FEATURE ARTICLE

Cloud-Based Collaborative Writing and the Common Core Standards

Soobin Yim, Mark Warschauer, Binbin Zheng, & Joshua F. Lawrence

Cloud-based writing environments offer students the ability to access documents from multiple locations and collaborate with peers by sharing comments, making editing suggestions, or co-authoring whole documents. When used in K-12 classrooms, can the cloud help students meet the writing demands of the Common Core?

In today's knowledge economy, the prevalence of electronic and wireless communication requires increasingly high levels of technology-based writing skills (Graham & Perin, 2007). New digital genres and forms of discourse are constantly emerging and diversifying, generating new discourse practices, norms, and communicative processes (Dobson & Willinsky, 2009; Lankshear & Knobel, 2007). It is therefore imperative that students have access to resources that will help them develop technology-based writing skills, which are necessary to successfully meet the literacy demands of the workplace and society.

The Common Core State Standards (CCSS), adopted by 46 states, emphasize the integration of technology into English Language Arts (ELA) instruction. Specifically, the Standards emphasize technology-based writing practices as a way to integrate and evaluate knowledge and skills through collaboration, presentation, and publication (see Table 1). The Standards also underscore the iterative process of writing (e.g., drafting, editing, commenting, and publishing), authentic writing, and writing for different purposes and audiences, all of which can be facilitated through the synchronous and asynchronous feedback features in a technology-enhanced writing environment.

Many educators have suggested the practicality and utility of online writing platforms and applications to realize the benefits of integrating technology into writing instruction. Cloud-based technology has become increasingly popular due to its accessibility, convenient interface, and sharing features that may support efficient collaboration. Cloud computing is defined as a networked computer system that harnesses the resources of several servers (Mell & Grance, 2011), thus allowing multiple users to access resources from different computers and collaborate in an online environment (Conner, 2008). Despite the educational potential of cloud-based technology,

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TABLE 1 Technology in the Common Core ELA Standards

Focus	ELA Sub-domains	Standards
Collaboration	Writing: Production and distribution of writing	Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas efficiently as well as to interact and collaborate with others. (CCSS.ELA-Literacy.W.8.6)
		Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. (CCSS.ELA-Literacy.W.11-12.6)
	Speaking and Listening: Comprehension and collaboration	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade appropriate topics, texts, and issues, building on others' ideas and expressing their own clearly. (CCSS.ELA-Literacy.SL.8.1)
Language	Language: Vocabulary acquisition and use	Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech or trace the etymology of words. (CCSS.ELA-Literacy.L.8.4c)
Use and Integration of Internet Sources	Writing: Text types and purposes	Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories; include formatting, graphics, and multimedia when useful to aiding comprehension. (CCSS.ELA.Literacy.W.8.2a)
	Writing: Research to build and present knowledge	Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (CCSS.ELA-Literacy.W.8.8)
	Speaking and Listening: Comprehension and collaboration	Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally. (CCSS.ELA-Literacy.CCRA.SL.2)
	Speaking and Listening: Presentation of knowledge and ideas	Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (CCSS.ELA-Literacy.SL.8.5)
		Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (CCSS.ELA-Literacy.SL.9-10.5)

little research to date has been published on how these new environments can support literacy instruction.

In this study, we intend to confront this gap by exploring how students and teachers at one school district utilized Google Apps, a prominent cloud-based writing tool, for writing instruction; our goal is to understand how these writing practices help students meet literacy demands required in academic school settings. Our analysis of students' writing and feedback patterns (Zheng, Lawrence, Warschauer, & Lin, 2014) and our qualitative accounts of the tools' practical and learning affordances (Yim, Warschauer, & Zheng, 2014) are detailed elsewhere. This paper highlights specific aspects of these findings to examine the affordances and challenges of the cloud-based writing practices in meeting the demands of five ELA Standards: (a) collaboration, (b) text types and purposes, (c) ranges of writing, (d) focus on language, and (e) use of technology for research, sharing, and publishing.

