

## INTRODUCING VARIABLES TO GRADE 4 AND 5 STUDENTS AND THE MISCONCEPTIONS THAT EMERGED

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Algebra's role as gatekeeper is well documented in helping students build a solid foundation early is important (Stephens, 2005). For this research study, we explored: What misconceptions do elementary students display when generalizing patterns using variables to justify a hypothesis?

We used communities of practice (Wenger, 1998) as an overarching theoretical framework. We sought to engage the students in a community that would be similar to how mathematicians practice mathematics. We used this theory as a way to engage the students in joint enterprise and mutual engagement as a way to hold the participants accountable for their goals of generalizing a conjecture through the use of variables.

Two students, one in Grade 4 and one in Grade 5, participated in three semi-structured, task-based interviews (Goldin, 2000). Each interview lasted approximately sixty minutes. During the interviews, students worked on the unsolved mathematical task called The Graceful Tree Conjecture. They examined graceful labelings of four different classes of tree graphs including: Stars, Paths, Caterpillars, and Comets. We encouraged the students to develop a justification or generalize a pattern for each of the classes to document that all graphs in the given class could be labeled gracefully. All of the students' work was collected and the interviews were video recorded. All the interviews were transcribed and analyzed. For analysis, we documented each instance where students attempted to use a variable to create a generalized pattern or discussed the use or meaning of a variable.

When attempting to create a generalization the students displayed several misconceptions about variables. First, when discussing where the biggest number for would be, they were able to label it as BN. Later, one student said that if it was the biggest number it would have to be infinity rather than the largest number in the set. Second, when attempting to label one less than the biggest number they wanted to label it as SB for second biggest. We pushed them to further their thinking and were hoping for a label of  $b-1$ . One student said they could label it as A or negative A because that is one less than B. The other student said it would be E because it is like half of the biggest and if you cut the humps off B it would become E, so E is half of B. Third, when discussing if the smallest number was one (which we always used one as the smallest number in our set), one student said the smallest number is not one, but should be  $-9999\dots$ . These misconceptions need to be addressed for students to later be successful in algebra courses.

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