THE EFFECTS OF UNIDIRECTIONAL PEER TUTORING ON MATHEMATICS
OUTCOMES FOR STUDENTS WITH LEARNING DISABILITIES IN
AN INCLUSIVE, SECONDARY SETTING

by

Daniel Pyle

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of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Disability Disciplines

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ABSTRACT

The Effects of a Targeted, Unidirectional Peer Tutoring Intervention on Mathematics Outcomes for Students with Learning Disabilities in An Inclusive, Secondary Setting

by

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Utah State University, 2015

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Students with disabilities’ participation in general education settings in U.S. schools has risen 25% over the last two decades with 60% or more of students with disabilities included for at least 80% of their day in general education settings. Students with disabilities included in general education settings often require varying levels of supports and services to execute classroom routines effectively while maximizing their learning opportunities. One support that holds potential to increase outcomes for students with disabilities in general education settings is peer tutoring. However, a majority of the peer tutoring interventions is conducted in elementary settings. These applications feature a classwide, reciprocal tutoring format, and focus on reading and language outcomes. The purpose of this study was to investigate the effects of a targeted, unidirectional tutoring intervention on the math outcomes of students with learning disabilities in a Secondary Mathematics I class. High school students that had advanced skills in mathematics served
as peer tutors and were trained to deliver the unidirectional tutoring intervention to students with learning disabilities who were identified as low achievers in mathematics. All three tutees increased their criterion and normative (i.e., as compared to their peers) performance on teacher-developed weekly mathematics quizzes when receiving the tutoring intervention. Furthermore, all three students increased their quantity and quality of mathematics problems completed as well as academic engagement during the tutoring intervention. Tutees, tutors, and a general education teacher indicated that they perceive the unidirectional tutoring intervention as effective and socially desirable.

(160 pages)
PUBLIC ABSTRACT

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Students with disabilities included in general education settings often require varying levels of supports and services to execute classroom routines effectively while maximizing their learning opportunities. One support that holds potential to increase outcomes for students with disabilities in general education settings is peer tutoring. Therefore, the purpose of this study was to determine the effects that a targeted, unidirectional tutoring intervention had on the math outcomes for students with learning disabilities in a Secondary Mathematics I class. High school students that had advanced skills in mathematics served as interventionists (i.e., peer tutors) and were trained to deliver the unidirectional tutoring intervention to students with learning disabilities who were identified as low achievers in mathematics. All three tutees increased their criterion and normative (i.e., as compared to their peers) performance on teacher-developed weekly mathematics quizzes when receiving the tutoring intervention. Furthermore, all three tutees increased their quantity and quality of mathematics problems completed as well as academic engagement during the tutoring intervention. Finally, tutees, tutors, and
a general education teacher indicated that they perceive the unidirectional tutoring intervention as effective and socially desirable.
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Bringing it back to the mid 1970’s, I would like to thank my parents for bringing me into the world and raising me with values that helped me grow into the man I am today. I would like to acknowledge the role that my siblings played in my development. My oldest brother, Chris, has helped me value the importance of being mentally tough and resilient despite the many obstacles that persist throughout life. My relationship with my sister, Molly, has become increasingly meaningful over time as I often reach out to
her for words of encouragement and support. Had it not been for my brother, Darren, exposing me to the possibility of working with adults with disabilities in residential settings, I am not certain that I would have entered the field of special education. My dad has been a strong supporter of my decisions, always ensuring I had the financial means to engage in experiences that have proved critical to my success. Most importantly, I am the product of a continuous stream of unconditional love and encouragement from my mom, which ultimately led me to continue my education at the university level.

I would like to acknowledge the highly collaborative faculty and staff at Steele Canyon High School (SCHS) that fueled my belief that all students, regardless of ability level, can thrive with their peers in the general education environment. Opening SCHS was the best imaginable start to my career in education; however, meeting Nicole Faye Block proved to be the most meaningful experience of my lifetime. I had the pleasure of watching her grow into my best friend, a doctor of philosophy, my wife, and the mother of our children. Having Nicole by my side has made everything possible - highlighted by the most precious blessings we share in Avy, Draeden, and Elanor. I dedicate this dissertation to Nicole, as her love and support has instilled in me the courage and confidence to continue to seek challenging adventures affording us a lifetime of invaluable and immeasurable experiences together.

Daniel Pyle
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CHAPTER I
INTRODUCTION

A critical concept in the Education for All Handicapped Children Act (P.L. 94-142) (1975) is that students with disabilities receive their education in the least restrictive environment. That is, to the maximum extent appropriate, students should be educated in the general education setting with typically developing peers. While the passage of P.L. 94-142 increased the number of students with disabilities in public schools, students with disabilities were not frequently accessing general education settings. In recent legislation (i.e., Individuals with Disabilities Education Improvement Act (IDEA) of 2004 (P.L. 108-446) and the No Child Left Behind Act (NCLB) of 2001 (P.L. 107-110) legislators mandated that students with disabilities participate in state and district testing with accommodations or alternative assessments. These mandates extend beyond simply accessing general education settings. Rather there is a clear emphasis that schools are accountable for improving academic outcomes for students with disabilities. As a result of these initiatives, students with disabilities’ participation in general education settings in U.S. schools has risen 25% over the last two decades and 60% or more of students with disabilities are included for at least 80% of their day in general education settings (Aud et al., 2010; McLeskey, Landers, Williamson, & Hoppey, 2012).

Secondary classrooms present one of the more difficult school settings in which to facilitate effective inclusion. Secondary schools tend to have more students per class than elementary schools and represent a wider range of ability levels as well as a variety of behavioral issues (Blatchford, Bassett, & Brown, 2011). Teachers in secondary settings
are confronted with choosing the most effective supports to facilitate a successful inclusion of students with disabilities while continuing to meet the needs of other students in the classroom. Students must have the skills needed to execute classroom routines effectively while maximizing their learning opportunities. A few examples of supports and services include extra time to complete assignments and tests, modifications of curricular materials (e.g., highlighted textbooks, study guides), and the use of assistive technologies (e.g., books on tape, word processing device, calculators). In addition, special education teachers often collaborate with general education teachers to ensure that students with disabilities in general education settings can access the supports needed to succeed. When students are not responsive to these commonly utilized supports they require additional, supplementary supports and services. One valuable, instructional support often overlooked when designing supplementary interventions are a student’s peers (Heron, Welsch, & Goddard, 2003).

Peers can help deliver features of effective instruction (i.e., modeling, multiple practice opportunities, immediate and corrective feedback) to those who need the most robust instructional support (Wexler, Reed, Pyle, Mitchell, & Barton, 2013). Following initial teacher instruction, peer tutoring provides students with opportunities to practice skills and concepts with the added advantage of structured feedback (Hudson, Lignugaris/Kraft, & Miller, 1993). Peers working as tutors can also improve academic engagement levels by helping their tutees stay engaged longer when working on academic tasks (McDonnell, Mathot-Buckner, Thorson, & Fister, 2001; Sideridis et al.,
1997). Finally, peers naturally blend into a class reducing the possible stigma that may be associated with ongoing para-educator or other adult support.

During the past 30 years researchers examined a variety of peer tutoring interventions that largely yielded favorable results for students with disabilities (Delquadri, Greenwood, Stretton, & Hall, 1983; Fuchs et al., 1997b; Klingner & Vaughn, 1996; Maheady, Sacca, & Harper, 1988). A majority of the available peer tutoring research is conducted at the elementary level with a focus on reading and language development (e.g., Elbaum, Vaughn, Hughes, & Moody, 1999; Greenwood, Arreaga-Mayer, Utley, Gavin, & Terry, 2001; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003). More recently, in several systematic reviews, researchers consistently indicate that peer tutoring has the potential to be an effective practice that can be used to increase outcomes for a diverse group of learners in secondary school settings (Okilwa & Shelby, 2010; Stenhoff & Lignugaris/Kraft, 2007; Wexler et al., 2013) and in mathematics (Kunsch, Jitendra, & Sood, 2007).

Kunsch et al. (2007) focused on peer tutoring effects on mathematical outcomes for students with learning problems. Only two (i.e., Calhoon & Fuchs, 2003; Roach, Paolucci-Whitcomb, Meyers, & Duncan, 1983) of the 17 studies reviewed were conducted in secondary settings, and both were conducted in self-contained special education settings. Although the researchers reported moderate effects for improving mathematics performance of students with learning problems, small effects were reported for students with disabilities who participated in peer tutoring in mathematics classes. Additionally, Kunsch and colleagues reported smaller effects for concepts and
applications compared to computation outcomes. Specifically, Calhoon and Fuchs (2003) investigated the effects of Peer-Assisted Learning Strategies (PALS) in combination with a curriculum-based measurement (CBM) system. On pre to post standardized measures of basic mathematic skills (i.e., computation) students in the PALS and CBM treatment showed moderate effects (ES = 0.40) as compared to the control group on the Math Operations Test-Revised (MOT-R; Fuchs & Fuchs, 1991). On measures that assess complex knowledge (i.e., application and algebra concepts), students in both conditions demonstrated minimal improvement on a pre to post standardized application measure (Math Concepts and Applications Test [MCAT]; Fuchs et al., 1991). Moreover, students in the control group performed better than students in the PALS and CBM treatment (ES = -0.29) on the Tennessee Comprehensive Achievement Test (TCAP).

Okilwa and Shelby (2010), Stenhoff and Lignugaris/Kraft (2007), and Wexler et al. (2013) reached the conclusion that peer tutoring can be considered an effective practice to increase outcomes for diverse learners (students with disabilities and struggling students). Despite their positive assessment of peer tutoring interventions, all researchers agree that more peer tutoring research studies should be conducted in secondary settings, especially those that meet high quality standards for treatment-comparison and single case design (SCD) research studies. Stenhoff and Lignugraris/Kraft assert that peer tutoring is an intervention that allows all students to receive individual attention and immediate feedback, which teachers cannot provide with large class sizes. They also note that researchers should carefully consider training as it may help produce the largest effects. Okilwa and Shelby reviewed the academic effects
of peer tutoring with secondary students and reported positive outcomes across settings (i.e., general education and special education), disability types, basic skills in a variety of academic content areas, and measurement types (i.e., standardized or researcher developed). Wexler et al. was the only reviewer to examine social validity findings across studies. Specifically, they concluded that secondary students and teachers believed that peer tutoring interventions were beneficial to learning, and students, in several studies, indicated that they enjoyed participating in PMIs. Additionally, teachers reported that they believed participation in a PMI decreased discipline problems and increased student engagement. Overall, reviewers’ findings regarding peer tutoring in secondary grades corroborates previous positive findings favoring peer tutoring interventions in the elementary grades.

Scruggs, Mastropieri, Berkeley, and Graetz, (2010) published a meta-analysis that reported the effects of special education interventions on the content learning of secondary students. Scruggs and colleagues identified a total of 70 research studies, five of which utilized peer tutoring in secondary schools. In all five studies, reciprocal peer tutoring was implemented for the entire class producing a large mean effect size (ES = 0.86). Notably, only two (MacArthur, Ferretti, & Okolo, 2002; Mastropieri, Scruggs, & Graetz, 2005) of these studies were implemented in general education classrooms. In the first study, MacArthur et al. (2002) examined how peer tutoring might be used in a social studies classroom that included a special education teacher. The researchers created an eight-week, project based unit and divided the students into eight heterogeneous teams. Students were instructed to work in cooperative groups to prepare for a debate at the end
of the unit. Importantly, the groups were not provided any additional procedural training. MacArthur et al. reported that students with disabilities and their peers without disabilities increased academic content knowledge from pre to posttest as well as increased their social participation and academic engagement levels from baseline to intervention. In the second study, Mastropieri et al. (2005) examined the effects of classwide peer tutoring on students’ with learning disabilities performance on chemistry content tests. They found that students in the classwide tutoring condition outperformed their peers in the teacher led control condition on posttests of chemistry content knowledge.

One peer tutoring model that is particularly suited to inclusive secondary education classrooms is targeted student or unidirectional peer tutoring. In a targeted student or unidirectional peer tutoring model, students who are more advanced in a particular skill serve as tutors for students who need assistance learning identified concepts, applications, and skills. Importantly, in this peer tutoring model, tutors are not necessarily students in that content class and tutoring is implemented only for selected students. Although the research on unidirectional tutoring is limited, in a few studies researchers investigated the effects of targeted student peer tutoring on social outcomes for students with more severe disabilities in secondary settings (Carter, Cushing, Clark, & Kennedy, 2005; Carter, Moss, Hoffman, Chung, & Sisco, 2011; Carter, Sisco, Melekoglu, & Kurkowski, 2007; Hughes et al., 2000, 2002). There is also limited research on unidirectional peer tutoring that addresses the academic outcomes of students with severe disabilities (Collins, Branson, Hall, & Rankin, 2001), and there is no
published research on unidirectional peer tutoring that focuses on academic or social outcomes of secondary students with mild to moderate disabilities in general education classrooms.

The purpose of this study was to evaluate the effects of unidirectional peer tutoring on students’ with disabilities academic outcomes in a general education Secondary Mathematics I class. The primary and secondary research questions that will be addressed are:

**Primary Research Question**

1. To what extent will unidirectional peer tutoring increase tutees’ percent of problems correct on weekly algebra quizzes in a general education Secondary Mathematics I class?

**Secondary Research Questions**

2. To what extent does unidirectional peer tutoring increase tutees’ student profile variables including the quality and quantity of Secondary Mathematics I problems completed per day, and the percent of intervals of academic engaged time in a general education Secondary Mathematics I class?

3. How do tutees, tutors, and the general education teacher perceive the social desirability and effectiveness of unidirectional peer tutoring when delivered to students with learning disabilities in a Secondary Mathematics I class?
CHAPTER II
LITERATURE REVIEW

The purpose of this literature review is to examine the available research on peer tutoring efficacy conducted in secondary schools (i.e., grades 6th – 12th). An electronic search was conducted in Academic Search Premier, ERIC, and PsycINFO databases to locate studies published between 1997 and 2014. Terms and root words related to peer tutoring interventions (peer partner*, peer tutor*, peer mentor*, peer mediat*, peer support, peer pair*, peer interaction, peer learn*, peer-to-peer, peer instruct*, reciprocal teaching, reciprocal peer tutoring, peers as tutors, peer-assist*, tutor-tutee, peer response group*, unidirectional tutor* and secondary, middle school, high school) were used to locate relevant articles. The initial electronic search yielded 1,432 articles. These studies were reviewed to determine which studies met the following inclusion criteria: (a) published in a peer-reviewed journal between 1997 and 2014, (b) conducted in U.S. schools in grades 6 through 12 (i.e., secondary schools), (c) included students with disabilities as tutees, and (d) took place in a general education content class. Studies were excluded if the researchers examined a peer tutoring intervention as part of an intervention package, and thus, did not evaluate the effects of peer tutoring alone (e.g., Kennedy, Cushing, & Itkonen, 1997). Also, studies conducted in special education settings (Calhoon & Fuchs, 2003) were excluded. A total of 11 studies met the inclusion criteria and were included in this literature review.
Peer Tutoring Interventions in Middle and High Schools

The peer tutoring literature in middle and high schools may be divided into research on classwide tutoring systems and targeted student tutoring systems (see Figure 1). In classwide tutoring all students in a class participate in the tutoring intervention. Students tutor each other or work together as partners to complete assignments (Maheady et al., 1988). In these peer tutoring interventions, students of varying ability levels in a class are heterogeneously paired and participate in a reciprocal tutoring format. That is, students take turns tutoring one another to ensure that both students serve the role of a tutor and a tutee. This tutoring model has over 30 years of research associated with a host of positive outcomes for students with and without disabilities in elementary schools (Delquadri et al., 1983), but there is limited research in secondary schools (Bowman-Perrott, Greenwood, & Tapia, 2007; Okilwa & Shelby, 2010; Stenhoff & Lignugaris/Kraft, 2007).

More recently, researchers examined a targeted student peer tutoring model that is more amenable to middle school and high school general education classes (e.g., Carter et al., 2011). In targeted student peer tutoring interventions, the lowest performing students in the class usually receive tutoring. That is, one student with advanced skills in a content area (e.g., mathematics, reading, social skills), serves as the tutor exclusively, while the other student serves as the tutee (Gaustad, 1993). The tutor helps the tutee practice knowledge and skills that the teacher taught previously to the whole class. In a targeted student peer tutoring model, same-age or older peers may serve as tutors. Often the tutors completed the class previously and participate in the class exclusively as tutors for
targeted students.

Understandingly, there is no research available on cross-age reciprocal classwide tutoring in secondary schools because classes are often available to students by grade level, especially core content classes. Therefore, an entire class of students at another grade level or age is typically not available to participate in a cross-age, classwide model. In addition, it is not clear how younger students might benefit from tutoring older students. If the older students were performing at the same level as the younger students then the risk of unwanted stigma might outweigh the possible benefits of having younger students tutor older students. Similarly, there appears to be no available secondary peer tutoring research on the academic effects of classwide unidirectional tutoring models.

Figure 1. Conceptual framework of peer tutoring in middle and high school.
with cross-age or same age peers. Entire classes of older secondary peers may not be available on a regular basis to tutor individuals in another content class. In addition, some students in the content class may not require tutoring support.

