Chapter 21

Employing Digital Tools to Support Writing in Mathematics and the Implementation of the Common Core State Standards

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ABSTRACT

The Common Core State Standards in Mathematics and English/Language Arts necessitate that teachers provide opportunities for their students to write about mathematical concepts in ways that extend beyond simply a summary of how students solve mathematical tasks. This chapter describes a series of vignettes about how digital tools can provide elementary school students with the opportunity to write about mathematics concepts that they are working with. Implications for providing these opportunities to elementary school students and supporting teachers are also provided.

INTRODUCTION

As part of the Common Core State Standards in both English Language Arts (CCSS-ELA) and Mathematics (CCSS-M), teachers are charged to provide opportunities for students to write and communicate about all concepts, including mathematics (CCSSI, 2011; Polly & Orrill, 2012). The English Language Arts CCSS require students to write arguments that support their analysis of substantive topics or text with valid reasoning and sufficient evidence. Further, students are required to write informative or explanatory texts that convey complex ideas clearly and accurately. The Standards for ELA stress producing clear, coherent writing that shows evidence of organization, audience consideration, and purpose. Students are expected to strengthen their writing through planning, revising, editing, and rewriting. Informational texts and technology are included in the standards to be used to support and produce writing (Table 1).

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Meanwhile, the authors of the CCSS-M included eight Standards for Mathematical Practices that delineate processes that mathematically proficient students consistently demonstrate (Dacey & Polly, 2012). Among these are calls for students to construct viable arguments (MP 3) and critique the reasoning of others (MP 2). Both (MP 2) and (MP 3) describe a mathematically proficient student as someone who understands stated assumptions, is able to analyze situations, reasons inductively, and justifies conclusions. The Standard (MP 6) attend to precision states that proficient students communicate precisely, using clear definitions, state the meaning of symbols, specify units, and label accurately. The ELA CCSS and the Mathematics CCSS complement each other and reinforce the importance of clear, coherent, accurate writing.

The CCSS emphasize written communication in mathematics. This focus is new to many teachers and students, therefore presenting unique challenges. Teachers now must have experiences and knowledge about using writing as a process to support learning and as a vehicle to communicate their understanding of mathematics (Totten, 2005). This emphasis on writing across the subject area has proven to be beneficial at integrating literacy into mathematics classrooms; however writing is rarely implemented (Baxter, Woodward & Olson, 2005). Studies indicate that teachers often struggle to combine writing and mathematics and honor the integrity of both disciplines (Wilcox & Monroe, 2011). Instead teachers find the integration of writing easier in the science or social studies classroom, where students can write more about the factual knowledge of those subjects (Varelas, Pappas, Kokkino & Ortiz, 2008).

Writing in Mathematics

The research about writing in mathematics classes focuses on, but is not limited to, four primary purposes: writing to assess (Draper, 2002; Ediger, 2006; Neil, 1996; Ntenza, 2006; Pugalee, 2001; Thompson & Chappell, 2007), writing to engage students in the authentic work of mathematicians (Muth, 1997; Draper, 2002; Kline & Ishii, 2008; NCTM, 2000; Ntenza, 2006; Thompson & Chappell, 2007), writing to develop metacognition (Bangert-Drowns et al., 2004; Muth, 1997; Ediger, 2006; Garofalo, 1987; Liedtke & Sales, 2001; Ntenza, 2006; Pugalee, 2001), and writing to make meaning about the content (Bangert-Drowns et al., 2004; Muth, 1997; Ediger, 2006; Garofalo, 1987; Liedtke & Sales, 2001; Ntenza, 2006; Pugalee, 2001). This body of research is further substantiated by mathematics education studies that indicate the importance of reflection and communication in building mathematical

Table 1. English Language Arts common core standards

<table>
<thead>
<tr>
<th>CCSS.ELA-Literacy.CCRA.W.1</th>
<th>Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.</th>
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<tbody>
<tr>
<td>CCSS.ELA-Literacy.CCRA.W.2</td>
<td>Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.</td>
</tr>
<tr>
<td>CCSS.ELA-Literacy.CCRA.W.4</td>
<td>Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.</td>
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<tr>
<td>CCSS.ELA-Literacy.CCRA.W.5</td>
<td>• Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach.</td>
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<tr>
<td>CCSS.ELA-Literacy.CCRA.W.6</td>
<td>• Use technology, including the Internet, to produce and publish writing and to interact and collaborate with others.</td>
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