

TEACHING AND LEARNING LINEAR ALGEBRA IN TERMS OF COMMUNITY OF PRACTICE

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Abstract

Communities of practice (CoP) are defined as groups of people who share a concern, a set of problems, or a passion about a topic, and who interact in an ongoing basis to deepen their knowledge and expertise. The purpose of this study is to examine the process of teaching and learning linear algebra within this theoretical framework. In this research, we used an ethnographic case study design to study three linear algebra instructors and their students at a large public university. The instructors have different educational and cultural backgrounds. Data included observations, a Linear Algebra Questionnaire, and semi-structured interviews. We observed significant differences in teaching methods between the instructors.

Keywords: Linear Algebra, Community of Practice, Ethnographic Case Study.

Communities of practice are based on social learning theory and situated learning theory. CoP are defined as groups of people who share a concern, a set of problems, or a passion about a topic, and who interact in an ongoing basis to deepen their knowledge and expertise (Wenger, McDermott and Snyder, 2002). A CoP includes three crucial components: the domain, the community and the practice (Wenger-Trayner and Wenger-Trayner, 2015). Education is one of the most important applications of the CoP framework. According to Wenger (1998), education is a mutual developmental process between communities and individuals. In this study, the process of teaching linear algebra will be examined within this framework.

Many studies have documented the challenges of teaching and learning linear algebra, which is a main subfield of mathematics (Dorier and Sierpinska, 2001; Hillel and Sierpinska, 1993). To this point, the CoP framework has not been applied to studying the teaching and learning of linear algebra.

The research questions addressed by this study are

1. How do instructors' cultural and educational experiences affect their teaching?
2. How do institutional policies and culture affect instructors' teaching?
3. How do the students experience the teaching?
4. How do instructors' cultural and educational experiences affect the students' experiences and learning?

Methodology

This ongoing study uses an ethnographic case study design. The participants consist of three linear algebra instructors, who have different educational and cultural backgrounds, and their students. Data consists of observations, a questionnaire and semi-structured interviews with both teachers and students. Each teacher was observed for ten weeks by the lead researcher. Responses to a Linear Algebra Questionnaire were collected from students at the end of the course. The questionnaire included questions about students' experiences in the course, and also asked them to solve several linear algebra problems from the Magic Carpet Ride Problem Sequence (Wawro et al., 2012). Data were analyzed and interpreted using standard tools of content analysis.

Preliminary Findings

Institutional Policies and Culture

The same general course outline, the same syllabus and the same textbook were used by all three instructors of MATH 33A (Linear Algebra and Applications).

Instructors' backgrounds

All of the instructors have different cultural and educational backgrounds.

Table 1. Instructors' Educations

	College	PhD	Post-Doc	Visiting Scholar
Lara	Netherlands	U.K.	U.S.A	-
Andres	Spain	Canada	U.S.A.	-
George	U.S.A.	U.S.A.	Canada	Germany, France, Japan, India

Teaching Methods

Categories were generated inductively from the classroom observation data. Results from some of the categories are presented in Table 2.

Table 2. Classrooms Observations

	Lara	Andres	George	
Teaching Methods		Teacher-centered approach		
Order of topics	Different from the course syllabus	Similar to the course syllabus	Similar to the course syllabus	
Resources used	Lecture notes, online resources, textbook	Textbook	Textbook	
Interacting in class	Medium Level	Low Level	High Level	
Interacting out of class	Piazza	-	-	
Classroom Activities	Reminding	-	Recall	Last time-Today
	Proofs	Informal Proof on Examples	Formal Proof	Formal Proof
	Giving Example	Linear Algebra Questions +	Linear Algebra	Linear Algebra Questions
		Daily life example (rarely)	Questions	+ Daily life example (often)
	Big Picture	The relations between the concepts	-	The processes of problem solutions
Using multiple representations	The representations of matrix, algebraic, graphic (often \mathbb{R}^2 , rarely \mathbb{R}^3)			
Assessment	Exams, Homeworks	Exams, Homeworks	Exams, Homeworks, Quizzes	

In this ongoing study, it has been observed that there are significant differences in teaching methods between the instructors. More results will be added after data analysis is completed.

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