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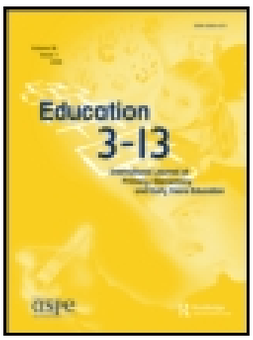

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Interactive whiteboard (IWB) use during student collaborative reading practices: A year-long comparison of instructional approaches

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ABSTRACT

The prevalent use of interactive whiteboards (IWBs) in K-12 classrooms has been met with questions regarding how teachers use such technologies to facilitate student learning. We analyzed recorded observations of 21 ELA middle school teachers over a single academic year as they developed knowledge about and competence with a structured reading programme, *Collaborative Strategic Reading* (CSR, Klingner, J. K., S. Vaughn, A. Boardman, and E. Swanson. 2012. *Now we get it!: Boosting Comprehension with Collaborative Strategic Reading*. Hoboken, NJ: John Wiley & Sons) while simultaneously learning IWB technologies. Findings suggest a) the importance of using explicit instructional prompts for facilitating student collaboration and b) the need for adequate time for teachers to gradually incorporate technology into classroom practices over the academic year.

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Interactive whiteboard; Collaborative Strategic Reading; teacher education

Introduction

The large touch-screen display of interactive whiteboards (IWBs) are used prevalently in classrooms across the U.K., Australia, and the United States (Kearney et al. 2018; Kitchen et al. 2006). These technologies provide class-wide access to computerised applications and the Internet. With the mere flick of a finger or stylus pen, teachers and their students have, in theory, immediate shared access to the outside world, thus opening the classroom to collaborative and learning opportunities that could serve to enrich inscribed school curricula (Finkenberg and Butler 2004). Indeed, leading media and technology scholars Higgins, Beauchamp, and Miller (2007) argued that the IWB may be 'the most significant change in the classroom learning environment over the last decade' (pg. 221).

Government-funding initiatives in the United Kingdom and the United States have undoubtedly led to the exponential increase in IWB presence in classrooms on a global scale since the outset of such technological development in 1990 (Moss et al. 2007; Hewitt 2014). The potential applications and educational affordances of IWBs include greater variety in modality of learning new information (Jewitt 2012; Shelly and Vermaat 2009), enhanced, dynamic and dialogic exploration (Dostál 2011; Hall and Higgins 2005), and increased motivation and engagement in subject matter (Hodge and Anderson 2007; Kitson, Kearney, and Fletcher 2005). Yet, despite these accolades, the recent research on how teachers and students are using IWBs in classrooms leave us skeptical about the contributions of such technologies for supporting the interactive, collaborative nature of learning emphasised in the Common Core State Standards (CCSS 2017), the body of English Language Arts and Mathematics standards that have been adopted by a majority of

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the states in the United States, as well as four U.S. territories. These challenges range from teachers experiencing technological issues (Gutiérrez-Santiuste, Gallego-Arrufat, and Simone 2016) to lack of change in teachers' pedagogical methods (Crook, Sharma, and Wilson 2015). This failure to shift pedagogical methods is particularly evident in the secondary grade levels (Kearney et al. 2018). These questionable potential benefits of IWBs for classroom use inspired our investigation of the proclivities and challenges of integrating IWB use during a reading-based approach designed for peer interaction and collaboration. Specifically, we employed the documented activities, reflections, and observed transformations of 21 middle school (students ages ten to fourteen) English language arts teachers as they learned to incorporate IWB applications during a collaborative reading programme across a single academic year to address the following empirical questions:

(1) What are the specific uses of IWB technology during student-driven, collaborative reading groups within a language arts middle school classroom?
(2) What is the relationship between IWB use and the type of observed CSR literacy practices among the students?
(3) What changes, if any, are observed in the frequency and variety of IWB use during collaborative reading lessons over the academic school year?

Our investigation is theoretically grounded a notion of literacy as varied, multimodal communicative acts that evolve as new technologies are introduced and used within learning communities. Such a dynamic notion of literacy stems from the revolutionary, multiliteracies framework developed by leading literary scholars who called themselves the New London Group (1994, 2000). The New London Group constitutes an interdisciplinary and international group of literacy and linguistics scholars who sought to elevate the multimodal (linguistic, visual, audio, etc.) forms of meaning making within a networked global community striving for participant agency and cultural diversity. Researchers and scholars within the fields of multiliteracies document literacy events, which consist of the various applications of reading and writing within local contexts (e.g. composing a piece of text; retrieving an image from a website) and which often reflect broader practices, or culturally constructed and shared approaches to making and producing meaning with text. Kress (2003), a member of the New London Group, asserted the importance for attending to how literacy practices and events are informed in relation to new technologies,

> The by now very extensive work in the area of literacy practices (and literacy events) needs to be complemented by work on the affordances and potentials of the stuff, the material which is involved in practices … practices can only be understood when the potentials and limitations of the tools with which one practices are understood. p.13.

