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# Supporting Teachers in Integrating Digital Technology Into Language Arts Instruction to Promote Literacy

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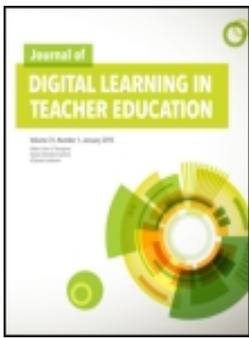
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## **Comments**

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## Abstract

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*A systematic review of relevant literature was conducted to provide a source of information and practical guidelines for teachers and teacher educators to consider instructional methods for using digital tools in elementary language arts classrooms to promote literacy. Focal studies are highlighted to provide rich descriptions of practical uses and considerations of integrating digital tools into literacy instruction. The following nine digital tools are discussed to provide methods, affordances, and potential obstacles to their use: (a) wikis, (b) digital video production tools, (c) blog/online threaded discussion, (d) iPad apps, (e) digital games, (f) Kindle e-reader, (g) podcasts, (h) digital cartoon creator, and (i) e-mail. Barriers from the research for each tool are also discussed to provide a comprehensive resource for teachers and teacher educators.*

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**D**igital technologies can support literacy instruction in many ways (Doering, Beach, & O'Brien, 2007; Hutchison & Woodward, 2013). For example, digital tools, such as e-readers, may be used to promote and enhance more traditional reading skills, while technologies such as wikis create platforms to support production and online sharing, collaboration, and writing skills in language arts. These literacy skills are important and relevant to appropriately preparing students to succeed in today's technological world (Leu, Kinzer, Coiro, & Cammack, 2004), but teachers often cite a lack of time or

preparedness to use digital tools in literacy instruction as obstacles (Hutchison & Reinking, 2010). Thus, it is critical to consider how we can support teachers in literacy instruction that effectively and seamlessly incorporates digital tools.

Researchers and teachers have been collaborating for several years to learn about effective uses of digital technology in the literacy instruction in elementary language arts classrooms. Findings from these collaborations have resulted in a significant body of research that may inform teacher education and provide research-based approaches for teachers to consider digital tools in language arts instruction. We believe that there is much to learn from the collective body of knowledge that has been produced as researchers have studied how elementary teachers integrate digital technologies into their literacy instruction. Therefore, the purpose of this article is to provide teachers, both those preparing for the classroom and those currently in the field, and teacher educators with practical guidelines to integrating digital tools into elementary classrooms, using a review of studies that have been conducted on integrating digital technology into elementary literacy instruction.

### Background and Theoretical Framework

Digital technology changes how readers and writers interact with text and the skills that they need to engage with new forms of text (Coiro, Knobel, Lankshear, & Leu 2008; Kress, 2003; Lankshear & Knobel, 2007). Kress (2003) argues that the printed page is no longer the dominant form of communication and that we must understand what it means to read and write multimodally, as digital tools (e.g., blogs, wikis, iPads, etc.) make it easier, and therefore more common, to communicate with color, sound, image,

and video. Similarly, Lankshear and Knobel (2007) argue that digital tools create new literacies, such as engaging in fan fiction, microblogging, sharing and contributing to memes, and remixing cultural artifacts, by providing opportunities to engage with various textual forms with new intents and purposes. Related still, Leu and colleagues (2004) describe the new skills, strategies, and dispositions needed for online reading comprehension.

These changes and possibilities created by digital technology have now been recognized to the extent that expectations about uses of digital technology have been integrated into the Common Core English Language Arts Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Indeed, Dalton (2012) recently noted, "The standards assume that being literate means being *digitally* literate" (p. 333). Although the Common Core English Language Arts Standards mandate the use of digital technology in the English Language Arts curriculum, no information is provided about how to accomplish that goal. Despite over a decade of study, we lack a comprehensive understanding of the types of learning afforded by various digital tools (Beach, 2012), and likewise, how those tools might constrain classroom instruction.

