

The UCSD/SDSU Mathematics and Science Education
Doctoral Program Proudly Presents a Dissertation Defense:

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Teachers' Understanding of Algebraic Generalization

Date: July 8, 2016
Time: 10am
Location: Center for Research in Mathematics and Science Education (CRMSE),
SDSU, 6505 Alvarado Rd, Ste 215

Generalization has been identified as a cornerstone of algebraic thinking (e.g., Lee, 1996; Sfard, 1995) and is at the center of a new conceptualization of K-8 algebra (Kaput, 2008; Smith 2003). Moreover, mathematics teachers are being encouraged to use figural-pattern generalizing tasks as a basis of student-centered instruction, where teachers respond to and build on the ideas that arise out of students' exploration of these activities. While more and more teachers are engaging their students in such generalizing tasks, little is known about teachers' understanding of generalization and their understanding of students' mathematical thinking in this domain.

In this work I address this gap, exploring teachers' understanding of algebraic generalization from many different perspectives. The study involved an in-depth, qualitative analysis of 4 eighth grade teachers. These teachers were exemplary, in the sense that they possessed a significant amount of experience with student thinking in general, and, in particular, in the area of algebraic generalization. In addition, a significant feature of this investigation is that I explored teachers' understanding of the generalization process up through and including the use of algebraic symbols.

In this talk, I report on the second phase of this study in which I observed the instruction of two of these teachers and used the lens of professional noticing of students' mathematical thinking to investigate their enacted knowledge of algebraic generalization. By comparing and contrasting these two teachers, I was able to characterize their knowledge of students' algebraic generalization and identify features of their understandings that supported them to effectively anticipate and respond to the needs of their students. Analysis resulted in an instructional trajectory based on the teachers' understanding of student thinking. The instructional trajectory includes not only the variety of thinking and actions that students' progress through as their generalizations become more and more sophisticated, but also infuses the role of various mathematical representations in supporting these types of thinking. The emergent framework serves as an instructional tool, guiding teachers to support their students in the generalization process and eventually develop a more meaningful understanding of the associated algebraic notation.