**Classwide Peer Tutoring**

One hallmark of classwide reciprocal tutoring interventions conducted with same age peers is a formal student grouping procedure. In most classwide reciprocal tutoring models students are grouped heterogeneously with higher performing students paired with their lower performing counterparts (e.g., Calhoon & Fuchs, 2003; Fuchs, et al., 1997a). Typically, students in the class are rank ordered based on a specific variable (e.g., reading ability level) to form dyads or groups of students of mixed ability without pairing the lowest performers with the highest performers. For example, students can be formed into dyads by rank ordering students based on reading proficiency scores and separating the list into two columns. Teachers may then pair the student on the top of one column (i.e., higher performing) with the student on top of the second column (i.e., lower performing; see Fuchs et al., 1997a). The most common manualized classwide reciprocal interventions used with same age peers are Class-Wide Peer Tutoring (CWPT; Delquadri et al., 1983), and PALS (Fuchs et al., 1997b). In other peer tutoring interventions researchers often use the basic CWPT or PALS structure and then modify or add one or more procedures (see Mastropieri et al., 2001; Vaughn et al., 2009). Finally, all classwide peer tutoring interventions have specific procedures that the students are trained to implement (e.g., structured presentation, and error correction/feedback
Table 1

*Peer Tutoring Intervention Studies*

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants, Gender, Grade</th>
<th>SPED Status</th>
<th>Content</th>
<th>Ethnicity</th>
<th>Total Duration</th>
<th>Tutoring format</th>
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<tr>
<td>Study</td>
<td>Authors</td>
<td>Participants</td>
<td>Sessions</td>
<td>Targeted</td>
<td>Classwide</td>
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<td>8</td>
<td>Mastropieri, Scruggs, &amp; Graetz (2005)</td>
<td>P1: ID, S/L IMP, ID, S/L IMP, ID, S/L IMP, hearing IMP</td>
<td>N = 10 LD</td>
<td>Chemistry</td>
<td>N = 39 M = 19 F = 20</td>
<td>Range: 33 to 34.5 hours, 90 min periods over 9 weeks</td>
</tr>
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<td>9</td>
<td>Mastropieri, Scruggs, Norland, Berkeley, McDuffie, &amp; Halloran (2006)</td>
<td>P1: MOD ID, SEV ID, ID, ADD Science</td>
<td>N = 44 n = 37 LD n = 7 EBD</td>
<td>Science</td>
<td>N = 213, 8 th M = 109 F = 104</td>
<td>W = 44% B = 27% H = 17% A = 4% ME = 5%</td>
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<tr>
<th>Study</th>
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<td>Science</td>
<td>N = 213, 8 th M = 109 F = 104</td>
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Note. N = total number of participants; n = number of participants in the peer-mediated instruction; M = male; F = female; P = Participant; MOD = moderate; SEV = severe; ID = intellectual disability; S/L IMP = speech language impairment; LD = learning disability; LD = Learning Disabilities; EBD = emotional behavioral disorder; ADD = attention deficit disorder; PE = physical education, ELA = English Language Arts; A = Asian; B = Black; H = Hispanic; W = White; ME = mixed ethnicity; TBI = traumatic brain injury; ASD = autism spectrum disorder; NR = not reported.

procedures). Since these are classwide interventions and all students in the class need to implement the procedures, tutors are often taught simple, foundation instructional routines (see Lignugaris/Kraft & Harris, 2014, for a description of foundation instruction).
Descriptive information. Researchers in five of the 11 peer tutoring studies in this literature review implemented a classwide, reciprocal model using same age peers (Hughes & Fredrick, 2006; Mastropieri et al., 2005, 2006; McDonnell et al., 2001; Sideridis et al., 1997; see Table 1). A total of 264 participants were included in the five reciprocal, classwide tutoring studies. Hughes and Fredrick (2006) included two black students and one white student in their study. McDonnell et al. (2001) included 2 White students and one Hispanic student whereas Mastropieri et al. (2006) indicated that out of the 213 participants, 44% were White, 27% were Black, 17% were Hispanic, 4% were Asian, and 5% were Multiracial. Mastropieri et al. (2005) reported that their sample included a wide range of racial and ethnic backgrounds and Sideridis et al. (1997) did not report or comment on ethnicity data in their participant sample. In four of these classwide tutoring studies, researchers employed their tutoring intervention with students with learning disabilities. In addition, Mastropieri and colleagues (2006) included seven students with emotional and behavioral disorders, while Sideridis et al. (1997) included one student with educable mental retardation and attention deficit disorder. McDonnell et al. (2001) reported that participants had moderate to profound intellectual disabilities.

Hughes and Fredrick (2006) and Sideridis et al. (1997) implemented their classwide peer tutoring models in a 6th grade English language arts class, where they examined the effects of peer tutoring on participants’ academic performance on vocabulary word sets. McDonnell et al. (2001) implemented CWPT in a pre-algebra class, physical education class, and history class examining participant’s academic performance on content posttests in each class. Mastropieri et al. (2006) implemented
their tutoring intervention in an 8th grade science classroom examining participant’s performance on science content unit tests and science high stakes, end of year state tests. Finally, Mastropieri et al. (2005) implemented their classwide peer tutoring model in a 10th grade general education chemistry class and investigated if students in the peer tutoring treatment condition performed better on chemistry post-tests than students in the typical instruction control condition.

There was a range of treatment lengths and durations across four of the classwide studies. Hughes and Fredrick (2006) had the shortest treatment duration ranging from 5.7 hours to 6.3 hours. More specifically, they implemented CWPT for 20 minutes each day for 17, 19, and 17 days for students one, two, and three, respectively. Sideridis et al. (1997) provided treatment for 18 total hours, which took place over 36 days for 30 minute sessions. Mastropieri et al. (2005) peer mediated intervention ranged from 33 to 34.5 hours, and was implemented over a 9-week period. Mastropieri and colleagues (2006) had the longest treatment duration, a total of 81 hours. The tutoring intervention was implemented daily for a total of 12 weeks, with 90 minutes sessions 4 days a week and a 45-minute session one day a week. Their total treatment duration is over three times the amount of hours that Sideridis and colleagues (1997) intervened and 13.5 times longer than Hughes and Fredrick’s total duration. McDonnell et al. (2001) did not report session length, which prevented calculating the total duration of the treatment.

Mastropieri et al. (2006) utilized a treatment comparison research design to study the effects of peer tutoring on participant’s performance on unit and statewide science content area tests. Sideridis et al. (1997) employed an ABAB reversal SCD to evaluate
CWPT on tutees academic performance (i.e., spelling tests) and social outcomes (i.e., social interaction and academic responding). Hughes and Frederick (2006) and McDonnell et al. (2001) both utilized a multiple probe design to examine the effects CWPT had on their participants. Mastropieri et al. (2005) employed a repeated measures ANOVA of science content post-tests.

**Classwide Peer Tutoring Intervention Procedures**

In three of the classwide studies the researchers utilized a standard CWPT intervention (Hughes & Fredrick, 2006; McDonnell et al., 2001; Sideridis et al., 1997). In the standard CWPT model students are grouped heterogeneously with higher students paired with their less advanced peers. Generally, tutor-tutee pairings are rotated weekly or biweekly. Tutor roles are highly scripted to ensure tutees receive frequent distributed response trials in a consistent format and to ensure that tutors apply a standard error correction procedure to tutee errors. Typically tutors provide the prescribed instruction to their partner, assess the correctness of tutee responses, praise correct tutee responses or correct tutee errors. To correct tutee errors, tutors typically prompt the tutee to verbalize or write the correct response multiple times (i.e., 3) before moving on to the next trial. CWPT usually includes a competitive feature where students are assigned to teams and earn individual and team points based on correct responses to determine weekly winners. At the end of the week, teachers and peers recognize the winning teams as well as individual students for their performance. Both Hughes and Fredrick (2006) and Sideridis et al. (1997) used this standard procedure in their classwide peer tutoring studies. Hughes and Frederick also awarded bonus points to tutors for demonstrating good tutoring
behavior. McDonnell and colleagues (2001) extended the CWPT procedure to teams of three participants who performed three roles - tutor, tutee, and observer. This was done to accommodate the differences in communication and academic skills of students with low incidence disabilities and their higher performing peers. Generally, two higher performing peers were paired with a student with severe intellectual disabilities. If the student with disabilities was unable to perform any of their duties (e.g., read the problem, determine if the tutee’s answer was correct) as either the tutor, tutee, or observer, the two higher performing students assisted the student with disabilities in fulfilling their responsibility in their specified role.

In addition to implementing CWPT, Hughes and Fredrick (2006) had tutors implement a constant time delay (CTD) procedure. In the CTD procedure the tutor initially provided the correct answer immediately following the task request (i.e., 0-s delay trials) for a predetermined number of trials. During subsequent trials, the tutor delayed providing the answer (e.g., 3 – 5 s delay) to give the tutee an opportunity to respond. The tutor then systematically extended the delay to promote independent responding.

Similar to the CWPT structure, Mastropieri et al. (2005, 2006) used a heterogeneous pairing procedure and ensured that students with disabilities were paired with stronger students who served as tutors first in the reciprocal format. In both studies, student pairs were instructed to complete differentiated science activities (e.g., worksheets) using hands on researcher created curriculum enhancement materials. Student pairs proceeded through materials independent of teacher assistance and recorded
their performance on recording sheets often moving from easier to more difficult material. Mastropieri and colleagues (2005) embedded mnemonic strategies and other verbal elaborations into their peer mediated intervention. Mastropieri et al. (2006) created three levels of materials for each concept so students who needed more support could access differentiated materials independent of the teacher.

**Fidelity**

Fidelity was reported in two of the five classwide reciprocal tutoring studies (Hughes & Fredrick, 2006; Sideridis et al., 1997). Hughes and Fredrick (2006) measured the teacher’s treatment fidelity before teachers trained the peer tutors, and measured peer tutor’s fidelity during training as well as during the treatment phases. Interobserver reliability of treatment integrity data was 100%. Sideridis and colleagues (1997) used Greenwood et al.’s (1998) 35-item CWPT fidelity checklist. Fidelity of implementation was reported at a mean of 98% with a range of 95 to 100%.

**Classwide Peer Tutoring Study Outcomes**

In the five classwide tutoring studies the researchers examined the effect of classwide peer tutoring on academic outcomes. In addition, McDonnell and colleagues (2001) and Sideridis et al. (1997) examined the effect of classwide peer tutoring on tutee’s academic engagement. McDonnell and colleagues (2001) found that all three students increased their academic engagement (e.g., writing, reading aloud) while they decreased competing negative behaviors (e.g., aggression toward others, disruption). McDonnell et al. (2001) also reported the average treatment posttest score of each student
but did not collect students’ baseline scores on content unit tests so it was not possible to interpret what effect CWPT had on the participant’s academic performance. Sideridis et al. (1997) reported that two of the three students increased their academic engagement (i.e., writing, reading aloud, reading silently, academic talk, task participation) an average of 46% and 57% of intervals from baseline to the CWPT treatment conditions. Academically, spelling accuracy also increased during the peer support condition. The average percent of spelling score improvement from baseline to treatment ranged from 36% to 42% across students. Lastly, all three students increased the duration and frequency of social interaction with peers from baseline phases to treatment phases. Student one displayed positive social interactions an average of 5.5% of the session time in baseline and average of 88% of the session time during treatment phases. Student two displayed positive social interaction an average of 6% of the session time in baseline and an average of 79% of the session time during treatment phases, while student three displayed social interaction an average of 26% of the session time in baseline and an average of 87.5% in CWPT intervention phases. Hughes and Fredrick (2006) reported that all three students increased the percent of vocabulary words correct across three word sets after receiving the tutoring intervention. Mastropieri and colleagues (2005, 2006) reported significant main effects on their measure. Mastropieri et al. (2006) measured a 34-question science unit posttest and the high stakes science test given annually. The effect size was moderate for both the science test (Cohen $d = 0.41$) and the statewide high stakes science test ($d = 0.35$). Mastropieri et al. (2005) reported a
42.5% gain for students with disabilities in the peer-mediated condition compared to the control condition.

**Maintenance**

Researchers examined the maintenance of academic gains in only one study. Hughes and Fredrick (2006) reported that student two maintained mastery on all 14 vocabulary word sets and student three maintained 13 of 14 vocabulary word sets. Alternatively, student one did not maintain mastery on probes for vocabulary sets B and C but maintained mastery on 4 of 7 probes for set A.

**Targeted Student Peer Tutoring**

Targeted student peer tutoring is provided in general education settings using a unidirectional tutoring format. That is, a high performing peer tutors a lower achieving tutee. All of the targeted student peer tutoring studies included tutees with low incidence disabilities. Both cross-age and same age peers are utilized as tutees across these studies. Selection of tutors is generally based on the ability level and the willingness of tutors to support their peers with low incidence disabilities. In contrast to classwide reciprocal tutoring interventions, in targeted student peer tutoring models that offer a unidirectional approach, tutors are often required to select instructional procedures that fit the instructional context rather than simply implement an instructional script. For example, Carter et al. (2011) trained their peer tutors to use strategies from a menu of supports, giving them the autonomy to choose the support procedure that was the best contextual fit for the activity they were engaged in. This flexible and adaptable format is essential for
peer tutors when they are expected to deliver support in settings in which the new content changes frequently and may require tutors to adjust their instructional routine.

Targeted student peer tutoring interventions have become more commonplace, especially in secondary schools, as practitioners look for solutions to provide academic support to struggling students. Despite the apparent growing use of this practice, there are few research studies that utilize a unidirectional tutoring format especially those that focus on academic outcomes for students with high incidence disabilities.

**Descriptive Information**

Six of the 11 studies in this literature review feature a unidirectional tutoring format for targeted students (Carter et al., 2005, 2007, 2011; Collins et al., 2001; Hughes et al., 2000, 2002). The total number of participants across all targeted student peer tutoring studies is 23 students. In two of the six of the targeted student peer tutoring studies, the authors did not report the ethnicity of their participants (Collins et al., 2001; Hughes et al., 2002). In the four remaining studies, researchers identified 8 participants as White and five as Black.

In five of the six targeted student peer tutoring studies, all or some of the participants had an intellectual disability (ID), and additional complicating disabilities (e.g., Prader-Willi syndrome, profound hearing loss, impaired vision, or hemiplegia). Hughes et al. (2000) included participants with a language/speech impairment. In addition, three of the five participants in Hughes et al. (2002) were labeled ID and one participant was diagnosed with Autism, learning disabilities, and also having a language impairment.
In four of the six studies, authors provided participant grade levels in secondary settings (i.e., 6th to 12th grade) with 11th graders participating most frequently \( (n = 4 \text{ total participants}) \). Two researchers did not report grade levels (Hughes et al., 2000, 2002). Science and English language arts were the only core content areas represented across the six targeted student unidirectional tutoring studies. However, targeted student peer tutoring studies were conducted in elective classes (e.g., culinary class, physical education, art) and during lunch more often than in core classes. The fact that an overwhelming majority of studies take place in elective classes, a setting that allows for more communication opportunities, is not surprising given that five of the six targeted student peer tutoring studies included measures of social skill outcomes.

Of the six targeted student peer tutoring studies in this literature review, the authors of four studies provide enough information to determine the amount of total time participants spent in treatment conditions (Carter et al., 2005, 2007, 2011; Hughes et al., 2000). Hughes et al. (2000) reported the shortest total treatment duration, which ranged from 1.1 to 4.4 hours. Carter and colleagues (2007) employed the longest treatment duration at 5.8 hours to 20.8 hours followed by Carter and colleagues (2011) that ranged from 7.5 hours to 14.2 hours. Lastly, Carter and colleagues (2005) reported that students in the treatment group received 8.3 hours of total treatment duration. Hughes et al. (2002) did not provide session length and one author reported that the participants only stayed in the general education classroom long enough to finish their writing assignment but no session length was provided (Collins et al., 2001).
The researchers in the six targeted student peer tutoring studies used an SCD. Carter et al. (2007, 2011) and Hughes et al. (2000, 2002) employed a multiple baseline design (MBD) in their unidirectional tutoring studies. Collins et al. (2001) utilized a multiple probe design and Carter and colleagues (2005) employed a reversal design.

In five of the six targeted student peer tutoring studies, researchers evaluated social/behavioral outcomes (Carter et al., 2005, 2007, 2011; Hughes et al., 2000, 2002) and Collins et al. (2001) examined academic outcomes, more specifically, the effects of unidirectional tutoring on tutee’s letter writing development.

**Targeted Student Peer Tutoring Intervention Procedures**

In all six targeted student peer tutoring studies the authors utilized researcher developed, unidirectional tutoring interventions. The researchers in 4 of the 6 targeted student peer tutoring intervention studies featured peers that were concurrently enrolled in the same class as their peers with disabilities (Carter et al., 2005, 2007, 2011; Collins et al., 2001). In the remaining two studies, Hughes et al. (2000, 2002) utilized peers that were enrolled in a one-credit elective peer buddy class in which the students were expected to spend at least one class period per day interacting with students with disabilities.

In general, the tutoring procedures used in the targeted student peer tutoring studies are more complex than those used in classwide peer tutoring studies. Moreover, tutors are often given the autonomy to decide which strategy should be delivered based on a particular situation. Tutors are then provided feedback based on their decision-making and strategy implementation. In two targeted student peer tutoring studies, Carter
and colleagues (2005, 2007) recruited peer tutors and provided initial training that lasted between 2 and 4 days. During this training, peers were instructed to sit next to students they were supporting and adapt class activities, provide instruction related to IEP goals, implement relevant behavior intervention plans, and promote communication between students with disabilities and their nondisabled general education peers. To accomplish these tasks, tutors were taught to use a range of instructional procedures including rewording and paraphrasing questions, breaking assignments into smaller tasks, facilitating partial participation in class activities, prompting students to interact socially, extending conversational turns, redirecting inappropriate conversations, praising correct answers, providing corrective feedback on class activities, introducing partners to other classmates, and highlighting shared interests and commonalities with other students.

After training, the tutors continued to receive ongoing feedback regarding their implementation of the strategies. Carter et al. (2007) reported that tutors were taught to provide periodic support and that maintaining completion of their own work was a priority. Furthermore, they were told to ask paraprofessionals and teachers for assistance or information as needed. Carter and colleagues (2011) provided tutors with a menu that included academic-related supports \((n = 16)\), social supports \((n = 7)\) or other supports \((n = 3)\). Examples of academic-related supports are; helping check the accuracy of assignments, sharing or assisting with note taking, explaining a key concept or how to solve a problem, or modifying/adapting assignments. Examples of social supports are; facilitating interaction with other classmates, explicitly teaching specific social-related goals, and providing emotional support or giving advice. Lastly, other supports examples
include helping tutees self-manage their behavior, explain/demonstrate specific classroom rules, and explain the class schedule.

Collins and colleagues (2001) used peer tutors as teacher instructional assistants throughout the study. As instructional assistants, the tutors helped the teacher implement tutees instructional program. The tutors prompted the tutees through trials, both in baseline and treatment phases, and included the following procedures: (a) initiate the session (i.e., tutor prompted tutee to enter the class, take a seat, and raise hand to signal teacher they were ready for the day’s assignment), (b) prompt the tutee with a general attention cue (i.e., previews the assignment for the day is, reminds the tutee that they can ask the peer tutor for help if needed and asks “are you ready?”), (c) wait for an attending response from tutee (i.e., tutee nods head, makes affirmative reply), (d) present the task directive (i.e., tells the tutee to begin the letter writing task), (e) give tutee a 5 second response interval to initiate the first component of the letter, (f) help with assignment completion (i.e., assists with spelling after tutee stops writing for 5 seconds or indicates they are finished, (g) terminate trial (i.e., tutor prompts tutee to raise hand to signal to the teacher that the assignment is complete), and (h) terminate the session (i.e., teacher reads the letter and gives non-contingent praise for performance). During the treatment condition, Collins and colleagues added the system of least prompts (SLP) as an error correction strategy. The least prompt hierarchy proceeded from independent task completion to a tutor verbal direction (e.g., tutor/instructor prompts the tutee to “skip a line under the date and write ‘Dear John’, on the left side of the paper.”), a tutor gesture (e.g., verbal direction in combination with pointing to the correct line on the left side of
the paper), a tutor model (e.g., verbal direction and model of a paragraph on piece of paper), and if necessary, tutor physical guidance (e.g., verbal direction and guidance of the student’s hand in writing the date). The tutor delivered descriptive praise on a continuous reinforcement schedule until the participant met a criterion of 100% correct, independent responses for one session. Praise was thinned to the end of the session until the participant met the criterion for two additional days. Importantly, it is not clear to what extent the peer tutors delivered instructional trials independent of the teacher or to what extent the peer tutors involvement with tutees was consistent from day to day.