Further, digital tools may both constrain and support literacy instruction (Mishra & Koehler, 2006), and these aspects of using digital tools should be studied to provide teachers and teacher educators a useful starting point to consider the implementation of digital tools and technology in elementary classrooms. Scattered studies

have reported on the value of individual digital tools, but there has been no source of guidelines offered from the research that may support researchers', teacher educators', and teachers' efforts to integrate digital tools into literacy instruction. In this article, we review literature on how digital technology has been successfully used in elementary literacy and language arts instruction to offer such guidelines, as well as lessons learned or special considerations for using the tools.

### The Review

We specifically wanted to report on articles that focused on literacy and language arts instruction and on specific uses of various digital tools, rather than, for example, articles that reported on general classroom implementation of laptops, strategies for searching for information online, or areas other than literacy and language arts. We also limited our contexts to K–5 classroom settings to encompass elementary grades and provide the most relevant review for classroom teachers. We then eliminated studies that used dated technology programs or used technology in a

perfunctory way, such as sending a traditional letter through e-mail, that teachers might be less inclined to use in classroom instruction. Using those parameters, we conducted a content analysis (Krippendorff, 2004) of published empirical articles to collectively describe how digital tools are being used in literacy instruction and analyze the trends, uses, and outcomes of employing these digital tools in elementary classrooms.

We used major search engines in education (ERIC, Education Research Complete, and Education Full Text) to retrieve articles. Because much research addressing the use of digital technology in literacy instruction typically falls within two broad categories, digital literacy or new literacies, we included both of these search terms for our initial database search. The search was also limited to articles published between 2000 and 2013 because we wanted to consider digital tools still relevant and being used in present-day classrooms. The result of this search yielded 491 studies. After excluding any studies focusing on higher education, out-of-school or after school programs, dated technological tools, literature reviews, commentary, grades 6–

12, and nonempirical research, we narrowed this pool considerably. We then considered the remaining studies and condensed our pool further to include only those studies that provided rich information regarding context, use, and results of using digital tools, because we aim to provide practical suggestions, grounded in research, for integrating digital tools into language arts instruction to promote literacy in elementary grades. Table 1 provides an overview of our final pool of studies.

In this way, our review is untraditional and should not be read as a resource of all studies focusing on using digital tools to promote literacy in language arts. Instead, we hope that this approach might provide in-depth content and descriptions for teachers to study when considering the integration of digital tools into language arts instruction to promote literacy.

### How Digital Tools Can Support Literacy Instruction

Our review resulted in providing a summative source of guidelines for the integration of digital tools in three areas of literacy and language arts instruction in

**Table 1.** Overview of Studies Described

Author(s)	Age/grade of students and setting	Digital tool used	Method
Andes and Clagett (2011)	Second-grade students receiving Title I instruction	Wiki	Qualitative
Bogard and McMackin (2012)	Third-grade classroom in New England	Digital video production tools	Qualitative; exploratory
Burnett, Dickinson, Myers, and Merchant (2006)	Fourth- and fifth-grade students in England	E-mail	Qualitative
Hansfield, Dean, and Cielocha (2009)	Fourth-grade self-contained bilingual classroom	Blog/online threaded discussion and digital cartoons (Comic Creator)	Qualitative
Hutchison, Beschoner, and Schmidt-Crawford (2012)	Fourth-grade classroom in the midwestern United States	iPads/apps	Qualitative
Owston, Wideman, Ronda, and Brown (2009)	Fourth-grade students in Ontario, Canada	Online games	Mixed methods
Larson (2009)	Fifth-grade classroom in the midwestern United States	Online message board/online threaded discussion	Qualitative
Larson (2010)	Second-grade classroom in the midwestern United States	Kindle e-reader	Qualitative; case study
Merchant (2005)	Children ages 9–10 in England	E-mail	Qualitative
Putman and Kingsley (2009)	Fifth-grade students	Podcasts	Quantitative; experimental
Vasinda and McLeod (2011)	Second- and third-grade students classified as struggling readers	Podcasts	Mixed methods

grades K–5: (a) supporting reading comprehension, (b) promoting discussion, and (c) encouraging collaborative learning. In this section we provide an overview of the uses and affordances supported by the nine digital tools that emerged from our review. We created these separate sections based on overarching purposes for uses of digital tools in the studies we reviewed, yet we recognize that these tools may easily fall into more than one of the sections and promote more literacies than are described in these sections. To provide a summative source of guidelines we present a table at the conclusion of this section, and after describing the successful use of the tools we reviewed, highlighting the affordances and considerations/constraints of the digital tools we reviewed to guide educators in considering how to successfully use digital tools to support literacy instruction (see Table 2, shown later).

