Summary

The fragmentation of strategies that distinguishes the more successful elementary grade students from those least successful has been documented previously. This study investigated whether this phenomenon of divergence and fragmentation of strategies would occur among undergraduate students enrolled in a remedial algebra course. Twenty-six undergraduate students enrolled in a remedial algebra course used a reform curriculum, with the concept of function as an organizing lens and graphing calculators during the 1997 fall semester. These students could be characterized as “victims of the proceptual divide,” constrained by inflexible strategies and by prior procedural learning and/or teaching. In addition to investigating whether divergence and fragmentation of strategies would occur among a population assumed to be relatively homogeneous, the other major focus of this study was to investigate whether students who are more successful construct, organize, and restructure knowledge in ways that are qualitatively different from the processes utilized by those who are least successful. It was assumed that, though these cognitive structures are not directly knowable, it would be possible to document the ways in which students construct knowledge and reorganize their existing cognitive structures.

Data reported in this study were interpreted within a multi-dimensional framework based on cognitive, sociocultural, and biological theories of conceptual development, using selected insights representative of the overall results of the broad data collection. In an effort to minimize the extent of researcher inferences concerning cognitive processes and to support the validity of the findings, several types of triangulation were used, including data, method, and theoretical triangulation. Profiles of the students characterized as most successful and least successful were developed. Analyses of the triangulated data revealed a divergence in performance and qualitatively different strategies used by students who were most successful compared with students who were least successful.

The most successful students demonstrated significant improvement and growth in their ability to think flexibly to interpret ambiguous notation, switch their train of thought from a direct process to the reverse process, and to translate among various representations. They also curtailed their reasoning in a relatively short period of time. Students who were least successful showed little, if any, improvement during the semester. They demonstrated less flexible strategies, few changes in attitudes, and almost no difference in their choice of tools. Despite many opportunities for additional practice, the least successful were unable to reconstruct previously learned inappropriate schemas. Students’ concept maps and schematic diagrams of those maps revealed that most successful students organized the bits and pieces of new knowledge into a basic cognitive structure that remained relatively stable over time. New knowledge was assimilated into or added onto this basic structure, which gradually increased in complexity and richness. Students who are least successful constructed cognitive structures which were subsequently replaced by new, differently organized structures which lacked complexity and essential linkages to other related concepts and procedures. The bits and pieces of knowledge previously assembled were generally discarded and replaced with new bits and pieces in a new, differently organized structure.