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Perspectives on Algebra I Tutoring Experiences With Students With Learning Disabilities

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The researchers conducted a qualitative analysis of the perceptions of school personnel and pre-service teachers about an Algebra I tutoring program for students with learning disabilities. The researchers surveyed and interviewed the participants about the effectiveness of the program for the mathematics learning of the students with LD at the school and as a learning experience for the pre-service teachers. The school personnel indicated there was a mutually beneficial relationship between the tutors and the school. The perceptions of the tutors revealed considerations about the challenges they face as Algebra I tutors of students with learning disabilities including remembering Algebra I content, posing strategic questions to students, dealing with students' math anxiety, and conveying Algebra I content accessibly. The tutors reported positive experiences in the program including learning from field experience and, in particular, learning to promote the progress and learning of students with learning disabilities using gestures and strategic questioning.

Keywords: **Learning Disabilities, Algebra, Tutors, Perceptions, Pre-service Teachers**

Introduction

Education legislation and policy in the United States mandates that students with learning disabilities (LD) access and succeed with grade level content in mathematics; students with LD are expected to take and pass courses at grade levels with their corresponding age level (Every Student Succeeds Act, 2015; Individuals with Disabilities Education Act, 2004). However, students with LD are susceptible to difficulties in mathematics such as challenges with remembering facts and procedures, word problem solving, and problem solving processes in general (Andersson, 2008). Despite the difficulties facing their students, teachers of students with LD face pressure for their students to pass and demonstrate growth on high stakes tests (Croft, Roberts, & Stenhouse, 2016; Ysseldyke et al., 2004). Some universities have developed tutoring programs in part to address the pressures faced by schools and the challenges facing students with LD; these programs are also designed to provide professional development opportunities for undergraduate education majors (e.g., tutoring experiences that supplement their teacher preparation courses) (Brownell, Hord, Richards-Tutor, Barber, & Benedict, 2016). While tutoring programs have been established and successful in various subject areas (e.g., Maheady, Mallette, & Harper, 1996; Maheady, Harper, Mallette, & Karnes, 2004), more research is needed in particular on tutoring in mathematics.

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Pre-Service Teachers Tutoring Students with LD

In response to this need and the need for undergraduates to gain valuable experience from fieldwork (Leko, Brownell, Sindelar, & Kiely, 2015), teacher educators have designed and implemented tutoring programs so that pre-service teachers can gain experience in the field in ways that are also beneficial for the school. For example, Maheady and colleagues (1996) set up a program for pre-service teachers to deliver reading tutoring in a local school. The tutors reported that they enjoyed participating and appreciated the chance to tutor in the program to learn about their field. The students who received tutoring improved at reading and the school personnel expressed gratitude for having the tutors working at the school saying that they "need all the help they could get" (p. 294) to manage the demands of teaching a diverse set of learners. The teacher educators who implemented the program reported:

> One important lesson we have learned from our restructuring efforts is that there is no shortage of need for individualized instructional services in the public schools. Ironically, there is also no shortage of need for direct instructional opportunities for preservice educators in most teacher preparation programs (p. 295).

In the study by Maheady and colleagues (1996), the school personnel and the tutors both reported that the intervention was effective and provided a positive experience for the students and the tutors.

In 2004, Maheady and colleagues reported on a program they designed targeted toward the teaching of spelling. They found that the tutors were able to implement the intervention with fidelity and the students who received tutoring improved at spelling. In general, both programs were successful at providing opportunities to prepare pre-service teachers for their upcoming employment in a way that was also beneficial for the school. The researchers found a way for the pre-service teachers to improve while also making a positive difference for students and to provide extra help for the school personnel.

Concerning mathematics instruction, special education researchers have found that tutoring can promote growth in mathematics learning for struggling learners in elementary school (Jitendra et al., 2013; Fuchs et al., 2008). Regarding secondary level tutoring, Karsenty (2010) designed and implemented a tutoring program for struggling learners in mathematics involving high school graduates as "nonprofessional" mathematics tutors. Karsenty found that these tutors could be successful in helping the students improve their mathematics performance. Watt and Wasburn-Moses (2018) designed and implemented a mathematics tutoring program for pre-service teachers to gain field experience and the students with LD who were tutored in this program demonstrated growth in mathematics. These studies demonstrated instances in which tutors could provide needed assistance to school personnel and provide a boost for the students in need of some extra help. This research work lays an important foundation for future researchers to investigate how mathematics tutoring can be provided in ways that are mutually beneficial for the schools and pre-service teachers in the context of mathematics tutoring.

