumental in group work becoming successful for him. He feels "they understand me a lot" and says they work with his parents and him closely. When seeking help from his teacher due to being discriminated against for either his race or his autism, he feels "the teachers have been very cooperative. If I report any matter to them, they will deal with it maturely and also used a lot of diplomacy in resolving the issue." Anderson feels interacting with his peers during learning is more successful when his teacher is there to supervise other students so that other students cannot mock him or misbehave. Sometimes,

Anderson feels that working with his peers is less successful when the group is unsure of what is expected of them. In these moments, he would prefer to be in a larger group:

> Like we could not have an idea, all of us, of what is expected of us, or what we are required to do. So, at times that when you'd prefer you could have been like a larger group because you could have like exchanged a lot of ideas that at the end of the day, you could have got a way out of that.

For Anderson, the teacher setting high expectations influences the success of peer learning in the classroom. This includes the teacher setting clear expectations of what the groups should be doing academically, but also how peers should interact with each other interpersonally. In Anderson's experience, this relates to a teacher's "moral and also the good things society expects from us…we learned that these are the good things we should be doing". Anderson feels his teacher expects "the best from us, and with that I'll work to my best to achieve the best because my teacher would expect the best for me." From Anderson's perspective he does wish the teacher was more familiar with his needs and supported other students in learning how to support Anderson and interact with him. He wishes his teacher was "able to learn more about your character and with that they be able to share more with the with my fellow students and with that I think would be able to build a very conducive environment for each and everyone."

Navigating the Interpersonal

Anderson reflected on the difficulties he experiences when navigating interpersonal interactions with his peers during learning. Compared to other participants, Anderson has had more negative experiences with working with his peers during learning than positive experiences. For Anderson, he feels:

> They can discriminate me on the business of being an autistic student and also, I feel there's also some racism in it, because I'm Black American. So being Black and also being autistic, I usually feel like most of the time they discriminate [against] me, and it lowers my morale in my classroom, my concentration and also at times, I feel they really distract me a lot…its quite embarrassing and I feel it kind of in a way affects my mental health.

These difficulties with interpersonal aspects of working with peers impacts Anderson's engagement in class and his concentration, reducing his access to learning opportunities. These negative experiences also affect his mental health, leading to periods of stress, depression, and hopelessness. In Anderson's view, this further affects his "learning a lot" and decreases his engagement in the classroom with his peers during learning "because I really feel like if this the life I'm going to have, if I'm going through these in the studies, in way it makes me lose my morale because I don't see any sense of going all through this."

In Anderson's experience, the efficacy of interacting with his peers during learning is contingent on "the character of the students and how cooperative they are". Anderson wishes his peers would see him for who he is, and value his strengths, and support his weaknesses. This would allow him to feel more comfortable around his peers and more integrated in the classroom learning environment:

> I do wish that they could be made more aware of what I expect from them, because I expect them to handle me with care and also not to make me feel like being abused or other discriminated. And they should also be able to assist me in any way I like request of them, and I think with that I'll be very comfortable in their company and not really feeling like I'm lonely or out.

Anderson wants his peers to value his contributions during academic interactions. He wants a reciprocal relationship where he learns from peers and peers learn from him. He feels he has valuable skills that can support his peers when working in a group, such as being the "timekeeper" or "knowing the agenda" and being "very honest and truthful" and "sincere". He believes these should help him "earn respect from [his] peers". Anderson also shared that working with his peers is harder when peers are impatient with him. Given the discrimination Anderson endured at the hands of his peers, Anderson showed a profound ability to empathize with his peers and forgive them. For Anderson, he recognizes that many of his peers treat him poorly because they are ignorant to what he goes through on a daily basis. When discussing his peers not understanding his autism, Anderson shared:

> I'll say I'm really patient with them because I understand they can't understand my situation and so they'll be able to adapt with me in the near future, and with that I don't blame so much to them. They don't understand what I go through.

