# ILLUMINATING INEQUITABLE LEARNING OPPORTUNITIES UNDERLYING EFFECTIVE COLLABORATIVE PROBLEM SOLVING IN ALGEBRA

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A thematic objective of mathematics-education researchers focusing on algebra content is to develop theoretical frameworks that account for students' difficulty with problem solving. Yet while these frameworks are being developed, the national achievement gap is increasing, even amid calls for equity in mathematics education and, in particular, to improve the accessibility of algebra content for students from minority groups and economically disadvantaged backgrounds.

Radford's (2003) *semiotic–cultural* approach theorizes mathematics learning as the personal construction of meaning for canonical semiotic artifacts (e.g., algebraic symbols such as the variable "*x*") through authentic discursive utterance. By repeatedly expressing their presymbolic notions in available semiotic means of objectification, students build personal meaning for the mathematical notation and develop procedural fluency. Specifically in pattern-finding problems, students solve by progressing through factual, contextual, and symbolical generalizations.

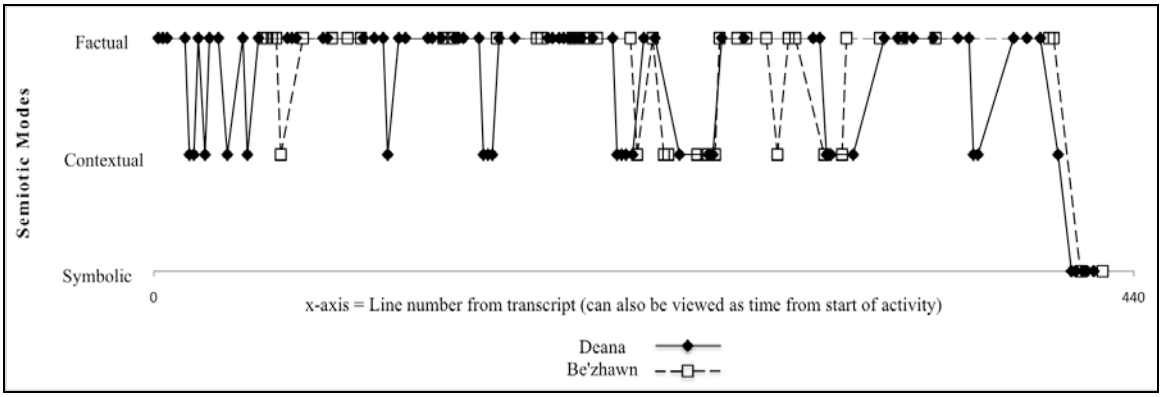


**Figure 1. Two collaborating students' utterances over 28 minutes, by semiotic mode.**

I propose an elaboration on the semiotic–cultural approach that enables researchers to delve into cognitive planes below external discursive manifestations. By applying this elaboration to empirical data from an intervention conducted at a school for academically at-risk students, I expose tension between one student's overt, positive contributions to shared problem solving and his covert ungrounded reasoning as illustrated in Fig. 1.

Students' effective contributions may blind teachers to underlying discontinuities in meaning construction. I thus propose: (a) a theoretical refinement to the semiotic–cultural approach; and (b) a methodological approach for distinguishing between process and product in collaborative (algebraic) problem solving.

## References

Radford, L. (2003). Gestures, speech, and the sprouting of signs: A semiotic-cultural approach to students' types of generalization. *Mathematical Thinking and Learning*, *5*(1), 37-70.