

Chapter 4

Enhancing Preservice Teachers' Mathematical Knowledge Through Writing: From Peer Review to Inter-Institutional Conversations

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ABSTRACT

In this chapter, the authors present and analyze a mathematical writing activity for preservice elementary school teachers with a novel peer review component. The products of this activity, referred to as “journals”, are detailed representation-rich explanations of problems solved in small groups. These journals were exchanged across institutions, and the addition of a computer-mediated communication platform transformed the peer reviews into inter-institutional conversations. An analysis of the journals and the conversations they sparked reveal four opportunities to develop mathematical knowledge for teaching. Evidence, in the form of journal and review excerpts as well as two case studies, suggests that the process enabled preservice teachers to deepen their understanding of foundational concepts from the elementary curriculum, to communicate mathematics more effectively to others, to better make sense of the mathematical thinking and writing of others, and to incorporate their colleagues’ suggestions into their future writing. Potential future research paths are discussed.

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INTRODUCTION

In this chapter we describe a mathematical writing activity designed to enhance preservice elementary school teachers' mathematical knowledge for teaching (MKT) (Ball et al., 2008). The addition of an inter-institutional exchange of this written work enriched the learning opportunities for both parties involved in the peer-review process; and, after shifting to an online platform, the process evolved into a mathematical conversation grounded in their written work. We will identify four key opportunities to learn within this activity and present evidence of growth observed in our students' writing and their ability to offer, accept, and use critique of mathematical explanations and representations.

BACKGROUND

The relationship between oral and written mathematical communication and mathematical understanding has been highlighted by numerous scholars. Hiebert and his colleagues (1997) emphasized reflection and communication as major components of learning mathematics with understanding. Accordingly, the Standards for Mathematical Practice from the Common Core State Standards and the key standards documents of the National Council of Teachers of Mathematics (NCTM) encourage mathematics teachers to support written and oral communication of all learners of mathematics (National Governors Association Center for Best Practices, and Council of Chief State School Officers, 2010; NCTM, 1989, 2000, 2014).

NCTM's (2020) Standards for the Preparation of Middle Level Mathematics Teachers expect that "Candidates [will] organize their mathematical thinking and use the language of mathematics to express ideas precisely, both orally and in writing to multiple audiences" (p. 18). Therefore, it is important that preparation programs for preservice teachers (PSTs) provide rich mathematical writing experiences. Writing in mathematics can help PSTs "consolidate their thinking because it requires them to reflect on their work and clarify their thoughts about the ideas" and communicate them (p. 61). Through communication, ideas become public. We can "challenge each other's ideas and ask for clarification and further explanation" which might, in turn, result in additional reflection (Hiebert et al., 1997, p. 5). Thus, we believe that mathematical writing is an important activity to support PSTs as they transition from learning mathematics for personal use to learning mathematics for others. Expressing their ideas clearly in writing helps PSTs build their mathematical knowledge for teaching, but the act of reading, interpreting, and reflecting on the mathematical ideas of others offers the potential for additional growth as future teachers.

The APEX Cycle and Inter-Institutional Conversations

Content courses are critical sites for the development of mathematical knowledge and practices that teachers will use when teaching children (Ball, 2000). As part of a large Noyce Mathematics Fellows project, we redesigned the Mathematics for Elementary Teachers courses at a large urban public university and a nearby college to improve students' MKT (Ball et al., 2008). This conceptualization of the knowledge needed to teach mathematics encapsulates both content and pedagogical knowledge. The domains of MKT that are relevant to our work are Common Content Knowledge, Specialized Content Knowledge, and Knowledge of Content and Teaching. Common Content Knowledge includes facts, skills, and understandings that are drawn upon by all users of mathematics. Specialized Content Knowledge is the

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