

Chapter 3

Explanatory Writing: A Window Into K–8 Prospective Teachers’ Reasoning About Contextual Problems

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ABSTRACT

This chapter contributes to broader research on mathematical discourse and its multimodal forms that reveal how students interpret, make meanings in mathematics, and communicate their understandings. Central to this chapter is explanatory writing in mathematics, which targets a specified audience to explain and transmit mathematical ideas. In the context of a mathematics problem-solving course and focusing on contextual problem-solving situations, this chapter illustrates how explanatory writing in mathematics offers a window into prospective elementary school teachers’ (PTs’) reasoning and communication skills. The chapter highlights PTs’ strategic reasoning and sense-making and describes how they communicate their problem solutions. It provides mathematics teacher educators with insights into how PTs think about contextual problem situations, offering directions for planning how to help PTs develop new ways of thinking. This chapter also includes suggestions for future research on PTs’ learning to construct written mathematical explanations.

INTRODUCTION

This chapter contributes to broader discussions focused on mathematical discourse as a multimodal practice involving a range of modes of communication used to coordinate and complement the meaning-making processes in mathematics. While *mathematical discourse* encompasses both written and spoken mathematical communication, in this chapter, we limit our discussion to only written communication. We situate this chapter in the context of elementary teacher education and focus on prospective elementary

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teachers' (PTs') explanatory writing in contextual problem-solving situations, that is, writing through which PTs explain and justify their problem solutions. This work contributes to the knowledge about the significance of engaging PTs in mathematical writing and illustrates implementing and assessing mathematical writing in a mathematics course for elementary school teachers.

The focus on explanatory writing that engages PTs in describing and explaining their reasoning in problem-solving contexts is warranted for several reasons. First, focusing on mathematical explanations supports PTs' mathematical development as problem solvers. Formulating problem explanations helps "building and connecting knowledge in a systematic, structured way by linking an explanandum (i.e., the issue that needs to be explained) to an explanans (i.e., [means] by which the issue is explained)" (Prediger & Erath, 2014, p. 317). Prior researchers also identified that producing (and evaluating) mathematical explanations supports the development of ways of mathematical thinking that promote reasoning and proof (e.g., Bicknell, 1999; Hodds et al., 2014). Written explanations have particular advantages because the act of writing is reflective; thus, it can further enhance understanding (Steele, 2007). Writing increases awareness about the way one conceptualizes mathematics and solves problems (Berkenkotter, 1982; Pugalee, 2001).

Second, the mathematics education community affirms the importance of integrating writing into learning mathematics at all levels (Casa et al., 2016; National Council of Teachers of Mathematics [NCTM], 2000; Santos & Semana, 2015; Taylor & McDonald, 2007). At the same time, many mathematics teachers still consider writing an add-on rather than an integral aspect of mathematics learning and teaching (Sezer, 2010). Researchers document that practicing mathematics teachers are often reluctant and uncomfortable incorporating writing into their instruction (Fukawa-Connelly & Buck, 2010; Kosko, 2016). Engaging PTs in explanatory writing in the problem-solving course can provide them with first-hand experiences with writing in mathematics *as students*. PTs' prior experiences with writing as mathematics students are typically limited, and thus, they might not consider writing in mathematics as a high-leverage pedagogical practice (Kenny et al., 2014; McCarthy, 2010). PTs need to experience writing as *learners* and *doers* of mathematics in a consistent way to help them develop views of mathematical writing as an integral aspect of problem-solving and, thus, the development of problem-solving skills. When PTs experience writing in mathematics as students, they will likely be better positioned to think about writing in mathematics as a pedagogical practice and integrate writing into their future practice as mathematics teachers.

Researchers largely agree that by engaging students in mathematical writing, teachers have the opportunity to understand the depth of their students' mathematical knowledge (Steele, 2007; Teledahl, 2017). Writing can serve as a window into students' knowledge and ideas and, thus, could be used to assess students' mathematical knowledge and understanding. At the same time, research on writing in mathematics primarily addresses writing in K-12 mathematics classrooms. Studies with PTs are scarce overall and predominantly focus on PTs' perceptions of using writing-to-learn activities in mathematics (Craig, 2016; Kenney et al., 2014; Sezer, 2010). Research that examines how PTs communicate their mathematical reasoning in writing is even more scarce (Colonnese & Castro, 2023; Magiera & Zambak, 2020).

This chapter adds to research on PTs' mathematical writing by focusing on how PTs communicate their mathematical reasoning in problem-solving contexts. This chapter also adds to the growing body of research on mathematical writing by providing important pedagogical and theoretical implications. Pedagogically, this chapter illustrates PTs' strategic reasoning and sense-making and describes how they communicate their reasoning in solutions to contextual problems by providing examples of their

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