# University of Alberta

**Interactive Whiteboard Use:**

**Changes in Teacher Pedagogy in Reading Instruction in the Primary Grades**

By

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## Abstract

Interactive Whiteboard (IWB) use is increasing in Canadian classrooms accompanied by numerous claims of benefits for pedagogy and learning. The purpose of this study was to examine how IWBs are integrated into reading instruction in the primary grades (K-3), how their use enhances or alters teacher pedagogy and practices, and supports curricular technology integration mandates. Four teachers who taught in mainstream primary classrooms and were frequent IWB users participated in this four-month study. Eight English Language Arts lessons were observed per teacher. Data sources included interviews, observational data, logs, reflective journal responses, and training materials. Quantitative data on duration and frequency of activities with and without IWB use were analyzed to compare teacher and student use, the content of reading instruction, and the interactivity of activities. IWBs were in active use for approximately 50% of instructional time. The most frequent uses were guided practice, information provision, and questioning. Students engaged in paper-based literacy practices such as worksheet completion and shared and independent reading. The type and duration of students' IWB use varied between and among classrooms. Paper-based texts and not digital texts predominated. Overall, the primary use of the IWB was to display information and interactive affordances were used infrequently. The teachers perceived IWB use made lessons more engaging and motivating, but support for their perceptions was inconclusive and mixed. Teachers concluded the IWB was a tool that improved the efficiency and effectiveness of teaching, however the nature of their pedagogy had not changed.

My results contribute comprehensive, empirical support to the growing debate over pedagogical benefits and changes with IWB use, particularly for interactivity. The appeal of the IWB is such that use of the interactive and multimedia functions may overshadow the development of effective pedagogies and materials. Administrators are cautioned to consider carefully reports of benefits to determine under which circumstances use would be beneficial for their teachers and students. Additionally, teacher training must provide support for pedagogical decision-making in subject areas. Further research to determine the optimal conditions for training and use would assist educators and administrators to use the IWB to best benefit in teaching reading.

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## Chapter 1: Introduction and Theoretical Context

Computer technology use is increasingly prevalent in Canadian society and, through provincial and territorial curricula, Canadian Ministries of Education have recognized the need to educate children both about and with various computer technologies (for example, Alberta Learning, 2000b; Prince Edward Island Education and Early Childhood Development, 2010). Although it is difficult to determine the exact number of computers within Canada or the degree to which they are used by children, we may draw inferences about the degree of children's contact with computer technology by examining their home access to the Internet. Statistics Canada (2010) reports that 91.1% of adults residing in single family households with children under 18 years of age have Internet access in their homes, reflecting an increase from 80.9% in 2005 and 86.4% in 2007. In addition to their homes, children encounter various forms of computer technology in their schools. For example, one widely used technological tool in schools is the Interactive Whiteboard (IWB). In some provinces, IWBs have been recommended for every classroom (Alberta's Commission on Learning, ACOL, 2003) and the lead manufacturer and distributor of IWBs (SMART Technologies, 2012) reports their products are already installed in over 1.8 million classrooms across North America. Technology use in the classroom reportedly benefits student achievement, motivation, and time on task (Butzin, 2001; Judge, Puckett, & Bell, 2006; Page, 2002) and similar claims are made for IWB use in instruction, particularly for interactivity with content and for student motivation (Haldane, 2007; Quashie, 2009), yet systematic analyses of how IWB use alters teachers'

pedagogy and classroom practices are rare.

The purpose of the current study was to examine how IWBs are integrated into reading instruction in the primary grades (K-3), how IWB use enhances or alters teacher pedagogy and classroom practices, and how IWB use supports curricular technology integration mandates. Technology use and integration are mandated for classrooms in Canada. Thus, it is important to explore what researchers report as the benefits to teaching and learning when technology is integrated into instruction. The general benefits of technology use and the specific benefits cited for IWB use in education are presented under Technology Use in the Classroom.

## Technology Use in the Classroom

Canadian Programs of Study reflect the trend of increased technology use in education. Beginning in 2000, Canadian Ministries of Education mandated technology be integrated into the daily education of students. Some ministries have given general statements about technology integration across the curriculum, (often referred to as Information and Communication Technologies, or ICT) such as "The ICT curriculum is not intended to stand alone, but rather to be infused within core courses and programs" (Alberta Learning, 2000b, p. 1). Other ministries have given more specific statements about technology's capacity to enrich classroom teaching, such as "Information and communications technologies (ICT) provide a range of tools that can significantly extend and enrich teachers' instructional strategies and support students' learning in language" (Ontario Ministry of Education, 2006, p. 30). In these and other

curricular documents, technology integration is perceived to be positive and technology is considered to be a tool used in problem solving situations that replicate situations students might encounter outside the classroom (Prince Edward Island Education and Early Childhood Development, 2010).

