Chapter 19

Complexity of (Re)Learning the Meaning of Multiplication of Fractions in the Context of a Mathematics Content Course: An Exploration Study

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ABSTRACT

The context in which preservice teachers (PSTs) learn the mathematical knowledge required for teaching in an elementary classroom is still less obvious. This chapter addresses the complexity of PSTs (re) learning the mathematical knowledge for teaching multiplication of fractions in a mathematics content course. The existing literature on PSTs’ learning in a mathematics content course has focused on models for designing the course and efforts for designing innovative pedagogies. In addition, more recent studies have explored the design and implementation of mathematical tasks in a content course. However, studies that have provided insights into the affordances and complexity involved in developing fraction concepts using the basic principles of critical thinking are limited. The aim of this chapter is to explore the extent to which PSTs can develop a conceptual understanding of multiplication of fractions in the context of a mathematics content course designed using the basic principles of critical thinking. The complexities, challenges and tensions confronted by PSTs and the instructor as they (re) learn the meaning of multiplication in more nuanced ways will be discussed.

INTRODUCTION

Math has never been a strong subject for me throughout my schooling. I can do most of it but when it comes to explaining how I got there, it is a little more challenging. In elementary school, I was always given a piece of paper with different multiplication and division problems on it. The class would be given, I think it was a minute to finish as many problems as we could within the minute. I never liked these because I did not do well with the pressure of a minute… (Kathy- Prospective Teacher Reflection- Spring 2018)

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The method of a lot of my teachers back then was more the “I, We, You approach”. The teacher would introduce the new concept with a couple of example problems, we were to do a couple problems in class and then be assigned our homework to complete at home. If I was not comfortable on the new skill, I would struggle at home, or even worse, with the problems we were doing as a whole group in class…

(Leah-Perspective Teacher Reflection- Spring 2018)

Kathy and Leah’s (pseudonyms) remarks are typical comments found in an initial self-assessment assigned to PSTs1 enrolled in a mathematics content course for elementary and middle school teachers in a university located in the Midwest region of the U.S. These remarks are consistent with prior research that has reported that PSTs’ prior mathematics substantive understanding tend to be rule bound, compartmentalized and can “impede them in developing conceptual understanding” (Ball, 1990; Li & Superfine, 2018). The remarks also reflect the procedural nature of content knowledge that PSTs bring with them into teacher preparation as well as a lack of mathematical habits of mind described in the Common Core State Standards of Mathematics (CCSS-M, 2010). Consequently, the nature of mathematical knowledge for teaching that PSTs need to be well prepared beginning teachers have received increased national attention in the US. (American Association of Colleges for Teacher Education [AACTE, 2013], Conference Board of Mathematical Sciences [CBMS, 2012; National Research Council, 2001; Standards for Preparing Teachers of Mathematics [AMTE, 2017]; National Mathematics Advisory Panel [NMAP] 2008). These reports have emphasized the need for PSTs to be given opportunities to experience instruction that focus on sense making and develop an understanding of the mathematics that they will teach as beginning teachers. For example, CBMS (2012) argues that mathematics content courses “…should not only aim to remedy weaknesses in mathematical knowledge, but also help teachers develop a deeper and more comprehensive view and understanding of the mathematics they will or already do teach” p. 23). More recently, AMTE (2017) standards recommended that well prepared beginning teachers should “understand and solve problems in more than one way, explain the meanings of key concepts, and explain the mathematical rationales underlying key procedures” (p.25). However, the context in which PSTs learn the mathematical knowledge required for teaching in elementary and middle school classrooms in more meaningful ways is still less obvious

Furthermore, the call to prepare aspiring teachers differently might leave teacher educators lingering with questions like: Which weakness in mathematical knowledge do we need to remedy? How do teacher educators develop a deeper understanding and more comprehensive view of the mathematics that PSTs will teach? What might opportunities to develop mathematical knowledge for teaching in more nuanced ways look like in a mathematics content course? To answer these questions, this study hypothesizes that teacher educators need to investigate the complexity of this work and redesign the mathematics content courses to equip prospective teachers with critical thinking skills that would help them re-engage with the mathematics content that they will teach in elementary and middle school classrooms in more meaningful ways. Redesigning will require purposeful efforts (for both the instructors and PSTs) as they learn how to teach critically, and for PSTs to learn how to use reasoning as a mode of learning. It will involve creating spaces and a positive environment for PSTs to reason as they develop deeper conceptual understandings of concepts. Using the existing literature and data collected from PSTs enrolled in a mathematics content course, this chapter explores the following research question:

To what extent would PSTs enrolled in a mathematics content course designed with basic principles of critical thinking develop conceptual understanding of multiplication of fractions?