Herein, we are interested in examining the instructional approaches that encompass classroom literacy events and practices such as questioning or prompts that foster students sharing and discussing ideas from texts or peer writing in conjunction with Interactive Whiteboard integration; all such documented literacy events and practices provide a lens for understanding the culturally normative (and ideologically informed) approaches to reading and writing in various collaborative contexts (Street 2003).

This multiliteracies perspective served as a guiding force for the present study, which is a mixed-methods investigation of observed teacher and student practices during collaborative reading sessions. Further, collaboration and digital tool engagement, were particularly relevant to the central purpose of the nationally funded programme called *Collaborative Strategic Reading*[1] (CSR, Klingner and Vaughn 1999; 2000; Klingner et al. 2012), which provided the opportunity for the present study. Below is a description of the CSR programme.

The importance of collaborative reading

Collaboration has been widely defined by educational researchers and scholars within the various fields related to multimedia, new literacy studies, cognitive psychology and computer-supported learning as interactions between persons focused on a shared learning through various multimodal discourse practices, including oral discussions, written exchanges, and co-constructions of visual models (Bellanca and Stirling 2011; Dillenbourg 1999; Gee 1991; Gee and Green 1998; Lankshear and Knobel 2011; Paulus and Nijstad 2003; Winne, Hadwin, and Gress 2010). Peer interactions during literacy-based activities (reading groups, writer's workshop, etc.) have been largely defined as student-led discussions involving sharing, building on ideas, and offering feedback (e.g. Bolter 1998; DiPardo and Freedman 1988; Godwin-Jones 2005; Kuiper, Volman, and Terwel 2009; Palincsar, Anderson, and David 1993). Such interactions provide a particular picture of collaboration that enables members to achieve shared learning goals related to school literacies that may otherwise be inaccessible should students work independently (Cole 2014; Lawrence and Jefferson 2015; Wilson, McNeill, and Gillon 2015). Peer mediated instruction significantly increases language and literacy learning among emerging bilingual students (Cole 2014). Such notions of collaboration are emphasised in the *Common Core State Standards* (CCSS), which call for 'collaborative discussions' that build in increasing complexity, moving from turn-taking strategies in the early grades to building on one another's ideas for persuasive purposes in later grades (ELA Speaking and Listening sections K-12, para. 1). As such, teacher educators are faced with the task of preparing and supporting teachers for fostering collaborative skills within an ever-evolving and technologically rich era.

Engagement in the digital age

Language in its various forms provides a medium through which we build understanding of ourselves and our roles within the multiple, socioculturally-situated life worlds in which we engage on a daily basis (Gee 2010; Hull and Schultz 2002; Michaels 1981; Street 2005). The rich theories that frame this field stem from the revolutionary shift in what counts as literacy that began by a consortium of scholars called the New London Group (1996). This group of ten literacy and discourse scholars (Courtney Cazden, Bill Cope, Norman Fairclough, James Gee, Mary Kalantzis, Gunther Kress, and Allen Luke, Carmen Luke, Sarah Michaels, and Martin Nakata) converged in 1994 in New London, a town within New Hampshire to discuss the growing disconnect between standard definitions and expectations of literacy in schools and the technologies and uses of literacy within sociocultural contexts. This group recognised the modern varied practices and modalities related to literacy; reading could no longer connote a single, printed text that would be interpreted for the single purpose of summarising main ideas. Writing, similarly, could not be viewed as a written or printed five-paragraph essay. Within the ever-evolving digital world, reading and writing involve multiple modalities and purposes.

Readers are meaning-makers who must learn to interpret various modes of texts (printed words, graphic images, data, simulations, etc.) for a variety of purposes that include the goal of designing one's social future. This view of multiple literacies frames knowledge as 'embedded in social, cultural, and material contexts,' and elevates notions of knowledge construction, hands- on experiences, and multimedia design as important concepts for literacy research (Cope and Kalantzis 2000, 30).

Middle or junior high schools are complex, transitional institutions that serve students ranging in age from ten to fourteen years who must learn to engage in active, strategic uses of language across content areas as they navigate the linguistic and cognitive demands from one classroom to the next (Schleppegrell 2004; Walquí and van Lier 2010). There is still so much we do not know about adolescents, such as the ways in which to facilitate theoretical uses of prior knowledge and specific strategies as they engage in content area literacies (Baxter & Reddy, NICHD, 2007).

Multiliteracies scholars have long shown how peer collaboration can be enhanced by technological innovations (Jewitt 2012; Kress 2003; Street 2008). Jewitt, for example, found that the multimodal components of digitised poems that incorporated IWB applications–like visual layering of images and

annotation–fostered a significant shift of authority and dialogue to the students who were better able to participate in discussions with greater critical inquiry. The New London Group (2000) described a key component of multiliteracies pedaogogy as, Critical Framing as such,

> Through Critical Framing, learners can gain the necessary personal and theoretical distance from what they have learned; constructively critique it; account for its cultural location; creatively extend and apply it; and eventually innovate on their own, within old communities and in new ones (p.34).