Theoretical Framework

This study draws from a sociocultural approach to literacy known as the New Literacy Studies (NLS),

which conceptualizes literacy as socially situated in the context of literacy events (Gee, 1997; Lankshear & Knobel, 2007; Street, 1984). This approach views reading and writing as dialogic meaning-making processes that are embedded in social contexts, rather than as discrete skill sets acquired independently of social interaction (Bakhtin, 1986; Gee, 1997). The transformation of social literacy practices through the affordances of new media technology has led to an emergence of a related framework: the New Literacies Studies (Lankshear & Knobel, 2007). Building from the NLS, which explores literacy as a sociocultural practice, the New "Literacies" Studies looks into the types of literacy practices associated with use of digital media (Gee, 2009). The New Literacies Studies argue that the meanings to which technologies give rise are shaped by the social and cultural practices of diverse communities and actors (New London Group, 1996; Lankshear & Knobel, 2007). In this sense, new literacies are more participatory, collaborative, and distributed in nature than conventional literacies (Coiro, Knobel, Lankshear, & Leu, 2008).

In K-12 education, there have been attempts to incorporate changing notions of literacy in instruction and to propose educational frameworks and standards to support the 21st-century literacy skills that are required in colleges and careers (e.g., Partnership for 21st Century Skills, 2004). Specifically, educators are increasingly recognizing the value of technology-based collaborative writing for developing new literacies, as such writing provides students with opportunities to explore the fluid and multifaceted nature of literacy in the process of co-constructing meaning and knowledge (Dobson & Willinsky, 2009).

However, there has been little published research on how to incorporate collaborative online writing into K-12 instruction (Zheng, Warschauer, & Farkas, 2013) or how such writing may facilitate the development of standard academic literacies. Several existing studies focus on the teaching and learning processes of incorporating wikis, a collaborative writing tool, into writing instruction (e.g., Luce-Kapler, 2007) or on students' perceptions of the collaborative writing experience of a blog-based intervention (e.g., McGrail & Davis, 2011). Despite their widespread use, cloud-based collaborative platforms, such as Google Docs, remain largely underexplored in K-12 writing research, specifically in terms of how they may assist students to develop standard proficiencies that are required in formal academic settings. This examination of how a district-wide implementation of Google Docs may help students meet the ELA literacy standards of the Common Core addresses this gap.

Methods

Study Context

The research sites were four middle schools (grades 6–8) in a suburban Colorado school district, with mostly white and middle-to-high socioeconomic status families but with significant pockets of non-white (19%) students, children from low-income families (20% receiving free or reduced price lunch), and English language learners (7%). The district implemented a laptop initiative called Inspired Writing (i.e., one-to-one laptop program with a focus on authentic writing) from fifth to tenth grade starting in the 2010–2011 school year. Under the initiative, each student in the program was provided with a low-cost netbook computer and open source software for use in English language arts (ELA) classrooms. Following an initial positive impact on students' writing and academic achievement (see Warschauer, 2011, for comprehensive review), the district transitioned into a district-wide implementation of Google Apps for Education as an additional part of the laptop program in the 2011–2012 academic year. Perhaps due to this history of one-to-one technology in the district, a majority of teachers and students indicate in the survey that they feel confident about using technology in the classroom (i.e., 60% of teachers and 59% students rating their ability as advanced or expert). Following a writers' workshop model similar to that developed by Calkins (1994; 2006), a typical ELA classroom in the district begins with a short mini-lesson that covers the day's topic. Students then work individually or in small groups to write using Google Docs and exchange feedback to each other, and may share or present their work at the end of the period. Teachers involved in this program also participated in a week of training before the beginning of the school year, mainly on the hardware and software and the integration of this technology into the curriculum.

Data Collection

Interviews. A total of 16 teachers, literacy coaches, administrators, and students (grades 6–8) in two focal schools were interviewed at the beginning and at the end of the 2011–2012 school year. Interviews averaged 15–20 minutes and were digitally recorded and later transcribed.

TABLE 2 Online Feedback Analysis Framework

Types of Feedback		Descriptions and examples
Corrective Feedback	Direct Feedback	Feedback provider directly corrects or edits the writing. (e.g., interrupt-> interrupt)
	Commentary Feedback	Feedback indicates an error by commenting about the error or asking for clarification and revision. (e.g., you might want to be more clear about what this means.)
	Highlighted Feedback	Feedback provider does not indicate the nature of the error, but highlights it to indicate its location. (the way his was)
Non-corrective Feedback	Affective Feedback	Feedback provider provides writer with encouragement or their own emotional response to the writing. (e.g., This is very interesting! I can't wait for you to finish.)
	Evaluative Feedback	Feedback provider provides a more general evaluation of the written texts. (e.g., Well-written poem.)