For Anderson, working with his peers affects his learning "in a positive way and also in a negative way" depending on how patient his peers are with him: "I would require someone who's patient with me because, at times like I would not be remembering the content which was taught in class and so failing to be patient with me, it will affect me." When interpersonal interactions with his peers during learning are successful, his peers:

> Play a major role [in his education] because they are the people who are there…helping me, giving me assistance, and keeping in touch with me, also observing me. It could be like I have been attacked or I'll need some assistance, they'll also like help me. Maybe we are given some assignments, and also those are major roles that they play in my education.

Relational Trust

Trust and patience are both essential in the level of success Anderson experiences in collaborating with his peers. For him, "it depends on the connection you have with the people you're dealing with, but the fewer people, the more I trust, because it has been very difficult for me personally to trust a lot of people…I would say being in a smaller circle, its helps you build that trust, because it will be very okay, or very easy for you to learn them". Similar to the experience of other participants, Anderson has found that it is easier to connect and adjust with a smaller group of peers. In the trust Anderson has built with his peers, there is a sense of reciprocity:

> It's one of the best things because, like it's a mutual relationship, because I expect to learn from them, they also expect to learn from me, so we benefit each other. So, it's a mutual benefit, like our relationship and that something like I would enjoy and not being lonely for that time. I think, each and every person, you're like our friends benefitting each other's company."

It seems that Anderson not only wants friends who he can trust, but he also wants to be trusted and valued by others. One-sided supports, where one student helps another student academically can be valuable, but they fail to provide a reciprocal, mutual relationship where both partners feel needed and valued. When working with certain peers, Anderson is able to get help and also give help. He is valued by his peers and friendships have been able to be developed because the relationships were based on mutual acceptance and trust. This has impacted how Anderson experiences the social climate and community of his class. For Anderson, working with certain peers has:

> Been quite interesting for me…you don't feel like you are alone, you also have other people to interact with and also you feel like you're not lonely. And you are going to share ideas and also like just meet after you're through with the assignment you are working on and that's how you have to get some very good friends out of it, because these are the people you have been working with each and every time, so you know them, you will understand them.

Consistency and structure in groups has helped form the interpersonal relationships necessary for building trust with his peers during learning. This has led to not only academic support, but also social and emotional support by his peers, all of which are essential to the schooling experience:

> They haven't like only been helping me in the education sector alone. I'll say that some emotional support you will also require maybe for some life situations, so you will need some guidance and also seek some knowledge from your friends and also some advice. So, I'll say them sharing with me their experiences and also the advising they will give me, sharing with me some knowledge and also being prayerful to me and I'll say support which can't go unrecognized, and I feel like I am having the best company, at times, and also getting the good support. Although I don't get these from all of them, but most of them I'll get it, and that's something which I'll say boosts my morale and keeps me going in my studies.

The emotional and social support Anderson has received from his friends has positively influenced his ability to interact successfully and learn, despite the bullying and discrimination he endures from some of his peers.

Colleen

Colleen was an 18-year-old, English-speaking, Black woman in the 12th grade at the time of this study. She identifies as an autistic person and chooses to partially disclose her diagnosis. She identifies supports in school as helping her with social and emotional skills and learning to take breaks during lessons. Colleen enjoys working with her peers, but prefers to engage through listening, rather than talking.

The Role of the Teacher

Colleen's teachers have been instrumental in helping Colleen and her peers navigate interpersonal interactions during learning. Colleen feels particularly understood by some of her teachers and feels they structure groupwork carefully, to maximize the effectiveness of peer interactions during learning:

> I feel like my teachers have been a great help for me because they actually understand me…they always try to like find people whom we actually get on well and that, for me, has really worked. In school I'm able to interact with those people and able to share ideas with them.