Research evidence supporting the use of technology in the classroom is mixed. Commonly reported benefits include increased time on task and increased motivation (Norris, Sullivan, Poirot, & Soloway, 2003) and improved literacy skills (Littleton, Wood & Chera, 2006; Savage, Abrami, Hipps, & Deault, 2009; Savage, Abrami, Piquette-Tomei, Wood, & Deleveaux, 2009), yet researchers have also reported many instances where technology is not integrated into instruction (Becker, 1998; Dwyer, 2007). Barriers to technology use and integration in the classroom reportedly include availability of resources, teacher attitudes toward technology, and teacher training (Dwyer, 2007; Judge et al., 2006; Norris et al., 2003). Norris et al. (2003) and Judge et al. (2006) reported the ratio of computers to students in schools is approximately five or six to one but computers are often concentrated in a central computer lab where they are inaccessible outside regularly scheduled time periods. In their survey of over 3500 American teachers' use of technology in education, Norris et al. found up to 28% of teachers had no (about 2%) or had inadequate (26%) access to technology for the students in their classes (p. 19). The criteria used to determine inadequate computer access were having no more than one computer in the classroom and sporadic computer lab access. Teachers' attitudes towards technology also influence how technology is used in their classrooms and the degree of integration

which occurs in classroom lessons. Dwyer (2007) concluded computer resources are distributed inequitably within schools, particularly in favour of older students. Of particular interest to my study are the following points: several primary grade teachers reported the perception that technology use was inappropriate for young students, the focus of instruction should be on learning to read not on technology, and traditional instructional methods and materials such as hard copy books were most appropriate for teaching reading (Dwyer, 2007).

The reports of benefits of technology use in the classroom are general, and often refer to the use of computers, rather than to the use of other computer-based technologies such as the IWB. Many of the benefits of computer use in the classroom are also claimed for IWB use in the classroom. A more detailed explanation of specific claims for the benefit of IWB use in the classroom follows next.

**Interactive Whiteboard Use in the Classroom**

By way of rationale for the importance of technology use in education, Alberta's Commission On Learning (ACOL, 2003) stated,

> Technology will be pervasive and a "given" in most children's lives, in their homes, their entertainment and their communication with friends and family. They will come to school with expectations that the same kinds of technology and multimedia will also be pervasive in their schools. Most, if not all, jobs and careers will require young people to have a range of skills in using technology and to continue learning new technology skills in the workplace. (p. 105)

The ACOL recommended meaningful integration of technology into education through the provision of better access to technology and technological resources, as well as better training for teachers in how to use technology appropriately to

support student learning in applications and problems that simulate problems outside of the school setting. One recommendation was that all classrooms throughout the province have IWBs installed. Yet, in their retrospective report ACOL (2009) reported although the state of technology education in Alberta had improved, some of the upgrades recommended had not yet been realized (such as IWB installation in all classrooms within the province).

The ACOL (2003) did not provide a specific rationale for their recommendation that an IWB be installed in every classroom but it is likely they were aware of the benefits of IWB use reported by various researchers. For example, the benefits of IWB use reported in research literature typically come from case studies of classroom practices (such as Haldane, 2007; Mohon, 2008; Quashie, 2009). These studies, and others, report three main benefits to IWB use in classrooms:

1) Improved student motivation, engagement, and achievement;
2) Increased lesson interactivity; and
3) Improved teaching (more effective pedagogy).

The benefit of IWB use most often reported in studies appears to be student motivation and engagement (for example, Haldane, 2007; Lovell & Phillips, 2012; Quashie, 2009). Quashie claimed, "A common view shared by teachers and students alike is that the IWB increases the level of engagement, motivation, and participation in a lesson" (p. 35). Quashie offered an example from her own observations of six lessons taught to secondary math students by four teachers within her department, "What was clear is that the majority of students were enthusiastic about using technology in the lesson. This was evident

by the way students were eager to be selected to use the IWB, or to offer answers to the teacher" (p. 35). When Quashie interviewed students about whether they perceived IWB use resulted in lessons that were more engaging or enjoyable, a few students reported feeling less likely to ask questions or interact during IWB lessons. Students and teachers alike stated when teachers chose to use the IWB in interactive ways, the IWB lessons were engaging. In contrast, some teachers used the IWB as a static projector, which in turn was perceived by teacher and student respondents to decrease interaction and engagement. Overall, most students and teachers in Quashie's study were positive about IWB use in the observed lessons and commented the IWB had a positive effect on students' level of engagement.

