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# Where is Difference? Processes of Mathematical Remediation through a Constructivist Lens

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ABSTRACT

In this study, we challenge the deficit perspective on mathematical knowing and learning for children labeled as LD, focusing on their struggles not as a within student attribute, but rather as within teacher-learner interactions. We present two cases of fifth-grade students labeled LD as they interacted with a researcher-teacher during two constructivist-oriented teaching experiments designed to foster a concept of unit fraction. Data analysis revealed three main types of interactions, and how they changed over time, which seemed to support the students' learning: *Assess*, *Cause and Effect Reflection*, and *Comparison/Prediction Reflection*. We thus argue for an *intervention in interaction* that occurs in the instructional process for students with LD, which should replace attempts to "fix" 'deficiencies' that we claim to contribute to *disabling* such students.

## 1. Introduction

In the study reported here, we examine the interactions between a researcher-teacher and two children labeled as having learning disabilities (LD) during a series of tutoring sessions designed to support and extend each child's knowledge of unit fraction concepts. This examination contributes to the ongoing debate about ways to effectively support mathematics learning of students with LD. Our approach, which is not commonplace in the literature about instructional interventions for students with LD in special education, draws on constructivism to define knowing as individual cognition and learning as the interplay between the cognition and interpersonal interactions that unfold in a shared instructional space. We focus on teacher-child interactions, particularly the verbal communication patterns of the *teacher's response to each girl's mathematical activity* (e.g., her actions, her statements, etc.), and how those interactions may foster the intended learning in each girl.

Our study can contribute to understanding reasons, and possible remedies, for difficulties and struggles children often experience in mathematics over their school age years (Hecht & Vagi, 2010). For some children, the difficulties become persistent and compound into unique learning challenges. These challenges can occur across mathematical domains (Geary, 1993) or in one domain foundational to later mathematics performance, such as number sense or rational number sense (Mazzocco & Devlin, 2008). Regardless, the challenges permeate these children's mathematical experiences, and often lead to barriers in accessing high level mathematics, such as algebra (National Mathematics Advisory Panel, 2008). To address these challenges, systems are often put into place in schools to afford supplemental instructional opportunities in an effort to amplify children's learning (Fuchs & Fuchs, 2006). Within these systems, a common goal rests in the desire to remediate, or make better, the children's difficulties that seem to emerge in the regular classroom. In this way, remediation is the *process* by which teachers work to augment mathematical conceptions, while intervention

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is the *system* through which the process occurs.

In terms of the intervention *system*, researchers in the USA posit a three-tiered structural approach in which the intensity of supplemental instruction increases gradually in each sequential tier (Bryant, Bryant, Gersten, Scammacca, & Chavez, 2008). The first tier is usually understood as the mathematics classroom, where whole class mathematics teaching is employed and procedures are put into place to monitor children's learning. The second tier consists of instruction that is in addition to whole classroom teaching, which occurs in small tutoring groups over a period of several weeks (Bryant et al., 2008; Fuchs et al., 2008). The third, most intensive tier is where children and teachers interact at an individualized level (Fuchs & Fuchs, 2006). Thus, children participating in the tiers typically progress from whole class communication to small group exchanges to one-on-one interactions. The one-on-one instructional interactions in the third tier focuses on aligning, in an expeditious manner, children's mathematical performance with that of their non-struggling peers.

In terms of the process of providing remediation, the design of mathematics instruction is a critical component. In much of the literature, this design becomes increasingly direct (Gersten et al., 2009; Jitendra et al., 2007). In fact, mathematics teaching practices in the second and third tier often entail an explicit delivering of information by teachers onto children, positioning children's learning and competence in mathematics as a responsiveness to teacher-led instruction. This instruction often includes (a) teacher-specified strategies to be used by children to learn new material, (b) teacher modeling of the new material, and (c) multiple opportunities for children to respond to and restate the teacher's thinking. A wealth of research documents increased mathematical performance when this process of re-mediation is used (Brophy & Good, 1986; Ellis & Worthington, 1994); this research seems to solidify the usefulness of the approach to increase and align children's performance with that of their non-struggling peers.