### **Digital Tools to Support Reading Comprehension**

Multiple tools to support reading comprehension, such as iPads, e-readers, online games, and podcasts, were identified. These tools provide an array of approaches to digitally promote reading comprehension.

#### *iPads*

Hutchison, Beschoner, and Schmidt-Crawford (2012) collaborated with a fourth-grade teacher to integrate iPads into her curriculum. They studied how iPads apps could support literacy instruction through electronic books and apps that supported students' reading. Specifically, they reported on the following apps: (a) Popplet to help students learn how to sequence events; (b) Doodle Buddy to work on visualization and identifying the main idea and supporting details within a text; (c) Strip Designer to help students learn how to retell information; and (d) Sundry Notes to help students illustrate cause and effect relationships.

iPads encouraged students' creativity and independent learning because iPads apps offered opportunities that differed

from paper-based activities. For example, unlike worksheets, which often prescribe graphic organizer layouts and number of text boxes to complete, the Popplet app allowed students to consider their own sequencing of stories by shifting text boxes, adding new text boxes, and easily modifying text boxes. Students also learned how to manipulate the size and shape of the text boxes to highlight the importance of certain text or distinguish supporting-idea text. Further, the apps allowed students to visually represent and draw parts of text, which could then be projected to groups or the whole class and thus encouraged collaboration to achieve comprehension. Use of the apps also encouraged students to reread and revise as they worked to create a visually accurate portrayal of text. Finally, Hutchison and colleagues (2012) suggested that iPads encouraged a beginner's experience of nonlinear thinking, an important digital literacy skill, as students navigated hypertexts in iBooks to use the table of contents and dictionary features.

#### *E-Readers*

E-readers were also featured prominently as a digital tool to support reading comprehension. For example, Larson (2010) reported on how second-grade students read with a Kindle e-reader, making use of features such as adjusting the font size, listening to parts of the story by activating the text-to-speech feature, highlighting key passages or vocabulary, using the built-in dictionary, searching for keywords or phrases within the book, and adding annotations to the text in response to what they were reading.

Reading with a digital device afforded increased opportunities to engage with and manipulate text through the electronic tools and features offered by digital devices. This engagement can increase connections between the reader and the text and provide the reader greater control than when reading printed text. Larson (2009) also indicated that digital readers allowed teachers the opportunity to gain insights into students' reading behaviors and comprehension skills by examining the

responses students provided through the use of the Kindle tools. Finally, the use of Kindle tools supported students' abilities to independently decode unfamiliar or multisyllabic words with the help of the built-in dictionary and a larger font size.

#### *Online Games*

Online games were also reported to support reading comprehension. Owston, Wideman, Ronda, and Brown (2009) in particular reported on how fourth-grade students created questions related to the regions of Canada that were then transferred to an online game format for their peers to play. The game was cross-disciplinary and featured a fictional character traveling through the regions of Canada to support students' language arts and social studies skills. This study found that having students create high-level thinking questions can increase content retention, can promote higher engagement in activities related to comparing and contrasting information, and can encourage students to utilize more and different kinds of research materials. By creating digital games, students were forced to reflect on unit content and then repurpose it into a game format. This meant that the students had to have a strong understanding of the material and had to do extensive research when they needed more information or explanation. Additionally, creating games for an audience of peers meant that students were motivated to carefully construct their questions and check them for grammar and spelling mistakes.

