Navigating "Disability": Complexity and Small Environments

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Abstract: Exploring how children's conceptions might advance through *their* implicit knowledge provides a fundamental view into children's mathematics and elucidates possible alternative definitions of "learning difference (LD)". I present an evolving theoretical framework that depict children with LD's knowing and learning as nascent understandings that emerge from a real-time negotiation of meaning within "small environments" of instructional intervention. These negotiations are supported, or not, by the teacher's propensity to engage in the knowledge of children and use teaching to construct *shared goals* for learning. Implications of the work include new ways educators might define LDs as a complex phenomenon that reflects how children's knowledge of mathematics advances, or not, through a shared cognition grounded in children's unique knowing and learning.

Conceptualizing "Difference" in terms of knowing and learning mathematics

The major issues addressed in this work are conceptualizing "disability" and what it means to "know and learn mathematics" in instructional settings. Historically, researchers define instruction for these students as intervention: the addressing of deficiencies or differences in children's mathematical knowledge (e.g., Hudson & Miller, 2006). In some research, specific factors (e.g., working memory, processing, spatial reasoning, retrieve basic facts, identifying and/or compare number magnitudes and symbols) are tested alongside instruction (or before and after instruction) in a predictive manner to explain "learning disabilities" as a non-response to explicit, teacher-led instruction (e.g., Compton, Fuchs, Fuchs, Lambert, & Hamlett, 2012; Jordan, 2007; Mazzocco & Devlin, 2008; Murphy, Mazzocco, Hanich, & Early, 2007; Vukovic, 2012).

The propensity to equate these children's knowing and learning as a response to direct or explicit instruction is probable due to the manner in which disability is being defined or conceptualized. Societal norms, the teacher's knowledge, or some combination thereof becomes the driving force behind mathematical knowledge as a remediation (Vygotsky, 1978). Yet, this literature is incomplete and at times misleading for those who do not equate *remediation* with *learning*. I frame learning as adaptation (Piaget, 1951/1972/1980) and argue that because disabilities or differences in learning are far more dissimilar than they are similar (Compton et al., 2012), instruction should be based in a complex model of children's knowing and learning that I call "small environments".

Learner complexity in "Small Environments" — mind, goals, and environment

"Small environments" ground learning within adaptation as opposed to remediation done through direct instruction or explicit strategy modeling. If we accept that students possess a way of knowing mathematical content (DiSessa, 1988), then we also have to accept that even if students engage with learning situations in unexpected ways, their knowing and reasoning cannot be conceptualized as "deficient" or, arguably, even "different." It must be conceptualized as *their knowledge*: unique, complex organisms comprised of strengths and challenges that every person utilizes to make sense (Rose & Fischer, 2009). I draw from Piaget (1967/1972/1980), who argued that, often times, these ways of making sense are individualized, especially when we consider that the ways children reason are not the same as adults (Flavell, 1996). For Piaget (1972), knowing and learning was defined by the individual child, or "little scientist," who learned through a complex way of adapting her internal cognition (e.g., prior experience; current conceptions) through interactions with her environment that facilitate negotiated meanings.

Negotiated meanings take place in the small environment <u>first</u> as children's attempt to adapt their internal cognition with the environment and <u>second</u> as a bi-directional reasoning and sense making process started by children and facilitated by the teacher as a responsiveness to children's reasoning (Brown, 1992; Bruner, 1999; Piaget, 1951, 1972). A focus on the process through which cognition exists and adapts inside children's minds (i.e., schemes) as they negotiate the environment is one way to understand learning. Piaget (1972) argued that, in attempts to assimilate their environments, children notice differences between what they "know" and their environment; this creates *disequilibrium*. The disequilibrium occurs when the knowledge children already have (i.e., how they "see" things) differs from their environment. Children's reflections within goal-driven activity caused by the disequilibrium are thought to promote abstractions and generalizations in reasoning. The core element that children draw upon within this reflective activity is the *goal* that drives their learning; this goal can be formed and motivated by various factors (e.g., social, personal, logical, Piaget). Defining learning, or differences in learning, in this way is provoking because it illuminates an inferred build-up of learning (i.e., such that learning becomes new knowledge) on the part of children as they negotiate their own minds (e.g., Boyce & Norton, 2017; Hunt, Tzur, & Westenskow, 2016; Simon, 2017; Steffe & Olive, 2010).

However, I assert that a sole focus on inferred processes by which children negotiate their own minds leads to incomplete depictions of learning or, arguably, *disabled* learning. This is because children's interactions with other people in the environment are also defining learning. Children constantly form and refines their goal for learning in activity, so their interactions with the small environment are already complex. Additional complexity is presented when an adult interacts with the child in the small environment, with her or his own "goals" for learning, which can also have varying motivators (e.g., pacing guides, mathematical content goals, mathematical process goals, depictions of growth from developmental trajectories, etc.). Children's learning, then, becomes negotiated by more than just their own interactions with the environment: learning becomes negotiated by the goals of the other person in the environment.

In this way, I equate complexity inside the small environment with the real-time negotiation of the goals these children experience in their own activity with adult's goals for children's learning as either perceived by the child, explicated by the adult, or set by the learning situation. I argue that within this negotiation, assumptions are made about who is setting the goals and what those goals are relying upon. *Children and teachers both set goals,* and these goals may differ. This is critical because each person's goals are effecting the interactions necessary for little scientists to understand and adapt to the small environments.

Responding to children's reasoning as they adapt it in intervention is critical (Empson, 1999) yet by no means an easy task. One reason is that children's prior experiences may not align with the teacher's theories for learning. Children may take a different kind of ownership of mathematical thinking (Woodward, 2004), attributing knowing and learning as quick response to teacher-given explanations or procedural steps (Woodward, 2004). Or, children may not believe that mathematics is attributable to effort, hard work, and mistakes (Boaler & Greeno, 2000). In the same way, teachers may have their own perceptions and beliefs about knowing and learning (Boaler, 2011). All or some part of these factors change learning and the goals that children and teachers set for themselves in the small environment.

Implications: Advancing or reducing shared understandings

Implications of this work are threefold. First, *if* researchers and teachers respond to the complexity of children's thinking in the small environment, then children respond to adults and adapt to the environment. They either match "how they see things" to what they perceive, are exposed to, or interact with (utilize existing mental schemes to make sense), or not (change existing mental schemes to make sense). In either case, the child makes an adaptation in themselves to "understand", not assimilate to, the environment.

Second, I argue that this definition of knowing and learning is far more empowering to children thought to have a cognition that *could* begin differently than a definition that seeks to impose onto children knowledge that they may not make sense to them. Zawojewski, Magiera, & Lesh (2013) illuminate why some children do not "progress" past certain ways of knowing:

> Do all students optimally learn along a particular normalized path (learning line, learning trajectory)? Do all students learn the "end product" in the same way? Likely not…. Particular goals for students' learning [are] regions… that are individualistic and dependent on a variety of interacting factors. (p. 473).

Finally, bi-directional constructions of understanding speaks to the human endeavor. *Equilibration*, then, can become multi-dimensional: a dilation and revitalization to children *and* teachers. Truly shared understandings can be a real result. This multi-dimensional knowing and learning is an expansion of child-driven negotiations of small environments into larger societies and shared, valuable understandings in STEM education.

Selected References

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