Colleen's teachers have supported her academically, socially, and interpersonally by carefully grouping Colleen with other students who will be good partners for her. Further, they help her advocate to other students, and they build peers' awareness of autism as many of her peers have misconceptions about Colleen and autism. They help other students see Colleen's strengths:

> They have tried to create awareness through some of the students, because some students, since they are not aware of what autism entails, for them, they just know that autism is just someone who's actually disabled and helpless, so there is a misconception that most of the students actually have. But, especially for my class teacher, she always tries to

> have that interaction with the students, so that they can be aware of the autism spectrum and some of the strengths that people actually have, beyond the condition.

When she is working with peers in groups, Colleen's teachers monitor how the groups are functioning interpersonally. Colleen may not always self-advocate when group work is challenging, but her teachers know and can recognize when she needs additional support. Colleen explains that her teachers:

> They always try to comfort people when they might be facing something. They may notice that and just come to me and asked me what is going on. With that I'm able to open up and share with them, so I can say, for me, I actually have quite a good experience with my teachers.

This is especially important for Colleen as she reports experiencing mood swings when feeling anxious. This affects her ability to attend to what is being taught in class. In these moments, she is sometimes unintentionally rude to her classmates which hinders her ability to work collaboratively with them. Some of her classmates try to engage in an argument with her during these moments while others disengage completely. Others insult Colleen based on having autism. When this happens, Colleen often goes and sees her teachers. Some of her teachers help her to develop important problem-solving skills by helping her apologize and attempt to restore the relationship with her peers. Colleen feels she can:

> Approach my teacher and tell them what just transpired. I can say that I have some great teachers because they do understand where I'm coming from and they try to just call us, the two of us who were arguing. And when they call us, she simply tries to hold that conversation to so that I can be able to like to say how it affected me, how it did affect

> the other person, and the other person says the same as well, and we try to like just to apologize for what happened and move forward from that.

Teachers also helps Colleen learn how to handle those situations through informal coaching, "they can give me some tips on how I'm supposed to handle some of the things, some of the reactions I might have that may affect other students. It has really helped me". Colleen really values when her teachers help her learn from these moments and build skills to use in the future.

Navigating the Interpersonal

From Colleen's perspective, she experiences difficulty in interpersonal aspects of working with her peers due to aspects of her autism, emotions, and peers misinterpreting her social cues. This heavily affects how efficacious working with her peers during learning is:

> In small groups, it's quite a challenge for me because I struggle to actually maintain eye contact with someone, and I feel like if I don't maintain eye contact, they tend to misunderstand me. Because they feel like I'm not listening to them.

This can lead to Colleen being "overwhelmed quite easily", "anxious", and "self-conscious when around people". Colleen further feels that she often does not know what to say when working with her peers, that everyone else knows what to say or has something to contribute, and she doesn't:

> If we have been assigned a project and everyone is given a specific task, and everyone shares his or her ideas on how we should go about the project. So, for me, that is quite a challenge, because as times I don't know what to say at that time, but for my peers, I feel like for them they always have something to say. So, for me, it's always awkward because some people tend to misunderstand me.

Because of this, Colleen prefers to work with her peers in smaller groups of one to two peers where she can communicate more effectively. In these moments, Colleen wishes her peers were able to read her body language more and were more supportive of her differences. Despite not maintaining eye contact, she listens attentively to her peers and tries to ask clarifying questions to show she is engaged when her peers are speaking:

> I just wish they will be able to read my body language. Because, as I have mentioned, I struggle to maintain eye contact. Someone might be saying something to me but I'm not maintaining eye contact much. I'm always attentive to what they're saying, because I always try to ask questions, clarification on where I haven't understood. But some people tend to like to misunderstand that for me not being attentive, and it has quite been a challenge, because not so many people want to like to interact with me.

Yet, Colleen feels that many of her peers misunderstand her lack of eye contact and are therefore reluctant to interact with her. She wishes they would look beyond her autism, see her for who she is as a person, and value her strengths:

> People just don't want to talk to me. And yes, there are some who are aware that I do have autism, so they just see me as having a disabling condition, rather than having to see my strength. And that, for me, has been quite a challenge, because they just see me for someone who actually has a disabling condition, rather than having to see the person that I am.

