

**ICT FACILITATING LEARNING FOR ALL:
INVESTIGATING HOW INTERACTIVE WHITEBOARDS CAN SUPPORT
TEACHING AND LEARNING FOR DIVERSE LEARNERS IN AN
ELEMENTARY, LANGUAGE ARTS CLASSROOM**

by

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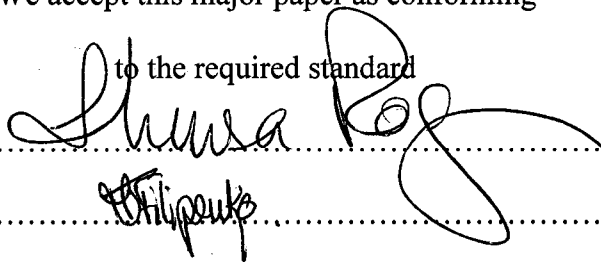
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ABSTRACT

Changing information and communication technologies (ICT) are radically altering how people navigate their world. Our students are adept at sending emails, texting friends and surfing the World Wide Web, but only within the last five to ten years have schools begun to improve the ICT available to them. As new ICT are incorporated into schools, it is important for educators to understand how to utilize their capabilities.

Recently, Vancouver schools have begun to purchase interactive whiteboards (IWB). Initial observations from teachers reveal that it seems like student engagement is increasing with IWB use. Perhaps more important is the question is teaching and learning shifting in response to IWB capabilities? Current research discusses the IWB's multimodal potential, including visual, auditory and tactile, that support student's learning. In addition, the research shows that teachers need a certain level of technological competency in order to fully incorporate these learning modalities and maximize the interactivity. This interactive nature has the potential to support our students' meaning making process in language arts by supporting critical literacy strategies, multi-literacies and reader response theory.

Teachers who are knowledgeable about these possibilities will be able to more fully resource their students and support their learning. As an example, a design for IWB unit plans is included to assist other teachers who wish to incorporate the learning modalities and interactive nature of the IWB into their classrooms.

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SECTION 1: INTRODUCTION

Background to the topic

When I started teaching eight years ago, I was struck by how the look of an elementary classroom hadn't changed since my days as a young student in the early eighties. In just the same way as my elementary teachers had all those years ago, I picked up the chalk and stood at a slate blackboard to begin teaching my lessons. In the first schools where I taught, we had a couple of computers at the back of some of the classrooms or perhaps a computer lab somewhere but these were not tools that were used every day. In short, the hardware in our educational settings had remained the same for decades. This was in spite of the fact that, in other sectors of our society, the use of computers and technology seemed to be moving at lightning speed. New technologies are now being adopted into both business and personal realms so quickly that many of us feel left behind. Although I believed that I should be incorporating more technology into my classroom, I felt ill-prepared to teach my students the skills they may need to function in this 'new' world; indeed, they usually knew more about technology than I did. However, five years ago, I moved to a new elementary school. Things here were different. Three of the teachers had something called an Interactive Whiteboard (IWB) in their classrooms and, although I never saw one of the teachers turn his IWB on, the other two certainly did and would talk about how their IWBs allowed them to save lessons and print off the notes from their respective boards so that missing students or those with written output challenges could have a copy. Lacking confidence in my technical abilities, I didn't want to explore the IWB and its capabilities myself. Instead, sitting quietly at the back of their classrooms, I watched each of the teachers use the IWB to support their teaching.

I discovered that an IWB is a large touch-sensitive screen that is connected to a projector and a computer. Anything that is on your computer screen is then viewed on the IWB. Using special multi-coloured pens, teachers can write on the board but they can also manipulate objects using their finger as a mouse. Our brand of IWB comes with educational software that is designed to support curriculum. I saw students go up to the IWB to answer questions. The students were not in awe or fearful, the IWB was a normal part of their day. Technology was being used to support the curriculum. I thought about how this information and communication technology (ICT) had potential to connect the day's lessons with current information and to increase the technological skill levels of students but since many of the classrooms at this time did not have one I didn't foresee getting one myself.

Fast forward five years and things have changed. As of this fall, my school has IWBs in every classroom K – gr.7, library, music room and resource room. Using funds from our parent advisory group, money given back to the schools after the 2005 province – wide teacher strike and soliciting donations and grants from the IWB company, my school has embraced this equipment and is leading the district and the province in terms of number of IWBs per students. We expect some other schools will catch up with us in the next two years. Three years ago, only 12 IWBs existed in our district. There will be 212 IWBs installed in Vancouver by the end of June 2009. An informal inquiry email completed by Vancouver principals, this October, revealed that there are 500 teachers who are interested in learning more and perhaps receiving an IWB. As each board costs about \$2500, significant money is being earmarked for this ICT.

Last year with a group of colleagues primarily from my school, we formed an inquiry group under the guidance of British Columbia Teachers' Federation (BCTF) staff and the University of British Columbia (UBC) Education faculty to analyze how our pedagogies and

practice are shifting as a result of using IWBs. Our monthly discussions help to clarify and refocus our teaching and learning. Personally, I have examined how IWBs support learners with special needs and how they support my instructional design and implementation. Particularly valuable is the opportunity to talk to my colleagues and hear their stories. This learning community inspires my teaching and has facilitated a highly collaborative work environment.

In addition to our discussions, some of us are offering workshops to other teachers across the province to share strategies that we feel best utilize the functionality of IWBs in bringing curriculum to life. These workshops are meant to be practical in nature and link directly to practice in our classrooms. We emphasize that teachers like us with little technical expertise can use an IWB and their students will benefit.

As a resource teacher working with academically struggling students, I am particularly interested in examining how IWBs can support student acquisition of literacy skills. Through the inquiry group, I have examined and recorded how IWBs are supporting my students but I am also interested in any research that supports or challenges what I have observed. How are others around the world using their IWB and is there more that I can do with mine to support my students? The focus of this paper is to find answers to following questions:

- What features of the IWB support student learning?
- To what extent does the skill level of the teacher determine the IWBs effectiveness?
- How can an IWB be used to develop the reading comprehension and writing skills of intermediate aged students who struggle with academic learning?

My intention is to review the literature in order to understand what research has to say about the potential of IWBs to support student learning in language arts. Additionally, I hope to pass on what I learn to other teachers by highlighting how to effectively utilize this technology.