Purpose of the Study and Research Questions

It is necessary for mathematics and special education researchers to find ways to effectively design and implement mathematics tutoring programs in schools to meet the specific needs and strengths of students with LD while still providing a needed service to local schools. While it is clear that pre-service teachers, school personnel, and students all stand to benefit from such tutoring programs, more information is needed on this topic. More specifically, more research is needed on the experiences of teachers and, especially, pre-service teachers who serve as tutors that can be used to inform the ongoing implementation of the program being investigated in this study as well as similar programs. The purpose of this study is to gain information on the perspectives of school personnel and pre-service teachers on the effectiveness of a mathematics tutoring program for improving student performance and providing a learning opportunity for pre-service teachers. The research questions for this study are as follows: (1) What are the perceptions of school personnel who are coordinating tutoring for students with LD by pre-service teachers at their school? (2) What are the perceptions of pre-service teachers of their experiences as tutors in an Algebra I tutoring program for students with LD? By documenting the expectations, experiences, and challenges that pre-service teachers experience in an Algebra I tutoring environment—and aligning those experiences with the expressed needs of the teachers they partner with—this study provides insights on how teacher preparation and tutor training can better prepare pre-service teachers to have productive tutoring experiences.

Method

Project Overview and Research Design

This work was part of a larger project funded by the National Science Foundation designed to study the preparation of pre-service teachers to teach Algebra I to students with LD as well as the mathematics learning of the students with LD who participated in tutoring. Two major focus points of the grant were the use of gestures and strategic questioning to teach Algebra I content to students with LD. The researchers refer to gesturing as physical movements such as moving of fingers, hands, arms, etc. to draw attention to key pieces of information or to communicate an idea (Alibali et al., 2013). We chose to focus on gestures to support students' working memory (i.e., the processing, storing, and integration of information; Baddeley, 2003) as they engaged in challenging mathematics. Gestures can support working memory, which is often a source of struggle for students with LD (Alibali et al., 2013; Hord, Marita, Walsh, Tomaro, Gordon & Saldanha, 2016; Swanson & Siegel, 2001). Gestures have been extensively studied in cognitive psychology (e.g., Alibali et al., 2013) and to some degree in special education (Hord et al., 2016); the researchers in this study applied these findings to tutor trainings on the use of gestures in the context of mathematics learning. For example, we discussed how gestures can be used to help students see and connect key information in equations. When we use the term strategic questioning, we are referring to questioning practices that balance open-ended questions to assess and expand students' understanding of mathematical concepts with more direct questions that facilitate direct progress towards complet-

ing a task. We focused on strategic questioning to provide both support when needed and a push toward engagement in challenging mathematics for students with LD (González & DeJarnette, 2015; Nathan & Kim, 2009; Ni, Zhou, Li, & Li, 2014). We applied these research findings to our tutor trainings. For example, we discussed how students may benefit from more challenging questions when they are having some success, but benefit from more supportive questions when experiencing challenges.