Note. Adapted and modified from Ellis (2009) and Robb et al. (1986).

Surveys. Online survey data was collected from both teachers and students in the district's four middle schools at the end of the 2011–2012 school year. These queried basic demographic information, self-perceived computer skills, and frequency of student laptop use for particular tasks and activities. A total of 2,152 middle school students (a response rate of 65%) and 25 teachers (a response rate of 76%) responded to the surveys.

Documents. All teachers were invited to ask their students to share their Google Docs with the research team. We collected and analyzed writing samples on Google Docs (N = 3,537) from 257 students in one sixth grade teacher's two ELA classrooms, during the 2011–2012 school year. In addition, 909 written documents by 40 students were randomly selected to conduct content analysis of feedback they received from both the teacher and their peers.

Classroom Observation. Observations were conducted in ELA classrooms (grades 6–8) in two focal schools in the district for a total of 10 hours. Observations focused on the classroom use of Google Docs during visits.

Data Analysis

The quantitative analysis of students' writing and revision patterns used descriptive statistics as well as a two-level individual growth model using hierarchical linear modeling (HLM) (see Zheng et al., 2014, for details). Analysis of feedback used a framework (see Table 2) that adopted and modified those of Ellis (2009) and Robb et al. (1986). Each feedback was coded once for feedback source (e.g., teacher, peer) and feedback type (e.g., direct, affective).

Additionally, students' and teachers' interview and survey data were qualitatively analyzed using a thematic coding method (Glaser & Strauss, 1967; Saldana, 2009). Descriptive analysis of survey data and examples of students' Google Docs were also used for triangulation purposes throughout the process.

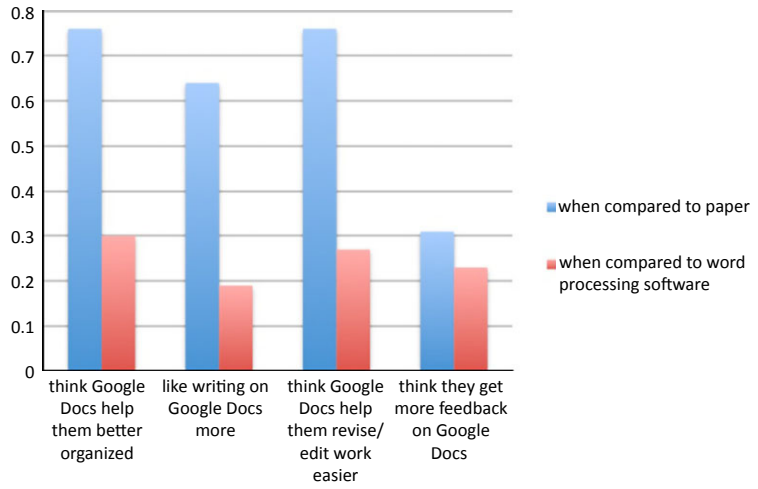
Results

Feedback: Collaboration and Support

The Common Core Standards recognize the importance of collaborative writing skills for successful college and career experiences (e.g., CCSS. ELA. Literacy.W.8.6.). The cloud-based writing environment has the potential to facilitate effective peer collaboration by allowing easy and simultaneous access from different locations and through convenient electronic feedback that happens both synchronously and asynchronously.

In the schools we observed, both teachers and students had positive perceptions of using Google Docs. When asked in a survey about the reasons for preferring Google Docs to paper, or any other word-processing tools, students responded that they became better organized and found it easier to revise and edit on Google Docs; they also stated that they received more feedback when using the platform (Figure 1). Their preference for Google Docs was stronger when the point of reference was writing by hand than when using word-processing software.