Theoretical framework

This paper rests on a theoretical foundation provided by the paradigm of socio-cognitive theory. Socio-cognitive theory states the prime determinant of individual development is an interaction between the learner and his or her social and cultural environment. This theory is based on the work of Lev Vygotsky (*Theory of Social Development*, 1978). Vygotsky believed that learning begins at birth and continues throughout all of life. One of the most important ways that advancements in development are achieved is through what Vygotsky called the *zone of proximal development* (ZPD). Vygotsky described ZPD as

[T]he distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers (p. 86).

Two levels of development form the boundaries of ZPD. The lower boundary is the child's independent performance or, to put it another way, the child's attained development. The upper boundary of the ZPD is the maximum learning the child can achieve with help and is called the assisted performance. Vygotsky (1978) writes that the upper boundary of the ZPD "defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state" (p.86). Thus, the skills and behaviours represented in the ZPD are ever shifting and changing. Vygotsky (1978) wrote "What is in the zone of proximal development today will be the actual developmental level tomorrow – that is what a child can do with assistance today she will be able to do by herself tomorrow" (p.87).

Thus, the learner's potential for understanding and problem solving is dependent on the relationship with a more knowledgeable other (MKO) like an adult or peer (Vygotsky, 1978).

My students seem to benefit when we learn collaboratively and, as an MKO, I raise questions or add new information to our conversation. Such an approach potentially supports higher level thinking skills as the MKO stretches and supports the learner's critical thinking abilities. I want to create lessons that will challenge my students. Therefore, I have reviewed literature to find recommendations and examples that will support this approach to teaching and learning.

Overview

This paper is organized into four sections: introduction, literature review, connections to practice and conclusions. The literature review will present theoretical perspectives and research findings that provide answers to the three posed research questions. In the connections to practice section, I will describe the rationale for choosing specific structures and features when I design a digital unit plan. By reviewing the notes from the inquiry group (mentioned above), I have access to nearly two years of personal observations. It is my intention that this document will provide other teachers with strategies that support student learning based on my classroom practices and findings that emerge from the literature review. I will be able to share this document at the workshops I present multiple times a year or perhaps as a chapter in a book my inquiry group is considering compiling. Finally, the summary will briefly highlight findings from the paper while discussing some suggestions for future research.

SECTION 2: LITERATURE REVIEW

Multimodal Features of Interactive Whiteboards (IWBs)

In Vancouver, most classrooms are composed of students with diverse learning profiles all following one curriculum. This means that gifted or bright students are learning alongside English as a Second Language (ESL) students and others with learning challenges. Educators are realizing that to make knowledge accessible to the greatest number of students it is necessary to incorporate multimodal approaches in conjunction with language teaching. The New London Group (1996), a group of ten international scholars who collectively investigate literacy pedagogy drawing from varied linguistic, language and socio-cultural perspectives, discussed how “mono-lingual, mono-cultural” forms of language are restrictive and do not support modern learners (p.60). They suggest that educators need to refocus their pedagogy to address the needs of our culturally and linguistically diverse globalized society. In addition, they recommend that a pedagogy that centres on “multi-literacies” recognizes the value of traditional literacy as well as responding to growing cultural and linguistic diversity and newer information and multimedia technologies that use many modes of meaning to convey information (New London Group, 1996). Therefore a multimodal lesson has a variety of sites of meaning such as, “linguistic design, audio design, spatial design, gestural design and visual design” (New London Group, 1996, p. 77). For Knobel and Lankshear (2006), these new literacies are informed by a second mindset where “the world is very different from before, largely, as a result of the emergence and uptake” of information and communication technologies (ICT) (p.81). With the introduction of IWBs to classrooms, it is important to understand how this ICT can support multiliteracies so that educators can purposefully use the appropriate features.

Three modalities of IWBs

Beeland (2002) identifies three learning modalities that IWBs have the capacity to support. First, the visual learning modality includes “the use of text and pictures to the use of animation and video” (Beeland, 2002, p.1). When students or teachers are using the IWBs, they have access to a plethora of visuals. In a matter of seconds, they can choose the fonts, the features of the font, colour, pictures from the software gallery, images from the internet, moving video clips and lines that can create charts and graphic organizers. By representing information through salient visuals, meaning can be clarified as the information is reviewed and different aspects can be showcased. McKendrick & Bowden (1999) found that visuals can extend students’ thought processes to levels that require higher order thinking skills. In Jewitt, Moss & Cardini’s (2007) study on interactivity and multimodality in teacher designed IWB lessons, teachers and students explained that “image and dynamic representations make concepts easier to see, share, discuss and understand” (p. 310). Beeland (2002) found that visual resources are the primary mode contributing to increased student engagement.

Beeland (2002) identifies auditory learning as the second modality. He defines this learning as using auditory features such as having students listen to languages, sounds or music. In Beeland’s (2002) research, only 60% of the classrooms observed had the hardware to support sound but it was noted that one student remarked that sound made lessons more fun. Martin (2007) noted that using the sound feature to read electronic big books was a significant advantage for less able readers as the text was above the reading level of some students. She discovered that “the variety of voices and regional accents used in the audio presentations of texts was also a motivating factor” (p. 32). Her research found two drawbacks of using sound. The first was that it affected the learning of other students in an open area classroom and the

second was that the teacher needed to be technically capable of accessing the computer's volume control panel and setting up speakers, especially if the IWB is not installed in a permanent space. So both researchers agree that sound adds another layer to a multisensory lesson that can support students in connecting and comprehending the curriculum.

The third modality of learning is the IWBs tactile capacity (Beeland, 2002). He described how students are physically able to interact with the IWBs via a keyboard or they can manipulate items on the screen. Also in this research, teachers felt that IWBs encouraged active participation as the students enjoyed getting out of their desks to come up to the front of the class to touch, tap or move things on the screen. A student said, "I get into the learning when it is hands-on. When I just sit and listen, I don't understand as well" (Beeland, 2002, p.4).

Surprisingly, his study found that the classes where the students had very little interaction with the IWB rated the use of a whiteboard the highest. After looking closely at the lessons, he felt that the high ranking classes used a variety of software programs and were very multimedia based whereas some of the lower ranking classes used their IWB mostly with text. Therefore, even though touching the IWB can help students to attend and understand information, lessons should be designed to include a variety of multimedia features and not only rely on text.