In the project, we set the goal of finding better ways to provide quality mathematics tutoring to the students most in need (e.g., Brownell et al., 2016; Maheady et al., 2004). To accomplish this objective, we targeted students with LD and Algebra I, which is a gatekeeper course in mathematics and crucial for students with LD to pass to access educational and occupational opportunities (Schoenfeld, 1985; Ysseldyke et al., 2004). In our program, pre-service teachers tutored students with LD on Algebra I content and participated in weekly, 45-minute trainings on gestures, strategic questioning, and other teaching strategies and considerations. In our trainings, we spent time analyzing student work and actual and simulated conversations between tutors and students as well as discussing the tutors' recent experiences in general working with the students. We carefully selected actual excerpts from tutoring session and designed simulated conversations between students and tutors to support learning about topics related to gestures and strategic questioning (often by describing and discussing key factors in student learning processes). Some key topics we targeted were tutors' knowledge of Algebra I content such as linear functions and systems of equations, how to utilize gestures on top of written work for solving and discussing equations, and how to choose between asking open-ended questions and more direct questions to keep a student moving forward. This study is targeted toward the perceptions of the tutors who participated in the project, as well as school personnel who coordinated tutoring, to gain insight into how to improve the project and how to maintain successful components of the project. We chose to conduct a qualitative case study to analyze the perceptions of school personnel and pre-service teachers at a micro-level to gain in-depth knowledge of this phenomena to inform research and programming decisions on a more macro-level (Creswell, 2013; Stake, 2010).

Participants and Setting

The tutoring in the project was conducted in a high school in a suburban setting in the Midwestern United States. To maintain the standard for creating a mutually beneficial relationship for the schools and the university (Karsenty, 2010; Maheady et al., 1996; Maheady et al., 2004), we consulted with two special education mathematics teachers, Mr. Harris and Mr. Clarkson, who were coordinating tutoring for the pre-service teachers at their school for students with LD. Mr. Harris had three years of teaching experience and Mr. Clarkson had 21 years of experience. Both teachers had spent their whole teaching careers that this same high school. Mr. Harris had experience as a tutor in a similar tutoring program when he was a pre-service teacher at the researchers' university. Both Mr. Harris and Mr. Clarkson had facilitated some pilot-tutoring (i.e., one preservice teacher tutoring six students with learning difficulties) at their school in a previous school year.

Focusing on the perceptions of the tutors in this project, the researchers conducted a small-scale qualitative case study of data from interviews with pre-service teachers who were tutoring students with LD on Algebra I content. When they began the tutoring program, the tutors were in their second year of study in a teacher-preparation program for special education teachers at a university. As part of their program requirements, the tutors had all taken—or were taking during the year of training—courses in quantitative reasoning, statistics, and college algebra. Additionally, at the beginning of the study, the tutors were all taking an upper level mathematics course designed for future mathematics teachers focused around the development of number sense and mathematical problem-solving skills; concurrently, they were enrolled in a mathematics teaching methods course focused on middle grades teaching. In these courses, the pre-services teachers were taught how to promote critical thinking among their students and to value conceptual understanding of mathematics in addition to procedural fluency.

All four of the tutors were selected due to their professional demeanor and strong academic effort in their math teaching methods course, for which the second author was the instructor. The participants consented to be a part of this study in accordance with stipulations set by the Institutional Review Board at the researchers' university. The tutors, Alice, Brittany, Linda, and Sandy, were all white females that were traditional undergraduates (i.e., with ages between 18 and 22). They participated in weekly trainings, led by the researchers, that took place in the school where they tutored on a weekly basis. In the first year of the project, tutors began training and tutoring in December and continued through the end of the school year. In the second year, the tutors continued tutoring students in Algebra I, but had no further training.

Data Collection and Analysis

Towards the beginning of the second year of the project, researchers emailed the school personnel interview questions to learn about their perceptions of the tutoring program. We conducted open coding of their responses and reported our findings in the results section (Strauss & Corbin, 1998). Regarding the pre-service teachers, the researchers emailed a brief survey to four pre-service teachers, who were participating in the tutoring program, to gather preliminary data to inform questioning for follow-up interviews. Then, the researchers interviewed each of the participants by asking questions about the program in general as well as more targeted questions based on their responses. For example, some of the participants mentioned struggles with Algebra I content knowledge and the researchers asked follow-up questions to those participants about that challenge. Also, two of the participants had tutored a student with math anxiety and expressed concern about the challenge of tutoring this student; in response, the researchers asked follow-up questions about their perceptions of their experiences tutoring a student with math anxiety. To maintain focus on the two major components of the project, the researchers also asked questions during the interviews about the tutors' use of gestures and strategic questioning during tutoring sessions and the trainings we implemented to inform students about these teaching tools.