FIGURE 1 Perceived Benefits of Using Google Docs Over Paper or Word Processing Software (Scale: -2 Strongly Disagree, -1 Disagree, 0 Neutral, 1 Agree, 2 Strongly Agree)



Throughout the ELA instruction, students were encouraged by their teachers to review their peers' writing and provide feedback as much as possible, but there was no explicit training or teaching on peer feedback strategies. Teachers and peers gave various types of feedback: direct feedback, comments, evaluation, and affective remarks (see Table 2 for feedback coding framework with examples). Forty students' Google Docs documents (N = 919) were randomly selected to conduct content analysis of their feedback (Zheng et al., 2014). Among the five types of feedback (i.e., direct, commentary, highlighted, affective, evaluative), the two most frequent types of feedback were direct feedback (teacher: 72%, peer: 78.8%) and commentary feedback (teacher 12.9%, peer: 10.2%). Peers provided more affective feedback (7.6%), such as compliments, than teachers (1.3%).

While both teachers and peers most frequently provided direct feedback, the teachers we interviewed stressed the value of commentary feedback, which often leads to more sophisticated revisions based on communication between the reader and the writer. According to one teacher,

> They [students] are moving into talking about the content of their writing rather than just using a Google Doc as an editing tool. We've been working on distinguishing the difference between editing talk and revision talk, making your writing better and I've seen an improvement with that over the last few years as we've been using Google Docs.

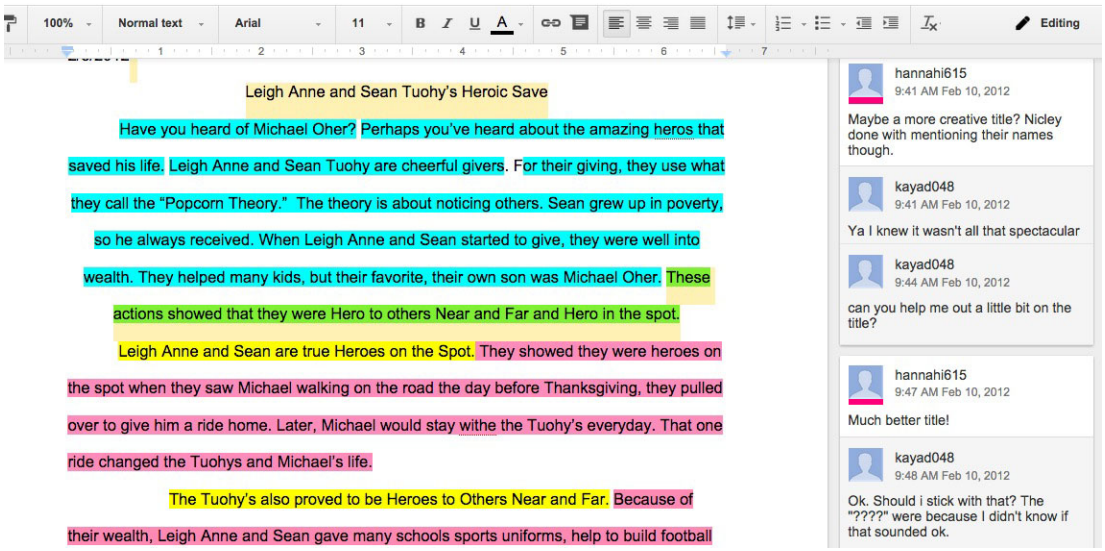
This change is important considering that meaning-based revision skills are often associated with higher-level, advanced writing skills, as revealed in previous studies (e.g., Graham & Perin, 2007).

Students also used Google Doc's feedback features to seek support from their peers and teachers. Students appreciated their classmates' constructive criticism, as is evident in the following comment from a student: "With this program, people can help me with my writing. When I share with a friend, they give me constructive feedback." Figure 2 illustrates an example of collaborative communication in which the main author asks his peer for suggestions in developing an appropriate title.

This type of threaded communication with peers allows students to "write one's way into understanding" and offers them opportunities for reflective thinking (Lapadat, 2002, p. 27). The Writing Standards note the benefits of peer scaffolding through collaborative interactions: "With some guidance and support from peers and adults, [students should] develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach" (CCSS. ELA. Literacy.W.8.5).

Although collaboration through giving and responding to feedback was common, collaboration through true co-authorship or multiple authorship was rare. In our sample, statistical analysis of 3,537 documents written by 257 students revealed that an average of 1.4 co-authors, and a maximum of six co-authors, collaborated on each document in Google Docs for editing and revision (Zheng et al., 2014).