Multimodal practices and meaning making

Educators can use their IWB to support a multimodal approach that incorporates a "variety of resources including colour, image, sound, spatial and kinesthetic" (Jewitt et al., 2007, p. 304) to create new classroom texts. Jewitt and her colleagues (2007) discovered that depending on how IWBs are used, they can mimic the traditional texts and function such as a worksheet or overhead. However, when teachers "reflect on what mode is best for what purpose" (Jewitt et al., 2007, p. 315) IWBs have the capacity for new designs in learning. Well designed,

teacher-made texts are vital to education because they allow “the curriculum to be situated within the perceived interests, ability and context of the students” (Jewitt et al., 2007, p. 305). They suggest that a well-designed text considers what information is integral to the lesson and how it should be taught. Also, they believe that teachers who include a variety of modes such as drawing, animating, listening and talking are facilitating their students’ engagement with a concept in multiple ways. These new multimodal texts enable students to “draw on their out of school knowledge and experiences” (Jewitt et al., 2007, p. 310). Multimodal texts created with IWBs are more dynamic and provide our students multiple pathways to understand new information.

Although, Kress (1997) believes that all modes can support learning, he argues that different modes are better suited for different meaning making activities. Therefore, depending on the content of the lesson, classrooms with IWBs have access to multiple modes that may support features more salient for different students, activities or goals. Giving students more tools through which to learn and communicate their understanding will help meet more of the learning needs in a diverse classroom.

Another important process in meaning making, is the ability to move meaning making processes into another mode when the “affordances of one mode begin to lose their communicative possibility” (Pahl, 2003, p. 140). In fact, children often transition, translate or transduct meaning to align with the available cultural resources and their experiences which are guided by their interests (Kress, 1997). To take advantage of this meaning making process, a teacher who creates lessons that transition from one mode to another can deepen her students’ understanding. However, it is important that teachers recognize that IWB multi-modal lessons can be problematic for some students. (Cutrim Schmid, 2008). Mayer and Moreno (2003) and

Seufert (2003) (as cited in Cutrim Schmid, 2008) found that students with “little prior knowledge have difficulties to process and relate different representations and to construct mental representations when exposed to multiple representations of subject material” (p.1556). Also, in interviews, students reported that sometimes the pace of the lessons was too quick. Cutrim Schmid (2008) concluded that, in these lessons, the students did not have time to construct meaningful knowledge. She recommends that teachers need to consider the purpose of using different modes and should avoid causing their students’ cognitive overload. In addition, teachers can encourage active engagement by allowing questions, discussions and time to process the new information.

Kitson, Fletcher & Kearney (2007) observed an exemplary IWB teacher whose lessons did not reflect her understanding of multimodal practices. Her lesson plans recorded an intention to include cultural and linguistic diversity and critical literacy but in practice these opportunities were missed. This research was able to reveal these gaps, such as not using the “meaning making potential of available semiotic systems” and not maximizing certain language forms, and the teacher is now shifting her classroom practice (Kitson, Fletcher & Kearney, 2007, p.37). In terms of talk, the researchers found that students need access to the technical language. This teacher unintentionally neglected to use words like ‘icon’ and ‘hyper-link’, instead used ‘this’ and ‘thing.’ Knowing the correct terminology would have created more opportunities to develop shared meaning. Their study revealed that understanding pedagogy is not necessarily the same as changing practice and that even masterful, well-intentioned teachers may need guidance to shift their teaching style.

Communicative practices in IWB classrooms

The communicative patterns in a class can be renegotiated and enhanced with the use of IWBs (Gillen, Staarman & Littleton, 2007). These scholars believe that IWBs are the “only educational ICT tool expressly designed for whole-class interaction” (Gillen et al., 2007, p. 244). Teachers who actively look for opportunities to create lessons based on shared experiences are able to design these relatively easily using digital technologies. In their study, a teacher made pancake batter with the class in anticipation of Shrove Tuesday. Each step of measuring and combining different ingredients was documented with a digital camera. The next day, this teacher used these photographs of the cooking event to design a writing lesson. Revisiting a class’ shared experiences through photos makes the new lesson tangible and current. Writing about how to make pancakes becomes meaningful to all students and the children have visual aids to help them remember each step. In their example, the students have a greater voice in the classroom dialogue. The teacher does not have to ask many leading questions as the students have a rich understanding and collective background knowledge. Gillen, Staarman and Littleton (2007) provide other examples where the classroom learning community showed more traditional communicative practices. These styles of dialogue can be very appropriate depending on the goal of the lessons. “An effective teacher is likely to engage in a balance of strategies at a number of levels” (Gillen et al., 2007, p. 254). IWBs provide teachers with more features that enable smooth transition between more teacher-directed to more spontaneous child-centred learning.

Technological competency and IWB effectiveness

Even though IWBs support multimodal lessons and classroom practice, teachers are not consistently utilizing these features. Beauchamp (2004) examined what technical skills and

pedagogical competencies do teachers and their students need for optimal interactive use of the IWBs. Through classroom observation and semi-structured interviews, he determined that there are five levels of IWB users.

Beauchamp's (2004) initial level, the 'black/whiteboard substitutes,' has the lowest interactivity. At this stage, teachers "predominantly use the IWB to write and draw, as they would on a traditional white/blackboard" (Beauchamp, 2004, p. 331). These teachers noted that writing with the digital pens could be difficult as the ink marks would not always occur where they thought they would go. He observed that when the teachers mastered the basic writing and drawing techniques, some teachers projected a text that had been previously saved but they rarely saved the text they had worked with in class. Also, most teachers were the primary users of the IWBs. Little interactivity was built into these teachers' lessons and the IWB was being used as an "information presentation platform" (Beauchamp, 2004, p.333). He postulated that perhaps these teachers needed significant professional development to increase their basic computer skills before they could transfer technological competencies to IWBs. Furthermore, Beauchamp (2004) speculates that these teachers may not have been aware of the potential and therefore did not create lessons that included effective pedagogical practice. The 'black/whiteboard substitutes' are essentially using traditional teaching methods and they are not incorporating all three modes into their lessons.

His next stage, the 'apprentice user,' is defined by the teachers' ability to use their existing computer skills in a teaching context. He states that these teachers described an increase in confidence using computers and were able to use more software programs. Also, he found that graphics were used in lessons but they functioned more decoratively than as visuals to enhance the lessons. His observations noted that more ICT vocabulary is used in the classroom as

students are, for the first time, given an opportunity to write on the IWB. Some of these teachers explained their confidence was diminished when their students' knowledge quickly surpassed their own, while others looked on this as an opportunity to further their ICT skills.

The 'initiate user' is a key stage as this is when teachers become aware of the IWBs potential to change their practice and begin to examine their pedagogy (Beauchamp, 2004). He discovered that these teachers recognize the value of interactivity in the learning process and are providing students with an opportunity to touch the IWB. Also, these teachers have more confidence accessing internet sites and the graphics they include in their lessons are chosen with purpose. At this stage, teachers begin to use some of the IWBs' multimodal capabilities.