Hughes et al. (2000) trained their peer tutors to utilize a self-prompted communication book in which they followed a series of five steps when working with their tutee. First, tutors presented a rationale for training and reaffirmed participants’ social goals. Second, tutors modeled how to use the communication book (look at the first picture in the book, point to the picture (i.e., self-prompting), ask the question represented by the picture). Tutors then waited for participants to respond, and if the tutee responded correctly, the tutor turned the page in the book. Peer tutors performed the same sequence with each picture in the book. Third, peer tutors provided instruction as tutees practiced self-prompting and asking questions using the book as demonstrated by the peer tutors. When tutees asked a question represented by a picture in their books, peer tutors responded. Fourth, tutees performed the self-prompted communication book sequence independently. Peer tutors continued to respond to participants' questions and provided prompting and corrective feedback only if a tutee failed to perform a step of the sequence. At the end of a session, tutors told tutees to use their books and ask questions
when talking to friends. In contrast, in Hughes et al. (2002) the independent variable was a direction to peer tutors to socially interact with peers. Hughes et al. (2000, 2002) reported that the students enrolled in the peer buddy class received no instruction from their teachers in how to interact socially with students with disabilities.

**Fidelity**

Researchers in five of the six targeted student peer tutoring studies reported fidelity (Carter et al., 2007, 2011; Collins et al., 2001; Hughes et al., 2000, 2002). Measuring fidelity of implementation is often difficult in targeted student peer tutoring research studies that offer a unidirectional format because tutors are given the freedom to adjust their instruction, and select instructional strategies based on participants responding or their perceived support needs. For example, in Collins et al. (2001) tutors needed to select the correct prompt level to use with tutees on each trial as well as deliver an appropriate consequence after the tutee’s response. Collins et al reported a mean fidelity of implementation index of 95%. Hughes et al. (2002) reported that intervention fidelity was measured across all sessions and that the intervention was implemented as intended during 100% of sessions. Hughes et al. (2000) reported that fidelity was assessed across 43% of treatment sessions that showed peer tutors performed their procedures at a mean of 97% with a range of 92% to 100%. Carter and colleagues (2007) did not measure fidelity of implementation of the tutoring procedures per se. Rather, Carter et al., (2007) measured the percentage of intervals participants with disabilities were in proximity to their peer during intervention. Finally, Carter et al. (2011) used a researcher-created fidelity checklist that included three categories of supports (i.e.,
academic, social, and other) that tutors could select from to implement tutoring depending on the tutee’s response. Any support provided by the tutor not on the checklist was written in by hand.

**Targeted Student Peer Tutoring Study Outcomes**

In the five studies in which researchers examined social interaction outcomes, the authors reported increased social initiations from students with disabilities from baseline to treatment sessions. Carter and colleagues (2007) measured social outcome data during baseline and intervention conditions to gauge the effectiveness of peer support interventions. Peer tutors facilitated improvements in peer interaction outcomes across all four students compared to a baseline condition in which participants received adult supports.

Carter and colleagues (2005) investigated if pairing two peers with one tutee would increase the frequency and quality of social interactions more than pairing one peer and one tutee. The tutoring procedures (described above) in the baseline and treatment conditions were identical except during treatment two peers were paired with a student with a low incidence disability. The peers were told to share responsibilities with no effort by the school staff to equalize the support behaviors provided by each peer. Outcomes were mixed. Although adding two peers increased contact with the general education curriculum and social interactions with the assigned peer tutors, it did not increase social interactions with other classmates. Hughes et al. (2000) reported students with low incidence disabilities increased appropriate initiations with familiar (i.e., peer tutors) and unfamiliar (i.e., other general education students) typically developing peers.
Furthermore, Hughes et al. (2000, 2002) reported increases in the amount of conversational topics participants discussed and decreases in inappropriate initiations by participants. Hughes et al. (2002) also reported improvement in the quality (as measured by a rating system) as well as reciprocity of interaction (i.e., the amount of social exchanges initiated between tutor and tutee) of all five participants.

Collins et al. (2001) measured the effects of unidirectional tutoring on the academic performance of students with low incidence disabilities. Collins et al. reported improvement in letter writing skills for all students as they met criteria on the 4 writing skills in an average of 14 sessions (Range: 7 – 16).

In three of the six studies (Carter et al., 2005, 2007, 2011) researchers examined the effect of the targeted student peer tutoring intervention on various dimensions of academic engagement. Researchers were interested in whether a unidirectional peer tutoring intervention that supported tutees social interaction levels would have a negative effect on academic engagement. Overall, researchers reported that providing unidirectional peer tutoring did not decrease levels of academic engagement for students with low incidence disabilities in the intervention. Carter and colleagues, in all three studies, examined the percent of intervals of academic engagement and found high variability across baseline and intervention sessions. Academic engagement effects were reported with four of the 10 (40%) participants across all three Carter et al. studies. Thus, it is not clear to what extent unidirectional peer tutoring might systematically increase academic engagement for students with low incidence disabilities.
Maintenance

Two researchers that utilized targeted student peer tutoring interventions reported maintenance data (Collins et al., 2001; Hughes et al., 2000). Collins and colleagues (2001) reported that all three students maintained 1 to 3 letter-writing skills two weeks after the intervention and more impressively, 2 to 4 skills six-weeks after intervention. To assess maintenance, Hughes et al. (2000) withdrew the self-prompted communication book training on a variable session schedule. All five participants continued to initiate conversations appropriately and maintained at least a minimum expected performance rate (i.e., 2 initiations per minutes) using their self-prompted communication book. Percentage of intervals in which participants performed self-prompting steps maintained at a mean of 93% during maintenance. Percentage of intervals in which participants initiated conversation appropriately increased from a mean average across participants in treatment (79.4%) compared to maintenance phases (89.6%). Lastly, the percentage of intervals in which participants initiated conversation appropriately and partners responded also increased across participants from 81% in treatment to 88% during maintenance phases.

Summary

Researchers examined peer tutoring interventions over the past three decades, largely revealing positive outcomes, especially for students with disabilities (Mastropieri et al., 2006; Stenhoff & Lignugaris/Kraft, 2007). However, the majority of the peer tutoring literature addresses class wide reciprocal tutoring models conducted in
elementary settings. As students enter secondary settings, classroom and curriculum
demands increase (Haisley, Tell, & Andrews, 1981), which emphasizes the need for more
effective supports. Furthermore, secondary classroom settings usually contain more students than elementary classes and offer a wider range of ability levels as well as a variety of behavioral issues (Blatchford et al., 2011). Many teachers in secondary schools have difficulty finding effective ways to differentiate instruction and increase academic engagement for struggling students (Kosanovich, Reed, & Miller, 2010). Peer tutoring is one strategy that teachers can use during the independent practice phase of the instructional cycle to build fluency, individualize content, and provide increased opportunities to respond with timely on-going corrective feedback (Greenwood, Carta, & Kamps, 1990; Hattie & Timperley, 2007; Hudson et al., 1993). Despite secondary general educators’ reported frequent use of peer tutoring interventions (Gaustad, 1993; Maccini & Gagnon, 2006), there is limited, yet emerging evidence to support their use in the literature. In three peer tutoring reviews (Okilwa & Shelby, 2010; Stenhoff & Lignugaris/Kraft, 2007; Wexler et al., 2013) researchers asserted that a research to practice gap still largely exists in having practitioners utilize peer tutoring interventions to support their students’ learning in secondary schools.

A targeted student peer tutoring intervention that utilizes a unidirectional format may be particularly applicable for supporting students with disabilities in secondary settings. While research is available to support the effect of unidirectional peer tutoring on social skills with students with low incidence disabilities, there is a dearth of research on the effects of providing unidirectional peer tutoring to targeted students on academic
outcomes for students with low incidence disabilities and for students with mild to moderate disabilities. Okilwa and Shelby (2010) assert that “further research is definitely needed to establish the effectiveness of peer tutoring in introducing more complex cognitive strategies such as comprehension strategies, critical thinking, math concepts or application.” (p. 460). The purpose of the proposed research is to examine the effects of a targeted student peer tutoring intervention that feature a unidirectional format on the academic performance of students with high incidence disabilities educated in a general education mathematics classroom.
Chapter III
METHODS

Participants and Setting

Tutees

Potential participants were identified using a two-step process. First, a middle school special education teacher identified students with disabilities entering 9th grade who received mathematics instruction in an 8th grade general education class and had a good attendance history. Second, students with an individual educational program (IEP) scheduled into a general education Secondary Mathematics I class were individually contacted and asked if they were interested in receiving support from a peer in their general education mathematics class. Interested students’ parents were contacted to gain permission for participation in the study. Three students from a comprehensive high school in the Western United States qualified as tutees in this study. All participants were 15-year old 9th grade students and received their mathematics instruction in a co-taught, general education classroom. All students were identified as learning disabled and received special education services as part of their IEP.

Tutee Characteristics

Edward has a math IEP goal that focused on improving his math skills (i.e., all math standards by grade level) and includes retaking homework assignments and quizzes that he scored less than 60% on. Edward’s school day consisted of attending all general education classes with one “transition” class which is taught by a special education teacher and intended to allow Edward to receive supports and services as part of his IEP.

Thomas is a 15-year old Caucasian male who speaks English as his primary language. Thomas scored in the 45th percentile on the Test of Nonverbal Intelligence, 4th edition (2010). On the Wechsler Individual Achievement Test III (WIAT-III; 2009), Thomas’ composite score summary in the area of mathematics was in the 5th percentile. Thomas has a mathematics IEP goal that was written to increase his quiz scores by 2% each quarter. Out the 14 classes that Thomas was enrolled in during his freshman year, he received instruction in a special education setting for five of 14 classes, which included one transition class each semester.

Paulina is a 15-year old Hispanic female who is identified as a native Spanish speaker but no longer receives English instruction outside of the general education classroom. Paulina scored in the 37th percentile on the Test of Nonverbal Intelligence, 4th edition (2010). On the WIAT-III (2009) administered in 2014, Paula’s composite score summary in the area of mathematics was in the 2nd percentile. Paulina’s IEP includes a math goal that is written to address improving her math skills (i.e., all math standards by grade level) and includes retaking homework and quizzes that scored less than 60%. Paula was educated in a special education setting in four out of 14 classes, which included one transition class each semester.
**Tutor Recruitment and Pairing**

Four tutors participated in this study. An additional tutor was needed due to a tutor changing classes during the study. The high school counseling staff helped recruit tutors who had completed Secondary Mathematics I and had a history of high achievement in previous mathematics classes. Interested tutors then completed a teacher-developed Secondary Mathematics I pre-assessment test (See Appendix A) to ensure they were proficient with the mathematics content knowledge. A score of 85% or higher on this assessment was required to qualify as a tutor. All tutors enrolled in peer tutoring through the high school and earned high school elective credit. Given the option to enroll in SPED 1000, a concurrent enrollment class that high school students may take to receive college elective credit from Utah State University, one tutor completed the additional requirements to earn the university concurrent enrollment credit. When pairing tutors, gender was a consideration for two of the three tutees. When pairing Thomas with a tutor, the general education, special education, and the researcher decided that Thomas might respond better to a female tutor, and therefore, placed a senior girl of high social status with him. The general education teacher was also concerned about matching Paola with a male tutor due to Paola’s potential to engage in “flirtatious behavior”. However, after losing a female tutor at the semester, the only trained tutor that was available was a senior male.

**Setting**

This study was conducted in a 9th grade general education Secondary
Mathematics I class. The Utah State Office of Education (USOE; 2013) defined Secondary Mathematics I as an extension of the:

linear relationships, in part by contrasting them with exponential phenomenon, and in part by applying linear models to data that exhibit a linear trend. Students will use properties and theorems involving congruent figures to deepen and extend understanding of geometric knowledge. Algebraic and geometric ideas are tied together. Students will experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

The 50-minute class met from 9:20 am until 10:10 am and had 25 students enrolled during the first semester and 26 students enrolled during the second semester. The general education Secondary Mathematics I class also included a special education co-teacher to assist in the class. In the co-teaching arrangement, the special education teacher typically provided individual assistance to students during independent work time. When the general education teacher was not in the classroom the special education teacher took a leadership role, but she rarely provided content instruction in a whole class format. Based on anecdotal observations, no modified assignments, quizzes, or individualized interventions were delivered to students with IEPs during class time.

Typically, the general education teacher began the class with a starter activity. She used the starter activity to either review difficult content or introduce new material while encouraging students to take notes on the lesson in their notebooks. Next, the general education teacher transitioned to the daily lesson where she either continued with new content or reviewed previously taught mathematics concepts that she planned to include on the weekly quiz. Finally, the general education teacher assigned problems from the Secondary Mathematics I student workbooks or supplemental worksheets for students to complete during independent work time.
Dependent Variables

The primary dependent variable that was used to evaluate tutee performance was the percent correct on weekly mathematics quizzes. Secondary dependent variables included (a) quantity of Secondary Mathematics I problems completed per day, (b) quality of Secondary Mathematics I problems completed per day, and (c) the percent of academic engaged time.

Primary Dependent Variable

Students took a teacher developed quiz each week, usually on Wednesday, that addressed the mathematics concepts taught during the current week(s).

Weekly mathematics quizzes. Weekly mathematics quizzes consisted of 10 problems, presented in multiple-choice format that included four distractors. This format matches the format used on the state core test. On 2 of the 22 weekly quizzes, the teacher included fill in the blank and/or graphing problems that required a production response. On multiple choice questions students responded on a scantron form. After completing the quiz, students ran their scantron document through a reader that scored each problem, and electronically entered the student’s overall score into the teacher’s computer. The majority of questions pertained to mathematics concepts taught the previous week, however a varying number of questions were included on the weekly quiz that tested retention of mathematics concepts taught in previous weeks. Each problem on the weekly quiz was scored as correct or incorrect. A weekly test performance score was determined by dividing the total number of problems correct by the total number of problems.
available and multiplying by 100 to derive a percentage. On quizzes that were composed entirely of multiple choice problems, students might respond correctly to 2 or 3 problems by chance by randomly completing the scantron bubbles for the quiz.

**Secondary Dependent Variables**

Data on the quantity of mathematics problems completed during class each day, the quality of the student’s mathematics performance each day, and the student’s engaged time were used to construct an academic profile for each study participant. In addition, data were collected on the tutee’s peers engaged time. Finally, participants’ perceptions of the intervention were collected and reported.

**Quantity of mathematics problems completed per day.** Completed problems were any problem that had any evidence of work shown or an answer was provided. A daily score was calculated by dividing the number of completed items from Secondary Mathematics I student workbooks and supplementary materials, by the number of available problems.

**Quality of mathematics problems completed per day.** A quality rating score was assigned only to mathematics problems that were completed in class each day (i.e., any problem that has any evidence of work shown or an answer provided). All mathematics problems were dichotomously labeled as either problems that required written work or problems that did not require written work.

Mathematics problems that required students to show work were scored on a 3-point scale. A score of “0” was given when tutees did not show any written work when solving the problem and provided a wrong answer, or when a student partially completed
the question without recording an answer. A score of “1” was given when tutees provided the correct answer without showing any written work. An example of a “1” rating is if a student used a calculator to solve the problem correctly but did not show any written work in their workbook. A score of “1” was given when tutees completed a problem and provided written work (i.e., one or more written responses) but provided an incorrect answer. A different example of a “1” rating is if a student showed written work but made a calculation error that resulted in an incorrect answer. A score of “2” was given when tutees completed the problem, provided written work (i.e., one or more written responses), and provided the correct answer. An example of a “2” rating is if a student wrote the mathematics expression in their workbook/worksheet, transferred numbers on both sides of the equal sign, showed simple subtraction before completing the remainder of the problem on their calculator and provided a correct answer.

Mathematics problems that did not require written work were scored on a 2-point scale. Problems were assigned 0-points for an incorrect response or 2-points for a correct response. A daily quality rating was determined by adding the total amount of points earned for each problem divided by the total number of problems attempted. For example, if a student attempted 5 total problems and scored a total of 7 points, the student’s daily quality rating was 1.4. The student’s quality rating was then divided by 2.0 to calculate a percentage (see Appendix B for a detailed description of the work quality rating scale).

**Academic engagement.** Academic engagement was collected four days a week for one, 15-minute interval that represented either a middle or end of a class session (see
Appendix C for the data collection form). Academic engagement was defined as: (a) having eyes oriented toward relevant materials for the task (e.g., algebra squares), the peer tutor, the teacher, or her materials (e.g., white board) during teacher led instruction, (b) writing in a mathematics workbook/worksheet, (c) appropriate manipulation of relevant materials to complete assigned mathematics problems. Examples of included using a calculator to solve algebra problems, using a protractor to make straight lines on graph paper, using a compass to draw a circle, using mathematics tiles to solve problems, and using a pen/pencil to write. Non-examples of manipulations include using a pencil for anything but the writing process (e.g., tapping), stacking algebra tiles on top of one another, or using a protractor to flick garbage off a desk. Additionally, when a teacher direction was given (e.g., “Write these notes in your Secondary Mathematics I workbook please.”), the tutee must actively engage in the requested activity to be considered “on-task”. For example, if a tutee is simply looking at the teacher following a direction to write a formula in their mathematics workbooks, the tutee was considered off-task for that interval.

The duration of the class was 50 minutes on the regular bell schedule but occasionally, the class periods were shorter (i.e., 40 minutes) on an assembly or half day schedule. Academic engagement was evaluated during a 15-minute segment of the total class time using a 10-second interval momentary time sampling procedure. The class segment was identified by randomly drawing either the middle or end segment each day. The middle of class was defined as the second 15 minutes of class (i.e., 16 to 31 minutes) and the end of class was defined as the last 15 minutes of class (i.e., 32 to 47 minutes of
class). The last 3 minutes of class were not included in the end segment as students used that time to pack up their materials before the end of class.