Critical Framing requires collaboration, and perhaps begins in these conversations when multiple perspectives are invited into the learning space. In some instances, the technology itself, by its nature of not working invites critique as well as transformation through troubleshooting. Kershner et al. (2014) found that students reported working through frustrations arising with technology and one another when collaborating in a Science lesson while using the IWB. Another suggested catalyst for fostering student centred engagement is the motivation and focused interest that IWB technology inspires within classrooms that have traditionally offered little more than books and worksheets as anchors for discussion (Torff and Tirotta 2010). Another explanation highlights the interactive nature of IWBs; the touchscreen function of IWB technology inherently aligns with interactivity between multimodal texts and students (Hwang, Wu, and Kuo 2013).

These positive findings for integration of IWBs in collaborative learning activities are also reflected by the CCSS, which explicitly states that English language arts (ELA) teachers should 'use technology and digital media strategically and capably' while fostering a collaborative classroom culture (ELA Introduction section, para. 7). Expectations are high for teachers to integrate innovative technology into classroom curriculum (Office of Educational Technology 2017). Thus, all pre- and in-service teachers will undoubtedly continue to feel the pressure to use such technology effectively, particularly within collaborative contexts. With the impending federally mandated accountability measures on teacher education programmes (Strauss 2013), this pressure may feel particularly acute.

Amidst the accolades and encouragement for IWBs are many questions and even a few concerns about the unique benefits of IWBs for facilitate learning (e.g. Smith et al. 2005; Torff and Tirotta 2010). IWBs may be effective for inviting students and teachers to manipulate multimodal texts such as images, video clips and print-based passages during literacy-based activities (Damcott et al. 2000), but it is less clear whether and how such practices lead to greater collaboration, learning (Jewitt, Moss, and Cardini 2007), and critical engagement (Garcia, Luke, and Seglem 2018) among students. Further, Torff and Tirotta (2010) suggested that findings and claims about the motivating benefits of IWBs are largely exaggerated. Finally, it is unclear whether students, teachers, district leaders, and educational researchers share the same understandings about the purposes and uses for such digital technologies and thus needs support for successful integration (Abuhmaid 2014; Mahiri 2011; Wong, Teo, and Russo 2013). Such ambivalence about the collaborative learning utility of IWBs is both arguably a natural consequence for the introduction of any new technology in classroom learning and the rationale for the present study that focused on the aforementioned CSR programme.

Collaborative Strategic Reading

Collaborative Strategic Reading (CSR) developed from the need to support teachers in helping students develop the strategies necessary for reading challenging academic texts (Klingner and Vaughn 1999; 2000; Klingner et al. 2012). CSR is designed to support the development of strategy-based, collaborative reading approaches in elementary and secondary language arts, social studies, and science classrooms and has been notably effective in increasing reading comprehension among emerging bilingual students (Boardman et al. 2015). As such, CSR guides teachers to introduce and model specific reading strategies for learning new words, terms, and phrases (e.g. using context clues to figure out the meaning of an unknown word or term) and identifying the most important information from an academic text. CSR strategies are tools that students use together in order to understand texts beyond the current ability to read independently. In this sense,

members of a CSR reading group are each pushed into their 'zone of proximal development' through peer-to-peer collaboration (Smagorinsky 2001; Vygotsky 1978). These strategies are framed by teachers as tools for students to use while engaged in reading a challenging academic text in small groups (three to four students per group). Participating teachers were guided by their coaches in the selection of texts that would be too challenging to not be read independently due to topical or linguistic complexity. As such, CSR collaboration involves peer-to-peer questioning and challenging members' proposed definitions of unfamiliar words and main idea statements as they help one another comprehend these challenging texts.

A CSR session begins with a brief introduction (less than 10 min) from the teacher, who presents the topic and purpose for reading a given text or set of texts. As teachers model and guide the use these strategies during shared reading in a CSR lesson, they explicitly encourage students to share or apply prior, shared classroom-based experiences and prior home and various communities knowledge and experiences during collaborative reading practices (Freire and Macedo 2013; Rios-Aguilar et al. 2011; Lave and Wenger 1991). For this study, we selected two components of CSR that are directly tied to this peer collaboration—*Click and Clunk* and *Get the Gist*. Once the teacher has introduced the topic and text for CSR, students are prompted to break out into groups, which were generally predetermined.