A second benefit often reported in the research literature is the capacity for greater interactivity between and among teachers, students, and the lesson content when the IWB is used. For example, Haldane (2007) contrasted the interactivity of traditional lessons to the interactivity of the IWB. Haldane's article arose from her observations of IWB use by primary teachers in four schools in England over a two-year period as part of a government-sponsored evaluation project of IWB use. First, she discussed the interactivity of the lesson content. Traditionally, the teacher might be positioned at the front of the classroom beside a static whiteboard, chalkboard, or flipchart. The teacher might record important ideas on the static media to assist students in understanding the important concepts. In the case of the static whiteboard or chalkboard, the content would be lost once erased, and must be rewritten or redrawn if the teacher wished to revisit the content. In contrast, teachers using the IWB can easily revisit material from previous lessons

by opening the files where the materials were saved or provide further information about topics discussed by accessing multimedia content on the Internet. Haldane argued the capacity to open saved files and search for multimedia content quickly increased the efficiency of teaching time. Second she reported seeing activities where the teacher and students interacted with each other and with the IWB. Haldane was positive about the interactions she observed, yet the "interactive events" she observed lasted for a maximum of only four minutes. In addition, due to the inability of the IWB to respond to more than one touch at a time, in most cases the teacher and one student used the IWB while the other students observed and interacted verbally from their seats. Haldane observed each teacher in her study infrequently over a two-year period. Thus, it is unclear whether the situation reported (i.e., where the teacher and one student manipulated content on the IWB while the other students watched) was the normal pattern of interaction for these classrooms.

A third benefit of IWB use reported in the research literature is improvement to teachers' pedagogy. IWB use may provide for greater flexibility in lessons, as teachers review content from previous lessons by accessing the saved files or incorporate material from the teacher's computer or the Internet in response to student questions (Haldane, 2007). An additional benefit to IWB use, reported in a study of secondary foreign language teachers by Gray, Hagger-Vaughan, Pilkington, and Tompkins (2005) is improved classroom management. The main evidence cited for the claim of improved classroom management using the IWB was teachers' claims the use of animation and games in lessons held the

attention of students with challenging behaviours. In addition, teachers reported better personal organization and management of time were possible when using the IWB in their lessons, but specific examples were not provided to corroborate the teachers' perceptions. It is unfortunate Gray et al. did not provide examples to support the teachers' claims of changes to their pedagogy so readers could understand the specific ways in which teachers' pedagogy changed, rather than relying on general, unsubstantiated claims to understand the effects of IWB use on teachers' pedagogy.

It is not surprising there are researchers who question the benefits of new, widespread, and expensive resources such as the IWB. For example, Mohon (2008) contested many of the reported benefits of IWB use as "optimist rhetoric", citing lack of empirical evidence to support the claims. One of Mohon's main arguments surrounded claims for the interactivity of IWB use. For example, the IWB responds to only one touch at a time (point of contact), which means if all students were given an opportunity to interact with the IWB in a lesson, lesson pacing would be slowed and student attention may suffer. In addition, IWB use may promote whole-class teaching at the expense of individual or small group work. Quashie (2009) noted several students and teachers indicated that teachers' decisions about how the IWB was to be used, whether as an interactive tool or as a simple projector, determined whether the lesson was perceived to be interactive or not. Although the IWB has the capacity to allow teachers and students to interact with and manipulate objects, teachers could choose whether they used the interactive functions in their lessons. For example, one teacher commented, "I

don't think that the IWB affects interaction, I think that it can affect the way a teacher delivers a lesson and the variety of activities that the teacher provides and the methods employed by the teacher" (p. 36). Many activities that are possible on the IWB are also possible using traditional static media, but as Haldane (2007) suggested, the IWB may make these activities more efficient (such as integrating video content into lessons and accessing information saved from previous lessons).

Despite overwhelmingly positive claims for the benefit of IWB use in education by IWB proponents, critics have raised important concerns about the lack of empirical evidence reported to support the claims. Most reports are anecdotal in nature (see Mohon, 2008), or are based on limited observations of the classrooms under study (see Gray et al., 2005; Haldane, 2007; Quashie, 2009). Few studies set out to systematically observe how teachers' pedagogy changes over time after IWBs are introduced. In addition, most IWB studies examine use in other countries, often the United Kingdom and Australia, and these contexts may not reflect how IWBs are used in Canadian classrooms. The lack of empirical evidence and systematic study of how teachers' pedagogy and classroom practice changes after IWB integration is of concern, particularly when the installation of IWBs in every classroom represents a significant financial investment for most school jurisdictions.

**Teachers' Use of Interactive Whiteboards**

Teachers use educational technologies such as the IWB in various ways and their use affects the benefits students are intended to receive from IWB use.

For example, when teachers use the IWB in highly interactive ways, students often report higher levels of engagement, but when teachers use the IWB as a static projector, some students report lower levels of engagement (Quashie, 2009). Several factors may influence how teachers use the IWB in their classrooms including their overall comfort and experience with technology use in general and their comfort and experience with the IWB specifically. Teachers' overall ease with technology integration may influence their initial attitude towards and aptitude for IWB use. Additionally, their experiences with the IWB may reflect or change their attitudes towards technology use in general. Hooper and Rieber (1999) proposed a continuum to describe the stages of teachers' integration of technology into the classroom and the way in which technology adoption influences teachers' pedagogy. In the initial stage, *familiarization*, teachers are aware of technology and may use it outside the classroom, but do not use technology in their classrooms. In the second stage, teachers *utilize* technology in their classrooms but abandon its use if they encounter difficulties. Some technologically proficient teachers advance to the stage of *integration*, where they rely heavily on technology use for most lessons, even at the expense of other teaching methods and resources. In the integration stage, technological considerations may take precedence over pedagogical concerns about content and method. Few teachers progress to the final stages of *reorientation* and *evolution*, where they once again reconsider and rebalance technological concerns with pedagogical concerns. In these final stages, technology is treated as one tool that teachers use to enhance their teaching, and they use the technology to build on

