Chapter 13
Academic Literacy in Mathematics to Frame Mathematical Writing Research and Practice:
Writing and Revising for Mathematical Practices

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ABSTRACT

Oral student contributions are important for learning mathematics, but without a written record of students' reasoning, revising is difficult or impossible. While writing makes revising possible, research needs to theoretically frame what to revise, how to revise, and how to support revisions. The chapter addresses the question: How can the academic literacy in mathematics framework inform research and practice on mathematical writing? The examples illustrate how that framework provides a complex view of language and a focus on mathematical practices to frame research and practice on mathematical writing and revising. The chapter considers why student writing and revising are important and describes how both research and instruction can emphasize mathematical practices. The examples focus on explanatory and argumentative writing and several mathematical practices central to revising explanations or arguments: generating conjectures, connecting representations, justifying claims, constructing arguments, and attending to precision.

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INTRODUCTION

This chapter describes how the *academic literacy in mathematics* framework provides a complex view of language and an emphasis on mathematical practices to frame research on K-12 students' mathematical writing and revising. The examples illustrate how research can explore mathematical writing by emphasizing mathematical practices and how instruction can support revising by focusing on mathematical practices.

This chapter considers two components of how to theoretically frame research on mathematical writing: views of the nature of language and mathematics, because both inform views of mathematical writing. Researchers and practitioners alike bring multiple assumptions about what language and mathematics are, and these assumptions inform how we imagine supporting mathematics learning through mathematical writing.

Writing reveals and records one's thinking and reasoning, thus providing opportunities for reflection, revision, and discussion in more enduring (and perhaps also more concrete) ways than talk. A research agenda focused on writing to reason mathematically first requires clarifying what actually constitutes *academic literacy in mathematics*, so that we can theoretically frame what kinds of writing (and revising) matter for learning important mathematics.

Contemporary views on communication in mathematics education research provide a view of language as a resource for making meaning. These views also assume meanings are situated, contextual, and dynamic (not static or provided by textbooks or definitions) and emphasize the multimodal nature of discourse as oral, written, pictorial, and gestural. This chapter uses a complex view of mathematical language to define writing in mathematics classrooms. Language in general, and talking or writing in particular, are not forms or rules (e.g., vocabulary, grammar) but tools and processes for creating meaning. Researchers from the perspective of language as a meaning-making resource use phrases such as "writing as meaning-making" (Bunch & Willett, 2013, p. 142) and describe how such approaches "shift the focus away from writing 'skills' and native-speaker norms, toward expanding students' semiotic resources through apprenticeship into academic and literacy practices" (p. 142).

These complex views of language frame it not as something to learn but, instead, see using language as a process to construct meaning. This assumption is now central to work on oral aspects of discourse in mathematics classrooms and needs to be incorporated into further research on mathematical writing. Importantly, narrow views of language can result in deficit views of learners and may lead to impoverished approaches to instruction focusing on low level language skills (Moschkovich, 2015). An emphasis on the precise use of formal disciplinary vocabulary and the exclusive use of the official language of instruction (e.g., standard English in the US) over the use of other languages or informal/everyday language enacts deficit views of students whose first language is not the language of instruction or who use everyday language when they first encounter new ideas and as a resource to make sense of ideas. Instead, an expanded view of language for meaning, sense making, and reasoning as it relates to instruction can support learners as they refine both their thinking and the language they use to express that thinking.

A focus on writing to reason mathematically must include a contemporary perspective on language, including the definition of language as a tool for making meaning, as well the assumptions that meanings are situated and dynamic. A complex view of mathematical language that emphasizes its multimodal nature means that lessons need to include multiple modes, not only listening, reading and talking, but also writing. Mathematical writing needs to include multiple representations (gestures, objects, drawings, tables, graphs, symbols, etc.), because connecting representations has been documented as supporting student understanding (Hiebert & Carpenter, 1992). Lastly, but just as importantly, a complex view of