

THE LEARNING OF LINEAR ALGEBRA FROM AN APOS PERSPECTIVE*

Michael Meagher
Brooklyn College/CUNY
mmeagher@brooklyn.cuny.edu

Laurel Cooley
Brooklyn College/CUNY
lcooley@brooklyn.cuny.edu

Bill Martin
North Dakota State
University
william.martin@ndsu.edu

Draga Vidakovuc
Georgia State University
matdvn@langate.gsu.edu

Sergio Loch
Grand View College
sloch@gvc.edu

Introduction

This project reflects the development and implementation of an innovative course in Linear Algebra. Dual parallel courses were developed: a Topics in Linear Algebra course and a Learning of Linear Algebra course. The courses were designed to complement one another and are particularly aimed at college students preparing to be high school teachers of mathematics.

Motivation for the Study and Theoretical Framework

Research at the National Center for Research in Teacher Education found that teachers who majored in the subject they taught often were not able to explain fundamental concepts in their discipline more clearly than other teachers. (McDiarmid & Wilson, 1991, p.i). Further research shows that in addition to knowledge of advanced math, effective teachers need math knowledge organized for teaching—deep understanding of the subject; awareness of conceptual barriers to learning; and knowledge of the historical, cultural, and scientific roots of math ideas and techniques (Ma, 1999). The parallel courses developed in this study aim to bridge this gap between the technical “know how” of the mathematics and “know why” need as a foundation for the building of pedagogical content knowledge.

The *Learning of Linear Algebra* course is a constructivist-based education course which employs the Action-Process-Object-Schema (APOS) theory of learning collegiate math. APOS theory represents an extension of Piagetian theories on children’s reflective learning to the realm of higher level abstract mathematics. Analysing mathematics from the APOS standpoint allows for the development of ways of thinking about how abstract mathematics can be assimilated and learned and, therefore, provides a powerful tool for the students in the course to think about what it means to learn, and how that knowledge can inform teaching approaches and strategies. The *Topics in Linear Algebra* course is designed to highlight connections between collegiate linear algebra and secondary math from an advanced standpoint.

Design of the Study, Methods, and Results

The primary data for the study consists of the course materials and syllabi developed before and during the first semester of teaching the parallel courses. Supplemental data includes student work from the courses such as concept maps of key ideas such as vector constructed at various stages and reflective papers written by the students about their growing understanding of how people learn.

The initial findings of the project are that students benefit from the linking of learning theory with their own learning of algebra. They also show an increased sophistication in their ability to link concepts together and their ability to articulate their own experiences of learning.

Alatorre, S., Cortina, J.L., Sáiz, M., and Méndez, A.(Eds) (2006). Proceedings of the 28th annual meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Mérida, México: Universidad Pedagógica Nacional.

References

- Dubinsky, E. & McDonald, M. (2001). APOS: A Constructivist Theory of Learning in Undergrad Mathematics Education Research. In D. Holton et al. (Eds.), *The teaching and Learning of Mathematics at University Level: An ICMI Study*, Kluwer Academic Publishers, 273-280.
- Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Mahwah NJ: Lawrence Erlbaum.
- McDiarmid, G.W., & Wilson, S. M. (1991). An exploration of the subject matter knowledge of alternate route teachers: Can we assume they know their subject? *Journal of Teacher Education*, 42(2), 93-103.

* The research reported in this paper was partially supported by National Science Foundation grant, DUE CCLI 0442574.