Interactions during these small reading groups (four members) include sharing and giving feedback on proposed understandings, questions, and co-constructions of definitions for unfamiliar words or terms and main ideas presented in the text. During these groups reading sessions, teachers

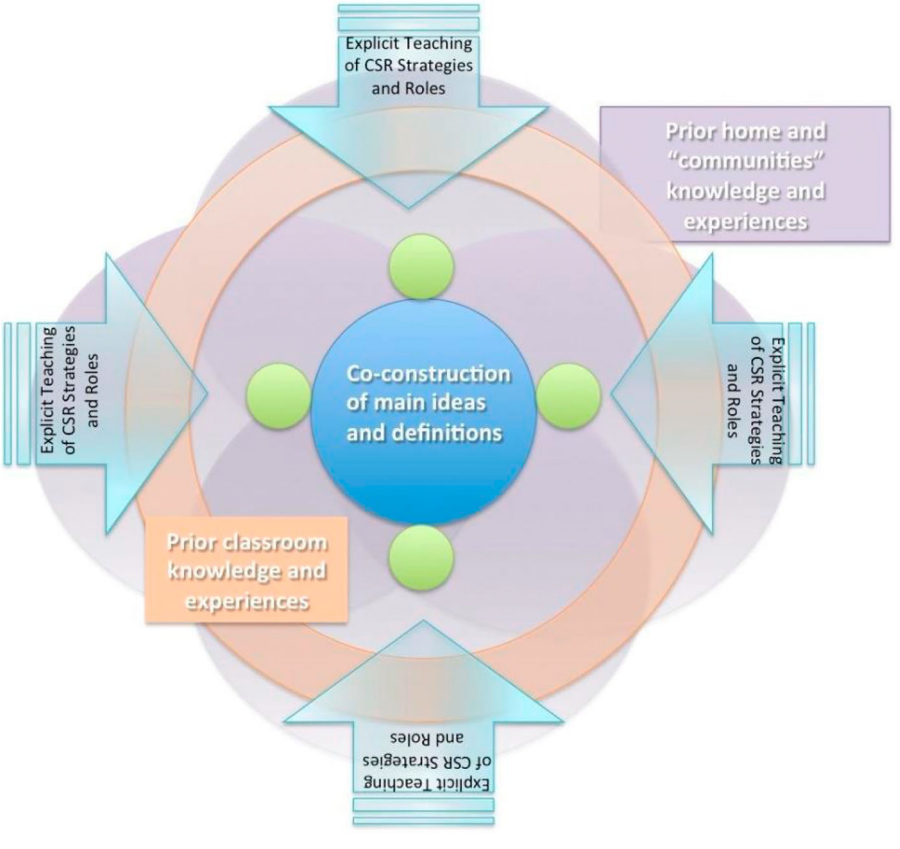

Figure 1. Collaboration in CSR.

move from one group to another, listening and offering feedback or encouragement as needed. Figure 1 below is a graphical illustration of the collaboration during CSR reading group activities.

As students use CSR strategies during these collaborative reading sessions, they also benefit from the prior knowledge (i.e. shared and unique knowledge and experiences) that each member contributes during discussions.

This study is an investigation of language arts teachers' use of the IWB during a portion of the CSR lesson that students, in small groups, are expected to work together and use reading strategies for understanding challenging academic texts. Thus, we aim to answer the aforementioned empirical questions restated below for convenience:

(1) What are the specific uses of IWB technology during student-driven, collaborative reading groups within a language arts middle school classroom?
(2) What is the relationship between the IWB use and the type of observed CSR literacy practices among the students?
(3) What changes, if any, are observed in the frequency and variety of IWB use during collaborative reading lessons over the academic school year?

This study was part of a larger 5-year project measuring the efficacy and scale up of Collaborative Strategic Reading within a large linguistically and racially diverse urban school district in the Western United States. While learning the instructional approaches of CSR, participating middle school teachers simultaneously learned to use a specific type of IWB.[2] We sampled all English language arts (ELA) teachers ($N = 21$) who participated in this larger study during a single academic year in order to clarify the specific instructional moves that facilitate student collaboration during IWB use during small-group collaborative reading.

Method

The district initiative

Per research design, over the course of the CSR project, 18 schools chose to be part of the larger CSR study. All schools were from the same large urban school district located within the western region of the U.S.. The teacher participants in this study were from three of these schools. This district's student population is 20% white, 59% Hispanic, and 15% African American. Seventy-two percent of the students receive free or reduced lunch (FRL, a proxy for low-income status) and 35% speak English as a second language. The school district refers to this portion of the population asEnglish language learners (ELLs). Similarly, all three schools in this study have a diverse population of students, ranging in percentages of students from nondominant backgrounds (53% – 83%) and students who are English Language Learners (ELLs, 16.5% – 31%).

Once school participation was accepted, CSR became a school initiative, and content-area teachers in language arts, science and social studies were expected to implement the model weekly and with fidelity. Each teacher was provided with the materials needed to implement CSR and an interactive white board to facilitate lesson delivery. They attended one to three days of initial professional development and several follow-up booster sessions at their school sites. Each teacher was assigned an instructional coach and a school-based teacher leader who were available to support CSR instruction and use of IWB.

Participants

A total of 21 middle school language arts teachers (six sixth-grade teachers, eight seventh-grade teachers, six eighth-grade teachers and one teacher) who taught both seventh and eighth-grade students participated in this study. These participating teachers (17 females and 4 males) varied in age (22 years to over 60 years old[3]) and experience (first-year teachers to teachers with over 20

years of experience). The majority of teachers (all but two) identified themselves as White, with one female self identified as Latina and one female identified as Asian.