and support their pedagogy effectively. Bauer and Kenton (2005) suggested few teachers progress past the initial stages of utilization of technology on Hooper and Reiber's continuum, where technology is treated as a novelty that is abandoned if it does not perform as expected. The danger of the utilization and integration stages is teachers may not consider whether the technology they use is appropriate for the educational goals of the lesson. Hooper and Rieber's continuum provides a useful framework for examining the degree to which teachers integrate specific technological tools, such as IWBs, into classroom instruction.

Beauchamp (2004) proposed a continuum to describe differences in teachers' use of the IWB and whether and how their IWB use reflects changes in their pedagogy. The initial stage, *Black/Whiteboard Substitute*, is characterised by the absorption of IWB use into existing pedagogical practices, especially where teachers write or draw on the IWB like a traditional blackboard or whiteboard. The computerized functions of the IWB, such as word processing files, are used on occasion to display information to the whole class as the teacher might have previously used an overhead projector. The Black/Whiteboard Substitute stage is characterised by teacher control of the IWB with little or no student use or interaction. The main benefits of the IWB use in this stage as identified by Beauchamp are increased lesson pacing because teachers do not have to recreate resources by hand and increased eye contact with students because teachers do not face the board to write as often. Beauchamp cautioned teachers in this stage may use the IWB to present or transmit information at the expense of more interactive activities such as questioning (and discussion). The second stage, *Apprentice*

*User*, is characterised by teachers' increased technical competence with the IWB and their increased use of computerized functions with the IWB. In this stage, lessons are linear in format and lesson content is set up in advance by the teacher. Teachers begin to use their computer skills to save files for reuse, utilize presentation software to sequence lessons, and incorporate graphics such as clip art to make lessons more visually appealing (i.e., "decorating" the work, Beauchamp, 2004, p. 337). Teachers may begin to use games from the Internet or other resources available on sharing sites to enhance their lessons. The Apprentice User stage is characterised by limited student use of the IWB for functions such as drawing, writing single words, moving objects, or clicking buttons on the screen. Sometimes, teachers ask students what action should be performed and then perform it for them, particularly if physical restrictions, such as the height of the board, hinder students' tactile interaction.

The third stage of Beauchamp's (2004) continuum, *Initiate User*, is characterised by increased variety in the types of programs used with the IWB and the use of multiple programs to facilitate different functions within the lesson rather than use of one program exclusively. In this stage, there is increased student interaction with the IWB and teachers plan this interaction as an integral part of their lessons, rather than as a supplementary feature of the lessons, although student use is directed by the teacher. Initiate Users begin to make changes in their pedagogy and to consider IWB use more purposefully, for example choosing programs or visual features that fulfill a specific need within the lesson and not just for visual appeal, but they do not yet use the IWB to

interact on a deeper cognitive level with students (p. 339). The fourth stage, *Advanced User*, is characterised by increased pedagogical change while teachers begin to experiment with features of the IWB to create new lessons and modify earlier lessons to be more effective in meeting instructional goals. Teachers begin to generate their own lesson content, using peripheral devices such as scanners and links to external resources. Beauchamp explained teachers begin to use hyperlinks and hypertext (i.e., links to content elsewhere in the document or on the Internet, for example) to navigate and their lessons become more lateral rather than linear. For example, teachers might use several resources in tandem, such as the Internet, scanned copies of students' work, and peripheral input devices. Beauchamp characterised this stage as having increased student use of the IWB where teachers relinquish some control over the IWB and allow students more control over their IWB use. The example given was the use of a slate, a portable, touch-sensitive input device that can be used to interact with the IWB from anywhere in the classroom. In the example, students pass the slate between themselves to interact with the content displayed on the IWB and their use might be spontaneous and unplanned. The final stage, *Synergistic User*, is characterised by the growing equality of teacher and student, which Beauchamp perceived to be a positive outcome of IWB use, and in which the interactive potential of the IWB is fully realised and teachers have a cooperative relationship with their students. Teacher and student interaction with the IWB in the Synergistic User stage is intuitive and both teachers and students have the ability to interact effectively and confidently with the IWB. Lesson structure is fluid and follows a constructivist

pedagogy where both the teacher and students control the pace and substance of the lesson, but the teacher retains control over the central theme.