#### *Podcasts*

Vasinda and McLeod's (2011) study aimed at increasing reading comprehension among third-grade students using podcasts. Students digitally recorded themselves each week reading a readers' theater script and then uploaded the script to a podcasting or blogging site. Producing these podcasts created an opportunity for students to self-evaluate their reading fluency, and to revise and improve their work. The permanency of the podcasts afforded opportunities for anytime learning and multiple exposures to content, yet the

**Table 2.** Types of Learning Supported by Digital Tools and Constraints of the Tools: A Guide to Practice

Tool	Types of learning supported by tool	Considerations/constraints for using the tool
Blog/online threaded discussion (Larson, 2009)	<ol style="list-style-type: none"> <li>1) Encouraged students to assume leadership roles.</li> <li>2) Students felt sense of responsibility to peers, responsibility to be careful writers, and held high expectations for peers.</li> <li>3) Provided equitable opportunities to share thoughts and voice opinions.</li> <li>4) Required students to learn new literacies skills.</li> <li>5) Provided opportunity to engage with text in new ways and improve attitudes about writing.</li> </ol>	<ol style="list-style-type: none"> <li>1) Teacher participation in online discussions is critical.</li> <li>2) Some students focused on format of posts rather than content.</li> <li>3) Some students preferred to talk rather than type and were hesitant to type lengthy responses.</li> </ol>
Digital cartoon creator (Hansfield, Dean, & Cielocha, 2009)	<ol style="list-style-type: none"> <li>1) Cartoons provided a visual aid and scaffold for students who struggled with linear and print text.</li> <li>2) Students were able to use multiple modes of communication to successfully engage in writing.</li> </ol>	<ol style="list-style-type: none"> <li>1) Some digital cartoon creators are extremely limited in their functions.</li> </ol>
Digital video production tools (Bogard & McMackin, 2012)	<ol style="list-style-type: none"> <li>1) Helped students see a relationship between image and text.</li> <li>2) Developed both traditional writing skills, such as developing voice and appropriate word choice, and new literacies.</li> <li>3) Required students to consider perspective since they were creating for a particular audience.</li> <li>4) Students perceived that work would be viewed by a real audience.</li> </ol>	<ol style="list-style-type: none"> <li>1) Teacher found it difficult to assess products created because of the non-traditional format.</li> <li>2) More instructional time was necessary to prepare students to use video technology.</li> </ol>
E-mail (Burnett, Dickinson, Myers, & Merchant, 2006; Merchant, 2005)	<ol style="list-style-type: none"> <li>1) This format motivated students to write and promoted the development of content-based writing and writing skills in general.</li> <li>2) The visual affordances of the screen (e.g., selecting font size and color and text format) enhanced students' abilities to construct their identities and meaning of text.</li> <li>3) Students became more aware of language choices.</li> <li>4) Students were able to draw on their out of school practices.</li> </ol>	<ol style="list-style-type: none"> <li>1) Limited keyboarding skills can act as a barrier.</li> <li>2) Some students became more concerned with the appearance of text than the content, using font and color to make the text visually appealing instead of meaningful.</li> </ol>
iPads/apps (Hutchison, Beschoner, & Schmidt-Crawford, 2012)	<ol style="list-style-type: none"> <li>1) Encouraged creativity and independent learning.</li> <li>2) Provided increased options for organizing and presenting responses to literature.</li> <li>3) Provided a simple way for students to represent their ideas visually.</li> <li>4) The ease with which work could be shared encouraged collaboration.</li> </ol>	<ol style="list-style-type: none"> <li>1) Students need time to become familiar with the touchscreen functions of the iPad and similar tablets.</li> <li>2) Many apps have only a singular function, thus it is important for teachers to know how to combine apps.</li> <li>3) Tablets require teachers to rethink how students will share and submit work.</li> <li>4) Many apps do not allow students to edit work once it has been saved.</li> </ol>
Kindle e-reader(Larson, 2010)	<ol style="list-style-type: none"> <li>1) Increased opportunities to engage with and manipulate text through the electronic tools and features.</li> <li>2) Affords the reader greater control.</li> <li>3) Affords teachers opportunity to gain insights into students' reading behaviors and comprehension skills by examining the responses students provide through the digital tools.</li> <li>4) Supports students' abilities to independently decode unfamiliar or multisyllabic words with the help of the built-in dictionary and a larger font size.</li> </ol>	<ol style="list-style-type: none"> <li>1) Book selection is narrower.</li> </ol>
Online games (Owston, Wideman, Ronda, & Brown, 2009)	<ol style="list-style-type: none"> <li>1) Game development served as a way to engage students in a broad range of literacy activities, such as questioning, reflection, and critical thinking.</li> <li>2) Provided opportunities to learn how to communicate using non-linguistic elements of text.</li> <li>3) Game development improved students' logical sentence construction.</li> <li>4) Due to the departure from traditional literacy activities, game development afforded a more equal relationship between the teachers and students.</li> </ol>	<ol style="list-style-type: none"> <li>1) Interaction and creativity with games was constrained by the unchangeable elements of the games that were developed by someone else.</li> </ol>
Podcasts (Putman & Kingsley, 2009; Vasinda & McLeod, 2011)	<ol style="list-style-type: none"> <li>1) Provided method for following up on class content.</li> <li>2) Provided multiple exposures to content without disrupting classroom instruction.</li> <li>3) Students perceived that they were performing for a broad, authentic audience.</li> <li>4) Increased achievement for vocabulary learning.</li> <li>5) Students were engaged and connected to out of school practices.</li> </ol>	<ol style="list-style-type: none"> <li>1) Required new way of organizing the physical environment and providing access to equipment.</li> <li>2) Rules and expectations for assignments had to be developed and negotiated because no routines for this type of activity existed.</li> </ol>

