

Supporting a Student With a Learning Disability Working on Algebra[1]

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We provide a detailed description of a purposefully sampled tutoring session during which a student with a learning disability displayed common tendencies we have seen in our work on algebra teaching. The student struggled with solving equations in general and especially with distribution and knowing how to distribute terms and what steps to take in the correct order. The tutor responded by helping the student offload information, gesturing while speaking with the student, and asking questions strategically to both support and challenge the student to think critically. The purpose of this paper is to provide, through a case study, an accessible description for teachers and researchers of how students with learning disabilities interact with algebra and how teachers can support and challenge these students in this context.

Keywords: **Mathematics, Algebra, Learning Disabilities, Gestures, Offloading, Questioning**

Introduction

In the United States, success in gatekeeper courses, like Algebra 1, is essential for all students, including students with learning disabilities (LD), regarding access to better opportunities in high school, college, and in the workplace (Ysseldyke et al., 2004). Algebra problems involve a lot of working with mathematics symbols, numbers, and variables in situations that require students to work through multistep problems, and this can create challenges for students with LD (Hord et al., 2018). Minimizing the demands on students' memory

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and processing through the use of visuals and asking questions that support students' thinking processes (as well as push them to think critically) seems to help students with LD as they engage with algebra (Hord, Ladrigan, & Saldanha, 2020).

Working Memory and Students with LD

In the United States, students with LD are a relatively academically successful group of students compared to other students with disabilities; these students are identified for special education services after a continued lack of improvement after receiving help in small group and individualized settings, yet these students often take the same classes as students without disabilities (Gresham & Vellutino, 2010). Students with LD often struggle with working memory which is the processing, storing, and combining of information (Baddeley, 2003; Swanson & Siegel, 2001). In other words, these students sometimes struggle with remembering and thinking about multiple pieces of information all at once. Fortunately, special education researchers have found ways to help students offload information (i.e., store information on paper), so they can avoid having to remember a lot of things all at once; they can store pieces of information on paper and then look at each piece and think about how the pieces are connected (Hord et al., 2018; Risko & Dunn, 2010).

Another approach for helping students with LD to overcome problems with working memory is to use gestures to support language (Hord et al., 2016). Gestures—hand movements that demonstrate meaning or draw attention to key information—can be used by teachers to support students with LD when talking about math (Hord et al., 2016). Students can think about and communicate information more effectively when they gesture as they speak (Goldin-Meadow, Nusbaum, Kelly, & Wagner, 2001). Students also learn better when they can observe their teacher gesturing (Cook, Duffy, & Fenn, 2013). Therefore, students with LD have better opportunities to think more clearly and effectively with math when they are gesturing and their teachers are gesturing when talking about math (Carrazza, Wakefield, Hemani-Lopez, Plath, & Goldin-Meadow, 2021; Hord et al., 2016; Rasmussen, Stephen, & Allen, 2004).

Students with LD can show sophisticated reasoning when teachers pose open-ended questions to explore students' understanding (Hunt & Tzur, 2017). Students with LD also benefit when teachers ask questions strategically to both support students and push their reasoning (Liu & Xin, 2017; Hord, DeJarnette, McMillan, & Baldrick, 2020; Xin et al., 2017, 2020). Special education researchers have found that using gestures in tandem with strategic questioning can be beneficial for students with LD (Hord, Ladrigan, & Saldanha, 2020). Teachers can use gestures to focus students' attention on key information in an algebra problem and then ask questions about that part of the problem to help the student focus on what they need to focus on as well as think their way through the

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next parts of the problem (Hord, Ladrigan, & Saldanha, 2020). There are also ways that teachers can provide more direct support through prompting questions when students are struggling, or teachers can choose to strategically ask more challenging, open-ended questions when students are doing well and are able to engage with more difficult concepts or tasks (Hord, in press).

By combining offloading, gestures, and strategic questioning, teachers can provide a combination of supports for students when they are struggling and push them to answer challenging questions when students are ready to do so (Hord, Ladrigan, & Saldanha, 2020). Offloading supports students so they do not have to remember and think about a lot of information all at once (Risko & Dunn, 2010). Gesturing makes information easier to think through compared to just speaking about math without gestures (Goldin-Meadow & Alibali, 2013). Overlaying gestures on top of offloaded information (e.g., pointing to parts of equations) can provide a necessary boost for students with LD when working on algebra (Hord, Kastberg, & Marita, 2019). Using offloaded information, overlaid gestures, and strategic questioning often provides the right balance of support and challenge that students with LD need as they engage with algebra (Hord, Ladrigan, & Saldanha, 2020).