The fourth stage, the 'advanced user,' demonstrates more confidence and competence with technology (Beauchamp, 2004). He observed that these teachers can use other types of hardware and scan their students' work for shared editing. Lessons are designed to support a variety of learning profiles and include videos, sound clips and link to relevant websites (Beauchamp, 2004). Also with an 'advanced user,' students get much more practice with the IWBs and teachers spontaneously include students by inviting them to demonstrate their understanding at the IWBs. These teachers are able to support student inquiry as their questions may take the lesson in a meaningful yet unexpected direction. Their lessons are more sophisticated and layered with learning modalities. At this stage, he states that teachers are hindered by a finite amount of storage space for digital files. Beauchamp (2004) believes that schools need to reconfigure to a network system or purchase storage devices so that the teachers can use all the multimodal features.

Beauchamp's (2004) final stage is the 'synergistic user.' He believes that these classrooms stand apart as there is a synergy of learning where the students and teachers construct

meaning together. Also, though the teachers retain the control over the central theme of the unit, the direction for the next lesson is decided in collaboration. ‘Synergistic users’ undergo a pedagogical shift and now “co-construct new understanding” (Beauchamp, 2004, p. 346) with their students. At the synergistic level, teachers and students have excellent technological skills. Interestingly, Beauchamp (2004) found only one teacher he considered to be approaching this stage. So although IWBs can support synergistic classrooms, teachers need the training, technological skills, confidence, pedagogic vision, time to practice and interest to utilize the potential. In addition, their students also need the same skills so that they can contribute to the decisions and classroom practice.

How IWBs can support literacy skills

As IWBs are a relatively new ICT, much of the research to date has focused on interactions between teachers, students and IWBs (Beauchamp, 2004) and practice that facilitates effective IWB use in classrooms (Beeland, 2002 Gillen et al. 2007, Jewitt et al, 2007). Currently, there are relatively few articles (Kitson, Fletcher & Kearney, 2007, Martin, 2007, Smith, Hardman & Higgins, 2006, Wood & Ashfield, 2008) that investigate changes in the teaching pedagogy in literacy classrooms using IWBs. Through studying literacy and mathematics classes, Wood and Ashfield (2008) found that IWBs facilitated direct teaching methods such as “explaining, modeling, directing and instructing” (p. 94). They did observe more child-centred, interactive literacy lessons supported with IWBs but these lessons were designed to support higher level thinking and stimulate discussions with open-ended, probing questions. Therefore, teacher pedagogy is essential in designing a ‘creative’ lesson that develops the students’ “capacity for original thinking and action” (Wood & Ashfield, 2008, p. 87). Cope and Kalantzis (2000) discuss multi-literacy practices including the use of ICT, incorporating cultural and

linguistic diversity and using a critical literacy framework. An examination of some guiding principles of reader-response theory, critical literacy and IWB literacy research will expand our understanding of how best to create literacy lessons that are stimulating, co-constructed with students and interactive.

Reader-response theory

A reader-response perspective acknowledges that the reader has an integral role in the meaning making process. Rosenblatt (1938, 1978), an acclaimed theorist in this field, believed that understanding literature involves a 'transaction' between the text, that functions as a stimulus, and the reader, who constructs personal meanings based on unique past experiences. This transaction is an active and ongoing process that is influenced by the background knowledge and values of the reader but is not a process of free association (Rosenblatt, 1978). Meaning must still be supported by the author's choice of words and the "images, feelings, attitudes, associations and ideas" (Rosenblatt, 1978, p.10) that these words evoke for the reader. She further develops the concept of the transaction by defining a continuum of stances that a reader might adopt to create meaning. First, when readers need to gather information from the reading, they will be looking at the text from a more analytical perspective or adopt a more 'efferent' stance. Second, readers who experience the text as art and immerse themselves in the act of reading while responding in a personal manner are adopting a more 'aesthetic' stance. This distinction applied to a spectrum model allows readers the flexibility to engage with text in the way best suited to their purpose. The interactive-nature of her transactional theory of literary reading acknowledges diverse readers and their varied experiences and purposes for reading.

Critical literacy

Reflecting on the New London Group's (2000) definition that multi-literacies are building upon the skills and values of diverse learners, it became evident that critical literacy theorists are also considering what their students bring to the reading experience and the socio-cultural implications of their lessons. Luke and Freebody (1999) believe that reading is a cultural practice and that to be effective readers, students need to be able to identify both their own assumptions and ideologies and those being presented by the text. Vasquez (2004) defines critical literacy lessons as those that attend to issues of social justice and equality. A critical curriculum is a place where "issues of diversity including culture, class gender, fairness and ability" (Vasquez, 2004, p. xv) are given importance. She believes that educators should design lessons that use language as a tool to investigate, evaluate and transform social and political conditions within the community that are being brought into the classroom by the students. Vasquez (2003) outlines four recommendations to bring critical literacy into the classroom. First, teachers need to use everyday texts, like posters, advertisements and greeting cards, in conjunction with children's literature. Second, teachers should frame their lessons within the context of social issues that are important to the students. Third, the classroom books selected should build upon and enrich the discussions on the social issues. Finally, teachers should include critical literacy across the curriculum. The classroom examples included in her books showcase students' ideas being honoured which in turn inspires these students to use their knowledge to enhance their communities. She demonstrates how literacy learning can be a shared experience between the teacher and her students.

Another critical literacy theorist, Comber (1992) identified three guiding principles that support critical literacy. First, students need to be engaged in language analysis that explores the

function and purpose of certain words. Second, teachers need to be aware of the multiple ways of being literate and how culture defines language and literacy. Lastly, students need to develop the skills to evaluate texts and look for overt and hidden or veiled meanings. Therefore, critical literacy creates space for discussing cultural differences and the value of multiple literacies.

Wilhelm (2008) agreed with Rosenblatt's (1978) transactional theory of literary reading and tenets of critical literacy and expanded upon this work to show how social interactions can support meaning making especially for struggling students. Working as a teacher-researcher with his own students, he documented strategies and meta-cognitive reading processes that were deemed most beneficial by his students. Class and group based action strategies that allowed students to use art, drama and conversations to help formulate their ideas often helped his students' to construct deeper meanings. Many of his examples illustrate how students found it very helpful to co-construct meaning through discussions that allowed them to build upon their classmates' understanding.