Colleen also finds it difficult to work with peers she has nothing in common with. She becomes unsure of what to say and is self-conscious. Interpersonal conflict makes it difficult for Colleen to access learning opportunities when working with her peers at times. When Colleen and her

peers experience conflict it affects her ability to concentrate on her classwork and engage meaningfully to learn:

> To some extent, I'm not able to concentrate on class. Because my mind, is always switched to what actually transpired if it's something that has that happened that, that didn't actually go well with the [other] students. So that is my main focus and I can say that this has really affected me because some other times, yeah, a teacher might even say something, and ask questions and I may not have captured what the teacher asked, so for me, that is quite hard, because I feel like I'm, there are some of the things that are missing, and it has also affected my performance because I'm not really performing, so my best way I wanted to be, but I'm still trying, yeah.

However, when interacting with her peers who are supportive of her, Colleen finds navigating interpersonal aspects of peer collaboration to be more successful. They support Colleen in areas she needs to support in, but also see and value the strengths Colleen brings to her peers. Some of her peers:

> Are my friends and I feel for them, they actually do understand me because they tend to understand my body language…at times I might be anxious, so they try to help me and that has really helped me in how I'm interacting with someone else. Since I'm always trying to like ask questions on where I did not understand something, that really makes them quite happy because they feel like the fact that I'm asking questions, I'm actually paying attention to what they're saying, and for me, with that it has enabled me to make to have some few friends.

When interacting with her peers during learning, she "look[s] out for those people that I feel like we do share something in common and for those that actually understand where I'm coming

from". This allows Colleen to engage in learning opportunities more meaningfully with her peers.

Relational Trust

Opportunities to work her peers during learning has helped Colleen build trust and friendships with some of her classmates. Her peers encourage her and support her interactions with other peers whom Colleen feels do not understand her. This has made school feel safer and more comfortable for Colleen:

> I can say for that it's quite great because with having them around me, I feel like I'm actually safe. Because there have been times where I don't want to attend classes, because I might have had some arguments with some other students. But for my friends, the people whom I get along with actually, they try to encourage me, and they made me feel like they're always there for me, regardless of whatever happens…it has been great to have such kind of people in my life and it has made school life much easier. It's really hard to, if we don't have friends in high school, it's really hard for you. But I can say having them around, it has been really it has helped me so much.

Working with peers who are her friends is significantly more effective for Colleen. She feels she is able to "just be myself" and "also have something that I can be able to share in the group". These peers give Colleen "the same attention that they give to other people" and make her feel like she belongs with them. This is something Colleen looks for when working with other students. When her teachers pair Colleen with peers she trusts to accept her and "who actually understand" her, she:

> Feels like I can actually be myself, and I can be able to just share whatever I have and not be self-conscious. Because that is what I'm always worrying about, saying something

> wrong or something off topic. But, having those people, it has really helped me a lot because they understand me, and they always give me a platform to say something that I want to share.

Colleen has worked hard to show her peers that she cares about them and listens to them. This has helped her peers learn to trust her. This has also helped them see her as a person rather than her disability:

> I feel like I always try to listen more and ask questions. I would never feel like I haven't understood anything and that has really helped me in making friends, because I'm learning to listen to people. People actually feel like you're actually there, you're actually present. It doesn't necessarily mean that you have to like maintain eye contact. The fact that you're listening to them makes it easier for them to approach you and share with you anything they want to share with you because they feel like they're being listened to, and they can be able to trust you. So that has really helped me actually because they actually see me as a person with a strength rather than shortcomings and with that I've been also, being able to make friends with that.

Ultimately, the trust Colleen and her peers have developed is a "two-way street" that has required growth and acceptance from Colleen and her peers. This trust supports Colleen's access to and engagement in peer interactions during learning.