All teachers were new to CSR in the beginning of the academic year and participated in professional development (PD) sessions designed for teachers new to the programme. Participating teachers attended an initial two-day professional development training of this programme to learn how to lead their classes in CSR lessons. Following this initial training, an instructional coach visited their assigned teacher on a weekly basis in order to provide ongoing support of the programme. All new CSR teachers received an IWB for their classroom and received professional development support during the initial two-day training and throughout the year as requested. None of the participants in this study had used any type of IWB prior to this study.

Over a single academic year, these teachers learned to use CSR and the IWB during reading instruction. One of three instructional coaches with CSR knowledge and expertise consulted with and observed each teacher at least twice a month throughout the academic year. An IWB consultant was also available to provide instructional support as requested by the coach and/or teacher.

Data collection

Reported coach observations

All participants were observed using CSR by their assigned coach for an average of 12 lessons conducted throughout the academic year, resulting in a total of 143 coach observations. One hundred eighty-two protocol reports of classroom observations of each of the 21 participating language arts teachers were analyzed for IWB use and peer collaboration. The design of our protocol followed documented IWB use from prior studies (Armstrong et al. 2005; Beauchamp and Kennewell 2010; Sharma and Barrett 2011) as well as the widely defined construct of collaboration as peer-to-peer sharing and discussion (e.g. Gee and Green 1998; Lankshear and Knobel 2011). All observers took notes based on a set protocol of items, which included the type of IWB use (i.e. displaying images, video clips, curriculum materials, texts, etc.; highlighting or annotating texts; eliciting contributions from students via clickers or approaching the board for the purpose of gaining consensus on new understandings from text), lesson duration, and the extent to which each of the CSR components were demonstrated by the students, as well as the quality of instructional facilitation by the teacher.

Reported IVC observations

In addition to the coach observations described above, each teacher also participated in two audio-recorded observations (for a total of 42 recorded observations) that served as part of a formal 'internal validity check' (IVC) of the CSR programme. These IVC observations were conducted by one of 13 coaches on the CSR research team (two of which were coaches for the participating teachers). For these IVC observations, the observing coach scripted (i.e. wrote detailed notes about the teacher and student behaviours) throughout the entire lesson. In addition to these scripted notes, the IVC reports about the type of IWB use (similar to coaching reports) during the lesson were also included in our investigation.

All coach and IVC observation reports (including scripted notes and indicated IWB usage) were logged in a centralised computer-based system. For this study, we selected items from both sets of observations that targeted IWB use and instances of peer collaboration during the reading group components of the CSR lesson. Table 1 below presents the items selected from each source of reported observation.

Interviews

In order to provide contextual support in explaining results from our quantitative analysis, we invited all participant teachers to engage in interview-conversations (i.e. open-ended, semi-structured interviews that are designed to engage the interviewee in a conversational manner) that begin with one of a series of the following possible questions, depending on the time of the interview: *So how was*

Table 1. Items from Coach and IVC Observation Reports.

Observation Report	Item	Observation Code
	Group Reading: *Click and Clunk*	Observer indicated evidence students' use of strategies for unfamiliar words and terms.*
	Group Reading: *Getting the Gist*	Observer indicated evidence of groups' identification of the main idea.*
	Cooperative Learning	Observer indicated whether groups worked together during group reading.
Coach Observation	Cooperative Learning Notes	Observer described instances of students working together during group reading.
	Use of IWB during group reading: • images • video • students at board • materials(curriculum/text) featured and annotated • programme template featured • other (e.g. digital timer or clickers)	Observer indicated yes/no for each option, filling in specific observed instance for *other*.
IVC Observation	Global IVC score (overall quality of lesson, including introduction, reading group time, and wrap up)	Scores ranged from 1 to 7 • 1–2: below proficient (e.g. no evidence of CSR strategies in use) • 3–5: proficient (most students using strategies) • 6–7: above proficient (collaboration is evident; all students engaged in process)
	Use of IWB during group reading: • images • video • students at board • materials(curriculum/text) featured and annotated • programme template featured • other (e.g. digital timer or clickers)	Observer indicated yes/no for each option, filling in specific observed instance for *other*.

your lesson today? (after a specific CSR lesson); *Tell me about your CSR lessons* (general); *How can I help with your next CSR lesson?* (prior to the next session). Final selection of five interviewees was determined first by participant consent and then by availability for conducting the interview. These five interviewees consisted of four females and one male and varied in age (25–60 years in age) and teaching experience (ranging from two to over 20 years of classroom teaching experience). We recorded and took field notes of these conversations, capturing verbatim and summarising the exchanges in the same manner as the aforementioned observational records. These interview responses are intended to be used for anecdotal, contextual support of observed patterns from our statistical analysis.