A Motivator© that emits a vibration at the end of each 10-second interval was used to signal the observer to record the presence (“y”) or absence (“n”) of academic engagement behaviors. Tutees were observed in a random order. Prior to beginning the study, each tutee was assigned a number and 15-minute observation sequences were created using a random number generator. Two rules were applied when creating the observation scripts. First, each student may be observed on no more than two consecutive time samples. Second, each student must be identified for an equal number of time samples. If a tutee was absent the data collector continued to observe the interval and put an “x” in the cell in place of a “y” or “n”. One of three ordered scripts was chosen randomly before each observation period. Observations for academic engagement were conducted 4 days each week (excluding quiz day). If the class was not meeting because of a school wide event (e.g., pep rally) the observation was not conducted on that day.

**Social Validity**

Social validity is measured to assess the usefulness and the social desirability of interventions that produce changes in behavior (Kennedy, 1992). To measure the usefulness of the intervention, a normative comparison approach was utilized. To measure social desirability, tutors, tutees, and the general education teacher were surveyed about the intervention as well as their perceived outcomes (see Appendices D, E, and F).
To examine how tutees were performing relative to their peers, peer composite data were collected on weekly quiz scores and academic engagement. The general education teacher provided weekly quiz scores for all students in the Secondary Mathematics I class. Tutee performance was evaluated relative to the overall class peer performance. Academic engagement peer composite data were collected by randomly identifying a student who is not a participant in the study at the beginning of each observation period. The peer composite was identified based on location in the classroom without any identifying characteristics (e.g., name, performance level, class standing). Academic engagement data for the tutees and the non-participating student, were collected as part of an observation rotation described earlier for the tutees participating in the study. Prior to each observation period a new peer (based on classroom location) was identified randomly.

On all survey measures tutees, tutors, and the teacher indicated their degree of agreement or disagreement with survey questions using a 5-point Likert scale (e.g., strongly disagree to strongly agree). The tutee social validity measure is a 15-question researcher-developed survey designed to assess the tutee’s perceptions of the unidirectional tutoring intervention (see Appendix D). Statements that tutees responded to were grouped into one of three categories (a) perceptions of intervention effectiveness \((n = 4 \text{ questions})\), (b) value of the intervention specific academic coach \((n = 5 \text{ questions})\), (c) value of the intervention not the specific academic coach \((n = 5 \text{ questions})\), and other \((n = 1 \text{ question})\). Three open-ended questions were included to capture as much information about this intervention as possible.
The tutor social validity measure was a 15-question researcher-developed survey for assessing the tutor’s perceptions during their experience working as a tutor (see Appendix E). Tutor responses were grouped into one of four categories: (a) perception on their tutee’s mathematics ability ($n = 4$ questions), (b) confidence in implementing intervention components ($n = 4$ questions), (c) value of the intervention ($n = 4$ questions), and (d) other ($n = 3$ questions). Seven open-ended questions were also included to solicit additional information that could provide useful in future research studies.

The general education teacher’s social validity measure was an 11-question researcher-developed survey for assessing the teacher’s perceptions of the unidirectional tutoring intervention (see Appendix F). The general education teacher responses were grouped into one of three categories: (a) value of the intervention ($n = 4$ questions), (b) perceptions of intervention effectiveness ($n = 4$ questions), and (c) other ($n = 3$ questions). Three open-ended questions were included as well as space for the teacher to include comments below all questions to capture as much information about this intervention as possible.

**Independent Variable**

The independent variable is a prescriptive unidirectional tutoring protocol embedded with features of effective instruction. The prescriptive tutoring protocol includes two major components: a least-to-most support procedure and monitoring tutee performance.
Least-to-most Support Procedure

Tutors were taught to deliver support to their tutee using a least-to-most support procedure. By using this approach, tutees were afforded the opportunity to complete accurate work as independently as possible. The least amount of support was to monitor tutee’s accuracy while the tutee works independently. All other levels of support required that tutors implement additional support procedures. In the second level of support the tutor provided a self-correction prompt for the tutee to check their work to address an error. The tutors gave the tutee a few seconds (but no more than 10 seconds) to find the error and correct it independently. If the tutee could not identify the error, the tutors asked the tutee if s/he knows how to correct the error. If the tutee knew how to correct the error, then the tutee made the correction independently. If the tutee did not know how to correct the error, the tutor moved to the third level of support. In the third level of support, the tutor verbally described how to correct the error. Finally, if the tutee struggled to make the correction when s/he received a verbal description, the tutor provided the fourth, and most intensive level of support. In the fourth level of support the tutor divided the problem into small steps while providing a written model to help the tutee correct the error. While tutors provided a correct model, they described the steps needed to make the necessary correction or proceed toward a solution. After modeling and reviewing the solution with the tutee as needed, the tutor turned over the paper on which the problem is modeled and directed the tutee to complete the problem or the current step in their workbook. Importantly, tutors were trained to always begin at the least level of support regardless if they were addressing an error or providing initial
instruction. Thereafter, the tutors used their judgment to provide the least level of support needed for their tutee to correct an identified error.

**Progress Monitoring**

Throughout each tutoring session, tutors monitored their tutees’ progress and if necessary, recorded the type of support they provided to their tutee on each problem on the progress monitoring sheet (see Appendix G). For instance, tutors checked the “P” box to indicate if a tutee completed the problem correctly and independently. If support was necessary, tutors marked which type of support was provided (i.e., prompt to self correct, verbal description only, modeling + verbal description). Finally, tutors marked “finished” after they ensured the problem was completed accurately.

**Tutor Training**

The lead researcher provided tutor training which consisted of training in basic tutoring procedures as well as training in how to deliver the prescriptive tutoring framework.

**Basic Procedural Training**

This portion of the training included basic procedural expectations and required one, 50-minute class session. Specifically, basic procedural training included (a) teaching tutors general expectations such as arriving to class on time, (b) taking their seat next to their tutee, and (c) greeting their tutee with a friendly demeanor. The lead researcher showed tutors verbal and nonverbal tutee behavior that might indicate anxiety about
receiving help. Also, the lead researcher discussed with tutors approaches they could use to ease tutee’s anxiety.

Another important aspect on this training was to teach tutors how to maintain a positive relationship with their tutee. Tutors were expected to provide an academic support and were not expected to address undesirable behaviors such as off task behaviors, refusal to complete an assigned task, and inappropriate peer interaction. If a tutee exhibited an undesirable behavior, tutors were instructed to tell their tutee that they are available to lend academic support when s/he is ready to begin working. Tutors were also encouraged to share observations regarding problem behaviors with the lead researcher or general education teacher after the class is over so a responsive and effective solution could be made. Importantly, the general education and special education teacher were informed that the tutor’s role is only to lend academic assistance rather than address undesirable problem behaviors.

Tutors also received training on how to respectfully support their tutee. One strategy to ensure that this happened was for the tutor to deliver positive feedback to their tutee before telling them how they could improve the next time they are working on a mathematics problem or task/assignment. Tutors were taught to deliver positive feedback regarding the tutee’s work ethic and approach to the target task (e.g., “You’re doing a great job working through this rather difficult problem.”). Tutors were also instructed to keep all information, communication and events that take place during the tutoring session, confidential.
Last, tutors were instructed on how to conduct themselves during class. Specifically, tutors were told that during the class they should only interact with their tutee or the teacher, and that they may not use personnel electronic devices, work on things of a personal nature (e.g., homework) or engage in other tasks that are not directly associated with their tutoring placement. Finally, to qualify for tutoring, tutors took a short, multiple-choice quiz to demonstrate didactic mastery (i.e., 100%) of the basic procedures (See Appendix H). Tutors mean score on the quiz was a 95% (Range: 90 – 100%). Any question that was not answered correctly was reviewed before tutors were assigned to provide intervention.

**Prescriptive Tutoring Training**

Training tutors to provide specific mathematics content was divided into three parts. Tutors were taught how to (a) modify Secondary Mathematics I problems into small, sequential steps, (b) apply a least-to-most supports tutoring system that incorporates effective teaching practices such as increasing opportunities to respond, modeling, and issuing corrective and positive feedback, and (c) monitor the tutee’s progress utilizing a checklist. This training, with time for role-play and skill demonstration, took place over a 2-week period and before the first tutor was paired with a tutee.

**Training on modifying Secondary Mathematics I problems into small, sequential steps.** First, the researcher modeled how complex, multi-step Secondary Mathematics I problems can be broken down into small steps. Then, tutors practiced breaking down problems and compared their step-by-step process to a researcher-
developed standard. Tutors continued to practice breaking Secondary Mathematics I problems into steps until they demonstrated their analysis skill. Performance criteria was breaking down novel Secondary Mathematics I problems that were within two steps of the researcher-developed standard on two consecutive problems.

**Least-to-most support training.** Students were taught to use the 4-step, least-to-most support training model in order to increase the tutee’s independent performance. Initially, the lead researcher demonstrated how to modify a mathematics problem into small sequential steps and integrated the least-to-most support procedure while one of the peer tutors volunteered to role-play as the tutee. Then, tutors were given one of the Secondary Mathematics I problems that they broke into steps in part 1 of the training sequence, and asked to apply the least-to-most support strategy in a role-play scenario. During these practice sessions, the students who assumed the tutee’s role were instructed to make errors to provide tutors with practice delivering parts 1 and 2 of the tutoring process. The students took turns role-playing as tutor and tutee to practice applying the least-to-most support system and breaking problems into small sequential steps with a partner. Specifically, tutors were given Secondary Mathematics I problems and instructed to apply the least-to-most support strategy in a role-play and if the tutor decided the tutee needed to move to more intensive support, they would break down the problem into small sequential steps verbally or through a written model. Tutoring pairs continued to role-play until tutors demonstrated that they could break a complex problem into small, easy-to-comprehend steps while providing least-to-most supports for two consecutive Secondary Mathematics I problems.
Progress monitoring. Tutors were provided a folder containing progress monitoring sheets that included check boxes indicating the level of support they provided to the tutee for each Secondary Mathematics I problem (see Appendix G). The lead researcher modeled how to complete the progress monitoring sheet for a Secondary Mathematics I problem. Tutors were shown how to fill out the progress monitoring sheet and indicate whether the tutee completed each Secondary Mathematics I problem successfully and if required, what level of support was provided to the tutee. The tutors then practiced the entire tutoring process with one tutor role-playing as the tutee. The role-play included using the least-to-most support procedure, breaking a problem into steps, and correcting the tutee’s errors while progress monitoring. Tutors continued practicing the tutoring sequence while completing their progress monitoring sheet until they completed the tutoring sequence with 100% accuracy on two consecutive role-plays. Tutors completed this entire training sequence before they were placed with tutees in the mathematics class.

Research Design

This study was conducted using a multiple-baseline design across participants. After tutees were targeted for participation in this study, they entered the baseline phase. A minimum of three data points with a stable or decreasing trend in weekly quiz performance was required prior to initiating the tutoring intervention. After the tutee entered the tutoring intervention and demonstrated an improvement in their weekly quiz score, the peer tutoring intervention was initiated with the next tutor/tutee dyad that had
stable or a decreasing baseline trend in their weekly quiz scores. This process was repeated for subsequent participants. Delaying the baseline for the other participants allowed the lead researcher to demonstrate experimental control without withdrawing the tutoring intervention, which could be considered unethical, especially if the tutoring intervention yields successful results, or the tutee wished to continue working with their tutor.

**Procedures**

**Baseline Condition**

During the baseline condition, tutees participated in all class activities with the teacher. The teacher started the class with a daily warm-up that took approximately 5 to 10 minutes to complete. She then provided direct instruction on mathematics concepts before moving the students into independent practice. She usually provided direct support to students that asked for help or expressed difficulty after assigning independent work time. The 50-minute class consisted of approximately 20 to 35 minutes of teacher led instruction leaving 15 to 30 minutes of independent work time. During independent work time, students worked on Secondary Mathematics I problems individually or at times, in groups. The general education and special education teacher informed the class that they could ask for help when working independently or in groups.

Each week, typically on Wednesday, all students enrolled in the mathematics class took a quiz. On quiz day, students were presented with a quick starter activity before putting everything away except a pencil/pen, a calculator, the weekly quiz and the
scantron form to record their answers. Baseline data were collected until all tutees had taken a minimum of 3 weekly quizzes and one or more of the tutees showed low but stable performance data or a decreasing trend away from the therapeutic effect. Tutees were required to participate in at least three of four class sessions during the week prior to the quiz for their weekly quiz performance to be included as a data point.

**Peer Tutoring**

Similar to baseline, during teacher led instruction, tutees participated in all teacher directed lessons. The tutor began implementing the tutoring protocol when the teacher assigned the class to work on mathematics problems in their Secondary Mathematics I workbooks or on supplemental worksheets.

Initially, tutors asked tutees if they needed help before starting each item/problem. If tutees acknowledge that they would like help on an item, tutors then asked one or more clarifying questions (e.g., Did you read the question?; What is the question asking you to solve?; Do you know how to start?). Based on the tutee response, the tutor determined the least level of support the tutee required to successfully solve the problem (i.e., verbal description only or modeling with verbal description). If during progress monitoring the tutees made errors, tutors applied the tutoring protocol to assist the tutee.

Tutors were not available to tutees when they completed their quiz. The administration procedure for the weekly quiz was the same as used during baseline.

**Interobserver Agreement**

Interobserver agreement was collected on quality and quantity of daily work as
well as academic engaged time. Two data collectors independently scored 30% of the tutee’s daily Secondary Mathematics I work, and 25% of the tutee’s academic engaged time. One data collector was designated as the primary observer. For the quantity rating measure a two-step process was used to determine an interobserver agreement index.

First, both data collectors determined how many total points were available in the daily assignment. For example, some mathematics problems contained multiple opportunities to respond and thus, the observers agreed on how many points each problem was worth. Second, the observers independently scored whether each problem was attempted or not attempted. An agreement was defined as both data collectors scoring a problem as attempted or not attempted. A disagreement was defined as any problem scored differently by one of the two observers. An interobserver index for quantity of daily work attempted was calculated by dividing the number of agreements by the total number of problems available on the day’s assignment and multiplying by 100. The mean interobserver agreement for quantity was 92% with a range of 54% to 100%. The lowest interobserver agreement score (54%) occurred the second time the data collectors calculated reliability. The work sample with scoring procedures were reviewed with the data collectors and IOA scores improved to higher levels of reliability.

Interobserver agreement for the quality rating measure was also a two-step process. First, the data collectors determined which problems did and did not require written work to be shown. Second, data collectors graded each problem attempted and assigned a score (i.e., 0, 1, or 2 points) to each tutee’s response. When scoring the quality of daily work, an agreement was defined as both data collectors scoring the problem the
same (i.e., 1 point). A disagreement was defined as any problem scored differently by the two observers. An interobserver agreement index was calculated by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100. The mean interobserver agreement for scoring quality was 99% with a range of 83% - 100%.

Interobserver agreement on academic engagement was calculated on a sample-by-sample basis. Two data collectors independently completed the same observation sequence on 25% of the observation sessions. An agreement occurred when both observers recorded the same code (i.e., “y” or “n”) on a time sample. A disagreement occurred when observers recorded different codes on a time sample. An interobserver agreement index was calculated for each reliability observation by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100. The mean interobserver agreement for academic engagement was 95% with a range of 60% - 100%. The outlier data point (i.e., 60%) occurred during the first observation session on the peer composite. Specifically, the data collectors disagreed on whether the randomly drawn peer was academically engaged. The peer was located across the classroom, and one data collector’s view of the student was limited. After reviewing the data, a decision was made that if data collectors could not view the randomly selected peer, they would reposition themselves to gain a better view of the peer before starting data collection. If the data collectors could not re-position themselves to adequately view the peer the data collectors randomly drew another peer to observe on that day. Academic engagement reliability data improved substantially after making this adjustment to the data collection procedure.
Fidelity

Fidelity of implementation of the independent variable was measured using a fidelity checklist (see Appendix I). Fidelity of implementation was assessed on all mathematics problems during the independent work time for one randomly selected tutoring session each week. Fidelity scores were measured on each problem attempted by the tutee and tutor.

Fidelity of Implementation Training

The lead researcher familiarized a research assistant with the fidelity checklist by modeling how to fill it out as well as explaining how it is to be scored. The research assistant was trained to score the fidelity checklist by completing each scoring item with “yes”, “no”, or “N/A”. Boxes that were scored “yes” were counted as a correct display of implementing the independent variable with fidelity. Any box scored “no” was counted as an incorrect application of the independent variable. Any box marked “N/A” was omitted when scoring fidelity. The fidelity of implementation training coincided with tutor training so the research assistants could practice taking fidelity data as the tutoring dyads role-played the tutoring procedure. Research assistants practiced using the fidelity checklists until they demonstrated a reliability score of at least 85% on two consecutive fidelity checks.

Fidelity of Implementation Procedure

Tutor fidelity was measured on all mathematics problems attempted for one day a week using a randomized rotation to collect data on a selected tutoring dyad. A one-way
FM audio listening device was used to help capture fidelity of implementation procedures delivered from the tutor to the tutee to reduce potential reactivity from tutors and to minimize any potential unwanted attention brought to the tutoring dyads. Tutors wore a microphone lapel and battery pack attached to their clothing that allowed data collectors to listen in on conversation between the tutoring pair. Data collectors were positioned in an adjacent room that included a window with a view of the tutoring dyad and listened to the conversation between the tutor and tutee to collect fidelity data. Tutors were assigned a number when they began the tutoring intervention. Specifically, the tutor that was placed with a tutee first was assigned “1” and the second tutor placed with a tutee was assigned “2”. This process continued when each tutor began working with a tutee. Each week, a random number generator was used to select the tutor with a rule that no tutor would be observed on consecutive weeks. If the tutor that was randomly selected was absent on the fidelity check day, then the observer randomly selected another tutor to observe.

A fidelity of implementation index was calculated by dividing the number of tutoring behaviors implemented across mathematics problems by the number of expected tutoring behaviors across mathematics problems and multiplying by 100 to derive a percentage. For example, if the tutee and tutor worked on three mathematics problems and the tutor correctly implemented 27 of the 33 tutoring procedures of the tutoring intervention, the fidelity of implementation index for that session was 82%.

Reliability on the fidelity of implementation was taken on 25% of the fidelity observations. Two observers independently completed a fidelity observation checklist.
An interobserver agreement index was calculated for each reliability observation by dividing the number of agreements by the sum of agreements and disagreements and multiplying by 100.

The mean fidelity of implementation of the intervention was 92% with a range of 81% - 100%. The reliability of the fidelity measure was 85% with a range of 75% - 100%.

