

Chapter 13

Critical Thinking and Mathematics Teaching and Learning

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ABSTRACT

The purpose of this chapter was to investigate pre-service teachers' noticing of children's critical thinking and views towards eliciting and using students' critical thinking in mathematics teaching. A mixed method study was used to provide a range of perspectives on pre-service teachers' views towards mathematics. The results indicated that the pre-service teachers initially held beliefs that mathematics teaching and learning consist of transferring information and students absorbing and memorizing information. The pre-service teachers based their instructional responses on experiences they had as students in elementary mathematics classrooms. The pre-service teachers described what they had observed about teaching mathematics as the ideal without regard for how the teaching behaviors they observed might influence children's critical thinking about mathematics. After completing a mathematics methods course, the pre-service teachers held beliefs more consistent with a reform-oriented classroom and demonstrated growth in their ability to notice children's mathematics thinking.

INTRODUCTION

Globally, education reforms over the past few decades have called for a shift away from classrooms where students passively receive knowledge and practice procedures modeled and demonstrated by teachers to classrooms where students actively construct understanding through authentic learning tasks. There is a need for classrooms that emphasize the development of critical thinking to meet an economic demand

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for a workforce that uses knowledge and information to construct new understandings and to solve problems. In mathematics classrooms around the world, thinking critically about mathematics concepts and ideas is a central goal of teaching and learning. Meeting this goal requires teachers who elicit and help develop students' critical thinking while also thinking critically themselves about pedagogy, subject matter and student learning. The ability to notice and think critically about a child's mathematical thinking is needed to effectively teach children mathematics using reform-based methods. Research has shown that professional noticing of mathematical thinking is developed over time (Jacobs, Lamb, & Philipp, 2010; Stockero, Rupnow, & Pascoe, 2017). As a result, it is important to consider how pre-service teachers are forming the knowledge and skills to effectively teach children mathematics using reform-based practices (Feiman-Nemser, 2001; Schussler, Stooksberry, & Bercaw, 2010).

The intent of this study was to determine how pre-service teachers' views of mathematics teaching and learning, as well as their attention to children's mathematical thinking develop during a university level mathematics methods course with an integrated field experience in an elementary classroom. A mixed-method study approach was employed to examine pre-service teachers' noticing of children's critical thinking and pre-service teachers' views towards eliciting and using students' critical thinking in mathematics teaching. Data sources included both qualitative and quantitative data to provide a range of perspectives on pre-service teachers' views towards mathematics. This chapter presents a study framed by the following guiding questions:

Research Question 1: What are pre-service elementary teachers' views of mathematics teaching and learning?

Research Question 2: How do pre-service teachers notice and propose to elicit and use students' critical thinking in mathematics teaching?

The mathematics methods course that was the context for this study was intentionally designed to engage pre-service teachers to think critically and analytically about both their own experiences as learners and also how instruction can support the development of children's mathematics understanding. The course syllabus included the following course purpose statement:

The purpose of this course is to explore how to help children learn mathematical concepts and skills with understanding. The emphasis will be on teaching children mathematics using an active learning and problem solving approach. We will examine theories and methodologies related to topics in elementary mathematics programs. We will analyze children's mathematical thinking through the lens of various learning theories. We will observe teaching and learning of mathematics and reflect on how teachers can help children make sense of mathematics. You will become familiar with materials and models used in teaching mathematical concepts to children. The field experience component of this course is designed to acquaint you with children and the classroom environment as related to mathematics education. This course will also explore the use of available technology in your learning and teaching.

The mathematics methods course was structured to include 18 days of fieldwork in an elementary classroom. The pre-service teachers started the semester with four to five weeks of study in the university classroom reading about, analyzing, and discussing topics such as Learning with Understanding, Teaching Through Problem-Solving, Problem-Based Instruction, Standards for Teaching and Learning, Building

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