Discussion

The purpose of this study was to examine autistic adolescents' experiences of peer interactions during learning (e.g., academic conversations, small group learning). Three themes emerged from the data that were essential components of participants' experiences: (a) the role of the teacher, (b) navigating the interpersonal, and (c) relational trust. Crucially, despite many

negative experiences of working with their peers during learning, all participants expressed a strong desire to interact with their peers and be valued members of their classroom community. All participants wanted relationships with their peers. Overall, when asked about working with their peers during learning, participants rarely reflected on the academic aspects of collaboration. Instead, participants discussed how it felt to be included and supported or left out and ostracized by their peers. For these participants, working collaboratively with their peers was significantly more about the social nuances of academic conversations than necessarily the academic content. Although participants benefited academically from positive relationships with peers, they also highlighted the necessity of interpersonal, social, and relational skills on successful interactions. Participants received help academically from their teachers and peers, but academic content was rarely highlighted by participants as a barrier to the development of successful relationships and the success of peer interactions during learning. The process and content were both necessary for successful classroom discourse. Participants needed the content of academic talk, but also the interpersonal skills required for the process of collaboration and cooperation.

The Role of the Teacher

Participants consistently reflected on the role their teachers played in setting up peer interactions during learning for success. Teachers provided structure and group member roles, clear expectations for academic assignments, and student accountability. Importantly, participants frequently described teachers grouping students so that participants had "allies" among their peer group members. Allies were often good friends who advocated for and defended their autistic peers. This helped participants feel more comfortable and confident in sharing with their peers during learning. Further, teachers provided students multiple opportunities to interact over time, allowing familiarity and trust to build. This increased

participants' perceptions of the efficacy of communication with their peers. When these factors were absent, participants reflected that peer interactions during learning were not as efficacious and conflict often arose. Working with unfamiliar peers was commonly cited as a source of stress and discomfort for participants. They often felt disengaged or that peer interactions with unfamiliar peers were detrimental to their ability to participate in their class content.

Teachers were also instrumental in helping students with and without disabilities navigate interpersonal aspects of peer learning such as conflict resolution and learning to embrace the strengths and differences of others. For some participants, teachers also acted as an advocate on their behalf to other students. Importantly, teachers helped grow the capacity of nondisabled students to work with their autistic peers. This included helping peers see beyond autism stereotypes and creating a safe classroom climate where differences were embraced, and it was acceptable to ask for help. This created space for participants to feel like they, too, could contribute to their group. Further, this helped move peer interactions from a one-sided helping relationship to a real two-sided relationship where all students were valued. These kinds of relationships were built on reciprocity, mutual respect, value, and need. The participants needed teacher-provided opportunities to demonstrate they could be a mutual friend and peer learner, not just a receiver of support. Participants noted that this was possible when their teacher really knew them and when they were responsive to their social and emotional needs, beyond just academics. Ultimately, what participants' teachers did or did not do had implications for the academic and social efficacy of peer interactions during learning.

Navigating the Interpersonal

Across participants, interpersonal aspects of interacting with peers during learning had implications for participants' engagement in class and the efficacy of their academic

conversations. When participants felt accepted and accommodated by their peers, small group learning was successful. Participants felt able to learn and meaningfully contribute. Conversely, when participants felt judged, bullied, or dismissed by their peers, they were less engaged and felt peer interactions hindered their learning. This included unresolved conflict which led to feelings of depression, disengagement, and social isolation. Ultimately, participants' fear of being judged led to the breakdown of interpersonal relationships with their peers. This prevented trust from being built, which in the participants' experiences, was essential for ensuring group work, academic conversations, and cooperative learning opportunities were effective and beneficial.

Several participants noted interpersonal difficulties when interacting with their peers that they attributed to their autism. This included their social and communication skills and body language. Participants also discussed the effect of disclosing their autism diagnosis to their peers. For some, this was a positive experience that led to acceptance. For others, this led to discrimination but their peers. In participants' experiences, peers who had negative stereotypes of autism and viewed it as disabling often excluded them or made fun of their autism. This led to participants expediting feelings of depression, isolation, and frustration when working with their peers.