In addition to collecting objective fidelity of implementation data, tutors provided subjective information about what tutoring procedures they were implementing on their progress monitoring sheets (i.e., error correction procedure, verbal description, and modeling with verbal description; see Appendix G). Tutors were asked to date each page, include how many problems were completed each day, indicate if the tutee worked independently or if tutor support was required, and for every problem that the tutor provided support what level of support from the least-to-most support procedures (i.e., error correction, verbal description, modeling with verbal description) was implemented. Tutors 1 and 2 completed their progress monitoring sheets consistently whereas tutors 3 and 4 sporadically recorded information on the support they provided to their tutee. Tutors 1 and 2 appeared to vary their level of support throughout the intervention. For example, tutor 2 assisted with 7 of 8 total mathematics problems on November 20th and provided error correction on one mathematics problem, verbal description on two of the mathematics problems, and provided modeling on 5 of the mathematics problems. Alternatively, the following day tutor 2 assisted with all 8 mathematics problems by providing modeling on one problem and error correction on the remaining 7 mathematics
problems. This demonstrates that tutor 2 provided different types of support from problem to problem and day to day when delivering the tutoring intervention; thus, indicating that tutor 2 tailored tutoring support based on her tutee’s responses. A similar pattern of support was observed for tutor 1.
CHAPTER IV

RESULTS

The purpose of this study was to examine the effects of unidirectional tutoring on the academic outcomes of 9th grade students with learning disabilities in a general education mathematics class. Outcome data are presented on weekly mathematics quiz performance, quantity and quality of daily work completion, and academic engagement. Tutee’s weekly quiz scores are described in terms of criterion performance and relative to class peers.

To what extent will unidirectional peer tutoring increase tutees’ percent of problems correct on weekly algebra quizzes in a general education Secondary Mathematics I class?

Criterion Performance on Weekly Mathematics Quizzes

During baseline, Edward’s scores ranged from 30% to 40% with a median score of 40% (see Figure 2). During the tutoring intervention, Edward’s scores ranged from 40% to 100% with a median score of 60%. Edward exceeded his highest baseline quiz score on 16 of 18 weekly quizzes during tutoring. Notably, his quiz scores ranged between 40% and 70% on his first 10 quizzes, while his quiz scores met or exceeded 70% on 4 of his last 8 quizzes.

Thomas’ baseline scores are lower than Edward’s scores ranging from 20% to 60% with a median score of 30%. Thomas’ baseline scores are variable across sessions with an overall decreasing trend. During tutoring, Thomas’ quiz scores ranged from 30%
Figure 2. Criterion performance on weekly mathematics quizzes for Edward, Thomas, and Paulina.
to 80% with a median score of 55%. Similar to Edward, Thomas increased his median scores from baseline to treatment. Excluding the first two outlying baseline quizzes, Thomas exceeded his baseline quizzes on 12 of 14 weekly quizzes during tutoring. Thomas’ pattern of quiz performance was similar to Edward’s performance pattern. That is, his quiz scores ranged between 30% and 60% on his first 10 quizzes, while his quiz scores met or exceeded 60% on his last four quizzes. Notably, two of the last four quizzes addressed a new content area, geometry.

Paulina’s baseline median score ($Mdn = 35\%$) was lower than Edward’s but slightly higher than Thomas’ ranging from 10% to 50%. In addition, her baseline quiz performance was more variable than either Edward’s or Thomas’ baseline quiz performance. During the tutoring intervention, Paulina’s scores ranged from 30% to 60% ($Mdn = 60\%$). Similar to Edward and Thomas, Paulina increased her quiz scores from baseline to the tutoring intervention. While Edward and Thomas scored at or above 80% on several weekly quizzes, Paulina’s quiz score never exceeded 60%. Thus, her quiz scores from week to week during tutoring were less variable than either Edward’s or Thomas’ quiz performance. Paulina only completed 10 quizzes during peer tutoring. Thus, we did not have the opportunity to observe if Paulina’s performance would replicate Edward’s and Thomas’ performance after 10 quizzes. In fact, Paulina’s performance decreased on her last two quizzes when geometry was introduced. Overall, there was less variability in Paulina’s quiz scores during tutoring than during baseline.

**Normative Performance Relative to Class Peers on Weekly Quizzes**

Figure 3 shows the weekly mathematics quiz scores mean percentile rank in
relation to their peers’ performance in the mathematics class. Figure 4 shows the weekly quiz scores of each tutee in the mathematics class. In addition, the median score for the class on each quiz excluding the target student’s score is provided in both Figure 3 and Figure 4 for each baseline and tutoring quiz. As tutees entered tutoring, their scores were omitted from the pool of peer composite scores. The total number of students that were included in the peer composite varied from 20 to 27 due to absences on quiz day.

Peer weekly quiz scores ranged from 40% to 80% with a median of 60% over the course of the study. Edward’s scores during baseline (Mdn = 40%; Range = 30% to 40%) were considerably lower than the peer median scores. His baseline quiz scores ranged from the 12th percentile to the 32nd percentile (average across weekly quizzes = 21st percentile). During tutoring, Edward met or exceeded the median score in his class on 13 of 18 (72%) quizzes. His quiz scores during tutoring ranged from the 8th percentile to the 75th percentile (average across weekly quizzes = 66th percentile).

Similar to Edward, Thomas scored well below his peers during baseline. Thomas’ baseline quiz scores ranged from the 8th percentile to the 75th percentile (average across weekly quizzes = 28th percentile). He met or exceeded the class median on one quiz during baseline. During tutoring, Thomas met or exceeded the class median quiz score on 50% of his quizzes. Thomas’ quiz scores during tutoring ranged from the 29th percentile to the 95th percentile (average across weekly quizzes = 55th percentile).

Similar to Edward and Thomas, Paulina often scored below her peers’ median score on her weekly mathematics quizzes during baseline. Specifically, Paulina’s baseline quiz scores ranged from the 4th percentile to the 55th percentile (average across weekly
Figure 3. Normative Performance Percentile Rank Graphs. Closed circles indicate weekly quiz score percentile ranks for Edward, Thomas, Paulina. Open squares represent median scores of peer performance on weekly math quizzes.
quizzes = 27\textsuperscript{th} percentile). She met or exceeded the class median on two of 11 weekly quizzes during baseline. Paulina met or exceeded the class median quiz score on 3 of 10 quizzes when she received tutoring. Her quiz scores during tutoring ranged from the 24\textsuperscript{th} percentile to the 78\textsuperscript{th} percentile (average across quizzes = 48\textsuperscript{th} percentile).

To what extent does unidirectional peer tutoring increase tutees’ student profile variables including the quantity and quality of Secondary Mathematics I problems completed per day, and the percent of intervals of academic engaged time in a general education Secondary Mathematics I class?

The purpose of this research question is to describe how tutee’s daily work profile changed on three key variables, quantity of daily work completed, quality of work on the problems completed, and academic engaged time. Overall, during the tutoring intervention participants daily work habits changed substantially.

Daily work assignment data are presented on box and whisker graphs and academic engagement is presented on a continuous line graph. Percent of problems completed is calculated by dividing the number of completed Secondary Mathematics I problems by the number of available problems. Quality of work is calculated by adding the points earned on each completed problem, dividing by the total number of points possible on the assignment, and multiplying the result by 100. Academic engagement was measured using a 10–second momentary time sampling measure. Peer comparison data were collected during all observations by observing one randomly selected peer during each observation. Peer academic engagement was highly variable across observations ranging from 13\% to 100\% (\textit{Mdn} = 73\%; \textit{Std} = 22\%).
Figure 4. Normative Performance Class Median Graphs. Closed circles indicate weekly quiz scores for Edward, Thomas, and Paulina. Open squares represent median scores of peer performance on weekly math quizzes.
In Figure 5 through Figure 7 each tutee’s performance is presented on each profile variable.

During baseline, Edward completed three in-class assignments. He completed between 82% and 100% of the problems on those assignments ($Mdn = 91\%$). Of the problems completed, Edward’s work quality score ranged from 42% to 93% ($Mdn = 59\%$). Edward was academically engaged from 46% to 93% of intervals during baseline ($Mdn = 80\%$). He met or exceeded the median academic engagement of his peers on 6 of 8 observations. During baseline Edward completed most of his daily work and he was usually academically engaged more than most of his peers. However, the quality of his completed work varied greatly. During tutoring, Edward completed 32 daily assignments. He consistently completed his daily work ($Mdn = 100\%; \text{Range} = 42\% - 100\%$).

![Graphs](image)

Figure 5. Edward’s Profile Graphs. Variables include quantity, quality, and academic engagement for Edward. Quantity and quality are represented on a box & whisker graph (left) and academic engagement is represented on a continuous line graph (right).
Importantly, the quality of his work increased markedly ($Mdn = 96\%$; Range = $25\%$ - $100\%$). Edward’s academic engagement ranged from $69\%$ to $100\%$ of intervals during tutoring ($Mdn = 100\%$). This was above the median academic engagement of his peers on 32 of 33 observations. Overall, while receiving tutoring, Edward continued to complete most of the problems on his daily assignments and demonstrated high levels of academic engagement. However, the quality of his work increased substantially from baseline to tutoring.

During baseline, Thomas completed a total of eight in-class assignments. He completed between zero and $67\%$ of the problems on those assignments ($Mdn = 28\%$). Of the problems completed, Thomas’ work quality score ranged from zero to $100\%$ ($Mdn = \ldots$)

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**Figure 6.** Thomas’ Profile Graphs. Variables include quantity, quality, and academic engagement for Thomas. Quantity and quality are represented on a box & whisker graph (left) and academic engagement is represented on a continuous line graph (right).
Thomas was academically engaged from 7% to 93% of intervals during baseline (\(Mdn = 47\%\)). He met or exceeded the average academic engagement of his peers on only 1 of 17 observations. During baseline, Thomas completed less than a third of the assigned daily work. Moreover, his work was low quality, and he was less academically engaged compared to most of his peers. During tutoring, Thomas completed 23 daily assignments. He consistently completed his daily work (\(Mdn = 93\%; \) Range = 50\% - 100\%) and improved the quality of his work (\(Mdn = 93\%; \) Range = 80\% - 100\%). Thomas’ academic engagement ranged from 73\% to 100\% of intervals during peer tutoring (\(Mdn = 100\%\)). This was at or above the median academic engagement of his peers across all observations. Overall, while receiving tutoring, Thomas completed most of the problems on his daily assignments, with high quality, and was academically engaged more frequently than most of his peers.

\[\text{Figure 7. Paulina’s Profile Graphs. Variables include quantity, quality, and academic engagement for Paulina. Quantity and quality are represented on a box & whisker graph (left) and academic engagement is represented on a continuous line graph (right).}\]
During baseline, Paulina completed a total of 27 in-class assignments. She completed between zero and 100% of the problems on those assignments ($Mdn = 26\%$). Of the problems completed, Paulina’s work quality score ranged from zero to 100% ($Mdn = 56\%$). Paulina was academically engaged from 13% to 100% of intervals during baseline ($Mdn = 60\%$). This was above the median academic engagement of her peers on 11 of 42 observations. During baseline, Paulina completed less than a third of the assigned daily work, with low quality, and was often less academically engaged than her peers. During peer tutoring, Paulina completed 13 daily assignments. In contrast to baseline performance, Paulina completed most of her daily work ($Mdn = 77\%;$ Range = $35\% - 100\%$) and notably, improved the quality of her work ($Mdn = 96\%;$ Range = $60\% - 100\%$). Paulina’s academic engagement score ranged from 73% to 100% of intervals during peer tutoring ($Mdn = 93\%$). This was at or above the median academic engagement of her peers on all observations. Overall, during tutoring, Paulina completed most of the problems on her daily assignments, with high quality, and was academically engaged more frequently than most of her peers.

**Profile summary.** Overall the tutoring intervention resulted in improved quantity of work completed, improved quality of work completed, and increased academic engagement of tutees who showed two different types of baseline profiles. Thomas and Paulina had similar student profiles during baseline, completing few problems with low quality, and high variability in regard to academic engagement. In general, they were less academically engaged than their peers and showed a decreasing academic engagement trend during baseline. In contrast to Thomas and Paulina’s baseline profile, Edward
completed most of the assigned daily work and displayed academic engagement levels comparable to most of his peers. However, the quality of his completed work was generally poor. Notably, Edward had only three assignments available during baseline so characterizations are speculative regarding the quantity and quality of his work.

*How do tutees, tutors, and the general education teacher perceive the social desirability and effectiveness of unidirectional peer tutoring when delivered to students with learning disabilities in a Secondary Mathematics I class?*

Tutee, tutor, and teacher’s perceptions of the social desirability and effectiveness of the tutoring intervention were solicited using researcher-developed questionnaires. Tutees, tutors, and teachers responded to questions grouped into 3 or 4 broad categories. Tutee categories included: perceptions of intervention effectiveness, value of the intervention specific academic coach, value of the intervention not specific academic coach, and other. Three open-ended questions were included to capture as much information about this intervention as possible. Tutor categories included: perception on their tutee’s mathematics ability, confidence in implementing intervention components, value of the intervention, and other. The general education teacher categories included: value of the intervention, perceptions of intervention effectiveness, and other. Three open-ended questions were included to capture additional information about this intervention.

**Tutee’s Responses**

The three tutees that participated in the research study responded to questions consistently across all categories (see Table 2). Overall, all tutees agreed that the tutoring
was effective. However, tutees felt less confident that the intervention helped them on weekly quizzes compared to the tutor helping them stay on task, and complete work correctly as independently as possible. Tutees also indicated across all questions that they valued their specific tutor. All tutees strongly agreed with the statement “I like my tutor” and agreed that their tutors were critical to their success in mathematics class, were knowledgeable with the mathematics content, broke complex mathematics problems in smaller, easier to understand steps, and helped them understand mathematics concepts better. When asked what they liked most about working with their tutor, two of the three tutees responded that they understood mathematics better and the remaining tutee said “getting my work done and getting to know someone new”. One of the tutees responded that their tutor helped them understand mathematics better and helped her “stay on task.” Another tutee indicated that the tutor “helped me understand better than the teacher”.

All three tutees agreed that they valued the intervention regardless of their specific tutor. Two of three tutees strongly agreed they could be successful with any tutor. Moreover, two of the three tutees agreed that they would like to work with a tutor in mathematics, or another content area, next year. On the open ended questions, all tutees reported that they “liked everything”, when asked about participating in the research study. When asked what they liked least about working with a tutor, one tutee responded to this question by stating “the math”. The tutees had different answers when asked how they benefited most from working with a tutor. One tutee said, “It helps me better with learning and how to understand it [mathematics]”, while another tutor indicated, “by getting successful grades”, and the last tutee responded “I pay more
attention. I stay on task and it helps me more to stay focused and finish my work.”

Finally, all tutees strongly agreed that they would tell friends who needed help in mathematics about the tutoring intervention.

Last, tutees were asked if they were “concerned what other students in the class think when I work with a tutor”. Two of the three tutees had no concern about what

Table 2

*Tutee Social Validity Responses*

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>Tutee 1</th>
<th>Tutee 2</th>
<th>Tutee 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of effectiveness of</td>
<td>Working with an academic coach helped me complete my work correctly on</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>intervention</td>
<td>a daily basis.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Working with an academic coach helped me on weekly tests.</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Working with an academic coach helped me stay on task.</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>My academic coach allowed me to work as independently as possible and</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>only helped when</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of their specific Academic</td>
<td>Working with my academic coach was critical to my success in my math</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Coach</td>
<td>class.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>My academic coach was knowledgeable about the math content</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>My academic coach helped me understand math concepts better by the way</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>he/she explained them.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>My academic coach broke complex math problems into smaller, easier to</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>understand steps.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I liked my academic coach</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Value of intervention (not specific</td>
<td>I enjoy being taught math by an academic coach compared to being taught</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>to their academic coach)</td>
<td>by a teacher.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I could be successful with any academic coach</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>I would like to work with an academic coach in Secondary Math II next</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I would like to work with an academic coach next year in other subjects</td>
<td>4</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>too.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I would tell my friends about academic coaching if they told me they</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>needed academic help</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>I am concerned what other students in the class think when I work with</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>an academic coach.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
others in the class thought about them when they worked with a tutor. The third tutee provided a neutral response to the question.

**Tutor’s Responses**

The four tutors (two different tutors worked with Edward) were asked about several questions that related to four categories (see Table 3) as well as seven open-ended questions. The first category related to the perception of the tutee’s mathematics skills. All four tutors disagreed that their tutee worked independently and error free on most mathematics problems. They all strongly agreed that they provided verbal description on most problems compared to an error correction procedure (less intensive support) or modeling (i.e., most intensive support). The second category included questions that related to confidence implementing the intervention. All tutors expressed confidence in implementing the intervention and three of the four tutors strongly agreed that they had sufficient knowledge of the mathematics content. However, one tutor expressed that they could of “understood the math problems better” and that “sometimes I was relearning the math”. All tutors agreed that they felt they could break mathematics problems into smaller steps, and implement the least-to-most support system. Three of the four tutors felt confident implementing all features of the intervention simultaneously and one tutor provided a neutral response. However, one tutor did express that he could of done a better job “implementing the least to most” support procedures more. When asked about the value of the intervention, all tutors responded that they valued the intervention. Specifically, all tutors strongly agreed that they enjoyed working as a tutor and three tutors indicated they would like to work as a
tutor in Secondary Mathematics I in the future. Three of the tutors felt that they are interested in working as a tutor at a university, while one tutor was neutral. Three of the four tutors strongly agreed that they would recommend implementing the tutoring intervention to friends looking for a class to receive elective credit.

In the last category (i.e., other), all four tutors agreed that it was important to them

Table 3

*Tutor Social Validity Responses*

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>Tutor 1</th>
<th>Tutor 2</th>
<th>Tutor 3</th>
<th>Tutor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perception of tutee’s math skills</td>
<td>My peer worked independently and error free on most math problems</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>When I progress monitored, my peer frequently made mistakes</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>The peer I supported needed me to provide modeling on most problems</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>The peer I supported needed me to provide verbal description on most problems</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Confidence implementing the intervention</td>
<td>I enjoyed working as an academic coach in this research study.</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I would like to work as an academic coach in a Secondary Math I class in the future.</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I would be interested in working as an academic coach at the University level?</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I would recommend academic coaching to my friends who are looking for an elective credit</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Value of the intervention</td>
<td>I enjoyed working as an academic coach in this research study.</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I would like to work as an academic coach in a Secondary Math I class in the future.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I would be interested in working as an academic coach at the University level?</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I would recommend academic coaching to my friends who are looking for an elective credit</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>It was important to me how well my peer performed on their weekly quiz.</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>My peer’s quiz performance influenced my coaching the following week.</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>The peer I was assigned to coach appreciated my support.</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>
how their tutee performed on weekly quizzes. On an open-ended question, “What did you like most about the intervention?”, one tutor responded with “I liked helping my student and liked when his quiz scores improved”. Another tutor responded with “I liked helping my peer through his struggles and it helped me realize how much I enjoyed teaching and gave me ideas of what to study in college”. When tutors were asked what they liked least about tutoring, responses included “Sometimes it got boring sitting and waiting to be able to help my peer on an assignment” to “when they [tutees] don’t understand something they’ve already been taught” and “the class environment we were in was distracting”.