Purpose of Study and Research Questions

This paper is designed to provide information for both researchers and practitioners and can be used for professional development of teachers as well as by researchers to inform future studies. The purpose of this study is to further investigate the teaching and learning of algebra by students with LD and to provide an accurate and accessible description, for teachers and researchers, of how students with LD interact with algebra and how teachers can support these students in algebra contexts. Special education researchers have conducted studies that have led to emerging themes of offloading, gestures, and strategic questioning as ways of supporting and challenging students with LD. We will provide real-world examples of how these concepts are manifested in a one-on-one tutoring context. The research question in this study is, what are the experiences of a student with LD when learning algebra, and what teaching adjustments both provide support and push this student to improve with algebra?

Method

This study is targeted toward by researchers and practitioners. To gather and describe the teaching and learning of student with LD, we conducted a case study of a purposefully sampled session of a tutor working one-on-one with a student with LD on equations from an Algebra 1 course. We chose this course because of the implications of it as a gatekeeper to opportunities in educational and workplace settings (Ysseldyke et al., 2004). We chose this particular student due to him being identified for special education services as a student with LD;

specifically, he needed extra help with math. The content covered during this session was also particularly interesting because it provided the multi-step (or multi-piece) situations that are conducive for studying how students with LD struggle with algebra regarding working memory and how teachers can make adjustments to help students with LD overcome these challenges (Hord, Ladrigan, & Saldanha, 2020).

Participant and Setting

The study was conducted in a suburban high school in the United States during a one-on-one tutoring session. The algebra problems were provided by the student's special education mathematics teacher. Instruction took place in one-one settings. While the student was enrolled in a general education Algebra 1 class, his teacher chose to assign him work to do with the tutor individually for extra instruction catered toward the mathematics he was finding to be particularly challenging (e.g., multi-step equations). The tutor, Paige, was a pre-service teacher studying special education at a local university. The student, Charles, was 16-year-old white male who was a ninth grader/freshman at the time of the study. His school records indicated that he was identified as a student with LD and in need of special education services in early elementary school for reading, writing, and mathematics (both for calculation and problem solving). Charles received small group instruction for mathematics, but he participated in Algebra 1 with students without disabilities. Charles had below average scores on achievement tests in mathematics and a history of struggling with math in general.

The tutor said that Charles often needed daily refreshers on the content from the previous day to remember what to do. He often made errors with solving multi-step equations. He struggled with negative numbers, and he needed guiding questions and reminders to keep track of negative signs. She also said Charles was often quiet and seemed unsure of the reasoning of his answer even when his logic was sound.

Charles' special education teacher said that he was able to complete algebra problems, but only with a lot of modeling and prompting. She said he often did not turn in all his assignments, and often put his head down on his desk during independent work. She said he exhibited a lack of motivation to learn the material. At the time of the study, he had a passing, but low grade: a 73% average on assessments, and a 70% overall in his Algebra class.

Data Collection and Analysis

The researchers video recorded several tutoring sessions using document cameras to avoid recording the students' faces for confidentiality reasons, but to also capture the details of how the students and tutors offloaded information on paper (i.e., "showed their work") and gestured during the conversations they had about the math. We purposefully sampled one session from a larger set

of sessions involving other students due to the characteristics of the student and the content covered. We chose to focus on this session because it illustrated his tendency to struggle with multi-step equations, and this particular session being focused on that problem type, while other sessions were focused on comparatively more remedial skills. The first author watched the session and identified the important parts of the session needed for transcription. The fourth author in this study transcribed the session, took notes about gestures used by the tutor and the student, and took notes about trends she noticed in the data. Then, the first author coded the data using codes for offloading, gesturing, and strategic questioning (e.g., use of scratch paper to store information, hand movements to show distribution, and more vs. less difficult questions). Once the data was coded, we organized it into categories and searched for themes that emerged from the findings (Brantlinger, Jimenez, Klingner, Pugach, & Richardson, 2005). Then, we discussed the emerging themes in a research meeting.

