Google Docs in the Classroom: a District-wide Case Study

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Structured Abstract

**Background/Context:** Successful integration of educational technology is a complicated process that is influenced by multiple factors (Levin & Wadmany, 2008; Valcke et al., 2007). Recently, both within and across schools, educators have been searching for cloud-based solutions to address the challenges of integrating educational technology into their school systems — assessing whether these programs are affordable, accessible, and well-suited to improve learning. While the popularity of cloud-based applications among educational institutions and students is rapidly increasing due to their enhanced sharing features, accessibility, and cost-efficiency, there have been few efforts to investigate the impacts of these cloud-based applications in educational settings, especially in K-12 settings.

**Purpose/Objective/Research Question/Focus of Study:** This paper examines how Google Docs, one of the most popular cloud-based software applications, is integrated into middle school ELA classrooms in a school district with a laptop initiative. Specifically, this case study attempts to understand the contemporary challenges of and its accompanying opportunities for implementing the collaborative web-based tool, as well as the contextual factors for its implementation within the district.

**Research Design:** This qualitative study followed a grounded approach to data analysis (Glaser & Strauss, 1967; Saldana, 2009). Using primarily initial coding and thematic coding methods (Saldana, 2009), we analyzed interviews, surveys (from 2152 students and 25 teachers), classroom observations, and student documents collected over the course of the 2011-2012 academic year. Analysis revealed three key themes (i.e., access and workability, cost and practicality, affordances for writing), as well as the contextual factors of Google Docs implementation (i.e., district’s focus on instructional goal, professional development).

**Conclusion/Recommendations:** Our case study suggests that the introduction of cloud-based tools was perceived by students, teachers, and district officials to make technology use more accessible and convenient, to enhance cost-efficiency and productivity, and, most importantly, to provide ample affordances for writing practice and instruction. The district-wide implementation of Google Docs provided broad, accessible, and affordable simultaneous access to students and teachers, while increasing their opportunities to improve writing skills through features such as feedback, revision history, and reader selection. We also identified key contextual factors, such as the district’s focus on curricular integration and professional development that contributed to these favorable outcomes. As one of the few studies that explores cloud-based tools’ usability and benefits in K-12 settings, we hope to help school districts make informed decisions about adopting these applications for instruction. Though the particularities of context need to be taken into account, the case study nevertheless reveals a cloud-based environment’s salient affordances for learning in a district-wide implementation context.
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Executive Summary

The popularity of cloud-based applications among students and educational institutions is rapidly increasing due to these applications’ enhanced sharing features and accessibility, which support effective instruction. In addition, their cost efficiency coming from being widely available and free also contributes to their universal spread. Despite the many advantages of using cloud-based platforms, a majority of the research investigating their educational value has targeted higher education settings (Micrea & Andreeescu, 2011; Ouf, Nasr, & Helmy, 2010; Thomas, 2011) or adult second language learning contexts (e.g., Kessler, Bikowski, & Boggs, 2012); thus, little is known about these tools’ usability and benefits as a classroom tool in K-12 settings. The lack of relevant educational research on this particular environment makes it difficult for school districts to finalize their decisions to adopt these applications for instruction.

Addressing this need, we examine the integration process, specifically the perceived challenges and accompanying benefits, of Google Docs (one of the most popular cloud-based software applications) in K-12 English Language Arts (ELA) classrooms with a district-wide laptop initiative. Qualitative analysis from interviews, classroom observations, surveys, and student essays written on Google Docs over the course of an academic year, revealed three areas of challenge that the district encountered (i.e., access, cost, and learning of writing) as they implemented the tool within the context of their curricula. Analysis also revealed the contextual factors that contributed to overcoming these challenges (i.e., district’s focus on curriculum goal, professional development). Drawing from existing research on K-12 technology integration, especially on the use of Web 2.0 tools in literacy instruction, we ask whether the program
is affordable, accessible, and well-suited to fulfill the district’s learning goal of improving student writing.

The findings of this study suggest that the introduction of cloud-based tools was perceived by students, teachers, and district officials to make technology use more accessible and convenient, to enhance cost-efficiency and productivity, and, most importantly, to provide ample affordances for writing practice and instruction. Specifically, this study confirms the critical role of “easy access” as a key driving force for technology integration in K-12 settings (Zhao et al., 2003, p.157) and reflects how the district-wide use of cloud-based computing transforms both students and teachers’ work ethics from *performativity* into *workability*. Even with a well-designed online writing program, teachers were less likely incorporate technology into instruction when “access to the physical machinery was heavily structured, guarded, or restricted” or when teachers were confronted with frequent technical glitches and difficulties in familiarizing themselves and their students with complex program features (Olmanson & Abrams, 2013, p. 361). In the K-12 district we observed, Google Docs was perceived as an accessible and usable alternative to help teachers and students focus not on complex IT implementations, but on core curricular issues in writing instruction.

Next, although an exact cost-benefit analysis or evaluation was beyond the scope of this study, our survey and interview data suggests that the use of Google Docs was perceived as helping the district meet the challenge of reducing IT budgets for implementation and maintenance. Given the mounting pressure to reduce the costs of supporting educational institutions (Thomas, 2011), the issue of whether technology achieves better results at lower costs is an important criterion for evaluating the value of
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instructional technology (Noeth & Volkov, 2004). Addressing this question, districts took the initiative to search for a low-support means for achieving their educational goals while minimizing costs, and have found that Google Docs fits the criterion. However, adopting a cloud-based system throughout the district involved careful planning and strategies, not only for curricular integration, but also for financing.

Most importantly, the perceived affordances and challenges of Google Docs for writing instruction provided a significant implication. In a post-industrial knowledge economy and network society, skills of communication, collaboration, and horizontal networking play a prominent role. K-12 educators are increasingly attempting to integrate technology to teach these essential skills. As revealed in this study, when Google Docs is integrated into a solid curricular context, it enhances peer interaction and group work, facilitates sharing and distributing knowledge and information within a supportive community, and increases students’ productivity in the collaborative process. However, several challenges of integrating Google Docs into writing instruction have been observed, including the issues of over-reliance on technology and students’ reluctance toward collaboration. In response to students who are overly dependent on technology, teachers should guide those students in their collaborative processes and provide strategies (i.e. for problem identification, elaborate revision, and metacognitive reflection). Similarly, in order to engage students in meaningful collaboration, teachers should inform students of the shared goals and benefits of collaborative writing, as well as provide optional training in peer feedback and collaboration strategies.

This study reinforces the concept of the sociotechnical network, which consists of the intertwined relationships among technologies, people, and organizations (Kling,
1999). As Melvin Kranzberg (1986) argued, “technology is neither good, nor bad; nor is it neutral “ (p.545). Kranzberg stated that technology has neither a positive nor a negative deterministic impact; rather, its structure helps to shape human experience. Educational software and online environments can thus be considered according to how they are shaped by the social interests and motivations of their users (Buckingham, 2007).

