

ALGEBRA READINESS AND ALGEBRAIC STRUCTURE AS FOUNDATIONAL IDEAS FOR ALGEBRAIC LEARNING

David Feikes, Professor, Purdue University Northwest, feikesd@pnw.edu

William S. Walker III, Assistant Director of CATALYST, Purdue University, wswalker@purdue.edu

Natalie McGathey, Associate Professor, Prairie State College, nmcgathey@prairiestate.edu

Bir Kafle, Associate Professor, Purdue Northwest University, bkafle@pnw.edu

Abstract

Algebra readiness and algebraic structure have been core ideas in our curriculum development work to help students develop conceptual understandings of algebra. This research brief uses Kaput's (2008) definition of algebra to describe algebra readiness and algebraic structure, as they relate to *thinking about algebra* and *thinking with algebra*.

Algebra, Algebra Readiness, and Algebraic Structure

Kaput (2008) defines algebra as two core aspects. The first core aspect defines algebra "as systematically symbolizing generalizations of regularities and constraints" (p. 11). This core aspect aligns with our perspective of algebra readiness. Rather than formal algebra early (Carraher, Schliemann, & Schwartz, 2008), algebra readiness is helping students develop understandings of the fundamental concepts of algebraic thinking like recognizing and analyzing patterns, representing relationships symbolically, and making generalizations. Understanding these fundamental concepts allows students to solve algebraic problems using their understandings of arithmetic to interpret and operate meaningfully on algebraic equations and symbols. Our earlier algebra readiness project, Conceptual Algebra Readiness for Everyone focused on developing algebra readiness with children in grades 3-7. We characterized this approach as *thinking about algebra*. Similar to Kaput's first core aspect, the goal was for students to learn how to generalize and to represent their thinking algebraically.

However, algebra entails more than just generalization and symbolic representation. Kaput (2008) defines the second core aspect of algebra "as syntactically guided reasoning and actions on generalizations expressed in conventional symbols systems" (p.11). In other words, algebra is a manipulable language which allows one to express generality and operate on the generalizations. This core aspects aligns with our perspective of algebraic structure. Algebraic structure is what allows one to manipulate algebraic objects and symbolic generalizations while maintaining algebra's logical consistency. Our current project makes a distinction between *thinking about algebra* and *thinking with algebra*. We characterize the latter as manipulating the symbolic generalizations in meaningful ways (Feikes, Kafle, McGathey, & Walker, 2021). These core aspects of algebra provide connections to learning algebra through algebra readiness and algebraic structure.

References

- Carraher, D., Schliemann, A., & Schwartz, J. (2008). Early algebra is not the same as algebra early. In J. Kaput, D. W. Carraher, & M. L. Blanton (Eds.), *Algebra in the Early Grades* (pp. 235-272). New York: Lawrence Erlbaum Associates.
- Feikes, D., Kafle, B., McGathey, N., & Walker, W. S., III. (2021). Thinking with algebra: A project and perspective. In W. S. Walker, III, L. A. Bryan, S. S. Guzey, & E. Suazo-Flores (Eds.), *Proceedings of the sixth annual Indiana STEM Education Conference*. West Lafayette, IN.
- Kaput, J. (2008). What is algebra? What is algebraic reasoning? In J. Kaput, D. W. Carraher, & M. L. Blanton (Eds.), *Algebra in the Early Grades* (pp. 5-18). New York: Lawrence Erlbaum Associates.