FIGURE 2 Peer Feedback Example: Conversation Pertaining to Title Development. The Main Author Revises Her Title Based on Her Peers' Suggestion and Asks for Feedback on Her Revision



A large majority of the documents (73%) were written by a single person, with 22% of the total written or edited by two people and only 5% co-authored by two or more people. This appeared to be due to the nature of the writing assignments. Teachers frequently asked students to provide feedback on each other's writing, but seldom asked them to work together to co-author a collaborative project. Due to the prevalence of co- and multiple-authorship in real world contexts, finding ways to promote more co-authorship in classrooms, while still helping students hone their individual writing skills, could be of value.

Text Types and Purposes

The Text Types and Purposes domain of the CCSS Writing Standard encourages students to write for different genres, audiences, and purposes. Students are expected to practice different text types (i.e., informational, narrative, expository) so that they can effectively address and communicate their purpose to their audience. Students in our sample completed writing tasks for different purposes using a wide variety of genre conventions, ranging from biographies to investigatory reports and movie trailers. Interestingly, the ELA classes with Google Docs encouraged creative activities to explore different genres. For example, in a multi-genre research project, students were asked to produce research they conducted about a historical event (e.g., World War II) in a variety of genres, such as in a screenplay, comic strip, radio broadcast, or travel report. One student, after receiving positive feedback from a peer on a book review he had written, was inspired to develop the review into a movie script with that classmate. Together, they experimented with modifying their writing to develop creative storylines for different audiences and purposes.

In regard to the requirements of genre, the Standards expect students to consider who their readers are and how to meet their audience's expectations (e.g., CCSS. ELA-Literacy.W.8.3a). The feedback features of Google Docs seem to provide opportunities for peers to raise questions, concerns, and suggestions, which can help enhance the writers' general awareness of their readers and encourage reader-directed revision of texts. In the narrative writing example shown in Figure 3, the writer and his readers exchange clarifying questions and comments on the appropriateness of the details. This allows the writer to evaluate the document's logical flow while also realizing how the reader may perceive the content.

Ranges of Writing

ELA instruction with Google Docs also offered opportunities for students to regularly write for both extended and shorter time frames, which are critical aspects of writing instruction recommended in the Ranges of Writing domain (e.g., CCSS.ELA-Literacy.W.8.10). Writing longer pieces that require an extended time period can be both mundane and difficult to practice within a limited classroom