The district introduced Google Docs not as a turn-key solution, but rather as part of a lengthy and serious effort to reform and improve curricula, pedagogy, and instruction. The stages of technology integration appeared to be a critical factor in understanding the implementation context of the Littleton district (e.g., Sandholtz & Reilly, 2004). Based on four years of knowledge and experience gained from implementing the laptop program and modifying it at different stages of technology (i.e., entry, adoption, adaptation, appropriation, invention; for details, see Sandholtz et al., 1997), the district strategically altered its methods to integrate cloud technology into instruction. Due to the success of implementing laptop programs for four years, the district made a decisive choice in adopting these cloud-based tools. District leaders focused on a targeted learning goal, made efforts to empower and support teachers through professional development, and facilitated collaboration among multiple stakeholders, all with substantial success (see, e.g., Author et al., 2010; Author, 2011). The district’s continuous efforts to create a shared vision and to encourage collegiality and collaboration served as a sustaining force for technology integration, as previous research suggested (e.g., Hsu & Sharma, 2008).

Though particularities of context need to be taken into account, the case study
nevertheless reveals a cloud-based environment’s salient affordances for learning in the district-wide implementation context. Future research investigating how the tool can be embedded in different social and educational contexts – with different levels of student competency, economic backgrounds, and district cultures—will provide benchmarks for educators and researchers engaged in serious educational reform through the use of technology.
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Introduction

U.S schools have been integrating instructional technology into K-12 settings for more than 25 years, recognizing its potential to help transform education and improve student learning. However, successful integration of technology into classrooms is a complicated process that is obstructed by multiple factors (Levin & Wadmany, 2008). In some cases, the expenditure for purchasing and maintaining technology outweighs the potential educational value (Cuban, 2003; Cuban, Kirkpatrick, & Peck, 2001). In other cases, limited access to and availability of technology hinders implementation (Karagiorgi, 2005; Hohlfeld et al., 2008). Furthermore, supposing that these obstacles are resolved, the integration of technology in education may not reap the potential benefits of student learning or teaching practices as initially designed (Norris, Sullivan, Poirot, & Soloway, 2003; Lim & Chai, 2008; Author, 2011).

Recently, both within and across schools, educators have been looking for cloud-based solutions to help address these challenges. Cloud computing is defined as a networked computer system that delivers information technology (IT) services to many users in an on-demand environment (Mell & Grance, 2011). Given that it can harness the resources of several servers, cloud computing allows multiple users to access resources from different computers and collaborate in an online environment (Conner, 2008). The popularity of cloud-based applications among students and educational institutions is rapidly increasing due to these applications’ enhanced sharing features and accessibility that support effective instruction. In addition, its cost efficiency coming from being widely available and free also contributes to its universal spread. While there have been efforts to investigate the educational value of cloud-based platforms, most of this
research has targeted higher education settings (Micrea & Andreescu, 2011; Ouf, Nasr, & Helmy, 2010; Thomas, 2011) or adult second language learning contexts (e.g., Kessler, Bikowski, & Boggs, 2012), with little known about these tools’ usability and benefits as a classroom tool in K-12 settings. The lack of relevant educational research on this topic in turn makes it difficult for school districts to make informed decisions about adopting these applications for instruction.

Addressing that need, this paper examines how Google Docs, one of the most popular cloud-based software applications, is integrated in K-12 English Language Arts (ELA) classrooms in a school district with a laptop initiative. Specifically, the challenges and accompanying benefits perceived during the process of implementing the collaborative web-based tool is investigated. Qualitative analysis from interviews, classroom observations, surveys, and student essays on Google Docs written over the course of an academic year revealed three areas of challenge that the district encountered (i.e., access, cost, and learning of writing) as they implement the tool within the context of the curriculum and the contextual factors that contributed to overcoming these challenges (i.e., district’s focus on curriculum goal, professional development). Drawing from existing research on K-12 technology integration, especially the use of Web 2.0 tools in literacy instruction, we ask whether the program is perceived affordable, accessible, and well-suited to support the district’s learning goal in improving student writing.

**Background**

**Technology Integration in K-12 settings**
The question of whether the deployment and use of educational technology can bring positive changes to schools has been widely researched (e.g., Cuban, 2003; Norris et al., 2003). In K-12 classrooms, technology is employed for largely three different contexts: instructional preparation, instructional delivery, and as a learning tool (Inan & Lowther, 2010). Technology integration is considered to comprise of any of these three types of computer uses in the context of usage and support for classroom instruction (Smaldino et al. 2008). Research that explores the efficacy of these technology tools in classroom instruction has revealed the critical influence of multiple contextual factors.

As such, one of the mostly widely researched topics in K-12 technology integration deals with the factors that aid and hinder teachers’ actual use of technology in the classroom (e.g., Hew & Brush, 2007; Inan & Lowther, 2010). The barriers that inhibit successful technology integration efforts in school settings include availability and access to computers (Karagiorgi, 2005; Hohlfeld et al., 2008), cost of implementation (Cuban, 2003; Cuban, Kirkpatrick, & Peck, 2001), teacher beliefs and attitudes (Chen, 2008; Lim & Chai, 2008), demographic characteristics of participating teachers (Bebell et al., 2004; Van Braak, 2001), teacher knowledge and skills toward technology use (Hughes, 2005; Williams et al., 2000), and availability of technical or administrative support for teachers (Sandholtz & Reilly, 2004).

These multiple barriers can be categorized into two large categories (Ertmer & Ottenbreit-Leftwich, 2010; Lowther, Inan, Strahl, & Ross, 2008): first-order barriers including “institutional” barriers that are located outside of the classroom teacher’s control (Ertmer, 1999, p. 48), and second-order barriers including “personal” barriers that originate with the teacher (Ertmer, 1999, pg. 48). First-order barriers, which are often
imposed by school or district level, include lack of hardware, poor infrastructure, or insufficient funds. For example, the immense cost of educational technology and financing has been identified as one of the key determinants of successful implementation of technology-based instruction (Cuban, 2003; Sultan, 2010; Thomas, 2011). The costs associated with the use of instructional technology stem from many sources—infrastructure, hardware, technical support, faculty and student training, course design and development, administrative costs, and opportunity costs (Glennan & Melmed, 1996). Well-designed programs often fail because these compound sources have not been thoroughly factored into school contexts (Author, 2006). As such, efforts have been made to increase the cost-efficiency in integrating technology in K-12 settings.

Next, second-order barriers include teacher-internal factors such as teacher beliefs and attitudes toward technology use (Chen, 2008; Lim & Chai, 2008), or teacher knowledge and skills related to technology use (Hughes, 2005; Williams et al., 2000). For example, teachers’ opinions with regards to technology (i.e., whether or not they think technology can help them achieve the instructional goals) revealed critical impact on the level and quality of technology integration. The more connections teachers find between technology use and their specific content area goals, the more they value the need for technology integration and readily transfer their technology skills and knowledge to their own classrooms (Hughes, 2005).