Serow and Callingham (2011) adapted Beauchamp's continuum to include another stage (or category) they called *Technical Deficiency or Retreatism*, in which teachers initially do not use the IWB frequently due to technical difficulties, time constraints, and the perceived unsuitability of IWB use for the topic. Serow and Callingham researched teachers who were in the initial stages of IWB adoption and some teachers reported lack of proficiency and lack of comfort with the technology. Teachers in this category tended, when faced with technical glitches, to be overwhelmed and not attempt to redress or fix the issue, much like teachers in the utilization stage of Hooper and Rieber's (1999) continuum.

In both Hooper and Rieber's (1999) and Beauchamp's (2004) continua, it appears that after teachers learn to use the technology proficiently, they experience a period where technological features eclipse pedagogical concerns. Then they eventually refocus on their pedagogy and find ways to use the technology effectively to support student learning. Each of the authors stressed the developmental nature of these stages as teachers adopt new technologies and then become more confident and competent with their use. Both Hooper and Rieber (1999) and Beauchamp (2004) and those who built on their work (Bauer & Kenton, 2005; Serow & Callingham, 2011) observed teachers do not progress through the stages at the same rate and some teachers failed to reach the later stages of reorientation and evolution (Bauer & Kenton, 2005; Hooper & Rieber, 1999) or synergistic user (Beauchamp, 2004; Serow & Callingham, 2011). The

work done by these authors is important for interpreting teachers' use of the IWB in the current study because it may help to explain teachers' thinking about their pedagogy in the context of IWB use. Specifically, teachers who are in the initial stages of IWB integration, where they still struggle to master technological concerns, may not be as able to identify or discuss their pedagogical choices and may not have experienced pedagogical change beyond changes in display media (Beauchamp's *Black/Whiteboard Substitute* stage).

## Purpose of the Study and Research Questions

The purpose of this study was to investigate how IWBs are used in reading instruction in the primary grades (K-3) with a specific focus on how IWB use alters teacher pedagogy and classroom practices, and whether IWB use supports curricular integration mandates. Formal reading instruction begins during the primary grades and these are often the years during which students first encounter IWB use in instructional settings. If, as Dwyer (2007) reported, primary teachers privilege traditional teaching methods over technological methods, then IWB use in primary classrooms will be limited and effective integration will not occur. However, if, as Haldane (2007) reported, teachers of young children use IWB to enhance teaching practices, then the IWB will be used more frequently and interactively in classroom instruction.

In the introductory section of her study, Haldane (2007) asserted "despite suggestions from relatively early IWB research that teachers felt that electronic boards would not change their practice ... and that patterns of interactivity are the same in lessons with or without an IWB" (p. 258) teachers' pedagogy did undergo

change. Teachers in her study identified specific ways in which their pedagogy changed due to IWB use, such as increasing the interactivity of lesson content and increasing the speed at which they could access information in response to student questions. Other studies, such as Gray et al. (2005), Mohon (2008), and Quashie (2009), claimed changes in teachers' pedagogy occurred after IWBs were introduced into classrooms, although, aside from mentioning improved lesson interactivity, student motivation, and classroom management, specific examples of how teachers' pedagogy changed were not included. Mohon argued pedagogical changes occur incrementally as teachers explore the capabilities of the IWBs and how they are best used to support educational goals. A gap in the research literature exists surrounding the exact nature of pedagogic changes that occur with the introduction of IWBs into primary classrooms. For example, researchers have claimed lesson interactivity increases (Haldane, 2007; Quashie, 2009), yet the most commonly cited evidence appears to be teachers' perceptions of whether interactivity increased or not, rather than specific examples of how interactivity increased. Researchers have also claimed students' motivation improves when an IWB is used in lessons (Haldane, 2007), yet some students reported their motivation decreased (Quashie, 2009).

My research is guided by a general question: How does primary teachers' IWB use influence their pedagogical practice? Three specific questions provide a sharper focus. These questions are stated and a brief explanation is given for each.

1. *How do teachers perceive their pedagogy has changed through IWB use and are these changes manifested in teachers' practice?* If, as Haldane (2007)

asserted, the introduction of an IWB inevitably changes teachers' pedagogy and the pedagogical changes are positive, are teachers aware of the changes and in what ways is classroom practice affected? According to researchers such as Haldane, one example of an expected positive change is an increase in the interaction between teachers, students, and content in lessons where IWBs are used. Some researchers, such as Gray et al. (2005), Haldane, and Quashie (2009), used interviews and infrequent observations of classrooms they studied to ascertain how teachers' pedagogy changed, yet it is unclear whether teachers' perceptions were accurate and whether classroom practice and the dynamics between and among teachers, students, and content changed over time.

2. *What are teachers' perceptions of the pedagogical value of IWBs and how do teachers' perceptions affect their use of IWBs?* Teachers' perceptions of the value of IWB use, or the use of any technology in education, influence how those technologies are used in their classrooms. If, as Dwyer (2007) reported, teachers do not see the value of technology in teaching reading in the early grades, then technologies such as the IWB will not be used effectively to support reading instruction, despite curricular technology integration mandates.