The researchers audio recorded and transcribed the interviews of the participants. Then, the researchers searched through the transcripts of the interviews

and survey responses for trends to establish a set of open codes to document our initial interpretation of the data set and to establish a priori codes for the next round of data analysis (Strauss & Corbin, 1998). We established codes such as concerns about algebra content, challenges with strategic questioning, use of gestures, concerns about math anxiety, suggested adjustments to the program, and recommendations for keeping components of the program. Then, the researchers used these a priori codes to code the data (Stake, 2010). The data was arranged in a column for transcript and a column for codes. Then, in a separate document, the researchers put the coded data into "patches" to search for emerging themes (Brantlinger et al., 2005). The Results section of this paper was built around the themes that emerged.

To triangulate our findings, the researchers consulted with the tutors about the interpretation of the data (i.e., member checks) to monitor the interpretive validity of the researchers' data analysis regarding our inferences during data analysis (Brantlinger et al., 2005). We also consulted with an external auditor, a researcher not involved in this study, to check the interpretive validity of our data analysis (Maxwell, 1992). The agreed-upon data analysis by the researchers, the participants, and the external auditor are reported in the following section.

Results

Overview of Participant Perceptions

The school personnel were supportive and confirmed that we had found a way to build a mutually beneficial relationship with the school. When asked about whether or not we were benefitting the school as intended, Mr. Clarkson responded "I think it's been great so far! Once we laid the groundwork of getting locations, students, times, etc. all set, it seemed to almost run itself." When asked about how the tutors could benefit the school, Mr. Harris responded:

> Tutors can be an extension of us as teachers. They should be able to help the students and connect with the students in the same way that we do as teachers. They can help us by communicating any problems or a good breakthrough that they have while working with the students. They can help us by being able to have the student hear the information from a different voice instead of hearing it from the teachers every day.

We strived for meeting this standard in our work due our belief that field work for pre-service teachers should be conducted in ways the benefit both the university and the school. We also wanted to maintain the standard set by previous studies (e.g., Karsenty, 2010; Maheady et al., 1996; Maheady et al., 2004). Having established this relationship, the researchers will focus on the next section on the perceptions of the tutors.

Several themes emerged from our conversations with the tutors. Tutors found success in using visual representations including gestures. Yet, the tutors expressed concerns about their algebra content knowledge and their performance regarding strategic questioning. Two of the tutors, who had worked with a student with math anxiety, were concerned about their work with him, but also described ways they had succeeded with this student. From analyzing the tutors' perspectives, the

researchers gained valuable insight into which components of the project were working well and other components that could be added to strengthen the program (e.g., more of a focus on math anxiety in the trainings). We report more on each of these themes in the next section.

Using Visual Representations to Support Students

Some of the tutors reported that they used visual representations to help students make sense of the problems and that our trainings helped them use these strategies effectively. For example, we focused heavily on gesturing in the trainings to help the tutors understand the connections between how gestures can alleviate potential struggles with working memory and mathematics content in general (Alibali et al., 2013; Hord et al., 2016). When asked about our focus on gesturing during trainings, Alice said the following:

> I have learned how to use gestures to help simplify a question. It is easy to use gestures, but how you taught us to use them meaningfully has been helpful. Even in other subjects when we are tutoring, not just math. I think it helps the kids to think about how to break down problems. With Carley (her student) it has been helpful. When she goes off-task, I can say no, we are just focusing on this part. I just want you to focus on the $5x$ and covering up the rest of it.

During the course of our trainings we noticed that teaching tutors how to use gestures seemed to be something the tutors appreciated and, by their own account, were able to successfully apply to their work with the students. However, algebra content knowledge and strategic questioning were often more difficult to teach.

Challenges with Algebra Content Knowledge

The tutors reported they struggled sometimes with having to remember the algebra content and present this information in ways that were accessible to the students. They tended to describe challenges related to not working with Algebra since high school and how they had forgotten some of the content. Sandy described her challenges:

> The algebra knowledge piece has continued to be difficult because we are not studying much of it in our methods class and we haven't done this stuff ourselves since high school. I feel pretty strong in math in general, but it throws me off when they bring in content I haven't seen in a long time. When we get the material ahead of time, I will look over it and refresh myself beforehand. I find it's helpful to have my laptop open so that I can pull up an article or example of what they're doing from somewhere else online while it's happening so I can glance at it to refresh myself. I think what would be most beneficial is even if we had a very broad outline of the curriculum, just a broad concept or two for the day, we could look over it, know what's coming, and be able to more readily tie things together. I feel more confident in the math than last year, but it still is a problem sometimes.