*(continued)*

Table 2. Continued

Tool	Types of learning supported by tool	Considerations/constraints for using the tool
Wiki (Andes & Clagett, 2011)	<ol style="list-style-type: none"> <li>1) Students put forth more effort and were more deliberate and thoughtful.</li> <li>2) Students were forced to develop deeper and less casual understandings of their vocabulary words when having to use and discuss those words on a wiki.</li> <li>3) Engaged students in collaboration and consideration of others' ideas.</li> <li>4) Helped students make gains in academic progress.</li> </ol>	<ol style="list-style-type: none"> <li>1) Some students were intimidated about writing and editing on a forum where other users could view their work.</li> <li>2) Students had to become acclimated to writing and editing on a wiki.</li> <li>3) Constant technology support was needed to support the wiki.</li> </ol>

podcasts were efficient and were not disruptive to the rhythm of the classroom. Additionally, students who recorded their readers' theater performances and posted them online recognized that they were performing for a wider audience, which added authenticity and expanded their audience outside of the classroom walls. Finally, the use of podcasts afforded increased achievement, as evidenced by higher comprehension scores for students who participated in the readers' theater podcasting project.

### **Digital Tools to Promote Discussion**

The literature indicated that blogs and online discussion boards provided a platform for students to engage in discussion about language arts while promoting multiple literacy skills such as analysis of text, writing, and reading traditional and digital texts.

#### **Blogs**

Hansfield and colleagues (2009) studied a fourth-grade teacher who engaged her students in blogging and found it a valuable tool because of the expectation of social interaction that the students associated with blogging. The teacher's goal was to encourage students to interact through their writing. The fourth graders blogged on a variety of topics for the primary purpose of interacting with each other about their writing. Prior to using a blog, the students wrote in a response binder and did not see each other's writing. Although the teacher responded in each student's binder, she reported that students tended to ignore her responses, moving on to their next entry without responding

back. However, once students began blogging, they asked questions of each other and responded to one another's questions. The teacher also reported that students became more careful writers. Students who previously did not proofread their writing soon began adding conventional punctuation. Perhaps the greatest benefit of blogging for the students was how they critically read their peers' posts. Students questioned each other's comments and held each other accountable for their assertions by asking for more information about claims that students made in their writing. Finally, blogging was also beneficial because it afforded opportunities for language development within authentic conversations, which can be particularly helpful for English language learners (ELLs).

#### **Discussion Boards**

Larson (2009) described how fifth graders created collaborative online communities when responding to literature through an online discussion board. The students all spent about 30 minutes reading a common book and responding to the book in personal e-journals. The students then spent 15–20 minutes posting a response to what they read on a class message board. In addition, students often accessed the message board at other times during the school day. Larson (2009) also reported that students increasingly took on leadership roles and monitored their own discussions in the online discussion space, and the teacher acted more as a facilitator than she did with other types of instruction. The students held high expectations of their classmates, asked for clarification of

vague prompts and replies, and offered compliments for interesting ideas and alternate points of view. They also reported feeling responsible to engage deeply with their work to share ideas with others and consider multiple perspectives. Interacting with peers in this environment seemed to serve as a form of positive peer pressure. Additionally, the asynchronous online format afforded students equitable opportunities to share their thoughts and express their opinions. Finally, engaging in the online discussions required students to learn, or continue learning, new literacy skills, such as site navigation, in order to participate.