The research team conducted a "member check" (i.e., review of the transcripts and a written summary of our emerging themes) with the third author in the study, the tutor, to determine if our transcript and our interpretation of the data matched her interpretation and recollection of what happened during the tutoring session (Brantlinger et al., 2005). Then, the research team consulted with a researcher not involved in the study to do an external audit to monitor interpretive validity (Maxwell, 1992). After meeting with the external auditor and the tutor in the study, the research team came to a consensus on what should be included in the Results section. The following section contains our agreed upon findings.

Results

Paige tutored Charles on multi-step linear equations during the purposefully sampled tutoring session. A multi-step linear equation would be something similar to $2x + 1 = 3x - 5$, where solving involves collecting like terms (e.g., adding 5 to both sides of the equation; subtracting $2x$ from both sides of the equation) and then dividing by the coefficient of the x-variable to solve for x. Multi-step linear equations can be challenging for all students, and especially students with LD, because they require keeping track of one's work and anticipating what to do next. After solving a couple of equations with some help, Charles started struggling with the equation, $8x - 12 = 4x + 24$. On this problem, it was apparent that Charles was either missing some foundational knowledge or was overwhelmed by the multi-step nature of the problem. Charles struggled when he wrote $12x$ on the next step of his problem for combining $8x$ and $4x$, not realizing that it should be $8x - 4x$ rather than $8x + 4x$.

Paige: Where did you get $12x$ from?

Charles: The $8x$ and the $4x$.

Paige: Okay. So, you brought this $4x$ over to the $8x$?
Charles: Yes.
Paige: Are we going to subtract that $4x$ or...
Charles: Add it.
Paige: Why are we going to add it?
Charles: Oh wait, subtract it?
Paige: You tell me.
Charles: Subtract it.
Paige: Okay, why?
Charles: Because there's a minus sign right there.
Paige: Okay. Uhm… So, when we move things from side to side, why do we do the opposites?
Charles: Because uhm... So, it breaks it down.
Paige: It breaks it down? What are we trying to get this $4x$ to equal? Do we want it to equal a number or zero? Zero is a number, but...
Charles: Uhm... Just $1x$ like an x.
Paige: Okay, so if we're multiplying we want it to be 1?
Charles: Yeah.
Paige: But, since we're adding and subtracting, we want that to be zero, right?
Charles: Yes.

This part of the session illustrates an example of how to pose questions based on the student's current level of understanding. Paige's questions followed an interesting pattern as she assessed Charles' reasoning in the above excerpt. First, when she noticed Charles' error, she gave him a small hint ("Are we going to subtract that $4x$ or…") to help him notice it. When Paige realized Charles did not immediately notice his error, she pressed him with open ended "why?" questions to consider the rationale for adding or subtracting $4x$. Paige's open-ended questions revealed more clearly that Charles was struggling to remember the correct procedures for solving the equation. Paige had to address that he was struggling at this point and needed support. Once they established that they needed to add and subtract to make it zero, Paige returned to a more open-ended question to again challenge Charles to think about the procedure for solving the equation.

Paige: How are you going to make that zero? (POINTING to the 4x in the original equation)
Charles: Subtract it.
Paige: Subtract it, yeah. (pause while Charles works and correctly writes $4x – 12 = 24$;) Now, how are you going to make that 12 zero?

Charles: (pause) Would you add it?
Paige: Yes. So, like -12 plus 12 is?
Charles: 24
Paige: What's this going to equal? -12 plus 12 is?
Charles: Oh! -12 plus 12 is 12
Paige: Is... you take the… so
Charles: Or…

Despite Paige's prompting, Charles was still struggling to add positive and negative integers. To help him make sense of the situation, she made a connection to a real-world example using money, and he began to make progress.

Paige: If you owe somebody 12 dollars and you have 12 dollars and you give them the 12 dollars how much money do you have?
Charles: None
Paige: None, yeah. That's a zero now, which I think you knew.
Charles: Yeah.
Paige: But, now we have to add that 12 to the other side, right? (long pause while Charles works; Charles adds 12 to both sides and then divides both sides by 4; see Figure 1 for his work)
Charles: Oh uhm... Can I use a calculator?
Paige: Sure
Charles: 36 divided by 4?

