The effects of prior computer use on computer-based writing: The 2011 NAEP writing assessment

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ABSTRACT

Writing achievement levels are chronically low for K-12 students. As assessments follow the transition to computer-based writing, differences in technology access may exacerbate students' difficulties. Indeed, the writing process is shaped by the tools we use and computer-based writing is different from writing with pen and paper. We examine the relationship between reported prior use of computers and students' achievement on the first national computer-based writing assessment in the United States, the 2011 National Assessment of Educational Progress (NAEP) assessment. Using data from over 24,100 eighth grade students, we found that prior use of computers for school-related writing had a direct effect on writing achievement scores on the computer-based NAEP assessment. One standard deviation increase in prior use led to a 0.14 and 0.16 standard deviation increase in mean and scaled writing achievement scores respectively, with demographic controls and jackknife weighting in our SEM analysis. We also looked at earlier NAEP assessments and found that prior computer use did not positively affect the earlier pen and paper-based writing assessments.

1. Introduction

Writing is a complex and highly challenging activity (Deane, 2011). It is not only a problem-solving process, but also a constructive process of transforming, formulating, and constituting new knowledge (Bazerman, 2011). Most learners struggle with the prerequisite coordination of multiple processes and linguistic conventions (DeBono, Hosseini, Cairo, Ghelani, Tannock, & Toplak, 2012; De La Paz & Graham, 2002; Deane et al., 2008). For decades, the National Assessment of Educational Progress (NAEP) has tested U.S. students in a number of disciplines, including writing. NAEP has shown that the majority of students are not even minimally proficient writers, let alone skillful ones, with only 27 percent of all students, 11 percent of Black students, and 14 percent of Hispanic students at or above proficient levels (NCES, 2012). Similarly, the College Board (2015) has announced that the SAT writing results continue to decline at a rate nearly twice as large as the declines in math and reading over the same period. In addition, despite its importance and complexity, writing receives less instructional attention than subjects like reading and math, particularly in the elementary and middle school grades (Lyon & Weiser, 2013; Warschauer, 2011; Graham & Perin, 2007). Nonetheless, writing is connected to all content areas and the deficiencies in

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students' writing proficiency are hindering their development of academic English (Zheng & Warschauer, 2015) and subsequent college and career readiness (Graham & Perin, 2007).

Our society calls for vastly complex and ever-changing genres and text modalities to be learned. Children should be prepared for these evolving practices; in fact the Institute for Education Sciences (IES) Practice Guide recommends that students be taught to use the writing process for a variety of purposes and become fluent in multiple modalities of transcription including word processing. In particular, today's students need to successfully negotiate computer-based writing in order to have equal access to college and career options (cf., Applebee, 2007). High-stakes assessments are migrating to computer-based formats (e.g., Smarter Balanced and PARCC assessments of Common Core State Standards), and gateway tests for higher education are increasingly computer-based. In order for students to emerge from K-12 education "college and career ready"—the goal under the current Common Core State Standards—they need to be able to write using computers. Teaching students current forms of literacy, such as computer-based writing, are important to prepare them to participate fully in the community (Langer, 1991). In many instances, however, students receive inadequate explicit instruction in writing on computers.

These new technologies present new cognitive challenges and opportunities (Bazerman, 2011) that students and teachers will need to address. We know that the writing process is shaped by the author's tools (see discussion in Wertsch, 1991). Each development in technology affects the writing process itself. For example, current research finds that students write more and write better on computers (see discussion in Morphy & Graham, 2012; Collins, Hwang, Zheng, & Warschauer, 2014; Graham & Perin, 2007; Sandene et al., 2005; Russell & Haney, 1997; Russell & Plati, 2002; Applebee & Langer, 2009). This leads us to query how the introduction of a powerful tool such as a computer may transform the writing process and how that transformation may be shaped by prior experiences in individual students' lives.

In order to test the computer-based writing skills of our youth, computer-based writing assessments provide the closest measure (NAGB, 2010). However, most studies of computer writing by and computer assessment of K-12 students have used fairly small samples (see discussion in Bangert-Drowns, 1993). This secondary data analysis looks at the relationship between prior use of computers for writing and achievement on the 2011 NAEP computer-based writing assessment. Our research questions were as follows:

1. Does the prior use of computers positively affect students' results on a computer-based assessment?
   a. Does it matter whether the prior computer use is school-related or personal?
   b. Are reports of school-related use by students or teachers more predictive of improved writing achievement?
   c. Does a teacher's use of technology for writing instruction predict students' improved writing achievement?
   d. Does technology-related professional development for the teacher predict students' improved writing achievement?
2. Does the effect of prior use of computers on writing achievement vary by demographic group?

By understanding the model of how prior use of computers and writing achievement on a computer-based writing assessment relate, we hope to inform both assessment and instructional efforts to teach all students how to write effectively on computers.

2. Conceptual framework

Our work is based on a broad notion of the role of tools, which encompass the mental, linguistic, and physical devices used to enhance writers' performance (Englert, Mariage, & Dunsmore, 2006). We believe that writing is culturally situated and mediated by these tools (Deane et al., 2008; Wertsch, 1998). New technologies allow us to produce, transmit, store, and process written texts (Bazerman, 2011). Each development in technology affects the writing process itself (cf., Berninger & Winn, 2006). For example, some tools may constrain idea generation and elaboration (Berninger & Winn, 2006). Success with composing on these new devices depends upon a willingness and ability to change modes, adapt prior strategies (Cochran-Smith, 1991), and navigate the specific tool affordances that both promote and inhibit good writing. These concerns led us to our research questions, a desire to understand whether (and for who) the prior use of computers (the tool) improves students' writing in a computer-based writing assessment.

We expected that practice using a specific tool would affect the writing process with that same tool. We thought that it was possible for computer use beyond writing for school, such as e-mailing, could provide a comfort level and familiarity with the mode of digital writing that would impact the writing process in an assessment setting. Thus, we initially looked at a wide range of variables related to digital technology use.

Our variable selection was also impacted by our belief that literacy is culturally situated. Because of this, cognitive apprenticeships are important in the acquisition of writing skills. Cognitive apprenticeships teach novices the practices of the community, including the acquisition of the discourse, tools and actions. Teachers can make these practices of the writing process visible; and effective teachers model and describe the knowledge they have about writing (Englert et al., 2006; Vygotsky, 1981). These teachers provide support as novices acquire the discourses, strategies, tools, and actions needed. For this reason, one group of the survey questions examined for our prior use latent variable related to the use of technology by teachers when teaching writing. We also included teacher professional development in technology as a potential