Wilhelms' finding that co-constructed meaning, and often whole class strategies, can support some student's understanding is supported in an IWB study. Levy's (2002) research reveals that the students reported that using IWBs to display their personal work or showcase a classmates' project so that everyone had equal viewing access led to discussions that helped them to articulate and elaborate on their ideas. Furthermore, an IWB's presentation mode is useful for supporting discussions that lead to co-created knowledge. In addition, Levy (2002) states that students are more motivated to answer questions in IWB lessons because the information is visually appealing and answers can be found collaboratively and interactively.

Talk structures

Eeds and Wells (1989) found that talk is an effective response method that can allow students to build on the insights of others to reach deeper levels of understanding. However, they caution teachers that not all talk structures lead to grand conversations. In fact, many discussions can remain as ‘gentle inquisitions’ if readers are not given the support and time needed to develop insights collectively (Eeds & Wells, 1989). These researchers found that successful discussion groups will engage in four kinds of talk structures: constructing simple meaning, sharing personal stories, actively inquiring and valuing and critiquing the text. Also, if teachers dominate the discussion and manipulate what aspects of the text are focused on, students will not be able to practice their own skills of investigation or voice their own theories.

In classrooms that had used IWBs for over one year, Smith, Hardman & Higgins (2006) documented that “in those lessons which used an IWB there were significantly more open questions, repeat questions, probes, evaluation, answers from pupils, and general talk” (p. 450). Therefore, understanding talk structures can support IWB lessons.

However there may be difficulties with allowing students to guide the discussion. Lewis (1997) found that peer-led discussion groups were influenced by socio-cultural conditions, such as social class, gender and perceived ability, which pre-existed in the classroom. She continued that equitable talk structures do not emerge without an understanding of power and difference within each classroom. Interestingly, Smith, Hardman & Higgins (2006) did not observe any gender differences in frequency of answering between lessons with IWBs and those without, meaning that the percentages of boys who answered and girls who answered remained relatively stable and answering was not dependent on the ICT.

Maloch (2002) describes the teachers' role more as a facilitator who gradually builds up the capacity of her students before adopting more of a participant position. She showed that students need explicit instruction on talk structures to make the discussion process more visible. Also, effective use of conversational strategies is needed to facilitate the collaborative work required to understand literature.

Writing

Martin (2007) found using IWBs "to drive the writing lesson seemed at times laboured and contrived" (p. 34). She used electronic big books and direct teaching to introduce writing activities in her classroom. Her study showed that her higher achieving writers were better able to use the writing skills and methods taught with the IWB but Martin wondered if these same results would be evident with regular lessons. After these lessons, a student with behaviours on the Autism Spectrum said, "writing is easier because it (the IWB) gives you a picture". This student was better able to position his writing for the intended audience. However, another student with a language disorder demonstrated very little change and struggled to complete the assignments. As a classroom teacher, she believes that writing topics need to be meaningful for the students. Martin (2007) has observed that topics that consider students' experiences and interests facilitate better writing. She intends to continue this research and plans to investigate how IWBs can be used more effectively to teach writing and what strategies support all learners.

Conclusions

Creating a collaborative classroom that uses the principles of multimodality, critical literacy and talk structures is possible using traditional resources such as books, but IWBs provide access to wider variety of current information that can be manipulated to support the needs of all learners. These are different times and our students have ICT skills that need to be

utilized. Prensky (2001) states that today's students are the first to grow up with computers and technology as a regular part of their day. They are essentially "digital natives" and learn differently than our generations did (Prensky, 2001, p.1). On the other hand, he labels the adult generation as "digital immigrants" who speak a pre-digital language (Prensky, 2001, p.2). By using technology to explore social issues, teachers can bring digital-everyday texts into the lessons via the computer while still providing opportunities for the students to read, write and think critically. Therefore teachers who have technology skills that reach beyond simply functioning can create a space for their students to share their strengths. By giving credibility to the skills and experiences of students, teachers are creating classrooms that are open to diverse learners. It is in this environment that IWBs can be used to support the 'digital natives' and their teacher collaboratively learning together.

SECTION 3: CONNECTIONS TO PRACTICE

“Are you sure that all these things like fighting in the trenches are still connected to the Black Hand? I mean ... the assassination, of Franz Ferdinand and his wife, caused all this?”

On this morning, my grade five student was able to identify the cause and effect relationship that occurred at the beginning of the First World War. While clarifying her understanding, she was shaking her head in disbelief. After four weeks of lessons, this was the first time she shared her emotional response with the class and I was able to observe her deepening understanding. The structures and features of the First World War digital unit I created helped this student to understand the complex events that led to the Great War.

This student reads about two years below her grade level. As a resource teacher, I support her and other students who struggle with reading and writing. This group includes students with weakness in their academic skills, English as a Second Language (ESL) students or designated students with special needs. The First World War is typically not taught until high school and therefore most fiction and non-fiction books published are written at that reading level for this age group. Teachers for the late-intermediate students at my school are selecting sophisticated topics through which to teach the language arts skills and I want to provide access for my struggling students to the same topics that the more able, or perhaps book literate, students in the class are studying. Just because reading and writing is difficult, doesn't mean my students can't think critically. They simply need the information presented in multiple modalities. Well-designed digital unit plans utilize such modalities and help to increase my students' global knowledge so that they can become informed world citizens.

I had only been using an IWB for one year, when I first attempted to create a digital unit plan. Initially, I had used the IWB as a whiteboard or at the most prepared a single lesson in advance. A graduate-level university summer course assigned a project that was to facilitate student interaction with a digital portal. As the only IWB user in the class, I explored capabilities of the software and thought about how to enhance the interactivity. My first digital unit on modern day child labour was simplistic but when I shared it my colleagues they immediately saw potential and made suggestions. In collaboration with these teachers, I started to improve the overall design by thinking about how to support the diverse learning needs of every student with one unit. The following discussion is intended as a type of blueprint that will help other teachers design their own digital units and is illustrated with actual examples from the modern day child labour unit and the First World War unit.

Title page

Because it reveals all the chapters in the unit, the initial page is very carefully planned out. This page also functions as a portal with links to each chapter's first page. Instead of listing each chapter one underneath another, they form a web around our main topic. (see appendix A) I use the title page to reinforce how graphic organizers work. During our unit, the students will be required to web their knowledge at the end of each chapter. Then, one to two months later, without any group brainstorming, the students are required to record all information they remember from previous chapters or even the whole unit by using a web format so that I can better understand their retention. I want the mechanics of webbing to be mastered by the students prior to the retention exercise. Each day, the lesson begins with the title page and even though we may not review the chapters, the students are reminded of what we have studied before and where we are going next. A limitation of the web design is that there is only space for about eight

chapters. With my First World War unit, there are about fourteen chapters in total. I believe the value of the web as an organizer, especially for students who struggle with literacy, outweighs a design with an expanded list of all chapters on one page. In this unit, I have added a second title page that we will begin after four months.