3. *What training do teachers receive to integrate IWBs into instruction in ways that support pedagogical decisions?* Wozney, Venkatesh, and Abrami (2006) and ACOL (2003), for example, both identified the need to prepare teachers to effectively use technology in their classrooms. Without a focus on the reasons for using technology and how technology may be used to support, rather than to dominate, pedagogical decisions, "Computers [and, by extension other

computer-based technological tools such as IWBs] may simply maintain existing instructional practices that traditionally focus more on transmitting information than helping learners actively construct knowledge" (Wozney et al., 2006, p. 193).

## Significance of the Study

"In virtually every aspect of our society, our economy and our personal lives, technology is having a profound impact on the way people live, work, learn and do business" (ACOL, 2003, p. 105). Technology use is increasingly prevalent, particularly in the homes of parents or caregivers with children under 18 years of age, as evidenced by reports from 91.1% of parents and caregivers across Canada that they have Internet access in their homes (Statistics Canada, 2010). Yet, despite the reported prevalence of technology use outside of schools, some researchers as recently as seven years ago concluded technology is not widely used in schools (Becker, 1998; Dwyer, 2007; Norris et al., 2003), particularly with younger students. In contrast to reports from the early twenty-first century, it appears in the current decade technology use in the classroom may be on the rise because of the increased presence of other technologies, such as the IWB, that are designed for whole-class use. However, the presence of or access to technology does not ensure that it is being used or that it is being used effectively. In light of curricular mandates to integrate technology into instruction, it is important to understand how technology is actually used in primary classrooms, and indeed, whether it is used at all.

The significance of this research lies in advancing understanding of the changes in teacher pedagogy resulting from IWB integration. With this

understanding, informed decisions about pedagogy, implementation, and policy can be made on the basis of empirical evidence rather than on the basis of manufacturers' unsubstantiated claims. It is anticipated that my research will (1) assist teachers and administrators to plan for greater effectiveness in integrating IWB hardware by highlighting successful and unsuccessful practices and the need for effective teacher training; (2) increase educators' awareness of the need to reflect upon the purpose of technology use in classrooms and how technology use influences pedagogical practice; and (3) stimulate policymakers to purposefully reconsider, if necessary, how IWBs are to be used in schools.

## Explanation of Terms

**Technological literacy.** Technological literacy is defined in many ways. Even the terminology used to talk about being literate in the use of technology varies. For example, one term used to label the skills and strategies required for the literate use of technology is *New Literacies*. Donald Leu and his colleagues (Leu, Kinzer, Coiro, & Cammack, 2004) provided a definition of new literacies:

> The new literacies of the Internet and other [Information and Communication Technologies, or] ICTs include the skills, strategies, and dispositions necessary to successfully use and adapt to the rapidly changing information and communication technologies and contexts that continuously emerge in our world and influence all areas of our personal and professional lives. These new literacies allow us to use the Internet and other ICTs to identify important questions, locate information, critically evaluate the usefulness of that information, synthesize information to answer those questions, and then communicate the answers to others. (p. 1572)

Leu et al. focused on the importance of locating, evaluating, synthesizing, and communicating information, rather than on technical proficiency with computer hardware. In more recent work, Leu, Coiro, Castek, Hartmann, Henry, and

Reinking (2008) focussed on developing performance assessments for seventh grade students' comprehension of online text (containing both print and multimedia information) by asking students to locate, evaluate, synthesize, and communicate information on the Internet in response to comprehension questions and problems.

Whenever Ministries of Education address the issue of the increasing use of technology in society in their programs of study, they make such statements as, "Advanced technologies are more pervasive today than they have ever been, and their uses are expanding continually" (Alberta Learning, 2000b, p. 1) and therefore, "students must be prepared to understand, use and apply ICT in effective, efficient and ethical ways" (p. 1). Various definitions and explanations of technological literacy have been advanced by the Ministries of Education that extend the definition further than simply using technology in effective, efficient, and ethical ways (Alberta Learning, 2000b). A concise synthesis of technological literacy was provided by the British Columbia Ministry of Education (2006);

> Literacy in the area of information and communications technology can be defined as the ability to obtain and share knowledge through investigation, study, instruction, or transmission of information by means of media technology. Becoming literate in this area involves finding, gathering, assessing, and communicating information using electronic means, as well as developing the knowledge and skills to use and solve problems effectively with technology. Literacy also involves a critical examination and understanding of the ethical and social issues related to the use of information and communications technology. (p. 13)

This definition includes components found in other programs of study throughout Canada. First, technologically literate individuals obtain, manage, and share information (Alberta Learning, 2000b; New Brunswick Department of Education

Curriculum Development Branch, 1998; Newfoundland and Labrador Department of Education, 1999; Nova Scotia Department of Education, 2005; Ontario Ministry of Education, 2006). Second, technologically literate individuals evaluate information critically and use technology ethically (Alberta Learning, 2000b; Nova Scotia Department of Education, 2005; Ontario Ministry of Education, 2006). Similar to Leu et al. (2004), the British Columbia Department of Education definition focused on the importance of gathering, evaluating, and communicating information, but, unlike the Leu et al. (2004) definition, the British Columbia Program of Studies also addressed problem solving and the ethical use of computer technology.