### **Digital Tools to Encourage Collaborative Learning**

Two tools that may encourage collaborative learning are wikis and video production tools. Wikis encourage online collaborative learning, whereas production of videos may be particularly useful to promote face-to-face collaboration to support literacy learning in language arts.

#### **Wikis**

Andes and Clagett (2011) reported on using a class wiki page in a second-grade classroom, in conjunction with other digital resources (e.g., photo editing tools, PowerPoint, and electronic mail), as a space to share writing projects. Teachers developed monthly writing projects focused on improving written expression skills to motivate struggling students by providing them with authentic reasons to read and write. Students shared their work with electronic pen pals (e-pals) from South Africa, parents, and university students. The students

used many different digital tools for their writing projects, but the class wiki page acted as the site where they hosted all their work and collaborated with their e-pals in sharing writing products. Students participated in multiple types of writing activities to post on the wiki: (a) fictional story writing, (b) poetry writing, (c) biographical writing about someone they admired, (d) development of PowerPoint presentations to express ideas through color, sound, and images, (e) writing research reports about animals, and (f) documentation of virtual field trip experiences.

Several key factors made Andes and Clagett's (2011) project successful. Chief among these factors was that students wrote for a variety of authentic purposes and had an authentic audience through the wiki. The variety and authenticity of the assignments resulted in students being highly motivated to read and write because they were actively engaged in meaningful projects and communicated frequently with e-pals. As a result, students involved in the wiki project improved their literacy achievement more rapidly than did other second grade students not participating in the project, and their parents reported that they saw an increase in their student's enthusiasm for reading and writing.

#### *Digital Video Production Tools*

Digital video production may also promote collaborative learning along with writing. Bogard and McMackin (2012) used digital video with third graders to create digital personal narratives. Students followed a modified writing process that included the following steps: (a) planning for writing by mapping out key points using a graphic organizer that helped them to visualize the story; (b) using a Livescribe Pulse Smartpen to capture audio recordings and drawings that allowed the children to verbalize, elaborate, and revisit their developing stories; (c) replaying their recorded oral rehearsals and revising with a peer partner; (d) writing a draft of their story based on their recorded oral rehearsals; (e) creating a storyboard page for each frame of their digital story, which

included written narration for the frame and a list of media, such as a hand-drawn illustration or a photo; and (f) using iMovie to record their digital stories.

By telling their stories orally before drafting, students were able to easily revise their stories and avoid the anxiety some had experienced when beginning a piece of writing. Listening to their story ideas as they were read aloud helped students identify both extraneous details and where details should be added. Further, many students who had previously tried to avoid writing by drawing their ideas instead now shifted their focus to telling the story ideas rather than to the pictures. Students' vocabulary benefitted from recording themselves trying out new words so that they could hear them in the context of their story. Having a graphic organizer to accompany their stories also aided some children in the sequencing, revision, and elaboration of ideas. Overall, recorded oral rehearsal allowed students to formulate ideas, revisit their initial thinking, and make decisions without placing increased cognitive demands on working memory that writing text often requires.

#### **Conclusions and Considerations**

The research reviewed in this article considered multiple effective ways to use digital technology to support the literacy development of students across elementary grades. Broadly summarized, the use of digital technology supported literacy instruction and development in the following ways: (a) Students wrote for more authentic purposes; (b) inclusion of oral language activities using digital recording devices supported students' idea development and writing; (c) students had increased opportunities to interact and collaborate with peers, critically evaluate each others' work, and consider multiple perspectives; (d) students were encouraged to think about traditional content in new ways; and (e) digital tools provided insight into students' reading behaviors and comprehension.