Data analysis

Two researchers with expertise in CSR and IWB technology independently analyzed portions of the scripted notes for the IVC observations to identify instances of IWB use during the portion of the CSR lesson that involves students reading and discussing texts in small groups. All documented instances were then coded according to the extent to which the IWB use involved collaboration as defined earlier. Specifically, students needed to demonstrate more than sharing ideas in the way Lankshear and Knobel (2011) would describe as additive or cumulative contributions; collaboration was identified if students were providing feedback (agreeing, disagree, offering suggestions, etc.) or co-constructing main ideas or definitions of unfamiliar words. Thus, an instance of IWB use was coded a '0' if it was non-participant use (e.g. teacher uses the IWB as a display tool; presenting the text or a timer) for the teacher, a '1' if students merely shared ideas without providing or receiving feedback to peers, and a '2' if students demonstrated collaboration as previously described.

The separate double coding of the scripted field notes served as a reliability check on the consistency of marked instances of IWB use, resulting in an inter-rater reliability of 90%. Any coding discrepancies

were discussed and resolved. As an external reliability check, we correlated the coded collaborative instances of IWB use with the global IVC score (i.e. a score the IVC observer assigns each observation based on overall teacher performance in all aspects of CSR), which includes a key component for collaboration. These two variables were highly associated with one another ($r = .60$, $p < .05$).

Results

The following results are described according to our aforementioned research questions.

What are the specific uses of IWB technology during student-driven, collaborative reading groups within a language arts middle school classroom?

Of the 83 total instances of IWB use (i.e. teacher or students explicitly applied some aspect of the IWB during instruction whether in the form of reference for displayed information or actual annotations) during the reading group portion of the IVC lessons, student sharing (sending to or annotating the IWB display screen without revisions or discussions involving consensus on new understandings) was most prevalent observation (36 of all instances, 43%). The second most frequent observation (32 instances, 39%) was non-participant IWB use, which was earlier described as teacher-directed displays and reference points. Student collaboration (contributing to consensus making and newly shared knowledge via hand-held clickers or annotation directly applied to the display screen) was the least observed practice in IWB use (15 instances, 18%). Of these observed instances of collaboration, 10 instances involved the teacher prompting students or groups to select or submit the best definition for an unfamiliar word or to select the best main idea (gist) for a section of text. The remaining five instances involved the teacher prompting students to contribute ideas for revised or constructing main idea statements (3 instances, 2%) or to co-construct a main idea statement within individual groups (2 instances, 1%). Thus, all instances of collaboration were preceded by an explicit prompt by the teacher.

What is the relationship between the use of the IWB associated and the type of observed CSR-specific literacy practices among the students?

Two outcome variables (established outcome scores from the aforementioned IVC instrument) were each regressed on a single explanatory variable: the total number of instances of collaborative use of the IWB during reading groups. The two outcome variables were: *getting the gist* (i.e. quality of identifying the main idea for separate sections of texts); *proficient at the use of strategies* (quality of demonstrated strategy use by the reading groups). Both variables were moderately correlated with total instances of collaborative use (standardised effect sizes range from .3 to .4, $p < .05$).

What changes, if any, are observed in the frequency and variety of IWB use during collaborative reading lessons over the academic school year?

The sum of all forms of IWB use observed for each recorded lesson (i.e. each coded 1 if present and 0 if not) served as a proxy for variety in IWB use. For all first lesson observations, the mean score for this composite variable was 1.61 (less than two distinct uses of IWB) while the final observations averaged in 3.06 (more than three distinct uses of IWB), resulting in a significantly higher difference in variety of IWB use between the beginning and the end of the year ($t = 2.11$, $p < .05$).

Discussion

The recent influx of IWBs in schools has outstripped the pace of empirical investigations and scholarly work aimed to clarify and support the practices and processes for using such technologies,

particularly uses for supporting collaborative reading approaches such as CSR. We aimed to determine potential benefits of such technology by investigating the uses of IWBs during peer-led, collaborative reading activities as inscribed by the CSR programme.

Findings from our study suggested that teachers may not be prepared to integrate IWB technology with newly learned, collaborative literacy approach that is CSR. As such, instructional support for innovative literacy programmes that may also involve the implementation of new technologies would be most effective in the form of an instructional design that allows for a gradual increase in the ways in which teachers and their students enfold new technological applications in classroom practices. Initial professional development sessions might do well, for example, in focusing on the traditional 'blackboard' uses of displaying various texts and prompts, thus allowing for a full transfer of display knowledge before introducing more innovative collaborative applications of IWBs. Anecdotal examples from professional development sessions that we have led indirectly support this implication. For instance, during the beginning of the academic year, our participating teachers would frequently request (i.e. at least on a weekly basis, more than one participant for send a request for support) the need to revisit basic functions (e.g. inserting images into a display page), thus leaving the more interactive and collaborative functions unaddressed. The observed average increase in the variety of IWB use for the final CSR lessons may be explained by the participating teachers' needs for more time in becoming accustomed to the standard display functions of their boards as they in turn are becoming more accustomed to new pedagogical practices. Thus, participating teachers' awareness of technological knowledge may be inherently entwined with their pedagogical knowledge of CSR in that as teachers grow in their competence in one domain, they in turn develop competence in the other.