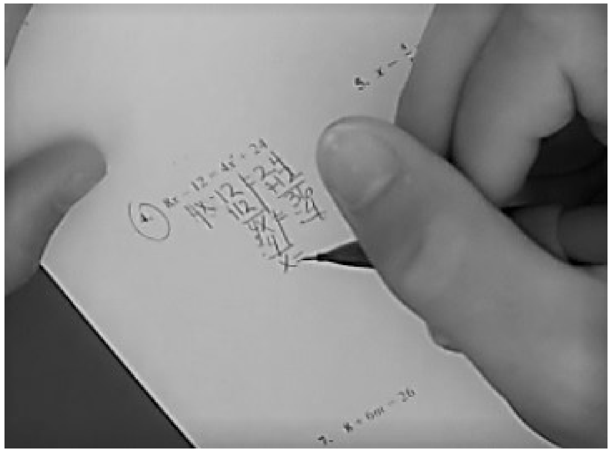

Figure 1. **Solving the Equation**

At this point, Charles was able to complete the last step and solve for *x*. However, he would have likely been frustrated and stuck on his work if Paige had not jumped in and provided some guiding questions and directions to keep him moving forward. Her questions ranged from more open-ended questions to give him space to more direct, guiding questions—even prompting—to help Charles keep making progress.

Work on the next problem illustrates the use of gestures and offloading. It was a multi-step equation that required distribution, $3 - 2(x + 1) = 5$, which added an extra layer of difficulty for Charles. In this problem, the gestures used by both Paige and Charles were important, as well as how Paige rewrote the distribution part of the problem, $-2(x + 1)$, separately to offload, or at least separate, that part of the problem away from the rest of the problem. Charles seemed to have trouble thinking about the distribution part of the problem more so when it was combined with the rest of the problem than when it was separated.

Paige: Let's try this one with the distributive property. What do you think our very first step is going to be?

Charles: Add those (POINTING to the $x + 1$ inside the parenthesis)

Paige: Okay, can you add *x* to 1?

Charles: Yeah. 2.

Paige: Does the 1 have a variable on it?

Charles: No.

Paige: No. Can you add numbers that don't have variables to variables?

Charles: No.

Paige: No. What could our other next step be?

Charles: Add those? (POINTING to the 3 and the 2)

Paige: Okay so…

Charles: And that would be 1.

Like in the previous example, Paige began with a fairly open-ended question ("What do you think…") to assess Charles' knowledge before intervening. From her questions, it became clear that Charles was really struggling, and Paige decided to intervene. She wrote the distribution part of the problem separately to see if Charles could think more clearly about it if it was separated from the rest of the problem. Paige wrote $2(x + 1)$ above the problem (see Figure 2). She then used this opportunity to overlay gestures on top of what she wrote to support the questions she asked Charles.

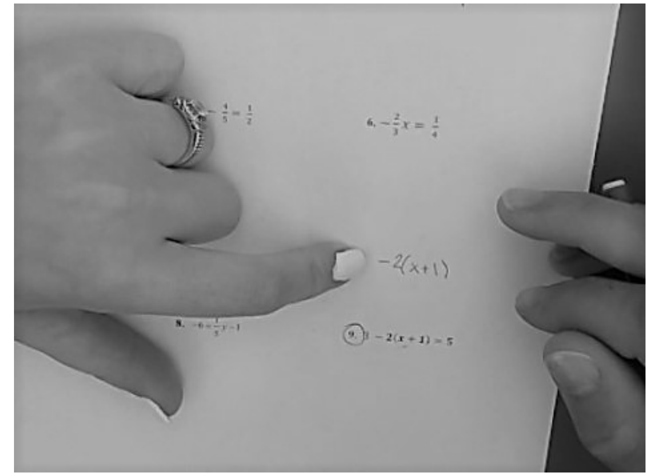

Figure 2. **Using Scratch Paper**

Paige: Okay, let me show you something. When we've got -2 with a parenthesis and *x* plus 1, do you remember what that means?

Charles: Yeah.

Paige: Okay, what are you going to do?

Charles: You take that and put it here. (POINTS the eraser of his pencil to the -2 and ARCHES to the *x*).

Separating the distribution part of the problem seemed to help Charles. He began to understand, and he gestured in a way that demonstrated his understanding of at least some of what he needed to do when he pointed to the -2 with his pencil and arched over the parenthesis to the *x* in the parenthesis (see Figure 3).