Despite these negative experiences, participants desired interpersonal relationships with their peers during learning. Participants wanted their peers to see them for more than their autism and understand their differences. They wanted their peers to see them as "normal" and active contributors to peer interactions during learning. Participants wanted interactions with their peers to be reciprocal. That is, participants wanted to help their peers in addition to being helped. They wanted their strengths and contributions valued by their peers. Notably, acceptance by peers

seemed to be a prerequisite for participants to feel comfortable and confident in interactions during learning. These feelings were needed for participants to feel safe in making mistakes in front of their peers and asking for help.

In addition to what participants wanted from their peers, they also reflected on their own grit, self-awareness, and self-acceptance that was necessary for navigating interpersonal aspects of working with their peers during learning. Participants were cognizant of their needs and differences. They were also aware that not all of their peers would become their friend, regardless of their autism, just as they did not want to become friends with everyone. Participants consistently reflected a growth mindset regarding interpersonal aspects of peer relationships. They knew it required a skill set they have to practice and develop over time. They knew navigating interpersonal aspects of relationships with their peers takes work, and they were willing to do it. Many participants found the interpersonal aspects of group work difficult at first, but as their and their peers' interpersonal and social skills developed and relationships were formed, interpersonal aspects of working with peers became more manageable.

Relational Trust

Developing relational trust with peers was a critical factor for participants' peer interactions during learning moving from perfunctory interactions towards authentic friendships. This trust was built over time and with many opportunities to navigate interpersonal interactions in the classroom and had implications for participants' academic growth and classroom engagement. When participants felt safe with their peers, this increased their access to the classroom and accommodations as participants shared that they felt they could ask questions, contribute more meaningfully to their group, and better concentrate in class. Participants felt they could solve problems with their peers and rely on each other. In developing relational trust with

their classmates, participants became increasingly confident and comfortable in interacting with their peers during learning. This is especially important given that it can be challenging to "expose" oneself and be vulnerable when seeking assistance or sharing ideas. This may be particularly important for students with disabilities given the historic deficit language often used around the learning and social abilities of autistic students.

Relational trust also had implications for participants' social and emotional development. In developing relational trust with peers, participants were able to be more confident socially, feel understood by their peers, and recognize the value of peer relationships. This supported participants in feeling they could be their full selves around their peers, and that their differences and strengths were embraced. Further, this allowed participants to feel "normal" and like they belonged just like other students in the classroom. Importantly, this trust was reciprocal. Participants wanted to trust their peers and friends and wanted them to do the same. When trust was broken down due to judgement by peers or participants not being accepted, this hindered participants' access to the learning environment and their willingness to attempt peer interactions in the future. Across participants, developing relational trust and authentic relationships with peers was influential in helping participants feel engaged in class and receive support and help in the classroom.

Ultimately, these three themes were interwoven in several important ways. First, the teacher's role and level of support influenced how students navigated interpersonal aspects of group work, embraced each other's differences, and the level of relational trust that was developed between students. Next, how students did or did not embrace differences in interpersonal aspects of academic conversations and group learning influenced the degree to which relational trust was developed. Further, there appears to be a potential relationship

between being open to differences in oneself and others, the opportunities that creates for interpersonal interactions, and the trust that develops where one can feel accepted and confident. Finally, embracing each other's differences in interpersonal interactions was a key aspect of working as classmates, but relational trust was essential in moving from classmates to friends. These all had implications for participants' engagement in class and their ability to benefit academically from peer interactions during learning.

Limitations

This study has several limitations to consider. First, this study is not generalizable given the nature of qualitative research, and our sample was limited to 8 students. However, our findings are aligned with emerging research suggesting autistic adolescents have the desire and potential for meaningful relationships with their peers (e.g., Cage et al., 2016; Calder et al., 2013; Hall, 2021; Petrina et al., 2014; Petrina et al., 2017) Second, our study was limited to secondary students. Additional research with younger students, students with additional cognitive and language support needs, and students in more restrictive settings could provide further insight or different findings. Finally, we did not collect data from participants' families, teachers, or peers. This prevented triangulation of participants' experiences with the perceptions of others. However, given the nature of the research question, it was appropriate that we chose to focus on the participants' lived experiences as they understood it.