Direct, systematic instruction seems beneficial if the goal of the remediation process is to increase children's performance with procedures or memorization of mathematical conventions (Hiebert & Grouws, 2007). Yet, we question the reduction of learning taking place in this process in terms of the ramifications for children's mathematical conceptions and their identities and sense of competence as mathematical thinkers. Overlooking the mathematical knowledge children *do* hold, along with social aspects of learning that occur within a shared instructional space, seems to position the "problem" *within the struggling child* as opposed to the processes that, in part, may have contributed to the inequities in the first place (e.g., Balu et al., 2015). In this way, we assert that framing re-mediation processes as a child's responsiveness to teacher-directed ideas is limited in that the approach may work to sustain views of the child as *mathematically disabled*.

Another view of a process of remediation that has been standard in mathematics education instruction might begin with the design of instruction as increasingly responsive to the child. In such a process, mathematical knowledge is not imposed on children (Baroody, Cibulskis, Lai, & Li, 2004), and performance is not equated with conceptual understanding. Instead, mathematical understanding [and learning] begins with the child engaging with mathematical situations that are "within [their] reach [while] grappling with key mathematical ideas that are comprehendible but not yet well formed" (Hiebert & Grouws, 2007, pp. 387). When researchers utilize this stance with children with LDs, they are positioned as *holding a knowing* that they use to understand and to learn. Interactions between a child and a teacher in a shared mathematical space constitutes a second aspect of learning. In this way, framing remediation as a teacher's responsiveness to child-guided activity may work to create and sustain views of the child as *mathematically enabled*, removing the attribution of "problem" from the child and placing it, as a challenge, on the educational interactions between teachers and children.

In a prior study (Hunt et al., 2016), we documented how a conception of unit fractions (1/n) evolved through the mathematical activity of two fifth grade girls labeled LD. We worked within each girl's ways of knowing and utilized a task that supported each girl to estimate the size of an equal share, or unit fraction, of one whole bar for *n* people. The child's activity involved estimating the length of just *one of n shares*, iterating it across the bar, and adjusting the length until the exact share size was achieved. Our findings included four distinct conceptual stages of unit fraction knowledge: (a) *No Conception of the Nature of Adjustment to the Magnitude of a Unit Fraction*, (b) *Evolving Anticipation of the Nature of Adjustment but not of its Relative Amount*, (c) *Anticipation of the Nature of Adjustment with an Evolving Partial Amount*, and (d) *Dual Anticipation of the Nature and Amount of Adjustment*. Our findings afforded a view into the nature of the conceptions these two children built through their own activity, positioning them as competent mathematical thinkers.

Yet, we suspect that the shared mathematical space constituted a second aspect of the children's learning. By documenting how each girl's concept of unit fractions was facilitated through child-teacher interactions, we aim to expound upon an alternate conceptualization of intensive mathematics re-mediation processes. In this paper, we argue that such processes are not grounded in the child's response to static, direct instruction, but instead the evolving interactions between the child and the teacher—who constantly adapts instruction to fit with the child's conceptual growth. As we will argue, this work may hold implications beyond intensive teaching processes. Specifically, we argue that our findings support a critical view of the origin of "difference" as it pertains to mathematics learning and the systemic nature of the "problem" of chronic, low mathematics performance.

The research questions we address are:

1. What patterns of verbal interactions are enacted between two children and a researcher-teacher within constructivist-oriented intensive mathematics intervention settings organized to support the development of unit fraction knowledge?
2. What might the patterns of verbal interaction tell us about each child's knowledge development over the course of the intervention sessions?

To contrast our approach with current, direct-instruction approaches for teaching mathematics to students with LD, in the following section we synthesize the history of a positivist view of knowing and learning that seem to underlie processes of intervention