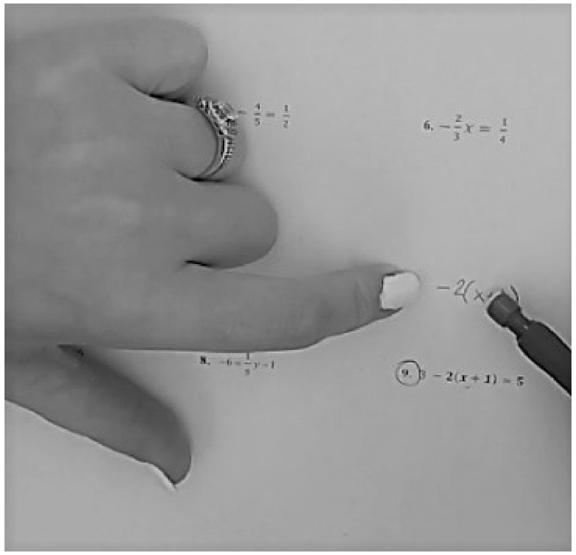

Figure 3. **Charles' Distribution Gesture**

Paige: Okay, so we're going to draw a little arrow.

Charles: Yeah

Paige drew an arrow from the -2 to the *x* to show the relationship (see Figure 3). At this point, Charles could see the relationship, which supported his work on the rest of the problem. Paige strategically gestured while she was explaining the relationship between the terms inside and outside of the parenthesis (see Figure 4).

Paige: But, the distributive property also means we need to move it to the 1, right? (POINTING the pencil to the -2 and MOVING the pencil to the 1)

Charles: Yeah.

Figure 4. **Paige's Distribution Gesture**

Then, Paige drew an arching arrow from the -2 to the 1 to complete the diagram to show the distribution to both terms in the parenthesis (see Figure 5).

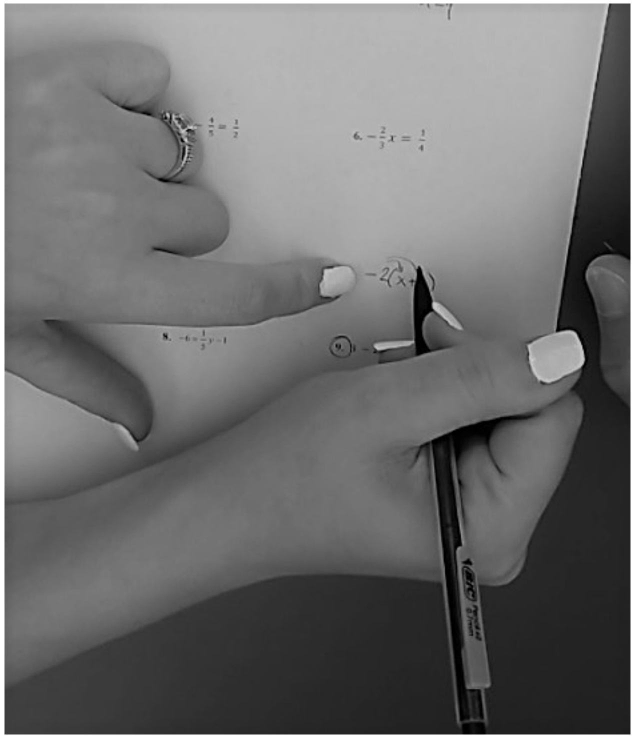

Figure 5. **Drawing Arched Arrows**

Charles moved his work back down to the original problem and continued to struggle with solving the equation, writing -4 + 3 = 5 below the first line of the original equation. Distribution was difficult for him at this point. Paige decided to refocus Charles on the separated distribution part of the problem (see Figure 6).