Linda described similar challenges:

> I know the content, but sometimes I haven't learned that in forever so I have to think about it for a second. I have to think back to when I learned it and figure it out. With one question last week, I had to think about it. Because he was stuck on it. I looked up one of the questions online. How to do it… And, I explained it to him. We didn't have an answer key and I didn't know what Mr. Harris wanted on the paper. So, I looked it up for myself and then helped him out and showed him.

When asked about having an answer key to guide her teaching, Linda responded that having one tended to help her with managing the challenge of remembering the content and presenting the content in accessible ways. She also described how having a list of the problems ahead of time gave her a better opportunity to prepare.

> I remember last year, a couple of times, Mr. Harris sent us the work before and we could look it over before the tutoring. Last year, when Mr. Harris sent it to us, I did the paper on my own. Just so I knew for sure that I knew how to do it. So, then when we went right into tutoring I knew exactly how to do it.

Linda then talked about the challenge of having to ask good questions of students while struggling with the algebra content, "If I'm doing it in my head and I try to explain it to them, it gets all jumbled up. Because I'm trying to figure it out, but I'm also trying to help them figure it out." Alice also expressed concern with the amount of attention and time she sometimes had to devote to remembering the algebra content.

> It's not that I don't know it, but I need to refresh my memory. And, I don't want to take away when we only have 40 minutes with them. I don't want to take away 10 minutes and… Oh, let me go back and re-learn this.

The task of remembering Algebra and presenting it in accessible ways was perceived as a challenge by the tutors. They also expressed concern with the challenge of asking the right questions of students while trying to remember algebra content.

Challenges with Strategic Questioning

During the process of training the tutors, we realized that the tutors' struggles with algebra content knowledge were adding a layer of difficulty for us as teacher educators and for the tutors. We also realized that, even in the best of circumstances, we faced a great challenge in teaching the tutors to ask good questions of students to promote critical thinking and progress through the problems. Linda described a situation in which she knew the algebra content, but still had difficulty talking about the content in a way that was accessible for the student and promoted his critical thinking:

> I knew the answer and what the definition of slope means in real-world terms. He knew the basics of it, but he wasn't quite getting it. And, I didn't know how to explain it without just telling him the actual answer. I know the answer and I try to ask him questions to get him to figure it out, but that doesn't get me anywhere. I don't want him to get frustrated either. I keep explaining around it and

> trying to get him to think about it and he would get frustrated. And, I don't want him to get discouraged.

Gathering information about students' current levels of understanding, as a basis for further questioning, added a layer of complexity. Sandy described this challenge:

> Asking kids to explain their thought processes is really helpful for Algebra I because there are so many things that I learned a long time ago that… They are engrained in my head now, so they make sense to me, but it is a lot harder for me to convey that same things to the kids, so I really need to get a good idea of what is going on in their mind because they can't read my mind and I can't read theirs.

Emotional factors also seemed to be affecting the tutors' questioning. Some of the students were anxious to complete their work and could be less receptive to questions that dug deeper into the mathematics. Alice described challenges she has faced with her student:

> Getting the kids to explain what they are doing is always kind of a challenge because they always just want to get their work done. And, asking the right questions to see what they are doing has definitely been one of the hardest parts. To make sure that we are not just rushing through this worksheet to get it done. That we are actually making sure we are seeing what they are doing.

Despite the teacher educators spending a significant amount of time in trainings on strategic questioning, the tutors still reported that they struggled with asking the right questions at the right time. This was an issue in favorable situations when the tutors were comfortable with the content, but even more so in situations when the students became anxious.