Although first-order barriers such as cost or technology access have a significant influence on the level and quality of classroom technology use, most studies on technology integration in K-12 schools tend to focus on what is done by teachers in individual classrooms (Hew & Brush, 2007). As Hew and Brush (2007) warned, more
efforts are needed to understand how teacher-external factors are related to teacher-
internal factors or changes in instruction. The relation between the two sets of factors has
been explored in a few recent studies. For example, Olmanson and Abrams’ (2013) study
of an early implementation of an online multimodal writing program revealed that
teachers’ implementation efforts are contingent upon complex and interrelated factors,
including access, administrator support, and district priorities. Other studies also suggest
that teacher interest in technology integration is closely linked to available resources
(Capo & Orellana, 2011), curricular or cultural alignment (Schifter, 2008), and technical
support and training (Rohaan et al., 2012).

While these studies examine the process of implementing a specific technology
software or tool (e.g., online writing software) in classrooms, there is limited information
about the district-wide curricular integration of cloud-based network system. Cloud
computing has already become a significant place in higher education landscape both as a
ubiquitous platform that supports collaborative research through new forms of peer
review, social networking, and open access to information (Thomas, 2011; Sultan, 2010),
as well as significantly lessening IT expenses by reducing the necessities of licensing and
software updating and maintaining servers (Micrea & Andreescu, 2011). While the
potential benefits of adopting a cloud-based solution in K-12 settings have been greatly
emphasized (Sultan, 2010), there have been no empirical studies that attempted to
identify the particularities of using cloud computing within K-12 settings. This study
aims to fill this gap by examining how a district-wide implementation of Google Docs – a
prominent cloud-based word processing tool – in ESL classrooms has been received by
students, teachers, and district officials, and what particular implementation challenges
have been perceived as resolved during the process of integrating the cloud-based Web 2.0 tool.

**Use of Social Media in Literacy Instruction**

In literacy education, a variety of information and communication technologies (ICTs) have been integrated into instruction. Over the last decade, social media tools, such as blogs, wikis, and social networking sites, have generated growing interest among K-12 educators (e.g., Jimoyiannis, Tsiotakis, Roussinos, & Siorenta, 2013). Social media tools are a collection of web applications that recycles user-generated content to initiate social interaction, typically through discussion, chatting, commenting, and collaborative writing (O’Reilly, 2005). In addition, depending on the degree of applicability and convenience, this system, such as cloud computing networks, enables collaborative functionalities to engage the particular community in active communication and bonding (Ouf et al., 2010). The educational value of social media has been extensively studied and documented in classroom, online, and blended learning contexts. Implementing these interactional and collaborative social media tools resulted in an increase in students’ participation, communication, and interaction, facilitating collaborative content generation and autonomous learning in the communities (e.g., Clark et al., 2009; Author et al., 2013).

The theoretical ground for the educational values of social media technologies can be drawn from communities of practice theory (Wenger, 1998). In Web 2.0 environments, students collaborate as they acquire a common understanding of shared knowledge within a community (Wenger, 2001). Students’ participation in communities of practice is based on iterative negotiation of the meaning of the shared domain.
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(Wenger, 1998). Becoming a member of such a community includes “learning how to collaborate in the community” (p. 109). In this light, online participation through collaborative tools, such as blogs and wikis, can also be considered as social practices and contextual negotiation of meaning. Collaborative writing is one example that supports student interaction to share knowledge in the learning community (Parker & Chao, 2007).

Along with the increasing prevalence of social media platforms in most academic and professional settings, the need to apprentice students to become familiar in a technology-mediated writing and collaboration environment has become imperative. Thus, opportunities to integrate these tools into instruction are continuously being investigated in K-12 settings. Several studies have explored the affordances of using social media as a classroom tool to support K-12 literacy instruction. For example, Woo et al. (2011) examined fifth grade students’ use of wikis for in-class writing activities, suggesting that, as a platform for sharing, peer-commenting, and co-construction, wikis could elevate students’ collaborative writing and collaboration skills, as well as their creativity and problem-solving skills (Woo, Chu, Ho, & Li, 2011). Similarly, blogging in elementary classrooms also has comparable benefits in that it could serve as a vehicle for promoting higher order thinking skills in reading comprehension (Zawilinski, 2009). Other studies examined students' perceptions of a blog-based intervention to induce their collaborative writing experience (e.g., McGrail & Davis, 2011), as well as to transform what was formerly considered "boring school writing" (Witte, 2007, p.92) into increased writing participation within middle school students.
Although much research has been conducted on the use of wikis and blogs in K-12 academic settings, a comparable social media tool, such as Google Docs, remains largely unexplored (Chu, Kennedy, & Mak, 2009). Most existing studies on the educational use of Google Docs were conducted in higher education or second language learning contexts. For example, Blau and Caspi (2009) analyzed different patterns of undergraduate students’ collaborative writing using Google Docs and how the patterns may influence students’ perceived quality of document and quality of learning. The results suggested that students perceive a collaboratively written document to have a possible higher quality than a document written alone, but did not perceive them as an improvement in learning. In another study, Kessler et al. (2012) discussed how Google Docs can be used to support a collaborative writing process of adult English learners. In addition to increasing students’ participation, the results suggested that collaborative writing features also help induce a process through which students focus on confirming the accuracy and identifying the different types of changes made to a text.

Although most of these studies have examined the learning processes and affordances of using social media tools within classrooms, the realization of these potentials largely depends on broader social contexts. Hutchison and Reinking’s (2011) national survey on literacy teachers’ perceptions of technology integration reveals that a majority of teachers view the role of technology in their instruction as supplemental, rather than core. Moreover, their perception of several obstacles, such as the lack of time to integrate technology during a class period, lack of access to technology, and lack of technology support and professional development on integration methods, further enhances their discontent in incorporating technology into their teaching curriculum.
Given these challenges in technology integration, supplemental efforts and information are required to address issues within a broader district context, such as cost, access, or district support toward the use of digital tools in literacy instruction. Therefore, in this study, we attempt to address this need by delineating how a district-wide integration of Google Docs into ELA instruction helped the school district address the challenges of cost, access, and improving learning and also by examining the contextual factors that contributed to these favorable outcomes. The specific research questions this study aims to address are as follows:

- RQ1: What were the perceived strengths and weaknesses of a cloud-based platform for helping a district meet its educational challenges?
- RQ2: What were the contextual factors that facilitated the district-wide implementation of the cloud-based platform?