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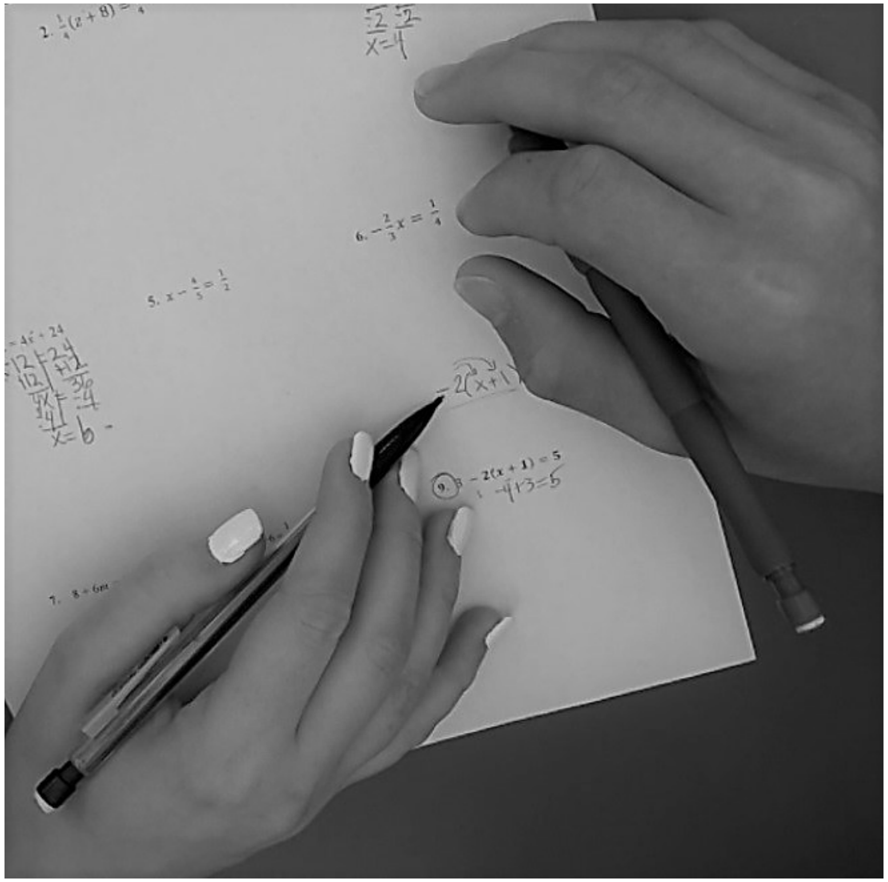

Figure 6. **Refocusing on Scratch Work**

She overlaid gestures on top of their work on paper and the original problem and provided more direct scaffolding.

Paige: Okay, so let's just re-write this first. Let's not put it in this part yet. Let's just rewrite it up here. We're multiplying right? So how would we rewrite this -2 times *x*? (POINTING to the -2 and to the *x*) And then -2 times 1. (POINTING to the -2 and 1) How would you rewrite that?

Charles: (writes -2*x* -2*x*) Like that?

Paige: Okay, you're really, really close. I got really, really excited. Okay, so this part is absolutely right (POINTING to the -2*x*) and then we are just multiplying the -2 times 1, so what's -2 times 1?

Charles: -2 times 1? -2

Paige: Yeah.

Charles: You just write -2?

Paige: Minus 2, right? Same idea.

Separating the distribution part of the problem from the rest of the problem seemed to help Charles. Also, Paige's gestures overlaid on the problem and direct questions seemed to help him see the relationships he needed to see. He did struggle with some multiplication of integers, but he was eventually able to, with a lot of support, distribute the -2 to come up with $-2x - 2$. Once he completed this part of the problem, Paige decided to help him rewrite the original equation and replace $-2(x + 1)$ with $-2x - 2$.

> Paige: It would be $-2x$ minus 2. And, now that we've written that, we can put that down here with the whole equation. We can take this part... this whole part... and replace it with this part, right? (POINTS with her pencil first to the $-2(x+1)$ in the original equation and then back the to the $-2x - 2$ in the scratch work and then back to where that needed to be put in below the original equation; see Figure 7). So how would you rewrite it using that now?

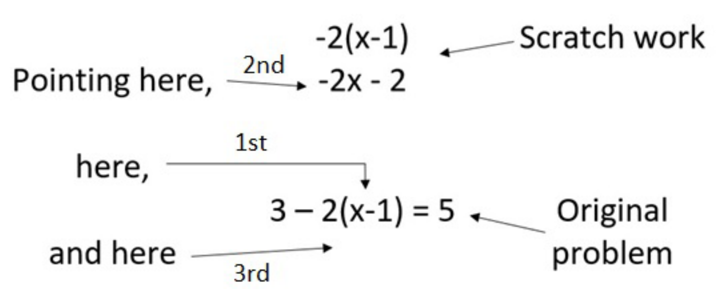

***Figure 7*. Transitioning from Scratch Work Back to the Original Problem**

Paige then helped Charles keep his work organized and think through the steps of solving the problem. She had to help him some more with moving the separated scratch work back to the equation. Paige used the offloaded (or separated) part of the problem (i.e., the scratch work) to help Charles more clearly see and think about that part of the problem and then reconnected that part of the problem back to the original problem using gestures. It seemed as though Charles needed a visual, along with what Paige was saying to mentally transition from their scratch work above the problem back to the original problem. Once they had completed the distribution and rewritten the equation as $3 - 2x - 2 = 5$, Charles said, "Isn't that the multi-step equation thing?" demonstrating that he made a connection between this problem and the problems he solved previously.