Challenges with Math Anxiety

The tutors reported significant concerns with dealing with students' math anxiety. Sandy said that the challenge of dealing with algebra content while teaching a student who has math anxiety is "definitely hard." Brittany tutored a student who had a history of math anxiety and this had an impact on many of her tutoring sessions with this student. She described the complexity of her situation:

> I feel like some of it is just knowing when it is anxiety and when it is not. Because some of it was… I think he just didn't want to work and some of it was anxiety. And, it was hard for me to recognize which was which because I just had never worked with him before. If I was working with him now, I would know like… Maybe you just need a break for a moment. I'll give you a five-minute break and you can play on your phone or do whatever. I think pushing through sometimes helped. But, sometimes it made him shut down. When he would get so frustrated, he would completely shut down and not do anything. And, he would just skip questions altogether. Sometime breaks help and sometimes not… Sometimes I would push him and he would learn something from it and sometimes I would push him and he would just completely shut down.

When asked about how she adapted to this challenging situation, she described her approach:

> If he was less anxious, or seemed to be less anxious that day, I would push him more to understand. Asking him "why" questions… Why he was doing that versus verbatim what he was doing. If he was really anxious, and I kept asking him why, that made him even more anxious and he started questioning himself that he didn't know why. Whenever he was less anxious, I was able to get more from him and really understand why he was doing the things he was doing and what he was thinking. But, if he was more anxious, he just didn't want to do that at all, so my questioning was more just like okay what is the answer versus why are we doing this, what does that tell us, stuff like that. A lot of times I knew that he didn't understand a question or we would finally get to the answer and I knew he had no idea how we got there. But, it took so much for us to get there and he was so worked up and if I kept pushing him on that, we wouldn't have gotten through any other questions. So, we just had to move on.

The dilemma of knowing when to ask more challenging questions versus asking questions to move a student forward in a problem is difficult in the best of circumstances. Based on Brittany's perception, anxiety made this an even more complicated situation.

Teacher Educators' Adjustments Based on Tutors' Perceptions

In future years, based on tutors' requests, we will have trainings devoted to addressing students' math anxiety. We also plan to continue to devote significant time to strategic questioning. While they indicated that they have made a lot of progress, students like Linda perceived that they need to learn more about questioning:

> I have learned how to ask questions that will make students think about what they are actually doing in the Algebra. I know a lot of students just go through the steps and memorize, but I have learned how to ask students how they got the answer and what they did. I still hope to learn other ways to explain and help students. I have not had many problems this year. But sometimes my student gets confused even after I have explained the questions. I would like to learn more ways of helping him so I do not confuse him more or just give him the answer.

We also plan on spending time on algebra content knowledge and devoting parts of our trainings to refreshing their memory about algebra topics. Linda described her wish for more training on algebra content.

> I wish I would have learned more about the content the students are currently working on. I like algebra but sometimes the work students are working on, I have not seen in a couple years. So, I would like to brush up more on that. I don't have a lot of trouble with algebra. I've taken multiple math classes. But, sometimes when you are not taking math classes… Like this semester, we are

> only taking one. And, I get stuck. I'm like I haven't learned this in forever. So, if it did get a refresher every week on what we are doing, then that would be easier for me to help my student.

In addition to a continued focus on strategic questioning and algebra content, we also plan on continuing to focus our trainings on direct connections to the real-world experiences the tutors are having with students with LD. While tutors value our discussions about simulated situations, such as student case studies, the tutors perceived real-world experiences (and discussions about these experiences) to be meaningful learning opportunities. Brittany described her experiences with the combination of tutoring and trainings.

> I think it was helpful to reflect on what we had and on the actual situations that we had. I think it would be helpful to talk about what we did do and what we could have done better. I think it was helpful to talk through different situations and actual, real things that were happening versus just like textbook what happened. I liked talking through what really happened and what really went on that day. It was helpful for me to have the meetings afterwards because I could talk about what just happened and why it happened. Which was helpful for me to try to figure out what would work better in certain scenarios and what wouldn't. The simulated questions obviously do help too, but we get that so much in our program and everything that constantly, but we are like, this is what's really happening. So, like, what are we supposed to do in this exact scenario. So, just getting more experience on, okay so we see this, what's the best approach on this is helpful.
>
> We've been doing a lot of case studies in our classes which is helpful too because we can get to know a specific student even though we don't know them. But, it's never going to be the same as when we actually get to work with a student. So, I think (working at a local high school) has been a good opportunity to use that. It's been really helpful to see an actual student and reflect on what we are doing with them and why it is helpful for them.