These positive outcomes, stemming from the inclusion of digital technology, illustrate the value of integrating digital

tools into instruction and can perhaps serve as encouragement for teachers who want to integrate such tools but face barriers, such as lack of understanding about how to integrate technology into instruction or lack of professional development on integrating technology (Hutchison & Reinking, 2011). However, it is also imperative that teachers consider the ways that digital technology can both enhance and inhibit their instruction and make informed decisions about when and how to integrate digital technology, particularly as the many states have adopted the Common Core State Standards (CCSS), which promote the integration of digital technology into literacy instruction. We consider this review of literature important for teachers to consider and plan different uses of digital tools in elementary instruction. For example, one tool that may support literacy teachers in planning such instruction is the Technology Integration Planning Cycle for Literacy and Language Arts (Hutchison & Woodward, 2013). This cycle can inform teachers' instructional planning and assist them in ensuring that literacy remains at the forefront of instruction by providing a structured approach to considering lesson objectives, the usefulness of technology to support lesson objectives, and finding professional resources to support teachers in planning to use technology in instruction. The cycle also offers exit points in which teachers may elect not to use technology if the technology may hinder more than support instruction.

Further, although the studies reviewed provided mostly positive implications for using various digital tools to promote literacy in language arts, some barriers were noted that should be considered when planning instruction. For example, Andes and Clagett (2011) noted that technology support is vital when using wikis in instruction. In schools where technology support is limited, teachers should consider the functions and limitations of wikis and address how other types of digital technology might be used in conjunction with a wiki to support learning activities. Additional research would be beneficial

to examine best practices for utilizing multiple forms of technology to meet common objectives. Bogard and McMackin (2012) indicated the importance of instructional support when using digital video in that some class time should be devoted to showing students how to use the technology, and modeling may be useful for technology support, as well as for helping students develop personal narratives using video technology. Providing additional instructional time for teaching students to use digital tools, such as podcasts, also allows students to become more independent and to require less assistance from the teacher (Vasinda & McLeod, 2011). We also encourage researchers to study useful formats for providing such instruction in a seamless manner that does not disrupt class time or create additional instructional tasks that currently deter teachers from using technology in instruction (Hutchison & Reinking, 2011).

Providing opportunities to use technology independently was also supported in the Hansfield et al. (2009) study. Hansfield and colleagues suggested the importance of providing students with their own personal blog site because a shared account for all students to use limits creativity and audience. Knobel and Lankshear (2006) have also suggested that to engage in authentic and powerful writing through blogs, students need opportunities to author their own online spaces, identify purposes for blogging, and to blog for a broad audience. For instance, students might participate in blog conversations with a small group of students who have common interests. This would enable students to build an online community centered around common interests and affinities, and to promote opportunities for meaningful interaction and motivation for conventional writing. Although independent blogging has become common in upper-grade instruction, research is needed to consider how these types of tools may support elementary students' writing and reflection skills. Further, with the increasing popularity of online social networks that support blogs and micro-blogs, it would be beneficial for research

to consider how such a network may enhance various forms of literacy in K–5 language arts instruction.

Teachers should also consider the learning curve necessary for elementary students to use digital tools in language arts. For example, although fifth-grade students created their own norms for communicating in online discussion groups (Larson, 2009), teacher participation in these discussions was still critical to increasing the level and complexity of student response. Additionally, the teacher in Hutchison and colleagues' (2012) research had to rethink many of her instructional routines when integrating iPads into language arts instruction, such as how the student work would be saved and evaluated. Some apps do not allow work to be edited once it has been saved, which is problematic when students have to quit their work before it is finished. Thus, both online threaded discussion boards and more recent technology, such as iPads and tablets, require teachers to consider how instruction should be adapted to support these tools and the level of support necessary for students to successfully engage in activities using these tools. However, both studies suggested the learning curve was slight, and students quickly adapted to using discussion boards and iPads. Nevertheless, it may be useful to study how teachers meet the challenges of using digital tools in instruction to understand how teacher educators, technology coaches, and literacy coaches might support teachers when they face such challenges.

In conclusion, we considered multiple ways in which we might serve teacher education and support teachers in integrating digital tools into language arts curriculum to support literacy. We discovered through our review and provide research-based methods for the types of literacy these tools might encourage. Further, we considered how this resource may prompt planning in teacher education courses and in teachers' own classrooms through either replication of or inspiration from the studies discussed here. We hope that by studying the ways that teachers have

integrated digital technology to improve literacy in their instruction, as reported in this article, teacher educators and teachers can integrate digital technology in meaningful ways.

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