We view our participating teachers as developing a kind of 'bilingual competence' in CSR and IWB use; the language used to navigate respective applications are both unique and complementary for supporting students in building content knowledge from texts. IWBs and CSR converge on collaboration, situating students at the centre of the reading event, offering teachers and students rich learning opportunities that align within a multiliteracies framework. Such instructional integration is a significant pedagogical shift for most teachers and their students. Our findings are consistent with previous studies citing resistance to changes in traditional positionings of teacher-directed instruction (Grimalt-Álvaro, Ametller, and Pintó 2019; Kearney et al. 2018). We concur with Grimalt-Álvaro, Ametller, and Pintó (2019) who argue that professional development importantly informs how teachers engage with and utilize new technology, and IWB in particular. What we contribute to this work is that even with weekly professional development and modelling support through coaching, traditional literacy practices, even with new digital technologies, are still very difficult to disrupt. Thus, spacing instructional workshops and focusing overtly on how teachers can utilise IWBs to promote student collaboration may further foster teachers' technological competence, which could then lead to an increase in collaborative IWB use among students as teachers can guide students to be self initiated in their use of the various available tools to assist them in their reading comprehension.

We found that as our participating teachers developed greater confidence and active understanding in the CSR approach (as determined by their IVC observation scores), their approach to student use of IWBs increasingly motioned towards collaboration. Further, the observed increase in variety of IWB use during CSR lessons from the initial to final recorded sessions suggests that the teachers also developed technological competence that would allow for greater, more varied approaches to CSR; thus providing greater access to content knowledge and opportunities for students and teachers to shape and transform in-school literacy practices.

Findings from our study may also be helpful for exploring the potential for critical reading practices an aspect of the multiliteracies framework not inherent to CSR, but one which we believe offers a fruitful avenue for how collaborative digital practices can be developed in a manner that emboldens both teachers and students to take ownership over in-school literacies.

Results from our analysis of initial and final coaching observations as well as teacher-reported use of the IWB during CSR lessons suggest that some teachers exhibited attitudes and perspectives

indicative of 'standing back' and 'viewing' CSR and IWB practices critically in relation to the instructional context (Cope and Kalantzis 2000, p.35). In this respect, the development of pedagogical knowledge and technological knowledge were inherently entwined;as these two forms of knowledge grew in tandem, content knowledge was made more visible, and thus accessible to both teachers and students for critique.

One limitation of this study is the lack of a control group (i.e. missing observations of teachers using CSR without the IWB), thus preventing us from investigating the unique effects of the IWB on collaboration during CSR reading groups. Findings from this study mark the beginning of a series of investigations about the importance of student collaboration during reading and of teachers' explicit invitations for students to use advanced technologies like IWBs in particular ways during collaborative reading practices. Questions about the ability of emerging technology as tools for interactive learning experiences have crossed into public discussions; findings from a recently reported study suggested that the emergence of new technologies run the risk of reducing the quality of parent–child interactions that are critical for socio-emotional and literacy skills development (Radesky, Schumacher, and Zuckerman 2015). Does technology support or hinder the kind of active collaboration emphasised by the Common Core standards? Furthermore, what do critical dispositions among teachers and students look like when using new pedagogical and technological practices? As students work together on the common goal of understanding challenging texts, the IWB is a potential tool for students to use as they share and co-construct ideas as they read, as long as teachers are supported in their gradual development of such new technologies to support such levels of collaboration.

The teachers in this study significantly increased the variety of ways they used IWB technology while developing their skills in using CSR during reading instruction. This finding suggests that teachers need time and support in order to use IWB technology in ways that facilitate active participation and collaboration within the classroom. However, when looking beyond the general patterns identified through our statistical analysis, we observed some noteworthy differences in the responses from our five interviewees. These differences seem to be tied to their perceptions about IWBs and CSR. This observation is consistent with research that correlates teacher's digital technology classroom practices with their pre-existing perceptions about quality education (Tondeur et al. 2017). All observed responses are presented verbatim with contextual descriptions of each respondent.

Two of our interviewees, Susan and Alice (pseudonyms, ages 25 and 26, respectively), respectively, were considered to be new teachers, and Alice was a recent graduate of the local Teach for America (TFA) programme. Both teachers were in their second year as teachers, and both expressed positive opinions about the CSR programme and little to no anxieties about the use of IWB during instruction. While both of these new teachers found CSR to be a beneficial approach for their students and their teaching, the newness of this programme seemed to be a challenge for technological integration:

> Susan: I love [CSR], but it's taken me awhile to get to the point where I can use the clickers for the during reading portion of the lesson. I already knew how to use [clickers], but not as part of group reading. Now my kids can actively participate in more ways, and I can see how they are getting more out of the readings.
>
> Alice: I never had a problem using [IWB] for the beginning part of CSR. A lot of it is pretty intuitive if you know how to use computers, but I still have a hard time using it during the reading group part. I didn't read in groups when I was in school, so this approach is so new to me. It's good, really good, but different from my own experiences in growing up in schools and learning how to read.