Our continued focus will be on the real-world experiences of the tutors. Yet, we also plan to include simulated case studies to make key points. In addition to continuing to teach about gestures and strategic questioning, we plan to incorporate more training time on math anxiety and how it can affect student learning and the decisions teachers make.

Discussion

Opportunities and Challenges

We were encouraged by the positive feedback from school personnel and by the tutors' perceptions of how beneficial the field work experience was for them. Yet, the complexities of the tutors' perceptions of their experiences provided both support for our current methods as well as a description of some of the challenges facing the tutors we, and other teacher educators, need to address in upcoming

years. Teacher educators need to carefully consider the challenges that tutors face with remembering Algebra I content while still being strategic with their gestures and questioning practices. Teacher educators also need to prepare tutors to deal with students' math anxiety in ways that promote progress through the problems, but still find ways to get students to think critically and deeply about the mathematics. We see opportunities for how we can be pro-active to prepare tutors through our trainings, but also opportunities for how we can teach our tutors to be reactive in strategic ways when they feel overwhelmed by the challenges of tutoring students with LD on Algebra I content.

Tutors' and Students' Anxiety with Mathematics Content

Students' anxiety towards mathematics was a recurring theme in our conversations with the tutors, especially with one tutor in particular. The math anxiety that the students with LD were facing was likely to divert their attention involuntarily towards concern for failure (on the given task or in general), or whether they would complete their work in the allotted time, rather than on the mathematics content of a given task (Eysenck, Derakshan, Santos, & Calvo, 2007). Students' mathematics anxiety was interwoven with the tutors' uncertainties about their own content knowledge. It is possible the tutors were experiencing similar feelings of anxiety about their knowledge of Algebra I content that could have interfered with their focus on the task at hand. All of the tutors in this program had chosen mathematics as a focus of their teacher preparation program, and they had all taken several college-level mathematics courses. And, while all of them were relatively high achieving in their mathematics content, several tutors expressed a desire for more training or review specific to the content for which they were tutoring. To lessen the anxiety tutors face with math content knowledge, we will need to provide more training on algebra content in future training sessions.

The concerns the tutors raised also brings up a broader challenge of the tutoring program, which was that the tutors did not always have time to prepare in advance of a tutoring session. Teaching, or tutoring in, mathematics requires knowledge of the content as well as more specific *pedagogical content knowledge*, which incorporates the knowledge of how to represent mathematical ideas to learners and the common conceptions and misconceptions that students may have (Carpenter, Fennema, Peterson, & Carey, 1988; Grossman, 1990). In this tutoring context, the tutors were viewed as an extension of the teacher. However, they sometimes had to infer the teacher's expectations or the class's norms for representing knowledge solving different types of tasks. Thus, while tutoring might be viewed as a straightforward process of helping a student complete his or her classwork, in fact, it is a complex process requiring sophisticated skills on the part of tutors. While this is a necessary challenge in many tutoring contexts, it puts substantial demand on the tutors. Teacher educators need to be aware of these demands and work toward finding ways to prepare tutors to meet these challenges. Though mathematics teachers and tutors need to be flexible and make good teaching adjustments in real-time to adjust to students' evolving levels of understanding, we also realize, as teacher educators and coordinators of our tutoring program, we will need to work more closely with the

school personnel in future years to gain access to lesson plans earlier to give our tutors better opportunities to prepare for their tutoring sessions. However, in addition to this measure, we also maintain that much of the preparation process should be designed to prepare tutors in ways that they can make good teaching decisions in the moment when inevitably, unexpected things happen when teaching children.