Other design aspects are purposefully included. For the backdrop, I choose an iconic image that represents the unit. These images are intended to support students who organize information visually. For example, the First World War Unit begins with a field of poppies and the modern day child labour unit begins with a child carrying bricks on his head. I look for an image that will generate discussions and questions. Before we even begin, I want the students thinking about what they already know about the topic.

Each chapter link is designed as a button with the name of the chapter and an image that can support the students who organize information visually. For example, the chapter on the 'alliances during WWI' has a square with the word 'alliances' underneath a handshake image. For the ESL students, I'm creating a miniature picture dictionary on the title page. The chapters are arranged in a chronological order following clockwise after the first button. I know the students are thinking ahead to the next chapters because if I change the sequence, they are disappointed. They have said things like, "I was looking forward to the chapter on uniforms. When are we going to do that?"

Lastly colour is very important. Sometimes a poor quality projector will alter the original colour so it is important to check what the students will be viewing. Some of my colleagues are less invested in this design aspect but I want something bright and visually pleasing that will catch their attention. I match the chapter buttons to a colour from the background image. I'm trying to create visual harmony so that my students' eyes flow around the title page and one

oppositional colour doesn't dominate or seem to be more important. I think about colour so that my students won't. Once the title page is complete, I start to build the chapters.

Chapter: introduction- accessing prior knowledge

The first page of each chapter should generate interest and help my students to examine their previous beliefs and knowledge of the topic. I believe that a page that is image – based, interactive and generates discussion is the most beneficial and can be used as a vehicle to introduce new vocabulary. Though this can be challenging depending on the topic, a strong initial page creates a collective mindset or a knowledge base that we now share as a class because of the thoughts and ideas that were contributed by the individuals. For example, in the modern day child labour unit, the chapter defining the rights of a child in relation to the UN convention begins with an interactive, t-chart sort. In this activity, the students must sort a variety of pictures of children working into either the harmful job category or the beneficial job category. Rich discussion emerged as my students tried to decide where to put the fast food worker and the smiling goat herder. (see appendix B)

Traditionally, I would have cut pictures out of magazines and made multiple black and white copies for the students to sort with a partner. There are three significant advantages of this IWB version compared to the traditional approach. First, the large screen of the IWB allows for a shared experience as we are making decisions together. With the traditional picture sort, students had to report out after completing the activity at their desks. Now they are able to scaffold and shift each other's thinking with their opinions. Second, the images' integrity is maintained. Nuances in the pictures are not lost due to a reduction in size or graininess. Colour supports the students' meaning making and we can use the IWB software's tools to increase the size of the picture if we want to see something up close. Finally, my preparation time is reduced. No longer

do I have to cut out images, photocopy multiples and re-cut the same pictures, multiplied by the number of my groups. Certainly, I have to search out images from the IWB software's gallery and the World Wide Web but with practice this search becomes reasonably fast.

Chapter: body- information

As mentioned earlier, it can be very difficult to find topic specific books that are informative and are at my students' reading level. With teacher-created information pages, I can adjust the reading level of the text. I use my own prior knowledge, multiple books and websites to inform the digital texts. The information and details are retained but the language is simplified. Key vocabulary words are included and I can increase the difficulty level of the text as the year progresses. It is empowering to my students to be able to read the text while knowing that they are learning the same topic as their peers. Many of my students have strategies for tuning out when they think the work is too hard. Texts at their level increase their engagement. Perhaps there is also something about the size and shared viewing of the text but I notice less off-task behaviour meaning that more of my students are following along and asking question instead of participating in side-conversations and playing with pencils.

The layout of these pages is carefully designed. First, I unify each page within a chapter with the same coloured background. Then on the left side of the page, I add a coloured box that complements the background colour of the page with purpose of framing the text. This text box highlights the information and gives the chapter a polished quality. If the page's background is dark, the text box is lighter or vice versa. Colour harmony is an important focus for me at this stage. The font is set to size twenty-eight so that it will be viewable wherever a student is sitting in the class. This is the minimum size recommended by SMART Technologies, our IWB company. (see appendix C)

Each digital page fits on one paper page so that it can be printed out for the students. No one has to copy a large body of notes off the board thus supporting students with low written output. The printout capability means that everyone has the same, legible text and their challenges don't alter what is written in their book. Also, valuable is the ability to print off the text created in class. After I record the notes of a class conversation or summarize some information, I can print off this page for my struggling students or those who are away. I have eliminated the pressure some students, with written output challenges, ESL needs and those with special learning needs, feel because they can't copy fast enough off the board. Another advantage is that this board is never erased. I can return to the exact record of the discussion we had. For some students, especially those on the Autism spectrum and others with processing challenges, transitions are difficult and this includes instructions that are not quite the same as yesterday. Being able to save our class-constructed text provides more continuity.

Also, with the text on the left hand side of the page, there is a large space allotted on the right side where I can include images that support the text or make notes. The items that supplement the text are perhaps even more important than the text. On the information pages, nearly every paragraph is supported with an image. For example, when we were learning about Franz Ferdinand, accompanying the text was an image of Franz Ferdinand and his wife. I have observed that my students have strong visual skills. By this, I mean that they seem to organize information around images. Therefore, they can access prior knowledge, make connections and retain facts through pictures. During our chapter about women in the Great War, it was evident that after viewing images of artifacts, people, old newspaper documents or historical posters is often when my students say things like, "I read a book about the suffrage and a woman jumped out in front of a racing horse, why?" or "On a television show, I saw people talking in code but

they understood what each other were saying.” Often when we view these pictures, I enlarge their size to be able to see the smaller details. Then I can easily return the picture back to its original place when we are finished.

As needed, the page is linked to a map so that the students can situate the events. I often do this by selecting the image of the country’s flag and creating an internal document link to the map page. If it is a present day map, I may increase the interactivity by having the students slide the country into the correct place on the continent. The IWB software provides many of these maps to choose from.