FIGURE 3 Feedback Example: Peer's Suggestion to Incorporate Reader's Perspective

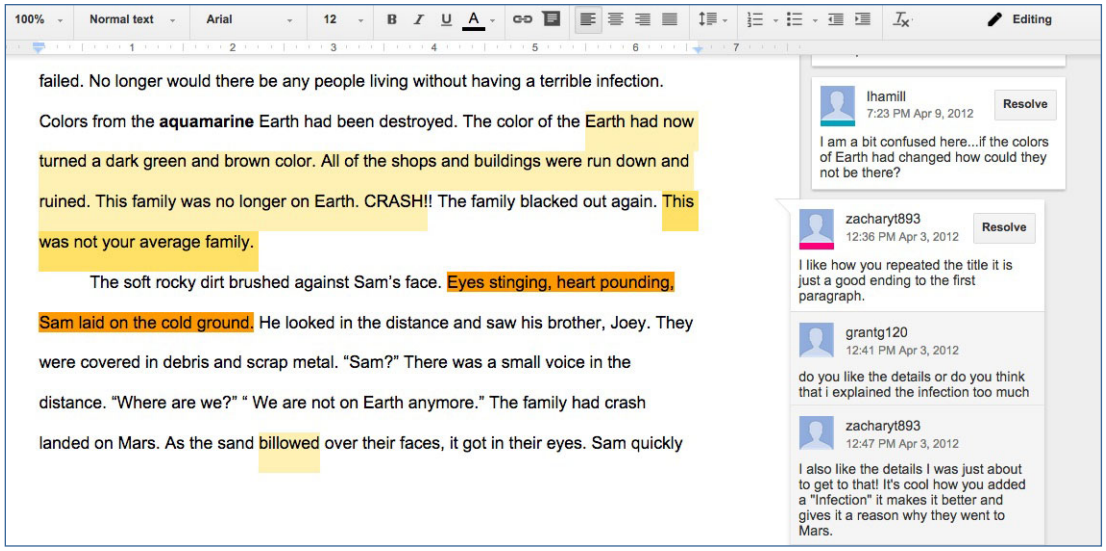


TABLE 3 Descriptive Statistics of Student Writing and Revision on Google Docs

	Mean	(S.D.)	Min	Max
Document level (N_1=3,537)				
Number of authors	1.34	(0.62)	1	6
Number of edits	4.93	(5.63)	1	74
Edit duration (days)	15.26	(38.93)	0	384
Word count of writing at first session	248.00	(350.83)	0	2,558
Word count of writing at last session	429.89	(457.50)	1	5,500
Session level (N_2=17,435)				
Words added	118.03	(239.24)	0	3,911
Words deleted	28.09	(120.03)	0	3,106

period. As a result, middle and high school students' typical in-class writing involves very short and limited practices. Prior research suggests that secondary students typically write a page or less of text during a nine-week grading period (Applebee & Langer, 2011) and seldom receive practice opportunities or explicit scaffolding to produce analytic writing that demands the use of reasoned thought (Lawrence, Galloway, Yim, & Lin, 2013).

Google Docs appears to be effective in supporting the continuity of writing and revision because of its accessibility from any location and frequent opportunities for exchanging feedback. In describing students' engagement in writing during an extended time period, one teacher explained that, with Google Docs, students learn "the life cycle" of a "living document" that continues to develop over time. She added that the collaborative features of Google Docs tend to encourage students to keep expanding and developing their ideas through multiple revisions.

This point, regularly brought up in teacher interviews, was backed by our examination of writing patterns. According to a quantitative analysis of students' documents collected over an academic year (N = 3,537), students engaged in frequent revision on Google Docs for extended periods of time (Zheng et al., 2014). They produced an average of 13.76 documents and 67.84 edits per document, working on each document for an average of 15 days during the 2011–2012 school year (see Table 3).

TABLE 4. Focus of Feedback Students Received on Google Docs

Focus of Feedback	Frequency	Feedback Provider	
		Teacher	Student
Mechanics	136 (40.6%)	81 (36.3%)	55 (49.1%)
Grammar	88 (26.3%)	56 (25.1%)	32 (28.6%)
Word Choice	15 (4.5%)	12 (5.4%)	3 (2.7%)
Content	46 (13.7%)	38 (17.0%)	8 (7.1%)
Organization	32 (9.6%)	29 (13.0%)	3 (2.7%)
Convention	11 (3.3%)	6 (2.7%)	5 (4.5%)
General	7 (2.1%)	1 (.4%)	6 (5.4%)
Total	335	223	112

Document lengths ranged from 248 to 430 words on average. Some students produced lengthy documents that were 2,500 to 5,500 words long and revised them for almost a year—extended writing practices that typically happen in real-life career or academic settings rather than in middle school—an especially impressive fact given the norms for this schooling level.

Focus on Language

The ELA Standards emphasize that in order to be college and career ready, students need "a firm control over the conventions of standard English" and that "they must come to appreciate that language is at least as much a matter of craft as of rules" (National Governors Association of Best Practices, 2010, p. 51). The teachers we observed took advantage of the simultaneous access and editing features of cloud-based technology by using templates and color-coding for guided and explicit teaching of grammar, vocabulary, and mechanics. One teacher explained this process:

> I model for them what I want them to do, then maybe with a student who volunteers, they put their things up on the screen. They can also use the doc camera, where they can come up at the end of class and show, and/or ask to have their document pulled up by me and show that they can interact on a Smart Board.

Another teacher explained that through an examination of learner errors in Google Docs, students not only understood grammar and writing mechanics in an engaging way, but also employed critical thinking skills. When confronted with errors, students had to understand "how… you analyze and make a decision about what needs to be fixed…. There's so much more critical thinking there," in the words of this particular teacher.

Google Docs' feedback feature also proved to be a frequently used feature for addressing students' problems in grammar, vocabulary, and mechanics. Analysis of 40 students' compositions (see Table 4) revealed that teachers' and peers' feedback focused on mechanics (40.6%) and grammar (26.3%), as well as convention (3.3%) and word choice (4.3%).

