

Chapter 36

Redesigning Mathematics Tasks: A Tool to Increase Critical Thinking Skills

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ABSTRACT

This chapter presents how the results of an empirical research study conducted with in-service teachers can be used to enhance and strengthen the critical thinking skills of pre-service teachers. The chapter begins with a description of the study methodology and the task redesign process. Data is presented (often in the words of teachers themselves) that paint a compelling picture of the process in real-time. Limitations and potential drawbacks of its use are discussed along with possible design ideas that may better align the process with the specific needs of pre-service teachers and their professors. It is followed by a summary of how the task redesign process could be redesigned to be used more effectively with pre-service teachers as a way to increase critical thinking about the teaching of mathematics. Potential benefits, including an increased capacity for critical thinking, are offered along with additional research directions and an invitation for suggestions into improving the task redesign process.

INTRODUCTION

Educating children is a complex, often daunting endeavor; and new teachers face many challenges as they begin their careers. This can be especially true in the area of teaching mathematics—a subject with which many teachers lack confidence and self-efficacy (Newton, Leonard, Evans, & Eastburn, 2012). Immersing candidates in the teaching of mathematics under the guidance of mentor teachers and professors during the preparation program is a way to approximate practice (Grossman, Compton, Igra, Ronfeldt, Shahan, & Williamson, 2009) and develop new teachers' skills with regard to teaching mathematics. This common and expected step of the certification process provides pre-service teachers the opportunity to experience the role of a teacher. During student teaching, the focus is typically placed on the act of teaching and mentor teachers and supervisors look at lesson delivery and classroom management to assess

DOI: 10.4018/978-1-7998-3022-1.ch036

competency on these important components of teachers work. Another important focus of teaching, the intentional interaction with curriculum materials to create lessons, is often absorbed by the cooperating teacher during student teaching, and perceived as a skill that can be honed during practice. It may not be until they have classrooms of their own that new teachers begin interacting with curriculum in any meaningful way. However, when just beginning, many new teachers experience significant stress due to the multiple demands of the profession. This stress can move them into survival mode (Moir, 2016), and possibly prohibit them from interacting with, and thinking critically about, either the curriculum or designing instructional experiences for their students (Achinstein & Athanases, 2006). Additionally, when new teachers take on classrooms of their own, they are usually assigned to teach from a particular curriculum program with which they may be unfamiliar—thereby adding an additional layer of complexity to an already steep learning curve. Supporting teacher candidates with explicit opportunities to develop and refine their critical thinking skills about mathematics instruction within the context of interacting with a variety of curriculum materials during the pre-service experience may help them to acquire some of the tools they need to successfully begin teaching mathematics to children.

This chapter presents the suggestion that a research-based intervention conducted with practicing teachers may be a beneficial way to increase the critical thinking skills of pre-service teachers. In the study, practicing teachers interacted with mathematics curriculum with the goal of searching for and redesigning tasks they deemed less cognitively demanding into tasks that would require a higher level of thinking from their students. The process, when used with pre-service teachers, has the potential to provide to beginners a level of comfort with curriculum materials and a way to think critically about the mathematics tasks they pose. Development of this practical and important skill could free up some of the mental resources of new teachers and help them construct a more solid understanding of, and way to think critically about, mathematics as they begin their careers.

In the following pages, the reader will find a summary of the study including the theoretical framework from which it was developed, the work it was extended from, and the methodology that was used for data collection, and results. There are examples of conversations between the teacher participants as they worked through the process; along with examples of the artifacts they developed. Connections between the study and how the results could be used to further refine the critical thinking skills of pre-service teachers are highlighted and defended, as well as disputed. The chapter closes with specific ideas about how this process might be redesigned to better align to a mathematics methods class, and an invitation from the author for additional research into the phenomenon.

BACKGROUND

In the early days of the Common Core State Standards for Mathematics, teachers were expected to teach to the level required by the new standards. However, neither school district funding nor writers of aligned curriculum materials had kept pace with the rollout of the standards. As a result, teachers were trying to make large shifts in instruction by using outdated materials and adapting them in ways they felt would help students meet the standards. In an effort to study this unusual teacher text interaction, a research project brought practicing teachers together where they received instruction on the cognitive demand of mathematics tasks and then were asked to collaboratively redesign low-level mathematics problems into tasks that required a higher level of thinking on the part of their students.

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