**Method**

**Study Context**

The research was conducted at four middle schools in a Colorado school district. The district hosts a predominantly middle income, white, suburban, English-speaking population, 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%). Starting from the 2010-2011 school year, the district launched a laptop initiative called Inspired Writing (i.e., a one-to-one laptop program with a focus on authentic writing) that was implemented from the fifth to tenth grades. Under the initiative, each student in the program was provided with an Asus Eee netbook and open source software for use in ELA classrooms. The initiative was exercised to provide
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diverse means and opportunities for students to write and share their writing through technological collaboration. Following an initial positive impact on students’ writing and academic achievement (see Author, 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.

In the beginning of the 2011-12 academic year, all ELA teachers in middle schools across the district were encouraged to use Google Docs to support student writing, but not required to. The study consists of a teacher population (N=25) of all females (100%) in which a majority are white (92%), in their 30s (43%), and hold Master’s degrees or higher (82%). They were mostly experienced teachers (teaching for 20 years or more: 36%, 11-20 years: 32%, 6-10 years: 24%), with only a few novice teachers who taught less than 2 years (4%). According to survey data, a majority of teachers and students in the district indicated confidence in using technology in the classroom (i.e., 60% of teachers and 59% of students rated their ability as advanced or expert).

ELA teachers were observed to utilize Google Docs in diverse ways based on their instructional approach. In two middle schools, ELA teachers were found using Google Docs more frequently and effectively in their classes. Thus, these two schools were selected as our focal schools in this study. In their classrooms, teachers frequently used Google Docs as a classroom tool to encourage peer collaboration and feedback on diverse types of genres covered in the ELA curriculum. There were no specific rules or guidelines for using Google Docs in their instructions, but the teachers followed a writers’ workshop model similar to that developed by Calkins (1994; 2006). A typical
ELA classroom at the two middle schools begins with a short lesson that covers the day's topic. Students then work individually or in small groups to write using Google Docs, and at the end of the period they may share or present their work to others.

**Data Collection**

**Interviews.** A total of 16 participants – including teachers ($N = 8$), literacy coaches ($N = 2$), administrators ($N = 2$), and students ($N = 4$) – in the two focal schools were interviewed at the beginning and end of the 2011-2012 school year. Selection of the students by teachers was based on their extensiveness to represent diverse student experiences. The first interview was a face-to-face interview, whereas the second interview was conducted over the phone. Interviews averaged 15-20 minutes and were digitally recorded and later transcribed.

**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 2152 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 written throughout the course with the research team. During the 2011-2012 school year, we collected and analyzed writing samples on Google Docs ($N = 3,537$) from 257 students in one sixth grade teacher’s two ELA classrooms. The writing data includes the work of the four students we interviewed.

**Classroom Observation.** Observations were conducted in ELA classrooms 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**

Qualitative analysis of data occurred as an iterative process requiring several layers of coding and interpretation that followed a grounded approach (Glaser & Strauss, 1967; Saldana, 2009). The first stage involved the repeated reading of the multiple data sources, (Clarke, 2005, as cited in Saldana, 2009), which subsequently led to bottom-up coding and inductive analysis of interviews, survey data, and student writing on the server, as well as analytic memos recorded during the different stages of coding. This bottom-up grounded approach method was considered most effective in drawing emerging concepts from data, rather preconceives. During the first stage of coding, descriptive coding was used to understand the basic topics of data by summarizing the topic in a word or short phrase, and the initial coding method was also used with an open-ended approach to explore data (Charmaz, 2006; Saldana, 2009). When appropriate, we also used the in-vivo codes (e.g., “respectful writing community” from a teacher’s interview response) and versus codes (e.g., peer vs. teacher feedback). During the second cycle of coding, the axial coding method was used to identify recurrent themes and patterns of the initial codes, making connections among categories that are relevant to the perceived challenges and benefits of integrating Google Docs in writing instruction. The last stage, theoretical coding, also known as selective coding, resulted in setting the salient themes that appear to have the “greatest explanatory relevance” for the phenomenon (Corbin & Straus, 2008 as cited in Saldana, 2009): technology integration factors in K-12 settings, in this case.
From cross-referencing multiple data sources, including interviews, classroom observation, and writing samples, a list of themes and subthemes regarding the key factors of technology integration emerged: key barriers and accompanying opportunities (i.e., access and workability, cost and practicality, affordances for writing), and contextual factors of Google Docs implementation (i.e., district’s focus on instructional goal, professional development). Descriptive analysis of survey data and students’ feedback patterns (Author et al., 2014) as well as examples of students’ writing on Google Docs were also used to support the themes for triangulation purposes, particularly in discussing affordances for writing.

**Findings**

**Access and Workability**

Students in the Littleton District enjoy a good deal of access to computers, reporting that they have an average of 3.2 computers in their homes, with a majority having five or more computers, whereas only 1.3% of the students have no access to a computer at home, according to our survey data. This percentage without a computer is substantially lower than the national average of 17.8 % students with no access to computer at home (Madden et al., 2013). Our study did not investigate any possible causal factors between the presence of computers in school and their widespread availability at home.

As students’ access to computers and the Internet has almost reached saturation rates both at school and at home in the Littleton district, it is not so much the access or availability of computers (Karagiorgi, 2005), but the “access to workload” that creates the differences in learning, as one teacher commented. The use of cloud-based technology in
the context of a laptop program reduces the restriction of time and space, thus allowing students and teachers increased access to collaborative writing tools through the process of simultaneous writing and editing from distinct locations. All students in grades 4-12 in the Littleton District have a Google account, which gives them access to working documents, file storage, and email tools through the web. Students use other Google products, such as Google Sites, to help create “a very transparent classroom, a very accessible classroom that's open 24/7 for help and assistance,” as another teacher stated. According to the survey data, students use Google Docs (ratio of school to home use of 3.5:2.5 times per week), 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 Maps (0.75:0.86).

Survey also exhibits that students used Google Docs for a variety of purposes (see Figure 1). Except for in-class activities, such as taking notes or filling in templates, students were engaged in similar writing activities both at home and at school. Revising/editing and writing drafts as a single author were the two most common activities both at school and home, followed by drafting with peers and making presentation slides. Interestingly, students spent more time revising on Google Docs compared to the time spent in drafting single-authored documents, which suggests an iterative writing process that has long been associated with good writing (Flower, 1979) but has been hard to integrate in schools. However, our data does not explain the causal factors of the increased revision activities.

--Insert Figure 1 here--
Teachers and students felt that the improved access to and flow of the workload with Google Apps made their learning process more convenient. As one teacher explained, “Before Google Docs, they had to do it all on hard copy or get into a computer lab and switch computers,” but now that the hassle has been eliminated, students are more focused on their learning instead of spending time making copies or carrying around USBs. One teacher emphasized that one of the dominant strengths of Google Docs is its simple and convenient interface for middle school students even with a low or average level of technology proficiency to understand and use. This aligns with what Zhao et al. (2003) termed “easy access (p.157).” Differentiating “access” from “easy access,” the authors emphasized that even though access has increased due to the prevalence of computers in schools, easy access is not guaranteed to students and teachers when logistical and environmental considerations limit the use of instructional technology (e.g., scheduling lab time in advance, spending time troubleshooting).