Through the cycle of giving and receiving feedback, as well as the subsequent revisions, struggling writers are likely to have more opportunities to become skilled in the conventions of Standard English (e.g., CCSS. ELA-Literacy.L.8.1), although more attention to content and organization is definitely desired as their writing proficiencies develop.

Use of Technology for Research, Sharing, and Publishing

Use of technology for research, sharing, and publishing is increasingly important in today's knowledge economy. In the Colorado school district, students reported that they use a variety of Google Apps to carry out individual and group projects. According to survey data, students use Google Docs (school use: 3.5 times per week/home use: 2.5), Google Sites (1.7/1.4), and Gmail (1.2/2) most frequently; they

also report less frequent, but regular use of other applications such as Google Videos (0.2/0.95) or Google Maps (0.75/0.86). Students accessed Google Docs, both at school and home, for a variety of purposes. Except for in-class activities, such as taking notes or filling in templates, most activities happened both at school and home with similar frequency patterns and purposes. Revising/editing and writing drafts as a single author were the two most common activities performed both at school and at home, followed by (in order of frequency) giving comments on others' writing, drafting with peers, making presentation slides, commenting on peers' writing, chatting, and working on spreadsheets.

The Writing Standard also emphasizes the ability to gather relevant information from multiple print and digital sources, to use advanced searches effectively, and to assess the strengths and weaknesses of each source to selectively integrate relevant information in their own writing while maintaining the flow of ideas (i.e., CCSS.ELA-Literacy.W.11-12.8). Although the focus of our study was more on the writing process rather than the broader research process, we also noted some examples of students' collaborative work for research. For example, groups of students worked together to create an investigative report by researching and collecting information on a given event. Others worked on a webcast activity in which students compared different websites to choose, evaluate, and synthesize information. However, the use of Google Docs for collaborative group work did not seem to be a priority for these ELA teachers. As discussed earlier, the majority of Google Docs documents were authored by one or two authors, that is, the main author maintained ownership of the document and received feedback.

Next, the Production and Distribution domain of the Writing Standards emphasizes the value of using technology to share and publish writing to present information and ideas, as well as to interact and collaborate with others (e.g., CCSS. ELA-Literacy.W.8.6). Google Docs provides a collaborative online platform in which readers can access, edit, and comment on documents with the author's permission. In Google Docs, students go through the process of sharing and publishing online with virtually all documents. Being a public author online with a broader range of audience can be an exciting experience for students, as one student commented: "We have our own websites so that our parents, friends, and just anybody can read our writing and comment on it in our discussion groups. Our websites and discussion groups are both from Google and it's so fun!"

When sharing, students used Google Docs' permission features to ensure personal control over their writing. In the open-ended survey responses, students expressed their comfort in having control in sharing and publishing their documents: "It's also really helpful that I can make them [the readers] able to comment, edit, or view, so I still have control over my document." Another student commented, "I like how you can share with as many people as you want of your choice." One teacher stressed the value of these control features for developing a sense of community:

> I think sometimes when they share with peers, they're typically sharing it with people they are comfortable with. I feel that when they get that kind of feedback, it's typically kind of a little bit of affirmation or helping them feel confident in their writing because they're sharing at a level that's really comfortable for them. It helps them feel good about what they've written.

As the teacher's observation illustrates, students' ability to choose their readers may further enhance their sense of supportive community by giving them control over their own level of security and comfort in the collaborative writing environment. As suggested by Hunter (2011), increased sense of ownership of documents in a collaborative environment may help students navigate between incorporating peer feedback and maintaining their own ideas, which helps in turn to establish student writers as public authors.

Discussion and Implications

In this study, we examined how Google Docs, one of the most widely used cloud-based tools in educational settings, is employed for ELA instruction in a school district with a one-to-one laptop initiative. Our analysis of interview, survey, and observation data, combined with our quantitative and qualitative analysis of writing, revision, and feedback using Google Docs, suggests that a cloud-based platform holds some special advantages for addressing specific domains of the ELA Common Core Standards. This principally flows from the opportunity to access cloud-based documents from multiple locations and the ease with which multiple students and their teacher can

synchronously or asynchronously collaborate on writing through sharing of comments, revising each others' drafts, and co-authoring documents.