Charles struggled a lot, but Paige's work with separating parts of the problem, on which he needed to focus at the time, from the rest of the problem and gesturing helped Charles make progress. Paige also followed a pattern of beginning each new problem with open-ended questions to let Charles consider the procedure for solving each equation (e.g., "how?" questions) and the reasons for those procedures (e.g., "why?" questions). These open-ended questions also allowed Paige to assess Charles' understanding, and Paige posed more direct questions only after it became clear that he needed more direct support. Charles did make progress through the work, and he did see the connection between the problems regarding their structural similarities. While Charles demonstrated that he was likely to struggle a lot with Algebra 1, he also showed that, with the right kind of help, he could make progress and make important connections with this level of mathematics.

Discussion

Charles seemed to benefit from a combination of offloading (or separating his work into more manageable pieces), gestures, and strategic questioning. Paige had the difficult challenge of deciding when to ask tough questions and when to support Charles with more direct questions or even prompts on what to do next. When he struggled, keeping his work organized on paper seemed to make a difference considering how he seemed to struggle more when working with steps combined in the original problem compared to when his steps were separated (e.g., writing the distribution part of the problem separately from the rest of it). This worked similarly to how storing information on scratch paper, rather than in short-term memory, eases the process of thinking about, remembering, and combining multiple pieces of information. In short, scratch paper is an ally of struggling learners. And, just as a teacher might diagram a word problem to support a younger child, Paige's use of separating parts of the equation for Charles made it easier for him to see what he needed to see clearly and think about the math successfully (Hord & Xin, 2013; Marita & Hord, 2017).

Gestures were also important for Charles. He made use of gestures to demonstrate his own thinking and also seemed to benefit from Paige's gestures. While he may not have immediately demonstrated understanding after each time she gestured, he eventually demonstrated understanding of distribution and how the different multi-step equations were similar. The role that gestures played in the tutoring session was consistent with existing research regarding how students can think and communicate more effectively when they gesture and when they observe gesture (Cook et al., 2013; Goldin-Meadow et al., 2001).

And, the study does provide further support to existing research that gestures can be important for the teaching of mathematics to students with LD (Hord et al., 2016).

Gestures played a role in tandem with strategic questioning as with previous studies (Hord, DeJarnette, McMillan, & Baldrick, 2020). Paige used gestures to draw Charles' attention to key parts of the problems as well as to help Charles see important relationships between parts of problems. Paige often prompted or questioned Charles as she gestured using gestures to support the conversation. Paige also adjusted her questioning from being more open-ended to more direct, when she noticed that Charles was struggling. Importantly, Paige began each new problem with more open-ended questions, continually creating space for Charles to engage in mathematical reasoning. Teachers need to carefully strike this balance to keep students with LD moving forward and avoiding frustration, but also to strive for questioning (whenever possible) to leave time and space for the student to think critically. Ideally, during parts of the sessions, teachers can ask questions that put the students in position to think critically even more about algebra than they would without the teacher's challenging questions.

Limitations and Directions for Future Research and Practice

The study was very small in scale and only included a purposefully sampled session with one student with LD and one tutor. However, the purpose of this study was to describe a real-world teaching session in a way that is accessible for teachers and other researchers while still contributing to the research base. Future studies should include more sessions with more students and multiple studies need to be completed on this topic to further develop the research base and to provide more description of how students with LD can be taught and learn algebra.

The findings from this study and similar studies provide information that is beneficial for teachers regarding how to keep students' work organized on paper in accessible ways, how to gesture on top of that work, and how to ask questions to support and challenge students. We encourage teachers to learn from existing research on how to teach algebra to students with LD and apply the principles in those studies and be empowered to come up with how to organize the math on paper, the gestures, and the right questions their students with LD need as they are engaging with algebra.

References

Baddeley, A. D. (2003). Working memory and language: An overview. *Journal of Communication Disorders, 36*(3), 189–208.

Brantlinger, E., Jimenez, R., Klinger, J., Pugach, M, & Richardson, V. (2005). Qualitative studies in special education. *Exceptional Children, 71*(2), 195–207.

Carrazza, C., Wakefield, E. M., Hemani-Lopez, N., Plath, K., & Goldin-Meadow, S. (2021). Children integrate speech and gesture across a wider temporal window than speech and action when learning a math concept. *Cognition, 210,* 104604.