Due to the simplicity of the tool, both students and teachers did not have to undergo the initiative fatigue of learning and familiarizing technology tools that typically follows initial technology implementation (e.g., Olmanson & Abrams, 2013). One literacy coach explained how the simplicity and ease-of-use of the tool may ultimately affect student writing, commenting that “we’re utilizing a device that takes away or at least minimizes the impediments to writing and allows the student to actually write.” A district official stressed the impact of easy access on teachers’ beliefs and attitudes toward instructional technology, pronouncing that “after a district-wide implementation of the Google Apps, teachers and administrators are starting to see the potential of the tool,” particularly in terms of increased workability. For teachers, achieving more in less
time and with less effort provides a significant incentive to connect to technology. The simplicity of Google Docs and its few technological glitches increases workability as it saves significant time for teachers who often find the use of new technologies doubling their workload, because back-up lessons and materials are often additionally prepared in the case of the network malfunctioning (Author et al., 2004). This helps teachers move beyond performativity in technology use, which refers to teachers’ tendency to focus on mastery of complicated hardware or software functions without paying due attention to larger issues of knowledge construction and purposeful learning (Lankshear & Knobel, 2003, as cited in Author et al., 2004). Instead of focusing on the completion of technology tasks as an end in itself, teachers at this district were able to attend to their relevant learning goal, which was to improve student writing.

**Cost and Practicality**

The Littleton district had a dedicated team of administrators and principals who searched for a low-support means to minimize costs while targeting their learning goals. They believed that Google Apps for Education, especially its cloud-based collaborative writing tool, Google Docs, to be both cost-effective and educationally valuable. One district official explained, “instead of depending on too many software titles, we've adopted a cloud mentality, which means we don't have to do much to maintain the devices.” The freely available cloud computing resources from Google Apps (e.g., Gmail, Google Calendar, Google Talk, Google Docs, Google Sites, Google Video) significantly saved the district the cost of a more traditional file system, storage server, and email maintenance. Cloud computing offers IT departments a flexible way to increase capacity or add additional capabilities when necessary, without investing in new and expensive
hardware or software infrastructure, training new personnel, or licensing more software (Thomas, 2011). As the cloud computing infrastructure resides in a large data center and is managed by a third party (i.e., cloud service provider), computing resources are provided as if it were a utility.

According to district officials interviewed, the use of Google Apps resulted in saving the district an excess of $100,000 on server replacement costs. In addition, the simplicity of Google Apps in its ability to be functional on any computer lessened the amount of technical support required from computer staff, because teachers or students were able to handle some of the technical issues. Furthermore, shifting responsibility to external providers for managing some aspects of their software and hardware infrastructures also resulted in cost savings with relation to labor, as fewer IT services staff will be needed than before. As of July 2013, only three computer support technicians service the district’s 22 schools, which is a substantial decrease in the number of computer-support technicians in comparison to the school years the district utilized alternative programs instead. Before the district-wide adoption of Google Docs, the district possessed 5,000 computers; after implementation of the cloud-based tool, they currently retain 8,400 netbooks with almost no net increase in technological labor or support. As the district’s Chief Information Officer explained to us, “The convergence of netbooks and Google has enabled the teachers and students to do more with less.” Given that technical support has long been a major component of school technology expenditures, as well as a major source of educational technology problems (see, e.g., Author et al., 2004), cloud-based solutions that may significantly minimize the burdens of technical support can correspondingly improve the value of technology use.
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Affordances for Writing

The third area of challenge that the district met was whether the district’s instructional goal of improving student writing was realized in the ELA classes that integrated Google Docs. While the quantitative analysis of students’ writing patterns and outcomes (Author et al., in press) are detailed elsewhere, this paper highlights student and teacher perceptions of using Google Docs as a classroom tool in writing instruction. Even before the introduction of Google Docs in the middle schools, peer collaboration was already a part of the curriculum in the school district and students were encouraged to exchange feedback on each other’s drafts. However, we found that Google Docs provides a favorable environment for the kind of collaboration school districts seek because of its inherent characteristic of supporting sharing and peer editing. Our analysis of students’ and teachers’ open-ended survey data and interview data suggested several benefits and challenges of using Google Docs in writing instruction.

Supportive writing community. Our analysis revealed that teachers and students perceive Google Docs as a shared online space with a strong sense of community and audience. One of the major contributing factors may be the frequent feedback from peers and teachers that are uniquely available in the technology-enhanced collaborative writing environment. Utilizing the commenting and chatting features on Google Docs, students are able to read, revise, discuss, and critique each other’s work as they develop the effective collaboration and communication skills in the process. In our sample, statistical analysis of 3,537 documents written by 257 students revealed that an average of 1 or 2 co-authors and a maximum of 6 co-authors collaborated on each document in Google Docs for editing and revision (Author et al., in press). Document analysis of students’
writing on Google Docs revealed that both teachers and students actively engaged in a variety of feedback types, ranging from direct, commentary, highlighted, affective, and evaluative feedback (for details, see Author et al., in press).

Students frequently sought scaffolding support from peers and teachers to aid them in their flawed areas of writing, as the following students’ comments illustrate: “With this program, people can help me with my writing. When I share with a friend, they give me constructive feedback,” and, “so if you have question[s] you can ask and they can help you understand what is wrong in your paper.” Students consider both peers and teachers to be valuable readers of their writing who offer them constructive feedback.

Figure 2 shows collaborative communications between one author and her peer reviewer, where the main author seeks suggestions and help in creating a title. Additionally, the conversation also involves both critique and encouragement from the peer followed by the main author’s own effort to improve the title and the peer’s affirmation.

---Insert Figure 2---

Stressing the value of peer feedback for developing a sense of community, one teacher commented on a unique feature of Google Docs, which allows students to select readers the student recognize and are comfortable with for sharing. This is unlike other online sharing tools that are typically open to a broader group of anonymous readers.

“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 comment 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 their online writing space.

Agency and authorship. In collaborative writing with Google Docs, one notable pattern in sharing is the writer’s level of control over their documents. For example, Google Docs offers writers a restricting feature of their documents to particular readers, which allows writers to possess and ensure personal control over their writing. The theme of control over the document ownership is evident in the following excerpts of interviews with students: “It's also really helpful that I can make them able to comment, edit, or view, so I still have control over my document;” “I like how you can share with as many people as you want of your choice.” Teachers also make efforts to promote students’ authorship by encouraging students to make their own decisions as an author; as one teacher explained to us: “I tell them somebody could give you a suggestion but you don't have to take it. You can decide; it's your piece of writing.”

An increased sense of ownership of their documents may help students navigate between incorporating peer feedback and maintaining their own ideas, which is an essential skill in collaborative writing. Given that peer feedback has been criticized for taking the ownership of writing from students, making them uncritical recipients of feedback (Dippold, 2009), students’ enhanced sense of text ownership in Google Docs appears to be an important aspect in document sharing practices.