Video clips are integral to adding an animated visual/auditory layer to the textual information. By video clips, I mean a video that is whole or may have been segmented into a length of anywhere from one to twenty minutes. I find that most videos around the five minute mark are a good length for our purpose. My students have observed that narrative style video clips are easier for them to understand. In the viewing process, I always add the closed captioning, the option of display the dialogue in text form on the screen, if available. Students sometimes have difficulty understanding an accent or a muffled voice and captioning helps them to follow the information. Also, we adjust the settings to make the video fill our entire screen. I can do this by adjusting the computer’s zoom level or pressing the full screen button if provided. We usually close some of the window blinds and turn off the front lights to reduce the glare on the screen. Adjusting the light makes videos with darker backgrounds easier to see. A set of external speakers is very helpful with the sound quality because computer imbedded speakers sometimes cannot be increased to an audible level for the entire class.

The process of viewing videos is very specific and I use a technique my colleagues call ‘guided viewing.’ If the video clip is short, initially we view the entire video straight through.

For the second viewing, I stand beside the screen and manually 'pause' the video which draws my students' attention to important characters, facts or actions. I am filling in the gaps that they may not have the frame of reference to understand. The final viewing involves 'pausing' the video again as we take notes collectively on a digital page in our unit or engage in a class discussion with many questions from the students. Multiple viewing reduces my students' anxiety level because we often see more things the second and third time. They don't have to notice everything all at once. If the video is longer, especially feature length films, I only show the video once but will 'pause' frequently to fill in the gaps. I'm showing this video for informational purposes and have no qualms disrupting the flow, and perhaps the entertainment or mood of the video, to deepen my students' understanding.

Our students are starting to preview videos at home by accessing recommended clips on the internet. Classrooms are often open to students during lunch hour and the school library is open before and after school to provide computer and internet access for those who don't have this opportunity at home.

Developing digital units reflect significant changes in the ways we teach. Our teaching pedagogy is shifting and we are trying to move away from the teacher as omnipotent and instead try to build knowledge together. An example is some students are using the teacher-demonstrated, guiding viewing techniques to support their peers watching a video, meaning the student pauses the video and fills in the gaps for the class. The classroom is a more collaborative space with teachers and students learning together. For example, student questions and comments are playing a bigger role in guiding the lessons and discussions because, by not following a published text, I have the flexibility to insert information pages to follow up on the sections my students are more interested in or need more instruction to comprehend. During the

chapter on airplanes in the Great War, originally I focused on Canadian pilots. When we listened to the Canadian World War One pilot Emerson Smith talk about being shot down by the Red Baron through CBC radio archives, I realized I needed to add another page that discussed the Baron Von Richthofen's role in the Great War because the students were intrigued with his fame.

Other students are reviewing the selected videos as part of their process for studying for a test. Teachers have noticed an increase in recall for some students.

Finally, videos are carefully selected. As mentioned, our students enjoy and are skilled at making meaning through pictures but it is important to evaluate images that may be psychologically damaging to a sometimes already fragile population. Graphic events depicting violence, death or destruction seem more gruesome on a video. As my students are still young, I purposefully refrain from showing clips that portray these events. Reading about a mass grave from WWII is less vivid than seeing photographs or a video of bodies being tossed on a pile. I still want to keep some of their innocence and not contribute to nightmares.

My videos are found from CBC archives, CBC Historica minutes, You-Tube, BBC and Discovery Education, a video streaming service. I choose an image from the video and paste it on to my information page and then create a hyperlink to connect that picture to the video. Some people prefer to download videos from the internet to guarantee that they can always find it, especially in locations with problematic internet connectivity, but I haven't had too many issues yet so I skip this step. Therefore, depending on the topic, an information page may contain none, one or multiple links to videos.

Chapter: questions to build critical thinking

As part of the summary process that reviews the information learned in each chapter, I try to include a 'deep thinking question' at the end of each chapter. These questions usually don't

have a right or wrong answer but can be argued from each side. For example in the First World War unit, the chapter on the assassination of Franz Ferdinand ends with the question “Is Serbia, the country, responsible for starting the war?” (see appendix D) The question in the women in war chapter is “Are you a feminist?” After viewing the question, the students have a minute or two to think about their response. Then the students have to write their names in the Yes or No column. The next step is very powerful as the students who voted ‘no’ or are ‘undecided’ need to partner with someone who voted ‘yes’ to discuss why they support one side or the other. Students have changed their opinions after talking to a peer. This also gives an opportunity for the unsure students to clarify their understanding. Being able to justify your choices and teach a peer generates higher order thinking skills and is very useful in developing social skills. These types of questions help the students to synthesize and evaluate the information from the chapter and help the teacher to assess if all the students understand the content based on the sophistication of their reasoning.

Chapter: review

The final page in each chapter is an interactive review. Sometimes the students will build the review for their class members using the information learned or the teacher may have prebuilt it. The IWB software provides many examples like a crossword, timeline, sort or quiz. (see appendix E) Reviews that require evaluative skills like ordering events from least important to most important and games are also used. To conclude the trench warfare chapter, we accessed a game on the BBC website where we had to decide what weapons to use and in what order to attack the enemy. The students had to quickly adjust their choices to take advantage of the element of surprise. For the review, some classes divide into teams to create a competitive

atmosphere, while others do the review collaboratively. The students look forward to the review and it can serve as a practice for a written test or assignment.

We're still teaching

While my units are now presented in a digital format, it is important to state that I continue to include traditional structures like written assignments, discussions and hands-on projects. In our First World War unit, we have eaten food that the soldiers were give as rations, tried on a WWI helmet, collected artifacts from home that remind us of a soldier's experience, written poetry in role and webbed new information we learned. Using the IWB is only one component of our lessons. We make the distinction that IWBs are not being used for technology sake but to support our multifaceted program. IWBs are a mode of curriculum delivery that is only as effective as the teacher who designs the lesson. My digital unit is designed to meet the need of the students I teach this year and can easily be changed as I reflect on how the lessons are understood. There is a large time investment in constructing these units but I had to make worksheets before having access to IWB technology. Perhaps one of the most significance differences is that I can design units that are more multimodal and are easy to share with my colleagues who teach the same units through our networked server. Though I share my lessons with my colleagues, they often choose to alter sections to best fit their students. It is easy to adapt the units for different groups of students. IWBs support our teaching and our students' learning.

SECTION 4: CONCLUSIONS

The purpose of this capstone paper has been to examine how IWBs can best be used in elementary classrooms to support literacy development. Today, researchers in the fields of ICT and educational use and language and literacy have identified learning modalities that both help students to use many strategies to construct meaning and can be supported with an IWB. Other studies show that although this potential exists without appropriate professional development for the teachers, IWBs can be used in a very traditional manner. To increase the interactivity and facilitate teachers and students constructing meaning together, both groups need technological skills, confidence and opportunities to share knowledge and ideas and interact with the IWB. Teachers with these traits can look to reader - response theory, critical literacy and talk structure strategies to help them to plan how to best implement the IWB's capabilities. A masterful teacher can be more fully resourced and provide an interesting variety of experiences within which her students can build their literacy skills.