Commonalities between the definitions include a focus on the gathering, processing, and communication of information using digital media, and also on the ethical and appropriate use of information. For the purpose of my study, which deals with how technology is used in Canadian schools, I have chosen to adopt the definition of technological literacy presented by the British Columbia Department of Education (2006) because it incorporates many of the ideas found in other provincial Programs of Study and is more comprehensive than the New Literacies definition presented by Leu and his colleagues (Leu et al., 2004).

**Technology integration.** In their use of the Hooper and Rieber (1999) continuum to describe teachers' use of computer technology in their classrooms, Bauer and Kenton (2005) noted few teachers progress past the utilization stage, where technology is seen as superfluous to teaching curricular outcomes. Further, if teachers' experiences with technology are positive at the utilization stage, they

will continue to use technology in their classrooms, but if teachers encounter technical or instructional difficulties, they will often abandon technology use. Some teachers progress to the integration stage, and are committed to technology use but, at times, may not critically evaluate why they use technology and whether technology use is appropriate for meeting curricular outcomes. According to Bauer and Kenton, few teachers reach the final stages of the continuum, where they treat technology as a tool that supports their pedagogical decisions. Importantly, Hooper and Rieber's continuum was intended to include, but not be limited to, the use of computers in the classroom. The continuum could easily be used as a framework to explain teachers' IWB use in instruction. The continuum emphasized the role of teachers' pedagogical thinking with regard to how they judge the role and importance of technology use in their classrooms to be and how technology use relates to the curriculum.

My study examined teachers' integration of IWB use into their teaching in the context of Canadian classrooms that are guided by curricula set forth by Provincial Ministries of Education. Unfortunately, although technology integration is mandated, Provincial Ministries of Education do not provide a definition for technology integration. Still, it is possible to infer how the Ministries intended for integration to occur by examining the statements made about technology's place in the curriculum. For example, in their Technology Program of Study, Alberta Learning (2000b) made the statement, "The ICT curriculum is not intended to stand alone, but rather to be infused within core courses and programs" (p. 1) and then discussed how technology should be used

as a tool for solving problems, making decisions, and researching information in other subject areas. The Alberta Program of Studies emphasized the incorporation of technology into other curriculum areas and the use of technology as a tool. Similar statements about cross-curricular integration of technology and the use of technology as a tool were made by other provincial Ministries of Education, such as Prince Edward Island Education and Early Childhood Development (2010). Their statement focused on

> … how CIT [Communication and Information Technology] can be used from grades 1-6 and across all areas of the curriculum as part of a more global strategy that will contribute to the development of technologically competent and literate individuals graduating from our school system. As technology is best learned within the context of applications, activities, projects, and problems that replicate real-life situations, the CIT program of studies is structured as a 'curriculum within a curriculum', using the core subjects of English Language Arts, Math, Science and Social Studies as a base. (p. 15)

Clearly, both of these provincial Ministries of Education supported the use of technology across all curricular areas as a tool for solving problems that are similar to problems that students typically encounter outside of school. The statements quoted for both Alberta and Prince Edward Island are typical of other provincial Programs of Study. In addition, similar to the Hooper and Rieber (1999) continuum, the Ministries of Education documents highlighted the relationship between curriculum objectives and technology use. Unlike the Hooper and Rieber continuum, the Ministry documents focused on students' learning and not teachers' pedagogy.

Both the Hooper and Rieber (1999) continuum and the Ministries of Education Programs of Study (Alberta Learning, 2000; Prince Edward Island Education and Early Childhood Development, 2010) were used to define the

characteristics of technology integration. The meaningful integration of technology in the classroom requires that teachers consider the appropriateness of technological tools, whether hardware or software, for the curricular objectives they wish to teach and balance technology use with other pedagogical methods (Hooper & Rieber, 1999). In addition, technology integration requires that teachers plan classroom activities that replicate the ways technology is used in society, connect to objectives in other curricular areas, and emphasize problem solving skills (Alberta Learning, 2000b; Prince Edward Island Education and Early Childhood Development, 2010).

Many provincial technology curricula, especially in Alberta where the current study took place (i.e., Alberta Learning, 2000b), predate the model of technology integration adopted by many current researchers of the use of educational technology, the Technological Pedagogical Content Knowledge (TPCK) model developed by Mishra and Koehler (2006) based on earlier work by Shulman (1986). Shulman reasoned that successful teachers must understand:

(1) not only facts or concepts but have a deeper understanding of the knowledge structures within the subjects they teach (subject content knowledge),
(2) not only how to teach but how the subject is best taught (pedagogical content knowledge), and
(3) not only the programs and materials that are used to teach topics within the subject but also knowledge of when and how to use alternative programs and materials (curricular knowledge).