Accountability in collaboration. The revision history feature of Google Docs automatically record the time, date, and content of each entry into the document. In group-based projects, it can provide unique support for managing and organizing tasks,
since it contributes to each student’s accountability by ensuring students’ fair participation. One teacher said “this is the first time I’ve ever had a genuine collaborative project since it’s always been somebody who does a project and a couple other kids who gets the credit.” Managing group tasks with responsibility and accountability is defined as an essential life and career skill by the Partnership for 21st century (2004). Although accountability is an important prerequisite for successful cooperative group work (Rogers & Finlayson, 2004), how a teacher structures, organizes, and manages group accountability in relation to technology use has been difficult to examine (Nath & Ross, 2001; Hew & Brush, 2007). The difficulty of teaching student accountability and responsibility in group tasks due to its abstract and vague concept directed the study towards solely on teachers’ and peers’ subjective impression. However, with Google Docs featuring records of feedback histories and consequent follow-ups, teachers can use revision histories not only as evidence of group participation, but also as rich sources of performance assessment.

**Advantages in writing practice and instruction.** According to survey data, students and teachers preferred writing in Google Docs to writing in other formats, such as word-processing software or paper, and found particular advantages with using Google Docs in the areas of organization, revising/editing, and feedback (see Figure 3). For both teachers and students, the preference for Google Docs was stronger when the point of reference was writing papers. Overall, teachers perceived the benefits more strongly than students in all areas, and students’ preference for Google Docs over paper was particularly strong when it came to the potential to produce higher quality drafts.

---Insert Figure 3 here---
The potential benefits of Google Docs for improving writing were also perceived by teachers and students, particularly in regards to its collaborative nature through features such as sharing, working with multiple authors, and getting feedback (see Figure 4). Specifically, teachers felt strongly that the sharing features of Google Docs can increase students’ motivation, though for students, the benefits were not felt as strongly. Both teachers and students agreed that feedback activities help improve writing skills, with teachers recognizing these benefits more strongly. Both students and teachers didn’t perceive benefits for having multiple coauthors as strongly as they did having students author independently but share their work and get peer feedback.

—Insert Figure 4 here—

Since cloud-based technology enables students and teachers to simultaneously access the same document, teachers easily employ demonstrative techniques in writing instructions, such as color-coding or modeling, to help students focus on revision processes. Compared to traditional tools, the digital version of annotating and highlighting in a Google Docs environment was perceived by teachers and students to be more beneficial as it is more convenient, fast, and encourages interactions among peers. Through an explicit instruction on revision skills, teachers made efforts to help students learn meaning-based revision skills that focus on organization or content, as well as the surface-level revision skills associated with editing grammar or spelling, as the following teacher comment suggests:

They’re increasing their revision skills, in the area of the content and organization and checking each other and talking to each other about what are their ideas that as a reader, they get the idea that the other student is trying to get across. I see
comments like that coming through. Also, in an area of craft and style, they try to help each other craft their sentences and their paragraphs and their form of their writing. I see more comments on that than I used to teach without Google Docs.

Previous studies on online collaborative writing environments indicate that peer discussion allows students to engage in higher-level concepts, such as an awareness of their audience and a broad focus on argument and structure (Hirvela, 1999; Elola & Oskoz, 2010). In the following example shown in Figure 5, two students apply a color-coding technique to the organizational components of the main author’s text and ask the teacher to clarify their confusion. This type of threaded discussions often allow students to “write one's way into understanding,” offering opportunities for self-reflection and sense-making (Lapadat, 2002, as cited in Rice, 2006).

—Insert Figure 5 here—

**Increased productivity in writing.** For students, the use of Google Docs allowed them more time to produce writing. One teacher commented, “I think what we are hearing from our classroom teachers is for the first time in a long time: the kids are excited to write and are producing more work that is quality work.” According to one teacher, previous projects that took teachers two to three weeks to get back to students now only consumed a quarter of the preceding time due to the ease of providing feedback made available by Google Docs. Compared to non-computer-mediated environments, where more time and consequent cost is invested in administering the redistribution of student work and the provision of feedback (Author, 2006), the use of cloud technology considerably sped up the feedback, revision, and communication process between the writer and multiple readers.
Quantitative analysis of student writing in Google Docs revealed that students engage productively in response to a collaborative revision process, with an average of 248 words produced in the first session, 429 words in the last session of edit, and 118 words added at each iteration of feedback session, producing an average of 13.76 documents per student and 67.84 edits per document during the 2011-2012 school year (Author et al., in press). The amount of writing done with this collaborative tool far surpasses that of previous research drawn from a national survey on typical middle and high school students’ in-class writing practices (Applebee & Langer, 2011), with more than 50% of students producing a page or less during a nine-week grading period.

*Over-reliance on technology.* While students and teachers generally acknowledged the value of Google Docs as a supportive community, there were also concerns regarding students’ over-reliance on technology. One teacher voiced such concern: “It's easier for them to do things electronically, but the downside to that for me is they rely on the computer to fix errors rather than learning about their errors. They just assume the computer will do the revision.” As the teacher’s comment states, an important caveat is that if students rely too much on technology (e.g., automatic spelling correction) or peers (e.g., request for revision, plagiarism), the practices of technology-mediated collaborative writing might negatively influence their writing skills or ultimately hamper adequate learning of content in the long term. As the following student survey excerpts reveal, some students think of peer feedback as an ultimate solution to their problem, rather than an aid in helping them to further refine their own writing skills. For example, one student wrote: “I like how you can type your story on the computer and be able to
share it and have someone revise it,” and another, “You can get templates of it instead of building your own.”

Such problems have been pointed out by earlier studies on peer feedback. These concerns mainly correspond to students with insufficient writing ability who has difficulty “self-monitoring just what their writing problems are,” and lack “access to techniques and methods for overcoming them” (Pea & Kurland, 1987, p. 295). Also, struggling writers may not be able to respond to peer feedback appropriately, consequently leading an unimproved product when editing their peers’ papers. In other words, if students engage in the peer-review process “without the necessary cognitive, metacognitive, and social understanding to make appropriate changes,” the potential benefits of collaborative writing and its accompanying feedback and revision might not help students who lack sufficient writing proficiencies (Myhill & Jones, 2007, p. 325). This complication suggests the need to take students’ diverse abilities and proficiencies into consideration during peer feedback and revision practices, and also to teach students specific feedback strategies to help overcome an over-reliant tendency on technology.