Susan was the first teacher from this study cohort to receive a full set of clickers (hand-held devices that students use to send various forms of responses to the IWB) for classroom use. Throughout the course of the year, neither teacher expressed any form of discomfort with the IWB. However, Alice's comment that IWB was an intuitive technology for her coupled with her tendency to draw on long standing beliefs about how reading should be taught based on her own schooling experiences may have been a hindrance for her adopting transformative literacy practices. In contrast, Susan's articulated understanding of how she could encourage student use of clickers during CSR instruction is

indicative of how she viewed the clickers as tools to transfer control to the students for the 'during reading' portion of the lesson. However, we are cautious to read this pedagogical move as an enduring or critically meaningful transference of power. For example, if students were using clickers to select from closed responses offered by the teacher then the instruction would still have been teacher directed.

Another teacher participant, Leslie (age 60), had more than 20 years of experience (approximately 25 years; Leslie was unsure about the actual number) in teaching English language arts within the K-8 context and was considered by several students to be one of the most favourite teachers at her school. When asked about her experiences with CSR and using the IWB, Leslie shared the following reflection:

> CSR is basically what I used to do, but it pulls it all together in a way that makes sense for the kids, but that board has been a real problem for me. It has taken me so long to figure out how to even show a picture on the screen, or to recalibrate the thing, and sometimes I can't get it to do what I want, like when I want to show a clip. [technology support staff] has been really helpful, and I'm getting better at using it, especially in the beginning.

Here, Leslie's allusion to 'the beginning' of the CSR lesson indicates that she was using CSR primarily as a presentation tool, as CSR begins with an overview of the reading and vocabulary. Thus, even when she was able to navigate the technological glitches, she did not seem to use the IWB to encourage student collaboration or even student thinking.

Further, while the general pattern from our results was an overall progression of the successful integration of CSR and IWB support during collaboration, not all teachers embraced either component. One of our participating teachers, Carol (age 50), was a later-in-life new teacher (in her fourth year of teaching) whose prior career was an executive in a private company. Carol expressed a concern for both CSR as a viable approach for supporting the development of reading comprehension skills and strategies and the IWB as a facilitative tool of CSR and other classroom activities. This concern was observed in the following reflection:

> Some students are just not ready and don't know how to handle collaboration, and the board is too much of a distraction. I got into teaching because I was tired of reading about the failure and dropout rates. These kids need discipline and skill building, and that can't really happen with this approach. Once the kids know what to do, then perhaps [CSR] could work. And I don't even turn on my board because it's better for the students. They all have such a hard time focusing.

The sentiment expressed in Carol's response is ideologically opposed to the CSR approach as well as to the generally supported stance on collaborative learning practices and critical framing as it relates to multiliteracies pedagogy. Such sentiments have been documented in previous classroom studies (e.g. Ertmer et al. 2012); teachers' personal ideologies about instructional practices, students' abilities, and technology undoubtedly affect the extent to which successful integration of collaborative and digital learning can occur. Yet, teacher participant Jim (age 35), who has been teaching for nearly eight years, demonstrated ideologies that directly opposed those expressed by Carol:

> Every week I learn something new about the board, and I hope to get a set of clickers so that I can capture more interactions from the students during the reading groups, like using the board to gather ideas electronically would be more efficient than people writing on the board. CSR works well for getting the kids to talk to each other about the text, and the board works to bring their talk to the whole so that kids can bounce ideas off each other more quickly.

For Jim, the integration of the new CSR approach and the IWB was a synergistic opportunity for more effective instruction and learning with texts. Jim's sentiment that 'kids can bounce ideas off each other' suggests an openness to using digital technology as a means for promoting student voice with groups and across the classroom during the collaborative process. Moreover, Jim seems to understand how the board can function archivally, enabling conversations about texts to continue beyond the end of the class period. We believe such understandings are necessary for nurturing collaborative and critical engagement with complex text among students.

The perspectives represented by the five participant teachers make visible the range and variation of how new literacy approaches and technologies are conceptualised. These anecdotal responses give a glimpse into the differences among the common pattern of increased complexity in the use of technology in the English language arts classroom. Future studies may include a deeper look into this ideologically-charged variation of collaborative ELA classroom practices within the digital age. A one-size-fits-all support for teachers as they learn new approaches for fostering literacy development may not be sufficient in addressing underlying ideologies that preclude full integration of such approaches with new technologies. Even weekly meetings throughout the school year with literacy coaches who have strong expertise in both literacy and technological practices may not be enough to move all teachers and their students toward more integrative, critical approaches. Perhaps the greatest lesson from this study is that in the twenty-first Century, teachers and students are grappling with the enormous challenge of learning new technologies while also adapting new approaches for fostering critical engagement in textual information. Stronger university-school partnerships that include consistent, ongoing support can help teachers gain a foothold and support schools in sustaining equitable and critical literacy practices with modern technologies.

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2. *Promethean Boards* were funded to participating classrooms with district grant monies that matched donations from *Promethean Planet*.
3. Several teachers preferred not to share their exact age, and as such, this information was not required for participation.

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