Cook, S. W., Duffy, R. G., & Fenn, K. M. (2013). Consolidation and transfer of learning after observing hand gesture. *Child Development, 84*(6), 1863–1871.

Goldin-Meadow, S., & Alibali, M. W. (2013). Gesture's role in speaking, learning, and creating language. *Annual Review of Psychology, 64*(1), 257–283.

Goldin-Meadow, S., Nusbaum, H., Kelly, S. D., & Wagner, S. (2001). Explaining math: Gesturing lightens the load. *Psychological Science, 12*(6), 516–522.

Gresham, F. M., & Vellutino, F. R. (2010). What is the role of intelligence in the identification of specific learning disabilities? Issues and clarifications. *Learning Disabilities Research & Practice, 25*(4), 194–206

Hord, C. (in press). Gesturing while tutoring a student with a learning disability enrolled in Algebra 1. *Learning Disabilities: A Contemporary Journal.*

Hord, C., DeJarnette, A. F., McMillan, L. A., & Baldrick, P. (2020). A student with mild intellectual disability and two-step equations. *Support for Learning, 35*(4), 506–521.

Hord, C., Kastberg, S., & Marita, S. (2019). Layering visuals to empower struggling students. *Australian Mathematics Education Journal, 1*(2), 6–10.

Hord, C., Ladrigan, E., & Saldanha, R. L. (2020). A student with a learning disability and multi-step equations with fractions. *Learning Disabilities: A Contemporary Journal, 18*(1), 113–123.

Hord, C., Marita, S., Ayaz, S., Tomaro, T. M., Gordon, K., Tunningley, J., & Haskins, S. (2018). Diverse needs of students with learning disabilities: A case study of tutoring two students in algebra. *Journal of Research in Special Educational Needs, 18*(1), 25–35.

Hord, C., Marita, S., Walsh, J. B., Tomaro, T. M., Gordon, K., & Saldanha, R. L. (2016). Teacher and student use of gesture and access to secondary mathematics for students with learning disabilities: An exploratory study. *Learning Disabilities: A Contemporary Journal, 14*(2), 189–206.

Hord, C., & Xin, Y. P. (2013). Intervention research for helping elementary school students with math learning disabilities understand and solve word problems from 1996-2009. *Learning Disabilities: A Multidisciplinary Journal, 19*(1), 3–17.

Hunt, J., & Tzur, R. (2017). Where is difference? Processes of mathematical remediation through a constructivist lens. *Journal of Mathematical Behavior, 48*(12), 62–76.

Liu, J., & Xin, Y. P. (2017). The effect of eliciting repair of mathematics explanations of students with learning disabilities. *Learning Disability Quarterly, 40*(3), 132–145.

Marita, S., & Hord, C. (2017). Review of mathematics interventions for secondary students with learning disabilities. *Learning Disability Quarterly, 40*(1), 29–40.

Maxwell, J. A. (1992). Understanding and validity in qualitative research. *Harvard Educational Review, 62*(3), 279–300.

Rasmussen, C., Stephan, M., & Allen, K. (2004). Classroom mathematical practices and gesturing. *Journal of Mathematical Behavior, 23*(3), 301–323.

Risko E. F., & Dunn, T. L., (2010) Storing information in-the-world: Metacognition and cognitive offloading in a short-term memory task. *Consciousness and Cognition, 36*(1), 1-74

Swanson, H. L., & Siegel, L. (2001). Learning disabilities as a working memory deficit. *Issues in Special Education, 7*(1), 1-48.

Xin, Y. P., Chiu, M. M., Tzur, R., Ma, X., Park, J. Y., & Yang, X. (2020). Linking teacher-learner discourse with mathematical reasoning of students with learning disabilities: An exploratory study. *Learning Disability Quarterly, 43*(1), 43–56.

Xin, Y. P., Liu, J., Jones, S. R., Tzur, R., & Si, L. (2016). A preliminary discourse analysis of constructivist-oriented mathematics instruction for a student with learning disabilities. *The Journal of Educational Research, 109*(4), 436–447.

Ysseldyke, J., Nelson, R., Christenson, S., Johnson, D. R., Dennison, A., Triezenberg, H., Sharpe, M., and Hawes, M. (2004) What we know and need to know about the consequences of high-stakes testing for students with disabilities. *Exceptional Children, 71*(1), 75–95.

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