**Unease with collaborative technology.** In addition, the simultaneous collaborative writing platform was unsuitable for some students. Some students preferred working individually or expressed discomfort about sharing their writing. As one student commented, “I don't enjoy the thought of people watching me write my document.” Another noted, “I think that it is a challenge to make changes or edits when writing a document at the same time.” Some students felt uncomfortable and distracted about the simultaneous editing function of Google Docs. Similar concerns have been raised by previous research, which suggest that students are reluctant to have their unfinished work
be seen by others (Parker & Chao, 2007), and to edit others’ work due to their concerns regarding their inexpert editing, which could potentially offend the writer’s feelings (Lund, 2008).

These sentiments could be amplified when using Google Docs, because once a document has been shared with teachers or peers, those collaborators will have constant access to it. In Kessler’s (2009) study on English learners’ collaborative academic writing in Google Docs, students were more willing to edit their peers’ work than their own, but the peer edits were found to be focused more on form rather than content because students felt that they lacked the authority to change the content of the original document. Similarly, most of the feedback observed in our sample was related to mechanics and grammar (66.9%) rather than on higher-level aspects of writing, such as content (13.7%) and organization (9.6%) (for details, see Author et al., in press). However, the suggested relationship between students’ discomfort and their editing tendencies is not explicitly proven by our interview data.

Some students and teachers also perceived challenges regarding the technological aspects of Google Apps. Examples include the environment’s technological glitches (e.g., errors in printing or copying) or limited technological affordances (e.g., formatting or importing features), as well as the need for additional features (e.g., integration with learning management systems).

**Implementation Factors in the Cloud-based Writing Instruction**

Whether the learning opportunities made available by instructional technology truly led to benefits will ultimately “be determined by the nature of the users and the circumstances of use, rather than directly by the attributes of the medium” (Pennington,
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1991, p. 267). Based on our bottom-up analysis of interviews, surveys, and observations, we found salient contextual factors that facilitated the integration of Google Docs: district priorities to establish clear curricular goals and supporting teachers through a variety of professional development opportunities.

**District’s focus on curricular goals.** The Littleton district spent a great deal of time considering learning goals, as well as curriculum and pedagogy, before they planned the details of Google Docs implementation. For example, there had been a district-level effort to adjust the ELA curriculum to infuse 21st century learning skills before seeking ways to use technology to achieve that goal. Following the lead of the curriculum department that stressed writing as a mediator for enhancing general academic achievement, the district proposed strategic plans to achieve that goal through the use of Google Docs. Based on four years of experience and know-how gained from implementing a one-to-one laptop program, the district strategically transitioned into using Google Docs and gradually expanded the program throughout the district.

This was made possible through close collaboration between the districts’ curriculum and technology departments, including the staff who both agreed on the curriculum-first approach and searched for ways to assist and enhance students’ understanding of content through technology. One teacher explained that the use of Google Docs is part of a change to the curriculum of language arts due to the shifting focus of teachers using the cloud-based tool for promoting 21st century skills, such as collaboration, information literacy, and self-direction, which are stressed in the Common Core standards that the state adopted. Another teacher echoed how the district is purposefully using Google Docs as a medium to achieve its instructional goal of
improving 21st century skills, specifically through the aspect of collaborative writing.

Given that the curricular match is often a factor that demotivates teachers to use educational technology (Schifter, 2008), the district’s effort to integrate Google Docs into the curriculum is encouraging. Hutchison and Reinking’s (2011) national survey of literacy teachers similarly identified low levels of curricular integration as one of the strongest obstacles to technology integration. Emphasizing the distinction between shallow *technological integration* that conceptualizes the integration of technology as independent from the curriculum, and *curricular integration* that views ICTs as integral to the curriculum, the authors conclude that authentic and effective technology integration is only possible with the latter type, for which the Littleton district strives.

**Professional development.** In the Littleton district, teachers as well as the literacy coaches and the technical support team frequently collaborate and discuss their common goals. Teachers typically participate in a week-long training session on specific techniques for using technology during the summer before the beginning of the school year, and methods for integrating technology into instruction before a major tool such as laptops or Google Apps for Education was introduced. According to interviews, many teachers actively engage in district-wide discussions on blogs. Survey data found that teachers use Google Docs on an average of about 2.5 hours per week to collaborate with other teachers. There are also district-wide collaborative, spontaneous, self-forming teacher groups that work together more intensively to share and implement ideas, such as the “Google Gals,” a group of middle school teachers from several schools in the district. A district literacy coach describes the collaborative process in professional development as building “a symbiotic relationship” through which the instructional team “helps
teachers with their classroom management and vision while the teachers help them learn what works” in turn.

Such collaboration tends to be interdisciplinary, as teachers from different subject areas share ideas to expand certain activities across the curriculum. Schools do not typically have a distinct technology teacher to solely offer technological assistance. Instead, each school tries to “embed technology throughout the entire system” by supporting and training teachers to integrate technology to leverage content, as one technical staff member commented. A district official further explains that the focus of formal and informal training opportunities is “training the tool within the curriculum” instead of “training the tool itself,” as many teacher training programs might mistakenly do. He emphasized that teachers are encouraged to unpack their curricular goals and subsequently tie them to the features of the technology through co-teaching and modeling practices. This type of professional development approach – which integrates technological, pedagogical, and content knowledge – was witnessed in an earlier study of the district’s laptop and writing initiative program (Author et al., 2010).

One teacher discussed how the liberation from technical support promoted feelings of empowerment; she emphasized she possesses “professional freedom” to try new things in her classroom while considering “not only how to use her training and knowledge with her students, but also how to work with other teachers in schools so that they can try new things with kids.” Teachers’ feelings of empowerment and diminished need for support are important indicators to determine the degree of effectiveness in the integration of instructional technology, as suggested in previous research (e.g., Zhao et al., 2002).
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Discussion and Conclusion

Our case study that attempted to identify the particularities of using cloud computing within K-12 settings suggests that, indeed, Google Docs was effective as an integrative learning tool for both teachers and students. Our study provides some preliminary evidence that the introduction of cloud-based tools was perceived by students, teachers, and district officials to make technology use more accessible and convenient, to enhance cost-efficiency and productivity, and, most importantly, to provide ample affordances for writing practice and instruction. The district-wide implementation of Google Docs provided broad, accessible, and affordable simultaneous access to students and teachers, while increasing the opportunities to improve writing skills through features such as feedback, revision history, and reader selection. We also identified key contextual factors including the district’s focus on curricular integration and professional development that contributed to the favorable outcomes.