We found that cloud-based collaboration has particular affordances for promoting skills suggested in the ELA domains of text types and purpose, ranges of writing, and focus on language. Our results suggest that students in a Google Docs environment explored a wide variety of genres ranging from biographies to movie trailers, while increasing their reader awareness as they attended to feedback from authentic audience and subsequently revised their writing. Students also wrote and revised extensively in Google Docs, often employing their extended writing practices similar to those that more typically occur in college and career settings. In addition, the simultaneous access and editing features of cloud-based technology were also well exploited by teachers, who provided explicit teaching of grammar and mechanics through modeling and color-coding activities, as well as through collaborative analysis of learner errors.

However, we also recognized two main limitations in how the cloud-based writing environment was used. First, there was relatively little true co-authorship; most collaboration consisted of a main single author receiving and responding to feedback from others, which is the simplest form of collaboration (Noel & Robert, 2004). This is understandable given that most of the teacher-assigned writing tasks in the ELA classrooms we observed were individual writing tasks that did not necessarily involve peer collaboration. Bower's (2008) study on wikis also raised similar concerns, arguing that the affordances provided by a technology tool need to match with the affordances required by a learning task for effective technology implementation (cf. Warschauer, 1999).

Given the ever-increasing demands for collaborative writing in professional and academic contexts, broader forms of collaborative authorship, in which multiple authors share various forms of responsibilities and contributions (e.g., joint writing or parallel writing; for detail, see Noël & Robert, 2004), should be encouraged by teachers. This kind of collaborative writing can be facilitated by detailed instruction on the different phases of collaboration (e.g., initiation, exploration, negotiation, co-construction stages, see Onrubia & Engel, 2009 for details) and on the diverse types of author control within these phases.

The second limitation observed was that while peer feedback was frequently exchanged throughout the writing process, it tended to focus mostly on sentence-level features of writing rather than broader issues of content and organization. This is consistent with previous research that points to the need for peer feedback training (e.g., Myhill & Jones, 2007) and can be partly explained by students' psychological ownership of academic products (Pierce, Kostova, & Dirks, 2003). We found in interviews that students are inclined to protect their own work from being changed or edited, and are reluctant to make major suggestions to others as well. Without explicit goals that encourage collaborative production, students may thus provide feedback on the superficial errors in their peer's writing rather than providing substantive comments on content or organization. In order to address this issue, teachers may want to share the goals and benefits of collaborative writing with students and offer them training in peer feedback and collaboration strategies. One effective strategy may be to use an online assessment system specifically designed to guide students through the process of peer review, ranging from problem identification to elaborate revision and metacognitive reflection (e.g., Cope et al., 2011, for details on *Scholar*, an online peer review tool).

Take Action

STEPS FOR IMMEDIATE IMPLEMENTATION

- Give more co-authored assignments. We usually think of assigning groups to work on larger projects, but smaller writing-to-learn activities can also be collaboratively performed in networked environments.
- Writing in shared spaces may be intimidating for students, especially at first. Create guidelines for appropriate and helpful feedback. Grade students on the feedback they give and how they integrate changes into their writing.
- Consider using Google Docs with classes of students who need to build writing stamina or need support in writing new genres and formats.
- Take time in designing clear guidelines and assessments of multimedia and research tasks. Tech leaders in schools will need to share best practices in these areas if cloud-based technology is going be used to its full potential.

Lastly, we want to emphasize that the potential benefits of using Google Docs for promoting literacy do not flow entirely or even principally from the technology tool itself. Our previous work within this district indicated a high prior degree of expertise and professionalism in making use of digital media for teaching writing, even before the district started using Google Docs (see, e.g., Warschauer, 2011). This study thus helps show what a well-organized district with an experienced teaching staff can accomplish using cloud-based tools. Educational leaders who wish to replicate the district's example will need to consider all aspects of the program—from implementation of the cloud-based environment to the provision of the necessary technical support and professional development—to achieve success in other contexts.

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More to Explore

CONNECTED CONTENT-BASED RESOURCES

- ✓ Lawrence, J.L., Warschauer, M., Zheng, B., & Mullins, D. (2013). Research in digital literacy: Tools to support learning across the disciplines. In J. Ippolito, C. Zaller, & J.F. Lawrence (Eds.), *What middle and secondary teachers need to know about adolescent literacy*. Cambridge, MA: Harvard Education Publishing Group.
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