Since beginning this master's degree, I have used this opportunity to become more familiar with current research in this new area and think carefully about shifting my classroom practice to become more multimodal and use ideas from reader-response and critical literacy to engage my students. Ultimately, I want my students to be global citizens who are aware of history, current events and conditions around the world. Having access to the World Wide Web and an IWB makes this task easier.

My growth has been significant and together with my colleagues in my inquiry group we have adjusted our practice to create a more collaborative paradigm between ourselves and with our students. The third section of this paper, Connections for Practice, is a result of these discussions and the resulting application in my classroom over the last 2 years. The powerful

learning that emerges out of topics like modern day child labour and the Great War awakens my students' interest in their world. IWBs have revitalized my teaching and help me to better accomplish my goals for my students. This design for an IWB unit plan has already been shared at a district workshop and may be published as part of my action based research. It is my intent to continue to support my colleagues across British Columbia and perhaps North America as part of the National Educational Computing Conference held June 2010 in Denver.

Suggestions for further research

The educational implication of IWBs is a relatively new area with many opportunities for further research. While familiarizing myself with current articles, it was evident that more research has been conducted in the areas of IWBs in math and science classrooms than in language arts. Further studies in literacy development and IWBs would be helpful for teachers. Specifically, information on relationships between IWBs, reading skills and achievement could be one area of further research. With only one article on how to use an IWB in a writing lesson, this too would benefit from additional research. Also, if teachers had more examples of how to use the features of IWBs to meet the needs of diverse learners, we could incorporate these recommendations into our practice. An investigation into whether the socio-cultural backgrounds of the students have any bearing on how effective IWBs are in support their learning could be another area for research. Certainly new articles are being published monthly and the upcoming book *Interactive Whiteboards for Education: Theory, Research and Practice* will include my chapter on David Livingstone Elementary's inquiry project into how IWBs are being used in our classrooms. As my expertise grows, hopefully, I will be able to continue contributing to this field.

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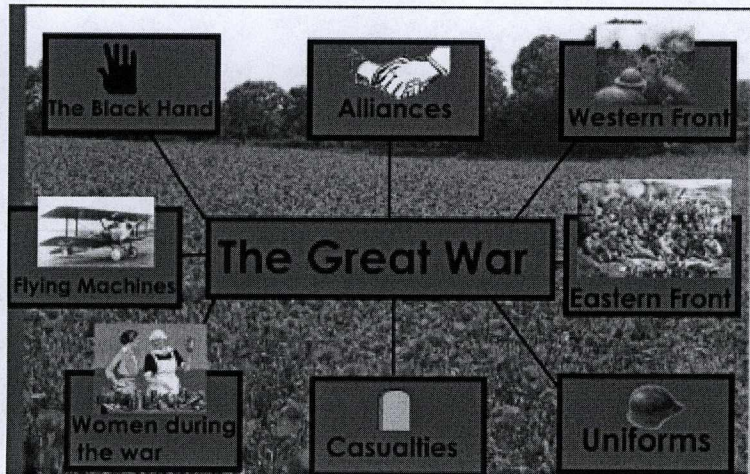
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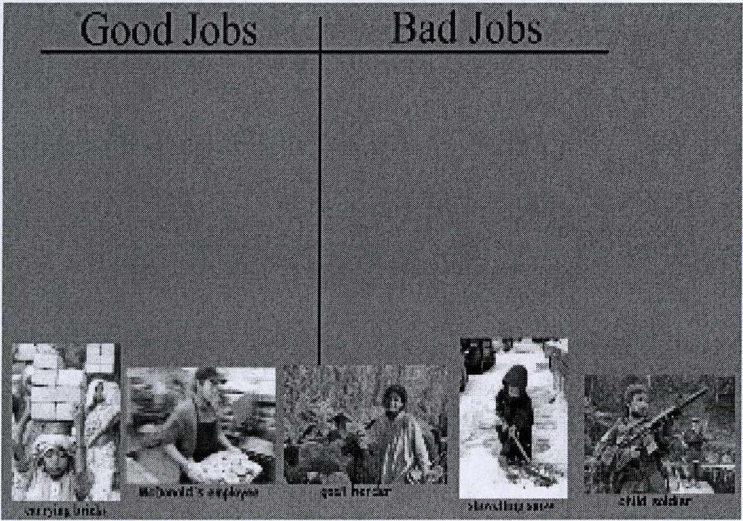
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APPENDICES

Appendix A: Title page – The Great War



Appendix B: accessing prior knowledge page – modern day child labour



Appendix C: Information page with photographs – Great War

Flying machines

Canada had no air force in 1914. The only way a Canadian could become a pilot was to join the British Royal Air Force. Fear of the top twelve flying aces in the Great War were Canadian pilots.


Flying machines were only invented 11 years before the war. Some Canadian inventors including Alexander Graham Bell designed flying machines. They tried to convince Canada's minister of militia and defence, Sam Hughes, about the machines' value. Sam said, "You say that these will never play any part in such a serious business as the defence of a nation."

Using airplanes to fight a war was a very new idea. The first planes were small and made of wood and canvas. In the beginning, they were used to photograph enemy positions. Soon the pilots began to drop bombs and grenades by hand over the sides of the open cockpit. Sometimes they would shoot at enemy pilots with guns.


The Germans built better planes than the British in 1915. But Germans figured out how to attach a machine gun to front of the plane. This plane was named the Fokker. Britain and France captured one of these planes to copy the invention.

German pilots were a good flyer and well made the battle. This changed in 1917 when the British developed a new plane called the Sopwith Camel. This new plane was good at turning like a pie at high speeds.

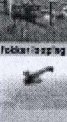
Both sides kept inventing better planes as the war progressed. The kind of air battles changed too. In the beginning, the planes fought one-on-one. Then the Germans used squadrons of 8 to 10 planes into the sky to tell number the enemy.




Sam Hughes




Alexander Graham Bell



Fokker



Fokker fighting



Sopwith Camel

Appendix D: questions to build critical thinking – Great War

Deep thinking question: Was Serbia, the country, responsible for starting The Great War?	
Yes	No

Appendix E: chapter review – SB quiz – Great War

Edit

Q.1

?

What is the name of the terrorist group responsible for the assassination?

A The Black Hand

B The Black Gun

C Serbs Unite

D Free Serbians