This study confirms the critical role of “easy access” as a key driving force for technology integration in K-12 settings (Zhao et al., 2003, p.157) and reflects how district-wide use of cloud-based computing assist students and teachers move beyond performativity to workability. A recent survey by the National Center for Education Statistics (NCES) indicated that 97% of all teachers have computers in their classrooms (Gray, Thomas, & Lewis, 2010). Despite such widespread access to technology in K-12 contexts, recent statistics illustrates that only 40% of K-12 teachers reported using computers frequently in the classroom, and over 60% of those who use technology indicated a primary reliance on presentation software for administrative tasks and for class preparation and instruction. Only 9% of teachers reported using more innovative
Web 2.0 technologies such as blogs and wikis. Even with a well-designed online writing program, teachers were less likely to use technology in instruction when “access to the physical machinery was heavily structured, guarded, or restricted” or when teachers were confronted with frequent technical glitches and difficulties in familiarizing themselves and their students with complex program features (Olmanson & Abrams, 2013, p. 361). The simplicity and ease-of-use that Google Docs offers to teachers and students has been echoed in another study on community college students’ adoption of cloud computing (Behrend et al., 2011). This study indicates that the ease-of-use perception was a much stronger predictor of adopting cloud-based computing than the usefulness perception. In other words, students were reluctant to invest the time needed to learn a new tool even if it is a useful one. In the K-12 district we observed, Google Docs was perceived as an accessible and usable alternative, which helps teachers and students focus more on core curricular issues in writing instruction, rather than on complex IT implementation.

Next, although an exact cost-benefit analysis or evaluation was beyond the scope of this study, our survey and interview data suggests that the use of Google Docs was perceived as helping the district meet the challenge of reducing IT budgets and costs for implementation and maintenance. Whether technology is achieving better results at lower costs is an important criterion for evaluating the value of instructional technology (Noeth & Volkov, 2004), and increasingly so when given the mounting pressure to reduce costs in educational institutions (Thomas, 2011). It is noteworthy that the district took the initiative to look for a low-support means that both minimizes costs and achieve their educational goals. Such an initiative is widely explored in higher education and professional settings, where a reduction of overall IT costs was found to be the main
driving force behind the adoption of cloud computing (Chandra, 2012). Cloud computing is found to relieve higher education institutions from the burden of handling the complex IT infrastructure management, as well as maintenance activities, and significantly decrease costs (Chandra & Borah, 2012; Micrea & Andreescu, 2011). In K-12 settings, adopting cloud-based system throughout the district ought to involve careful planning and strategies, not only in terms of financing, but also in the aspects of curricular integration. District-wide adoption should also involve high levels of consensus among different stakeholders, including parents and members from the curriculum, technology, and instruction departments.

Most importantly, the perceived affordances and challenges of Google Docs for writing instruction have a significant implication. In a post-industrialist knowledge economy and network society, skills of communication, collaboration, and horizontal networking play a prominent role. K-12 educators are increasingly attempting to integrate technology to teach these essential skills. Cloud-based tools, such as Google Docs, appear to have particularly advantageous interfaces, in that they incorporate office tools for professional writing and research (e.g., word processor, spreadsheet) as well as sophisticated functions for collaboration (synchronous and asynchronous multi-author editing, commenting, etc.). In theory, they provide a more potent option for integrating academic writing and research skills with new forms of 21st century literacy than other tools such as word processing software or chat rooms which promote one side of this duality over the other. As revealed in this study, Google Docs, when integrated into a solid curricular context, can help enhance peer interaction and group work, facilitate sharing and distributing knowledge and information within a supportive community, as
well as help students with collaborative authorship to write more productively.

Writing practices using Google Docs appears to hold the potential to enhance technology-based collaboration skills, for example, by encouraging writers to redefine the idea of authorship, pushing writers to move beyond “author-centric perspectives of textual ownership” (Hunter, 2011, p. 40) in an attempt to build a successful collaboration with multiple authors. However, issues of over-reliance on technology or students’ reluctance toward collaboration, as revealed in this study, need to be addressed through specific instruction on collaborative processes and strategies, which include problem identification to elaborate revision and metacognitive reflection (e.g., Cope et al., 2011).

In order to engage students in meaningful collaboration, teachers should inform students of the shared goals and benefits of collaborative writing, which correspond to district standards and classroom objectives, and provide optional training in peer feedback and collaboration strategies.

This study reinforces the concept of the sociotechnical network, which consists of the intertwined relationships among technologies, people, and organizations (Kling, 1999). As Melvin Kranzberg (1986) argued, “technology is neither good, nor bad; nor is it neutral.” (p.545) Kranzberg’s point was that technology has neither a positive nor a negative deterministic impact; rather, its structure helps to shape human experience. Educational software and online environments can thus be considered according to how they are shaped by the social interests and motivations of their users (Buckingham, 2007).

The district introduced Google Docs not as a turn-key solution, but rather as part of a lengthy and serious effort to reform and improve curricula, pedagogy, and
instruction. The stages of technology integration appeared to be a critical factor in understanding the implementation context of Littleton district (e.g., Sandholtz & Reilly, 2004). Based on four years of experiences and know-how gained from implementing the laptop program and modifying it at different stages of technology (i.e., entry, adoption, adaptation, appropriation, invention; for details, see Sandholtz et al., 1997), the district strategically altered its methods to integrate cloud technology into instruction. The district had successfully implemented laptop programs for a period of four years before adopting these cloud-based tools. District leaders focused on a targeted learning goal, made efforts to empower and support teachers through professional development, and facilitated collaboration among multiple stakeholders, all with substantial success (see, e.g., Author et al., 2010; Author, 2011). The district’s continued efforts to create a shared vision and to encourage collegiality and collaboration appear to act as a sustaining force for technology integration, as previous research suggested (e.g., Hsu & Sharma, 2008).

Finally, we acknowledge that this exemplary history of technology use in Littleton, as well as the socioeconomic context of the district, may mean it is difficult to generalize from this case. The poverty rate in Littleton approximately matches that of the state of Colorado, and the district has done an outstanding job of integrating technology in its one school dedicated to instruction of English language learners. However, overall, the district does not have high percentages of low-income students, underrepresented minorities, or English language learners. Rather, the school district is in a well-to-do community, technologically-rich, and highly successful. Integration of any technology in low-income districts is typically more challenging (see, e.g., Author, 2011), and we suspect that could be the case with cloud-based tools as well. In contrast, certain
affordances of cloud-based tools, such as their low cost and comparable ease of access, appear to be particularly well-suited for low-SES learners and their schools (Hohlfeld et al., 2008).

Though particularities of context need to be taken into account, the case study nevertheless reveals a cloud-based environment’s salient affordances for learning in the district-wide implementation context. Future research investigating how the tool can be embedded in different social and educational contexts—with different levels of student competency, economic backgrounds, and district cultures—will provide benchmarks for educators and researchers engaged in serious educational reform through the use of technology.
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Figure 1. Students’ use of Google Docs at home and school (times per week)

Figure 2. Peer feedback example: Conversation around title development
Figure 3. Perceived benefits of using Google Docs over paper or word processing software (scale: 0 strongly disagree, 1 disagree, 2 neutral, 3 agree, 4 strongly agree)

Figure 4. Specific advantages of using Google Docs in writing improvement and motivation software (scale: 0 strongly disagree, 1 disagree, 2 neutral, 3 agree, 4 strongly agree)
Figure 5. Author, peer, and teacher Engaging in conversation on color-coding technique for identifying organizational structure