When asked what suggestions they might have to improve the tutoring intervention they all suggested that this intervention should be extended to more students that need academic help and that the tutees they supported should receive the tutoring intervention for a longer period of time. When asked “what are the most significant values or ability a tutor must possess that are essential to be a good academic coach?”, 3 of the 4 tutors responded with “being patient”. Finally, 3 of the 4 tutors indicated that they felt like their tutee appreciated their support and the remaining tutor responded neutral.

**General Education Teacher Responses**

The general education teacher responded favorably across all questions pertaining to the value of the intervention and effectiveness (see Table 4). She rated all positively stated researcher-developed questions as “strongly agree” except for two questions which she rated both “somewhat agree”. The questions she rated as “somewhat agree” regarded her seeing quiz score improvement when her students worked with a tutor and her confidence with implementing the intervention without researcher involvement. She
expressed confidence in her ability to manage the tutoring intervention but not as “smoothly and effectively” if she had to do it herself, without researcher support. She was enthusiastic about the tutoring intervention and indicated that tutoring helped her students “that lack confidence and motivation to even know where to began a math problem.” She indicated that her students would “give-up” but working with a tutor “helped them engage because they knew they had immediate help when needed”. This point relates to student motivation in that tutor support may motivate tutees that demonstrate such low proficiency scores in mathematics to accept the tutoring intervention. Also, the teacher reported that “tutors must have training in advance, be held accountable and need to be

Table 4

*General Education Teacher Social Validity Responses*

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of intervention</td>
<td>I enjoyed having academic coaches work with students in my classroom.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>The intervention the academic coaches implemented is important</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I would use academic coaches in a Secondary Math I class I taught in the future.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I would recommend academic coaching to my fellow educators who are looking for additional support for low performing students.</td>
<td>5</td>
</tr>
<tr>
<td>Perception of intervention</td>
<td>I saw improvement in daily work when students worked with an academic coach.</td>
<td>5</td>
</tr>
<tr>
<td>effectiveness</td>
<td>I saw improvement with academic engagement when students worked with an academic coach</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I saw improvement on weekly quizzes when students worked with an academic coach</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>I saw improvements with attitude/demeanor with respect to my math class when students worked with an academic coach</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>The academic coaches took their academic coaching position seriously.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>The peer appreciated their academic coach.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>I could implement Academic Coaching without the support of university personnel.</td>
<td>4</td>
</tr>
</tbody>
</table>
praised” as critical features for successful implementation of the tutoring program.

Finally, she mentioned “the only negative part of the program is when it was over.”
CHAPTER V
DISCUSSION

One primary dependent variable and three secondary variables were examined in this research study. The primary research question addressed whether a targeted student unidirectional peer tutoring intervention would help tutees increase their performance on weekly mathematics quizzes. The secondary dependent variables, quantity of mathematics problems completed, quality of mathematics problems completed, and academic engagement levels, were analyzed as potential variables that mediated tutees’ performance on the weekly mathematics quizzes. Tutees, tutors, and teacher responses to a social validity questionnaire provide insight into various participants’ perceptions of the peer tutoring intervention.

Summary of Research Findings

All three tutees in this research study improved their criterion performance on weekly mathematics quizzes during intervention. All three tutees increased their quantity of mathematics problems completed, their quality of work, and their academic engagement from baseline to the tutoring intervention.

Quiz Performance

Criterion performance on weekly quizzes were similar for two of the three tutees in the research study as both Edward and Thomas started to make more meaningful gains in weekly quiz scores after the 10th weekly quiz. It is possible that the higher scores
toward the end of the study resulted from a cumulative effect of peer tutoring. Unfortunately, the remaining tutee in the study, Paulina, only had 10 data points and thus, it is not clear if she would realize the same pattern of responding that both Edward and Thomas demonstrated as a result of tutoring after 10 weeks.

Confounding this potential pattern was the content changing from algebra to geometry. It is possible that the pattern of performance that Edward and Thomas demonstrated would emerge for Paulina if there was time available for additional tutoring in algebra or if the content did not change from algebra to geometry. The change in content raises new questions for future research, especially considering the performance of Paulina and Thomas on the two geometry quizzes. It is possible that Paulina lacked foundation knowledge in geometry, which could not be overcome with a tutoring intervention that focused primarily on procedural aspects of mathematics. It is also possible that her low geometry scores were because her tutor was less competent with geometry content than with algebra content. Finally, it is possible that Paulina’s performance could rebound to previous levels (i.e., 60%) on subsequent quizzes or it could improve over time as it did when she started the intervention. Alternatively, Thomas’ two quiz scores in geometry included his two highest scores when receiving tutoring. Thomas’ high scores on geometry quizzes could possibly be due to stronger prerequisite geometry skills as compared to his prerequisite algebra skills, but might also be a function of the tutoring he received compared to Paulina. It is possible that Thomas’ tutor felt more confident explaining geometry concepts than Paulina’s tutor. Nonetheless,
in future studies, researchers should not only explore unidirectional tutoring with other content domains, but also different topics within a content area.

During baseline phases, all three tutees scored well below their peers on weekly mathematics quizzes. During peer tutoring, Edward and Thomas frequently met or exceeded the median score of their peers. While Paulina met or exceeded her peer’s median performance at about the same rate during peer tutoring as during baseline. However, her average percentile rank in class increased from the 27th percentile during baseline to the 48th percentile during peer tutoring. These are encouraging outcomes for tutees who scored at the 1st, 5th, and 2nd percentile on the mathematics portion of standardized achievement tests that were administered to determine eligibility for special education services. This finding increases our confidence that this tutoring intervention has the capability to help low performing students improve their performance on weekly mathematics quizzes. However, it is important to remember that the tutees in this study improved their median quiz scores to only 60%. While tutees improved their performance relative to others in their class and relative to their baseline performance, mastery on mathematics concepts is typically viewed as 80% or higher and the tutees in this study did not reach mastery level.

Importantly, the median performance of other students in the class was also below what is typically viewed as mastery level performance. While we did not conduct systematic observations or evaluate the teacher’s or co-teacher’s classroom performance, it is possible that including more effective educational practices, such as targeted instruction and data-based decision making, in the general education setting may improve
the median class performance on quizzes. If this were to occur, it is not clear if a peer tutoring intervention that focuses primarily on the procedural aspects of mathematics performance would be sufficient to raise scores of students with very low entry skills to mastery levels. Similar to Calhoon and Fuchs (2003) who combined a peer-tutoring intervention (PALS) with CBMs, researchers might examine the effects of a targeted student tutoring intervention in combination with a teacher professional development package that focuses on increasing teachers’ use of effective educational practices in co-taught, general education classrooms. Despite the co-teaching arrangement, the general education teacher appeared to be the only credentialed staff that delivered content in the room. Better collaborative efforts between the credentialed and school site support staff could improve the instructional environment and thus, raise median class performance on quizzes.

The peer tutoring in this study addressed tutees’ performance of grade level complex knowledge (e.g., applications, problem solving, algebra concepts). Much of the peer tutoring literature in mathematics documents students with disabilities demonstrating moderate to large effects on measures of basic knowledge and negligible effects on measures of complex knowledge (Kroesbergen & Van Luit, 2003; Kunsch et al., 2007; Okilwa & Shelby, 2010). The weekly mathematics quizzes in the current study included complex knowledge problems as compared to basic knowledge problems (e.g., computation). However, conclusions regarding the effects of this peer tutoring intervention on acquisition of complex knowledge are speculative since the quizzes were teacher-developed and lacked reliability and concurrent validity with the state, Student
Assessment of Growth and Excellence (SAGE) measure or other standardized assessments. Furthermore, it is not clear if questions on the math quizzes were aligned with the practice problems students completed in the week leading up to the quiz. Future targeted student peer tutoring research in secondary schools should examine unidirectional tutoring interventions that include standardized measures that assess students with disabilities performance on measures of complex mathematics knowledge as well as carefully controlling classroom curriculum-based measures.

**Secondary Dependent Measures**

One novel feature of this research study that is absent in the tutoring literature was the investigation of how tutees’ daily work habits change during the peer tutoring intervention (quantity of work completed, quality of work completed, and academic engagement). Two dependent variables that warrant the most salient attention are (a) quality of completed work paired with (b) academic engagement. Romberg (1980) defined academic learning time (ALT) as time spent by students engaged on a task in which few errors are produced (i.e., quality) and where the task is directly relevant to an academic outcome. Romberg posited that ALT is positively correlated with student achievement. However, Hofmeister and Lubke (1990) reported that ALT only accounts for 17% of the available time in the school day. Looking at engaged time and quality of work completed together might provide some insight as to why the tutees in this tutoring intervention made the observed gains on their weekly quiz performance. All three tutees’ median score during treatment was 93% or above for both quality of completed work and
academic achievement suggesting that tutees’ ALT was maximized when working with peer tutors.

It would be speculative to compare the ALT of peers to tutees since we only collected peer academic engagement data and did not collect data on peers’ quality of work. Peer academic engagement data was highly variable (Range: 13% - 100%) throughout the study. If both quality of work and academic engagement levels were highly variable, it might help explain why the median score of the class quizzes is fairly low (i.e., 60%). That is, high variability in academic engagement combined with inconsistent daily work quality might predict poor overall class performance. As discussed earlier, implementing effective instruction and management strategies within the class might generally increase tutees’ engaged time and quality of work. This improvement in ALT might lead to all students scoring higher on weekly quizzes, and thus increasing the class median score. This raises an interesting area for future research. Specifically, the extent to which a unidirectional peer tutoring intervention might be used to improve tutees’ quiz scores in mathematics classrooms with higher ALT levels than those observed in this classroom.

Limitation of Quantity and Quality of Work Measures

A limitation of this study in regards to collecting data on the quantity and quality of work was that the measure was limited to paper and pencil practice activities. At times the teacher had in class assignments where students were tasked to manipulate mathematics related items (e.g., algebra tiles, calculators). The quantity and quality measures used in this study did not capture if tutees attempted these tasks and if they did,
how well they completed these types of tasks during independent work time. Edward’s baseline data were most affected by this problem as these types of in class activities were frequently implemented toward the beginning of the academic year and decreased as the year progressed. During Edward’s baseline, activities using manipulatives were implemented frequently and thus, we were only able to collect hard copy evidence of completed work on three daily work assignments over the course of the first three weeks of the study. Given the few measures of quantity of work during baseline, Edward’s median baseline score on the quantity measure should be interpreted cautiously.

Another limitation in regards to the quantity of work completed measure was the dependency on (a) how much independent work time the teacher afforded and (b) the amount of problems assigned daily. For example, if the teacher gave the students under 10 minutes of independent work time and assigned 65 multi-step algebraic equations, the quantity scores would be low for that day regardless of the tutee’s effort level. One solution to more accurately reflect the tutee’s quantity of work would be to use a rate measure. Specifically, a rate measure could be employed to record how many problems are completed in a set time period (e.g., 1 minute, 5 minute interval). While a rate measure would adjust for daily time variation for independent practice, it would not account for the variability in the type of problems the tutee encountered during daily independent work time. For example, on one day the problems assigned might include multiple steps requiring more time per problem. Alternatively, on another day the problems might require few or no steps enabling the tutees to complete many problems in a short amount of time. Overall, a more precise quantity measure could be designed if the
teacher standardized the complexity of problems assigned daily (e.g., 5 multi-step problems and 5 problems that do not require the tutee to show work). In terms of this study, the percent of problems completed should be interpreted with caution.

Fidelity of Implementation

Implementation fidelity is a measure of the degree to which instruction is delivered as designed and as developers intended (Carroll et al., 2007). In reciprocal peer tutoring models, tutors implement relatively simple instructional routines (e.g., praise, error correction, question asking). Thus, it is relatively easy to detect if tutors are following an evidence-based tutoring protocol because tutors rarely need to make decisions regarding the type of instructional procedures to implement. In a unidirectional peer tutoring model at the secondary level, the tutor is expected to break problems into small parts and make decisions about the level of support the tutee requires. In many respects, tutors in the secondary grades need to make teacher level decisions when tutoring. Secondary tutors have demonstrated the ability to successfully meet this expectation. Carter et al. (2011), taught secondary tutors to select from a menu of three categories that subsequently included various types of support behaviors, including; academic-related supports \((n = 16)\), social-related supports \((n = 7)\), and other supports \((n = 3)\) to implement with their tutee depending on the instructional context and tutee response. In this context, fidelity of implementation was collected on the tutor via a researcher created fidelity checklist of the specific support behaviors provided the tutee. However, measuring fidelity of implementation with this type of targeted, unidirectional
tutoring intervention is complicated because of the expectation that the support provided was most appropriate based on the tutee response and instructional context. For instance, a tutoring fidelity measure for a targeted unidirectional tutoring intervention should measure whether the tutor implemented a strategy (when appropriate), whether the tutor chose the most efficacious support behavior given the tutee’s responding, and whether the tutor implemented the support correctly.

Fidelity of implementation for targeted student unidirectional peer tutoring interventions have evolved over time. In 2007, Carter and colleagues measured fidelity of implementation as the percentage of intervals that tutees were in close proximity to their peer tutor during intervention. In other words, Carter and colleagues were simply measuring if tutors and tutees were close to one another during the tutoring intervention. In more recent studies, Carter et al. (2011) evaluated whether the peer tutor implemented strategies from their list of supports. However, they did not measure whether the tutor chose the most efficacious support behavior given the tutee’s responding and whether the tutor implemented the support correctly. In the present study, we extended the fidelity of implementation collection procedures available in the literature by tasking the tutors to collect data on the procedures they implemented with their tutee on a per problem basis.

Collecting data on the level of support the tutor provides helps the tutoring facilitator (e.g., teacher, researcher, school site staff, etc.) decide if the tutor chose the most efficacious support behavior given the tutee’s responding. In essence, this procedure evaluates if the instructional support decisions the tutors make are appropriate given their tutees’ responses and thus lead toward successful tutee performance. After reviewing
tutor’s data collection sheets, the facilitator might confirm that the tutor is selecting a reasonable level of support to assist the tutee on a particular problem.

It may be necessary for the facilitator to provide additional training to help tutors make more appropriate decisions about which instructional support they should provide depending on tutee responding. For example, if a tutee does not demonstrate an improvement on his/her quiz performance, the facilitator might review the tutor’s monitoring forms to see what type of support was provided most frequently. If it was discovered that the tutor engaged in high levels of modeling and verbal description, (i.e., the most supportive tutoring procedure) on a majority of practice problems throughout the week with limited opportunities for the tutee to demonstrate successful completion of practice problems, then it may affect the tutee’s ability to perform successfully on an independent task, in this case, a weekly quiz. While this may not be the only reason why the tutee performed poorly on a quiz (e.g., poor prerequisite skill understanding, lack of procedural understanding, practice problems throughout the week were not in alignment with quiz questions) it provides information about how the tutor is conducting the tutoring session and might lead the facilitator to work with the tutor on helping the tutee solve problems with less support (e.g., verbal prompts alone or having the tutee complete smaller steps independently) to help the tutee demonstrate success on a measure of their independent abilities, such as the weekly quiz.

In another situation the tutee may make many errors and the monitoring form might show that the tutor only provided self-correction prompts. Thus, the tutor missed opportunities to help the tutee gain a clear procedural understanding of the steps required
to complete the problems. In this case the facilitator might work with the tutor on providing a model and verbal description of each mathematics step needed to solve the problem.

In this study, two tutors completed their data collection sheets consistently and two tutors completed their data collection sheets sporadically. As reported in the fidelity of implementation section the tutors who consistently collected these data demonstrated that they provided different levels of support (i.e., progress monitoring, error correction procedure, verbal description, and modeling with verbal description) to their tutee, which varied from problem to problem and day-to-day indicating that they did deliver the intervention as intended. However, there was no systematic procedure in this research study to determine if the tutors implemented the level of support that was most appropriate, given that tutors were directed to allow the tutee to work as independently as possible. Future targeted peer tutoring research should extend this type of fidelity of implementation measure and develop potential strategies to collect reliability measures on the tutor monitoring activities. This information might be used to ensure that the tutor employs the most appropriate level of support to produce the best tutee outcomes.

**Social Validity Findings**

Overall, tutees, tutors, and the general education teacher responded favorably to the tutoring intervention. This is important for a variety of reasons. First, even the most effective treatments applied with high levels of fidelity cannot be used if teachers do not value or agree to implement the intervention within their classrooms. The general
education teacher felt strongly about the value of the tutoring intervention. This sets the foundation to conduct additional research to explore the effects of this intervention.

Second, tutees must see value in the tutoring intervention to use the support effectively. Tutees reported that they valued the intervention, the support they were provided, and liked the tutors whom they worked with. Finally, because more advanced peers were the tutors, it is critical that the tutors responded favorably to implementing the tutoring. The four tutors responded favorably on the following (a) the value of the tutoring, (b) their confidence to implement the tutoring components, and (c) an interest to engage in some form of tutoring (i.e., high school or collegiate level) in the future. This again raises our confidence that more advanced peers may be interested in implementing the tutoring intervention with their peers with disabilities.

An aspect we did not examine in this research study was strategies for matching tutees with tutors. This is important to explore because if the tutee does not like working with the tutor this could ultimately compromise the effectiveness of the intervention. Certainly, the tutor’s behavior could play a role in whether the tutee likes working with the tutor so training and facilitation of matching tutors and tutees should be a critical consideration when designing future targeted tutoring interventions. Importantly, in this study tutees did not indicate that they were concerned about what their peers thought about them working with a tutor. The issue of how to best match tutors with tutees and integrate a unidirectional peer tutoring system into a high school inclusive classroom requires additional exploration. This is a critical variable because if the tutoring intervention is not socially desirable, meaning the tutees are not interested in working
with more advanced peers to receive support in the general education classroom, this intervention will not maximize its potential effectiveness. Training tutors how to minimize peer attention drawn to their tutees during the delivery of the intervention and how to respond to tutees in a way that makes them more willing to accept help from a more advanced peer could impact the success of this intervention. Overall, the tutees in this intervention did not perceive the intervention as stigmatizing. However, given the small sample size in this study and that it was limited to one high school, additional research is warranted to determine if other tutees perceive this intervention to be stigmatizing, and if so, develop additional strategies that will decrease any perceptions that could be stigmatizing to participate in this type of tutoring intervention.