Implications for Educators

The current study highlighted the important role teachers play in supporting students in academic conversations and interpersonal interactions during learning with several implications for practice. First, the emergent themes suggest that teachers should carefully attend to the

affective aspects of students working collaboratively in addition to the necessary content aspects. Students need to be supported in developing the social and emotional skills necessary for complex interpersonal interactions, even at the secondary level. This includes both students with disabilities, but also their peers. Students without disabilities may need additional support in learning to embrace differences and the strengths of their peers with disabilities. Attention should be given to helping students build capacity in working with students who are different from them. Peer work should be reciprocal, in that all students benefit academically and socially from the interaction. Peers may require additional assistance recognizing and valuing the unique contributions from students with disabilities. Educators should further provide students numerous opportunities to interact with their peers over time to help build students' sense of trust and belonging.

Additionally, teachers play a key role in providing structure to groups to foster equity and acceptance when students are working collaboratively. Teachers should monitor group roles, hold group members accountable, and address interpersonal issues between group members. In this, teachers should act as advocates for students with disabilities while providing needed coaching in social and interpersonal skills. No participant discussed formal social skills interventions, but all reflected on informal support. Even at the secondary level, teachers should consider incorporating formal social and communication skills interventions that target building complex interpersonal relationships. This will also support students with disabilities in developing self-advocacy skills needed for working with peers. Finally, teachers should attend to the social ecology of the classroom, or the classroom's micro-culture in how students interact with others, as that appears to be essential for learning, engagement in academic conversations, and the efficacy of interpersonal interactions during academic learning time. Educators should

work to develop a classroom environment where it is emotionally and socially safe to make mistakes and students feel empowered to seek help from each other.

Future Research

The findings and implications from this study have a number of important directions for future research that examines peer interactions during academic learning for autistic students. First, the emergent themes presented in this study were developed through an inductive approach of examining the lived experiences of individual participants. The individual themes and the relationships between them can now be examined through other research methodologies such as grounded theory or more deductive approaches. In particular, the findings of this study suggest that there is relationship between opportunities to interact over time, students' openness to differences, and the success of interpersonal interactions during learning. It appears these interactions further influence the level of trust that students develop with one another, impacting the efficacy of their academic conversations.

Second, future research should more closely examine trust between students as well as the mechanisms that influence the development of that trust. Findings from this study suggest that trust is essential in students feeling accepted by their classroom peers where they can receive and provide help to others. This help and the ability to make mistakes appears important in the overall efficacy in small group learning and academic conversations. Next, this research focused on the lived experiences of autistic individuals, and we did not include their neurotypical peers. Additional research examining how neurotypical peers experience academic conversations and interpersonal interactions during learning is warranted as this will provide additional contextualization to how academic conversations and interactions are experienced between neurotypical students and their peers with disabilities.

Third, additional research should examine the relationship between trust and a sense of belonging in interpersonal interactions between students during learning and its effect on academic achievement and engagement. Participants' reflections in this study appear to suggest an interplay between opportunities to work with their peers, the sense of acceptance and trust those interaction build, and their engagement in class and academic conversations. This may influence how students perform in class and their overall academic achievement.

Fourth, additional research is needed on varying contexts of interactions. This study focused on academic conversations, usually in small group peer learning, but interactions occur in various contexts throughout the school day. Further research is needed examining how autistic students experience those interactions and the differences in those contexts that may be present. This may influence the type of supports these students need in different situations.

Finally, in this study, participants consistently highlighted the important role their teacher played in providing opportunities to interact, navigate interpersonal aspects of groupwork, and develop trust and safety with their peers. Additional research is warranted that examines how general education and special education teachers conceptualize and enact their role in supporting the social ecology of the classroom and the affective aspects of academic conversations.

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