Applying Cognitive Science Principles to Improve Student Learning in Algebra

The field of cognitive science has research that is ripe for application to education practice. Some of the research from cognitive science that can be used to revise instruction and support student learning was highlighted in the What Works Clearinghouse Practice Guide, *Organizing Instruction and Study to Improve Student Learning* (Pashler et al., 2007). The intersection of research in cognitive science and mathematics education has grown in recent years; however, much work is still needed to identify and test the promise of cognitive science principles for improving student learning and instruction in authentic education settings. One topic area within mathematics education where cognitive science principles have the potential to make a substantial impact is algebra, where students continue to struggle with the procedural and conceptual understanding of important concepts. Research from cognitive science can help identify factors that may help or hinder student learning in algebra and strategies and skills that teachers and students can use in the classroom to improve both procedural and conceptual understanding of algebraic concepts. To that end, this symposium will highlight research from three studies that integrate research from cognitive science to improve student teaching and learning in algebra in authentic education settings.

In the first study, the researchers are focusing on identifying skills for improving algebra preparedness. Specifically, they are exploring the effects of learning procedural and conceptual aspects of algebra in varying orders (e.g., concurrently, or being taught procedural skills before conceptual knowledge).

In the second study, the researchers are developing an intervention for use in algebra classrooms that consists of sets of algebra assignments that interleave worked examples and prompts for self-explanation. The correct and incorrect examples of solutions to algebraic problems used in the assignments will be designed to directly target key mathematical concepts and common misconceptions that students hold about those concepts.

In the third study, the researchers are developing an intervention that provides high school students, who are in an Algebra I class and that use the Algebra I Cognitive Tutor curriculum, with different types of self-explanation exercises. The researchers are examining the contribution of correct versus incorrect worked examples for improving student learning in algebra.

Together, these three projects will highlight the promise of applying cognitive science principles to improve student learning of algebra in authentic educational settings. The implications of the findings for future research will also be discussed.