The social status of a tutor is another potential factor that might be considered when matching tutors and tutees. While we did not formally collect data on tutees’ attendance and attitude, we observed interesting changes in Thomas’ attendance and attitude in the mathematics class after beginning the tutoring intervention. During baseline, Thomas frequently had his head on the table, verbalized a negative attitude about his mathematics class, and displayed poor grooming habits (e.g., uncombed hair, wore the same hooded sweatshirt for multiple days). Within the first few days of receiving his tutor, he expressed excitement about receiving help in mathematics to two of his special education teachers, started to arrive early to class, remained engaged throughout the period, and improved his grooming habits. Thomas’ tutor was a senior female with high social status. This tutor assignment may have contributed to many of the behavioral changes observed. Kunsch et al. (2007) indicated the need to investigate
the gender composition of tutoring pairs. Overall, in future investigations researchers should explore the dynamics of tutor matching to help inform practitioners and researchers of this important variable that may contribute to tutee success.

Another confirmation of the value of tutoring was that anytime that a tutee’s assigned tutor was absent the tutee always requested a substitute tutor. This suggests that tutees were not concerned with only working with a tutor that they have established a rapport with but were willing to work with an unfamiliar tutor in order to receive the tutoring intervention. In a future study it may be useful to explore this further by systematically giving tutees an active choice about whether they want a tutor on a daily basis. Another variable not directly studied but may have a meaningful influence on the success of the intervention is the tutor’s ownership of the tutee’s success on weekly mathematics quizzes. All four tutors indicated that it was important to them how well their tutee did on their weekly mathematics quiz. Specifically, when Edward scored 100% on one of his quizzes he was visibly excited when interacting with his tutor. He received congratulations and “high-fives” from his tutor, which attracted positive attention from his other classmates and joined in to celebrate his accomplishment. In addition, tutors would typically inquire how their tutee performed on the weekly mathematics quiz to the lead researcher or to their tutee directly. In future studies researchers should explore if tutee performance is influenced when the tutor shows an interest in the tutee’s performance.
Implications for Practitioners

While a number of research questions remain, secondary teachers should consider using unidirectional peer tutoring in their classrooms for several reasons. First, implementing this tutoring intervention does not require additional financial costs to the school or district since high performing peers are used as the tutors. This is critical since schools are faced with decreasing fiscal resources. Second, this tutoring intervention demonstrated that significantly low performers in mathematics could demonstrate high levels of ALT, which is a variable that should be improved across all students to increase achievement. Third, tutors, tutees, and teachers were positive about the effectiveness of the intervention and their participation within the research study and endorse its continued application and development. Finally, while this study demonstrated the feasibility of unidirectional peer tutoring in mathematics, efficacy research is needed to ascertain if school personnel can implement this intervention and produce similar tutee outcomes.

Carter and colleagues (2005, 2007) demonstrated that peer tutors could be trained quickly to implement a variety of strategies with students with severe disabilities. However, the researchers continued to provide ongoing feedback to tutors regarding their implementation of the targeted strategies. In the present study the researcher provided extensive tutor training, made decisions regarding placement of tutors with tutees, and provided daily supervision that included occasional feedback and contingent reinforcement (i.e., praise) in response to their tutoring behaviors. The researcher regularly thanked the tutors for their participation in this research study. It is not clear if
this peer tutoring intervention would produce similar effects with less attention focused on participating tutors. Findings from this study, in combination with findings from similar studies, suggest that efficacy studies should be conducted to determine the extent to which peer tutoring interventions are effective at the high school level when implemented by practitioners (Carter et al., 2011). Specifically, researchers need to examine practical approaches that teachers might use to train tutors and efficient strategies for providing ongoing feedback that will sustain tutors’ instructional skills.

**Conclusion**

This research study extends the peer tutoring research in multiple ways. First, this study begins to build a research base focused on targeted student, unidirectional peer tutoring interventions to improve academic outcomes for secondary students with high incidence disabilities. Furthermore, many of the targeted student unidirectional tutoring interventions described in the literature were conducted in elective classes as compared to this study, which was implemented in a core content class. Scruggs et al. (2010) only found five of 70 studies that utilized peer mediation in secondary schools to increase content knowledge. Second, in this study we examined student profile variables that might mediate performance on the primary outcomes measure (i.e., weekly quiz scores). Additional research is needed in which ALT (high levels of engaged time producing quality work) is experimentally manipulated to determine if these variables are critical for a tutoring intervention to produce positive outcomes. Lastly, we know that peer tutoring interventions are associated with positive outcomes on mathematics measures of basic
knowledge (Kunsch et al., 2007; Okilwa & Shelby, 2010) but further exploration is required to understand how a targeted, unidirectional tutoring intervention can increase students with disabilities’ outcomes on measures of complex knowledge across content areas.

In conclusion, as secondary schools across the nation continue to look for effective instructional practices to increase outcomes for a growing diverse population of learners, a targeted, unidirectional tutoring intervention appears to be a supplementary intervention worth implementing. Despite the absence of a standardized assessment, the findings reported in this research study suggests a targeted, unidirectional tutoring intervention has the potential to increase student profile variables (i.e., ALT), which could mediate positive outcomes for secondary students with learning disabilities on mathematical measures of complex knowledge (i.e., applications, algebra and geometry concepts).
REFERENCES

* indicates studies that met inclusion criteria in the literature review


*Carter, E. W., Cushing, L. S., Clark, N. M., & Kennedy, C. H. (2005). Effects of peer support interventions on students’ access to the general curriculum and social*


Remedial and Special Education, 31(6), 437-449.


Wechsler Individual Achievement Test III (WIAT-III; 2009)

APPENDICES
Appendix A

Tutor Secondary Mathematics I Pre-Assessment
Math 1 Pre-Assessment
Do NOT write on this test!

1. A photo service charges $25.00 a year as well as $0.05 for each photo ordered. Which graph models the total cost of ordering photos?

   a. ![Graph A]
   b. ![Graph B]
   c. ![Graph C]
   d. ![Graph D]

2. You have no more than $60 to spend. You want a drink that costs $1.50 including tax, and you want to buy a pair of pants, which will have 4% sales tax. What is the inequality that represents the amount of money you have to spend?

   a. \( x + 0.04x + 1.50 > 60 \)
   b. \( x + 0.04x + 1.50 \geq 60 \)
   c. \( x + 0.04x + 1.50 < 60 \)
   d. \( x + 0.04x + 1.50 \leq 60 \)

3. If \( f(x) = 3x - 5 \) and the domain of \( f \) is \( \{2, 4, 6\} \), what is the range of \( f(x) \)?

   a. \( \{11, 17, 20\} \)
   b. \( \{-6, -4, -2\} \)
   c. \( \{2, 4, 6\} \)
   d. \( \{1, 7, 13\} \)
4. Given the graph of \( f(x) \) below, what is \( f(2) \)?

   ![Graph of \( f(x) \) with points labeled.]

   a. \( f(2) = 2 \)                      c. \( f(2) = 6 \)
   b. \( f(2) = 0 \)                      d. \( f(2) = 10 \)

5. If \( a_n = a_{n-1} + 4 \) and \( a_5 = 12 \), what is \( a_7 \)?

   a. 11                             b. 10
   c. 20                             d. 19

6. The recursive formula for an arithmetic sequence is given as \( a_n = a_{n-1} + 9 \) with \( a_1 = 3 \). What is the seventh term of the sequence?

   a. 13                             b. 21
   c. 48                             d. 57

7. The explicit formula for a geometric sequence is \( a_n = 3(-2)^{n-1} \). What is the fifth term of the sequence?

   a. \(-96\)                         b. 48
   c. 192                            d. \(-48\)

8. What is the solution to the equation \( 4x - 7 - 9x = 13 + 5x \)?

   a. \( x = -2 \)                     b. \( x = 2 \)
   c. \( x = \frac{1}{2} \)              d. There are no solutions to this equation.
9. What is the solution to the inequality \(10x - 7 \geq 3x + 28\)?
   
   a. \(x \geq 5\)  
   b. \(x \leq 5\)  
   c. \(x > 5\)  
   d. \(x < 5\)

10. What is the solution to the system \[
    \begin{align*}
    x + 2y &= 15 \\
    2x + y &= 9
    \end{align*}
\]?
   
   a. \((1, 7)\)  
   b. \((7, 1)\)  
   c. There are infinitely many solutions to this system of equations.  
   d. There are no solutions to this system of equations.

11. Which graph represents the solution to the system \[
    \begin{align*}
    2x + y &= 6 \\
    -x + 3y &= 1
    \end{align*}
\]?
12. Which data set is represented by the dot plot below?

- 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
- 2, 3, 5, 5, 6, 7, 7, 8, 9, 10, 11, 11
- 2, 3, 5, 5, 6, 7, 7, 8, 9, 9, 10, 11, 11
- 2, 3, 4, 4, 4, 7, 7, 8, 9, 9, 10, 11, 11

13. What is the mean of the data set below?

15 18 19 19 20 24 24 25 25 25 28 28 29 30

- 15
- 23.5
- 24.5
- 30

14. Which function is a good fit for the data in the scatter plot below?

- $y = 2^x$
- $y = 77x - 200$
- $y = 2x - 200$
- $y = 200x - 77$
15. Which linear function is a good fit for the data in the scatter plot below?

- a. $y = 1.9x + 22$
- b. $y = 1.9x - 22$
- c. $y = -1.9x - 22$
- d. $y = -1.9x + 22$

16. Given the diagram below, which of the following is a true statement?

- a. $\overline{OA} \equiv \overline{OB}$
- b. $\overline{XY} \equiv \overline{AB}$
- c. $\overline{AX} \parallel \overline{BY}$
- d. $\overline{AB} > \overline{XY}$

17. The point $A (-5, 2)$ has undergone the transformation $T_{-1, 2}$. Which point is the preimage of $A$?

- a. $(-6, 4)$
- b. $(-6, 0)$
- c. $(-4, 0)$
- d. $(-4, 4)$

18. What is the distance between the points $(-2, 4)$ and $(10, -1)$?

- a. $\sqrt{89}$ units
- b. 13 units
- c. 169 units
- d. $\sqrt{119}$ units
15. Which geometric construction matches the diagram below?

- construction of a segment bisector
- construction of an angle bisector
- copying a segment
- copying an angle

20. Which equation represents a line that is perpendicular to the graph and passes through (3, 3)?

- \( y = -\frac{1}{2}x + \frac{9}{2} \)  
- \( y = 2x - 3 \)  
- \( y = \frac{1}{2}x + \frac{9}{2} \)  
- \( y = 2x + 9 \)

21. What is the perimeter of triangle \( ABC \) with vertices \( A (-2, 1), B (4, 5), \) and \( C (2, -5) \)?

- 30.6 units  
- 36.8 units  
- 9.9 units  
- 24.6 units

22. What is the area of triangle \( ABC \) with vertices \( A (-2, 1), B (-2, 3), \) and \( C (2, 1) \)?

- 4 units\(^2\)  
- 8 units\(^2\)  
- 10.5 units\(^2\)  
- 21 units\(^2\)
23. The product of $-3$, $a$, and $b$ is represented by the expression $-3ab$. If the value of $a$ is negative, what must be said about the value of $b$ in order for the product to remain negative?

- a. $b$ must be 0.
- b. $b$ must be positive.
- c. $b$ must be negative.
- d. The value of $b$ does not matter.

24. What is the explicit equation for the graph below?

![Graph](image)

- a. $y = 2^x$
- b. $y = x + 1$
- c. $y = 2^x + 1$
- d. $y = 3^x$
Appendix B

Mathematics Quality Measure
Secondary Math I problems will be scored dichotomously as math problems that require work and math problems that do not require work.

<table>
<thead>
<tr>
<th>Type</th>
<th>Definition</th>
<th>Examples</th>
<th>Possible points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Secondary Math I problems that require work to be shown</td>
<td>Any Secondary Math I problem that involves more than one step to solve or requires manipulation of the problem</td>
<td>Filling in numbers for variables, subtracting a number on both sides of the equation, use a formula, creating a graph.</td>
<td>0 points</td>
</tr>
<tr>
<td>2) Secondary Math I problems that do not require work to be shown</td>
<td>Any secondary Math I problem that can be completed in one step or without manipulation of the problem</td>
<td>Finding an absolute value, plotting points on a pre-made graph, vocabulary questions.</td>
<td>0 points</td>
</tr>
</tbody>
</table>

### Math Problems that Require Work Scoring Rubric

<table>
<thead>
<tr>
<th>Score</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Provide a wrong answer, do not attempt, fail to complete by not providing an answer.</td>
<td>Student left the problem blank or partially completed the problem.</td>
</tr>
<tr>
<td>1</td>
<td>Complete the problem and provide the correct answer without showing work when work is required.</td>
<td>Student uses a calculator to solve the problem correctly but does not show written work in their workbook.</td>
</tr>
<tr>
<td>2</td>
<td>Complete the problem and provide the correct answer with showing work (one or more written steps) when work is required or providing the correct answer with no work when work is not required.</td>
<td>1.  Student writes the math expression in their workbook; transfers numbers on both sides of the equal sign; shows simple subtraction before completing the remainder of the problem on their calculator 2.  Provides a correct answer.</td>
</tr>
</tbody>
</table>
Math Problems that **Do Not** Require Work Scoring Rubric

<table>
<thead>
<tr>
<th>Score</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Provide a wrong answer, no attempt made, fail to complete by not providing an answer.</td>
<td>Student left the problem blank, partially completed the problem.</td>
</tr>
<tr>
<td>2</td>
<td>Complete the problem and provide the correct answer.</td>
<td>Provides a correct answer.</td>
</tr>
</tbody>
</table>

A five step procedure was used by two data collectors to reach consensus on determining when secondary I math problems require work and problems that do not require work to solve.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>The two data collector reviewed the definitions of what constitutes a problem requiring work and a problem that does not (included in tables above)</td>
</tr>
<tr>
<td>Step 2</td>
<td>10 secondary I math problems were randomly selected from the Secondary I math textbook to be used as examples of problems that the data collectors would define as required work and problems that did not require work to solve.</td>
</tr>
<tr>
<td>Step 3</td>
<td>Data collectors reviewed the 10 secondary I math problems independently and marked which problems required work, and which problems did not require work to solve.</td>
</tr>
<tr>
<td>Step 4</td>
<td>The 10 secondary I math problems that the data collectors independently scored as either problems that required work or problems that did not require work to be solved were checked for agreements and disagreements. Agreements were defined as data collectors both marking problems that required work or did not require work to solve, the same. On this exercise, data collectors were in agreement on 80% of problems.</td>
</tr>
<tr>
<td>Step 5</td>
<td>The data collectors discussed the two secondary I math problems that they were in disagreement and reached consensus on how they would determine problems that required work and problems that did not require work to solve.</td>
</tr>
</tbody>
</table>
Examples of Secondary Math I problems that **do not** require work to complete

**Example 2.1.3**

b. This question would not require work because the student already had the information provided to them on the graph. The student just needs to look at what direction line D is traveling and use the graph to figure out the change in Y.

Examine line D. What direction is it traveling from left to right? What number should be used for $\Delta y$ to represent this direction?

Line D is traveling downward and $\Delta y$ is $-2$

---

**Example 1 – 61**

b. This question does not require work because the function of absolute value is to show a number’s total value by taking away and negatives.

1-61. Find the following absolute values.

a. $|0.75|$  
b. $|-99|$  
c. $|4-2.3|$  
d. $|\pi|

answer: 99

---

**Example 2-44**

a. This question does not require work because what is required to solve this problem is knowledge of slope intercept form (i.e., $y = mx+b$) and the ability to extract the requested information from this question using slope (i.e., slope = m) and intercept (i.e., b).
Examples of Secondary Math I problems that do require work to complete

Example 3 - 118
This problem requires work to be shown in order to solve the equations to find the measures for each side of the triangle.
Example 2 – 71

(c) This problem requires work because the pairs of points must be entered into an equation in order to be solved.

2-71. Find the slope of the line passing through each pair of points below.

a. (1, 2) and (4, –1)  
b. (7, 3) and (5, 4)  
c. (–6, 8) and (–8, 5)  
d. (55, 67) and (50, 68)

\[
\text{Formula: } \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 8}{-8 - 6} = \frac{3}{2}
\]

Example 1-16

(c) This problem requires work to be shown by using equations given to solve for the value of \(x\).

1-16. What value(s) of \(x\) will make each equation below true?

a. \(x + 5 = 5\)  
b. \(2x - 6 = 3x + 1 - x - 7\)

c. \(3x + 1 = 43\)  
d. \(4x - 1 = 4x + 7\)

\[
\frac{3x}{3} = \frac{42}{3} \quad \frac{x}{3} = 14
\]
Scoring examples of Secondary I math problems that do not require work

Example 1) This example would be scored two points because the correct answer was provided.

2-44. State the slope and y-intercept of each line.

\[
\begin{align*}
\text{a. } y &= \frac{5}{3}x - 4 \\
\text{b. } y &= -\frac{4}{3}x + 3 \\
\text{c. } y &= -5
\end{align*}
\]

Example 2) This example would be scored zero points because only half of the answer was provided as the student provided the slope but did not provide the y-intercept.

2-44. State the slope and y-intercept of each line.

\[
\begin{align*}
\text{a. } y &= \frac{5}{3}x - 4 \\
\text{b. } y &= -\frac{4}{3}x + 3 \\
\text{c. } y &= -5
\end{align*}
\]
Scoring examples of Secondary I math problems that **does** require work

Example 1) This example would be scored two points because the correct answer was provided and work was shown.

CL 4-119. Solve these systems of equations using any method.

a. \[ y = 3x + 7 \]
   \[ y = -4x + 21 \]

b. \[ 3x - y = 17 \]
   \[ -x + y = -7 \]

   \[ \frac{2x = 10}{2} \]
   \[ x = 5 \]

Example 2) This example would be scored one point because the correct answer was provided but no work was shown.

CL 4-119. Solve these systems of equations using any method.

a. \[ y = 3x + 7 \]
   \[ y = -4x + 21 \]

b. \[ 3x - y = 17 \]
   \[ -x + y = -7 \]

   \[ x = 5 \]

Example 3) This example would be scored zero points because the correct answer was not provided.