Proactive and Reactive Training Strategies

The trainings that we conducted with tutors were designed to help tutors proactively plan to incorporate the use of gestures and strategic questioning to meet the needs of students. From our conversations with tutors, we learned of the ways in which they used these strategies proactively, but we also learned how they might use these strategies reactively to overcome challenges. To consider first the case of questioning, there were several ways in which tutors proactively applied practices that we had worked on in our trainings. Tutors posed questions to elicit student thinking and to broaden their understanding of mathematics concepts. In a more reactive way, Sandy's comment about asking students about their thought processes illustrated one way in which tutors could use questioning in reaction to their own mathematics uncertainties. In particular, when the tutors themselves did not quickly remember the content students were working on, they could ask the students to explain it to them. These types of questions served two purposes. First, it allowed tutors to refresh their memory of the content without having to look up information and potentially lose time. Second, it helped the tutors learn more about the expectations of the teacher with respect to how students completed their work. By explaining their thought processes in response to tutor questions, the students provided a bridge between tutors' prior knowledge of algebra content and the expectations and norms of this particular Algebra I class.

Additionally, tutors needed to make reactive decisions around how to pose questions when students were stuck, when they expressed anxiety, or when they seemed not to be making forward progress. A critical component of strategic questioning is that a tutor knows when to pursue a more direct, focused set of questions in order to scaffold a student's progress towards completing a task (Nathan & Kim, 2009; Ni et al., 2014). This aspect of questioning was difficult to plan for during our trainings and only became an explicit topic of conversation midway through the training program. The tutors, however, expressed how they had implicitly adjusted their questioning practices in response to the feedback they received from students. Future work can more explicitly prepare tutors to use questioning as a form of scaffolding when students are stuck.

In the case of using gestures proactively, we found that this was one of the easiest skills to teach our tutors during the trainings and one that they found very useful in working with students. The tutors reflected on how they have used and continue to use gesturing in purposeful ways—especially covering up particular parts of a task—to help students focus on the necessary parts of their work. There were many times when students struggled with working memory when faced with having to process, store, and integrate multiple pieces of information (see Baddeley, 2003).

There seems to be opportunity for a more prominent role for the use of gestures not only in response to students' challenges with working memory, but also in response to tutors' own challenges and as a reactive measure. In parallel with the students, there were times when tutors had to recall and coordinate multiple pieces of information—related both to the content they were teaching and to the questioning practices they were learning to use. Considering the possibility that tutors were sometimes mentally overloaded and struggling with working memory, the role of gestures (which can ease the burden on working memory) may also be important for making it easier for the tutors to remember and communicate complex information (Alibali et al., 2013). In addition to presenting information clearly to students, gesturing can help tutors think through and present their ideas more effectively (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). Therefore, when tutors feel anxious or overwhelmed by the math content and teaching challenges, they could reactively gesture to support their own working memory as well as the working memory of their students.

Limitations and Directions for Future Research

The study was conducted with a limited number of participants from only one local school. Yet, the findings do provide some rich description of the benefits and challenges of implementing an Algebra I tutoring program for students with LD with pre-service teachers as tutors. Future research studies should be built upon the descriptive findings provided in this study with larger scale studies possibly targeting quantitative measures of students' growth in Algebra I or other courses after being tutored. However, due to the complexity of this topic and because Algebra I tutoring is an understudied topic, more micro-level studies of this topic could add more valuable information for teacher educators. In particular, future studies may gain valuable information from interviewing students with LD about their experiences being tutored by pre-service teachers.

Utilizing pre-service teachers as tutors for students with LD in a variety of contexts—and especially in mathematics and at the secondary level (e.g., Algebra I)—is an important topic for further study. Schools need help from tutors and pre-service teachers need field experiences to become better prepared for their jobs (e.g., Maheady et al., 1996). Algebra I is a gatekeeper course and success in this course is tied to many educational and occupational opportunities (Ysseldyke et al., 2004). Students with LD need well-prepared teachers to support them in this course (Andersson, 2008). Pre-service teachers need to gain valuable field experience and be able to grow from and reflect upon these experiences to develop a complex understanding of the needs of students with LD and how these needs are manifested in Algebra I courses. As teacher educators, it is our responsibility to provide these kinds of experiences for our pre-service teachers, provide a service to local schools, and continue to improve the quality of our programs.

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