CL 4-119. Solve these systems of equations using any method.

a. \[ y = 3x + 7 \]
   \[ y = -4x + 21 \]

b. \[ 3x - y = 17 \]
   \[ -x + y = -7 \]

   \[ 2x = 10 \]
Appendix C

Academic Engagement Rating Form
<table>
<thead>
<tr>
<th>Tutee #</th>
<th>On Task?</th>
<th>Tutee #</th>
<th>On Task?</th>
<th>Tutee #</th>
<th>On Task?</th>
</tr>
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<tbody>
<tr>
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</tr>
</tbody>
</table>

6 = Peer composite
Appendix D

Tutee Social Validity Questionnaire
Using this 5-point scale (1 - strongly disagree, 2 – somewhat disagree, 3 – neutral, 4 – somewhat agree, 5 strongly agree) please circle a rating for each statement:

1. Working with an academic coach helped me complete my work correctly on a daily basis.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

2. Working with an academic coach helped me on weekly tests.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

3. Working with an academic coach helped me stay on task.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
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<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

4. My academic coach allowed me to work as independently as possible and only helped when needed.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
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</tbody>
</table>

5. I am concerned what other students in the class think when I work with an academic coach.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
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<td>2</td>
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</tbody>
</table>

6. Working with my academic coach was critical to my success in my math class.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>

7. My academic coach was knowledgeable about the math content.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tbody>
</table>
8. My academic coach helped me understand math concepts better by the way he/she explained them.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

9. My academic coach broke complex math problems into smaller, easier to understand steps.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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<td>1</td>
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</table>

10. I liked my academic coach

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

11. I enjoy being taught math by an academic coach compared to being taught by a teacher.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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</table>

12. I could be successful with any academic coach

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

13. I would like to work with an academic coach in Secondary Math II next year

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

14. I would like to work with an academic coach next year in other subjects too.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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</table>

15. I would tell my friends about academic coaching if they told me they needed academic help

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</tbody>
</table>
What did you like **most** about working with an academic coach?
What did you like **least** about working with an academic coach?
How did you benefit most by working with an academic coach?
Appendix E

Tutor Social Validity Questionnaire
Please indicate your answer by circling an answer for the following questions

I. Have you worked previously as an academic coach or peer tutor at Logan High School?  
Y    N
If “yes” please explain where:

II. Did you receive high school elective credit for working as an academic coach?  
Y    N

III. Did you receive university credit for working as an academic coach?  
Y    N

Using this 5-point scale (1- strongly disagree, 2 – somewhat disagree, 3 – neutral, 4 – somewhat agree, 5 strongly agree) please provide a rating for the questions below

1. I enjoyed working as an academic coach in this research study.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</tbody>
</table>

2. My peer worked independently and error free on most math problems

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

3. When I progress monitored, my peer frequently made mistakes

<table>
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<th>Somewhat Disagree</th>
<th>Neutral</th>
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</table>

4. The peer I supported needed me to provide modeling on most problems

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
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<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

5. The peer I supported needed me to provide verbal description on most problems

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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</table>

6. I felt confident breaking a math problem into small steps

<table>
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<tr>
<th>Strongly Disagree</th>
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</tbody>
</table>
7. I felt confident implementing the least-to-most support procedure.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

8. I felt I had sufficient knowledge of the Secondary Math I content to help my peer.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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<th>Strongly Agree</th>
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</table>

9. It was difficult implementing all features of this academic coaching intervention simultaneously.

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<tr>
<th>Strongly Disagree</th>
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<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

10. The peer I was assigned to coach appreciated my support.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
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<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</table>

11. I would like to work as an academic coach in a Secondary Math I class in the future.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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</table>

12. I would be interested in working as an academic coach at the University level?

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</tbody>
</table>

13. It was important to me how well my peer performed on their weekly quiz.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

14. My peer’s quiz performance influenced my coaching the following week.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</thead>
<tbody>
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</tbody>
</table>
15. I would recommend academic coaching to my friends who are looking for an elective credit class.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</thead>
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</tbody>
</table>

16. What if any personal benefits have you gained from being an academic coach?

17. What do you think you did well as a coach?

18. What do you think you could do better as a coach?

19. What did you like **most** about academic coaching?

20. What did you like **least** about academic coaching?

21. What suggestions do you have for improving the academic coaching program next year?

22. What are the most significant values, abilities or skills a person must possess that are essential to be a good academic coach?
Appendix F

General Education Teacher Social Validity Questionnaire
Please indicate your answer by circling an answer for the following questions
Using this 5-point scale (1 - strongly disagree, 2 – somewhat disagree, 3 – neutral, 4 – somewhat agree, 5 strongly agree) please provide a rating for the questions below

1. I enjoyed having academic coaches work with students in my classroom.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Comments: ________________________________

2. I saw improvement in daily work when students worked with an academic coach.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
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<td>2</td>
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</tbody>
</table>

Comments: ________________________________

3. I saw improvement with academic engagement when students worked with an academic coach.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

Comments: ________________________________

4. I saw improvement on weekly quizzes when students worked with an academic coach.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
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</table>

Comments: ________________________________
5. I saw improvements with attitude/demeanor with respect to my math class when students worked with an academic coach.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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</tbody>
</table>

Comments: 

6. The academic coaches took their academic coaching position seriously.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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</table>

Comments: 

7. The intervention the academic coaches implemented is important.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
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Comments: 

8. The peer appreciated their academic coach.

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<tr>
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<th>Somewhat Disagree</th>
<th>Neutral</th>
<th>Somewhat Agree</th>
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Comments: 

9. I would use academic coaches in a Secondary Math I class I taught in the future.

<table>
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<tr>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
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10. I would recommend academic coaching to my fellow educators who are looking for additional support for low performing students.

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Comments: ____________________________________________

11. I could implement Academic Coaching without the support of university personnel.

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Comments: ____________________________________________

12. What features of the academic coaching program benefitted your students most?

13. What features of the academic coaching program benefitted your students least?

14. What feature(s) of the academic coaching program do believe are critical to successful implementation?
Part II.
I have experience with other peer tutoring interventions in my classroom previously? Y N
If “yes” please answer the following questions

Please describe your previous experience with peer tutoring interventions

How was this intervention different compared to other peer mediated instructional practices.
Appendix G

Tutor Progress Monitoring Sheet
<table>
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<tr>
<th>Question#</th>
<th>Page #</th>
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<th>☐ Correct</th>
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<th>☐ Academic Coach</th>
<th>☐ SC prompt</th>
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□ Academic Coach
□ SC prompt □ VD only □ VD + Modeling
□ Finished
Notes:
Appendix H

Unidirectional Tutoring Procedural Quiz
Unidirectional Tutoring Procedural Quiz

1. What is the first thing you should do when approaching your peer?

2. Where proximally should you sit when providing support to your peer?

3. What materials should you have out at all times when working with your peer?

4. The teacher gives your peer a task to do, what should you ask your peer with 10 seconds of the teacher prompt?

5. If the student indicates that they would like assistance, what should you do next to determine what level of support they require?

6. What are the 3 levels of support starting with the least intensity and moving toward the most intensive?

7. If your peer indicates that they would like to work independently, what should you do?

8. What should be done to all math problems when giving explanations to your peer?

9. When your peer does something correctly or when they finish a problem, what should you deliver?

10. If your peer finishes their work and starts to pack up, what should you prompt them to do?
Appendix I

Tutor Fidelity Checklist
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<table>
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<tbody>
<tr>
<td>1</td>
<td>Tutor arrived on time &amp; greeted the tutee</td>
</tr>
<tr>
<td>2</td>
<td>Tutor sat next to (opposed to across or in front of) the tutee</td>
</tr>
<tr>
<td>3</td>
<td>Tutor opened AC checklist and wrote the date at the top of the page</td>
</tr>
<tr>
<td>4</td>
<td>Initially, tutor asked tutee if they need assistance (within 10 seconds of the start of independent work time)</td>
</tr>
<tr>
<td>5</td>
<td>Tutor asked clarifying questions (e.g., did you read the question?, what is the question asking you to solve? Do you know how to start?) to ascertian what level of support the tutee requires.</td>
</tr>
<tr>
<td>6</td>
<td>Tutor monitors progress while tutee works independently</td>
</tr>
<tr>
<td>7</td>
<td>When help is solicited/needed during progress monitoring, tutor provides support (within 10 seconds)</td>
</tr>
<tr>
<td>8</td>
<td>When providing support, tutor breaks down more complex problems by computing into small steps</td>
</tr>
<tr>
<td>9</td>
<td>Records the level of least-to-most support (minor EC, major EC, VD only, M+VD,) in progress monitoring checklist for each problem completed</td>
</tr>
<tr>
<td>10</td>
<td>Provided general praise upon completion of math problem(s)</td>
</tr>
<tr>
<td>11</td>
<td>Prompts tutee if they forget to circle the problem number upon completion</td>
</tr>
</tbody>
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CURRICULUM VITAE

PERSONAL INFORMATION
Daniel R. Pyle
Utah State University
Department of Special Education and Rehabilitation
2865 Old Main Hill
Logan, Utah 84322-2865
(619) 517-3136
danpyle@gmail.com

AREAS OF SPECIALIZATION
Designing evidence-based inclusive supports and services, peer-mediated interventions, PBIS, MTSS

EDUCATION
2012-present Utah State University, Doctoral Candidate of a Doctorate of Philosophy (Ph.D.) Specialization Disability Discipline Program in the Department of Special Education and Rehabilitation
2008 University of San Diego, Crosscultural, Language, and Academic Development (CLAD) Certification
2005 Azusa Pacific University, California Professional Clear Credential, Mild/Moderate Disabilities, K-12
2004 Azusa Pacific University, Masters of Science (M.S.), Physical Education
1999 SUNY College at Buffalo, Bachelors of Science (B.S.), Exceptional Education/Elementary Education Dual Teaching Credential

PUBLICATIONS


**In Review**


**In Preparation**


**Dissertation**


**UNIVERSITY TEACHING EXPERIENCE**

August 2012 – May 2013

SPED 4000 – Education of Exceptional Individuals

Utah State University, Logan, UT

- Worked one semester as a teacher assistant in a supportive role to the university professor
- Developed lessons and updated existing SPED 4000 content with current research statistics
Assumed all teaching & grading responsibilities for classes during the Spring 2013 semester

CLASSROOM TEACHING EXPERIENCE

Feb 2010 – May 2010          Special Education Inclusion Support Teacher, Grades 10 - 12
John B. Connally High School, Pflugerville, TX
- Team-taught Environmental Science and Integrated Physics and Chemistry
- Implemented PBS in classes to increase student motivation to make positive choices
- Wrote and conducted legally appropriate Individual Education Programs (IEPs) and Individual Transition Plans (ITPs)
- Served on Business Information Technology Academy Team and attended weekly meetings to collaborate with colleagues.

Jan. 2010 – May 2010          District Behavior Specialist, Grades 6 - 8
Pflugerville Independent School District, Pflugerville, TX
- Designed and implemented an afterschool social skills group for middle school students with Autism
- Provided corrective feedback to students after they responded to social situations we developed
- Worked as a consultant to the director of District Behavioral Support Services in secondary schools to help attain buy-in and oversee follow through of district protocol.
- Facilitated a meeting between a student interest group (Peer Assisted Leaders) and Principal of a fellow district high school to encourage start-up of peer leadership program.

Aug. 2000 – May 2009          Special Education Inclusion Support Teacher, Grades 9 - 12
Steele Canyon High School, Spring Valley, CA
- Opened a comprehensive, full inclusion high school
- Effectively integrated the special education program into all content area departments
- Provided academic support and services to a diverse population of students
- Designed and implemented modifications and adaptations to create access for students with disabilities
- Collaborated with general education teachers to develop curricula and assessments based on the California state standards
- Implemented, and coordinated the training and evaluation for the 5-credit elective peer tutoring course to support inclusive education program
- Co-developed, implemented, and directed the literacy intervention class for students with significant reading disabilities
- Provided on-going professional development for the staff
Aug. 1999 - June 2000
Special Education Teacher, Grades 6 - 8
Emerald Middle School, El Cajon, CA

- Taught a self-contained start-up class on a comprehensive middle school campus for 12 students labeled Severely Emotionally Disturbed (SED)
- Designed and implemented differentiated curriculum to accommodate the varying academic levels for students with severe behavioral needs
- Utilized a behavior point system to allow students to achieve appropriate behavior through positive reinforcements and rewards
- Served as administrative designee, acted as case manager, conducted, wrote, scheduled and implemented IEPs for students with significant disabilities in the area of Emotional Disturbance
- Designed athletic program to promote team building, fair play, and appropriate behavior while engaged in competition through physical education

GRANT AFFILIATIONS

Doctoral Student
Office of Special Education Programs (OSEP) Language and Literacy Training Grant, Utah State University Logan, Utah. Principal Investigator: Tim Slocum
- Received Full tuition waiver, insurance benefits, and travel fees to National conferences.
- Supporting secondary schools in reforming their special education service delivery
- Published a single subject research design article showing effects of a peer-tutoring model in inclusive settings.
- Supervised and provided feedback to pre-service teachers on effective based teaching practices.
- Completed a synthesis of peer tutoring in secondary settings.

September 2014 (not funded)
Doctoral Student
Spencer Foundation Small Research Grant (Under $50,000): Teaching, Learning, and Instructional resources, The Development and Evaluation of a Virtual Safe Space for Practicing Bully Prevention Skills. Utah State University. Logan, Utah. Principal Investigator: Nancy Glomb
- Developed literature review
- Provided input to the principal investigator on research variables to study
- Consulted with PI on research design
Sept. 09 – Feb 2010
District Behavior Specialist,
Grades 9 - 12
Title, ARRA, U.S. Department of Education, Pflugerville Independent School
District, Pflugerville, TX, Superintendent: Charles Dupree
- Implemented school-wide Positive Behavioral Support (PBS) in 3 comprehensive
  high schools
- Collaborated with district administration, school-site administration, and teachers to
develop a site-specific PBS model
- Collaborated with district administration, school-site administration, and teachers to
develop student Behavior Improvement Plans (BIPs)
- Coached teachers to set up classrooms for success in areas of behavior management,
time on task, seating arrangements, recognizing antecedent behavior, and positively
reinforcing expected behavior
- Served as a PBS coach for school site PBS Committees
- Facilitated the implementation of school-wide incentive system
- Presented PBS tiered interventions to district personnel and PBS team cohorts
- Developed and delivered PBS presentations for district dissemination

PROFESSIONAL PRESENTATIONS
in a co-taught, secondary math class. Presentation at Utah Multi-tiered Systems
of Support (UMTSS) connections conference. Layton, UT.
students with learning disabilities in an inclusive, secondary setting. Presentation
at the Council for Exceptional Children Annual Conference, San Diego, CA.
mediated interventions outcomes with English language learners. Poster
presentation at the Council for Exceptional Children Annual Conference, San
Diego, CA.
peer-mediated academic interventions for English language learners. Poster
presentation at the Pacific Coast Research Conference, San Diego, CA.
should know about the use of peer mediated interventions for English language
learners. Poster presentation Utah Multi-tiered Systems of Support (UMTSS)
connections conference. Layton, UT.
and social skills instruction. Presentation at the Association of Positive Behavior
Support Annual Conference, San Diego, CA.

and social skills instruction. Presentation at the Utah Multi-Tiered Systems of
Support Annual Conference, Layton, UT.


**PROFESSIONAL ORGANIZATIONS**

- Council of Exceptional Children (CEC), 2005-Present
  - Division for Learning Disabilities (DLD)

**LEADERSHIP**

August 2013 – August 2014

Special Education and Rehabilitation Doctoral Student Representative, Utah State University, Logan, UT

August 2005 – June 2009

Department Chair of Special Education, Steele Canyon High School, Spring Valley, CA

- Established positive working relationships with General Education Teachers, Administration and fellow staff members.
- Developed the master schedule for special education staff.
- Coordinating state and curriculum based assessments for identified students requiring special education services.
- Hired, directed, supervised and evaluated paraprofessionals.
- Managed the special education budget.
- Coordinated summer school special education program.
- Attended on going district wide special education directors meetings.
- Mentored and advised new teachers in a fully inclusive special education program

**Coaching Experience**


Varsity Football Coach, Logan High School, Logan, UT

- Special Teams Coordinator
- Linebacker Coach
- Duties including: opponent film breakdown, self scout film breakdown, coaching players on defensive scheme

Aug. 2010 – May 2011

Freshman and Varsity Football Coach, John B. Connally High School, Pflugerville, TX

- Coached H-Back position in spring football and moved to Wide Receivers to accommodate Head Coach’s request.
- Worked as Co-Special Teams Coordinator and was responsible to coach Punter and Place Kicker.
- Obtained CDL (Commercial Driver’s License) to assist with transportation of teams to save athletic budget money.
- Fulfilled assigned duties including; opponent film breakdown, self scout film breakdown, Recording Offensive Play Chart.

Aug. 2010 – May 2011
Freshman Basketball Coach, John B. Connally High School, Pflugerville, TX
- Organized, scheduled and ran practices
- Transported players to all away games and weekend tournaments
- Installed man and zone offense/defense concepts
- Broke down varsity team video and kept on going season statistics
- Designed weight program regiment for Freshman Basketball team
- Arraigned after school tutorials and managed student-athletes eligibility

Head Varsity Golf Coach, Steele Canyon High School, San Diego, CA
- Coached the boys golf program from the school’s inception in 2000
- First team in the school to win a league championship with only 9th, 10th, and 11th grade students
- Won the most league championships in the school’s history, six to date
- Created and maintained golf tournament fundraiser with proceeds exceeding $10,000 a year
- Designed and purchased quality brand golf bags and uniforms at competitive prices
- Set up a program through Taylormade/Adidas Golf to purchase gear, equipment and uniforms at 50% off the retail price
- Organized annual team tournaments to Hawaii, Cancun, Mexico and PGA West courses in Palm Springs

May 2006 – May 2009
Head Junior Varsity Football Coach/Defensive Coordinator
- Organized practices, meetings, scrimmages and games for 60+ players
- Hold a career record of 24-5 as a head football coach at the JV level
- Utilized multiple defensive fronts and blitz packages
- Studied the opponent through film & scouting, and created materials to help players understand our opponents’ strengths, weaknesses, tendencies and game plan
- Reviewed our own game film with players to prepare for the next game
- Created a team highlight video and served as emcee for end of the year banquet

Varsity Assistant Football Coach
- Coached defensive backs, defensive line, and linebackers, kickers, punters, and all special team units, and served as Special Teams coordinator for the 2005 season
- Attended at least one coaching clinic every year to further my knowledge in coaching practices, philosophies and schemes
- Helped students work through grade issues to ensure that they will maintain eligibility
- Assisted with strength and conditioning program in the off-season both after school and in the summer
- Attended college scouting combines with high school football players that had interest and ability to play at the collegiate level