Mishra and Koehler sought to develop a unified theory of technology integration and use (T) in the context of pedagogy (P) and content knowledge (CK), in response to atheoretical approaches such as case studies and reports of best practices. They proposed that the constant shift in (predominantly digital)

technologies within classrooms has brought collective attention to the resources used to teach. Much as Hooper and Rieber (1999) focused on the shift between teachers' initial familiarization with technology to their overuse of technology to their eventual balance between technology and pedagogy, Mishra and Koehler supported a balance between and among technology, pedagogy, and content knowledge. They proposed an examination of not only the relationship between technology, pedagogy, and content knowledge, but also between each of the pairs within this grouping. Thus, in the context of the current study, technology use must not be treated separately from what is taught (content knowledge) and how it is taught (pedagogy), but used appropriately and strategically to meet curricular goals. Thus, in the context of technology integration (Mishra & Koehler, 2006):

> Quality teaching requires developing a nuanced understanding of the complex relationships between technology, content, and pedagogy, and using this understanding to develop appropriate, context-specific strategies and representations. Productive technology integration in teaching needs to consider all three issues not in isolation, but rather within the complex relationships in the system defined by the three key elements. (p. 1029)

By combining both definitions of technology integration (Hooper & Rieber, 1999; Mishra & Koehler, 2006) and when examining the curricular documents in regard to technology integration, the complementary roles of teachers' pedagogy, practice, and understanding of content-specific knowledge align with the emphasis on pedagogy and practice in the teaching of reading in my study.

**Definition of Terms**

The definitions provided in this section reflect the usage of the terms for this study. I have examined samples of research and professional literature and selected definitions I believe to be most complete and applicable to my study.

Based on the discussion in the previous section, I have arrived at the following definitions for the terms.

**Technological literacy.** Technological literacy entails the ability to find, access, gather, critically evaluate, and communicate information using digital media in ways that are ethical, efficient, appropriate for the task, and replicate problems students might encounter outside of the school environment (British Columbia Ministry of Education, 2006).

**Technology integration.** The meaningful integration of technology in the classroom requires that teachers:

(1) consider the appropriateness of technological tools to curricular objectives or knowledge (Hooper & Rieber, 1999; Mishra & Koehler, 2006),
(2) balance technology use with other pedagogical methods (Hooper & Rieber, 1999), and
(3) plan learning activities that replicate the ways technology is used in society, connect to objectives in other curricular areas, and emphasize problem solving skills (Alberta Learning, 2000b; Prince Edward Island Education and Early Childhood Development, 2010).

## Theoretical Context

This study is situated primarily as a study of reading instruction. The use of educational technology, specifically the IWB, is considered to be secondary to reading instruction. The IWB is an instructional tool that may help to facilitate some parts of reading instruction. My qualified use of the phrase "may help" to describe how IWB use facilitates reading instruction is intentional. The features of reading and effective reading instruction are well-established in the research literature through the support of empirical evidence dating back over several decades. For example, the seminal work on beginning reading by Marilyn Adams

(1990) is considered in the reading field as the most comprehensive, historical, analytical, and theoretical examination of research on reading acquisition. In contrast, theoretical explanations of how technology use enhances the teaching of reading to emergent readers are limited to a discussion of the properties of digital text that may facilitate traditional decoding or comprehension such as digitized sound, graphics, or animations (see Anderson-Inman & Horney, 1998; McKenna, 1998). Others ignore emergent reading skills and focus on fluent readers' use of technology as an information-retrieval and communication medium (see Leu et al., 2004). Unfortunately, many of these theories lack strong empirical evidence, particularly in the absence of control groups or baseline data, focus primarily on technology use rather than on the teaching of reading, or do not address emergent reading in a technological context. For example, wide-ranging claims as to how IWB use promotes interactivity, student engagement, and motivation are made, but no formal, empirically-tested theory of how IWB use supports the teaching of emergent literacy has been advanced. Thus, in the absence of a formal theory explaining how technology use enhances the teaching of reading, it is important to first understand what is known about how children read and how they are taught to read, and then to examine how the theoretical understanding of reading may be applied to the context of technology.

**The Reading Process and Making Meaning**

Much is known about the varied and interconnected processes that work together to enable readers to decode and understand print and many theories and models seek to explain the cognitive and physical aspects of the reading process.

Marilyn Adams' (2004) model explains the physical and cognitive processes that must work together for the act of reading to be successful. She proposed the reading process is systematic, mostly sub-conscious, and based mainly upon pattern recognition. Readers use orthographic, contextual, and phonological cues to form a coherent and meaningful understanding of what has been read. These processes can be taught and practiced until they become automatic and effortless. Children can be taught to recognize letters. Multiple exposures to patterns of letters within words will help them to learn common word patterns and increase their efficiency in decoding words. They can be taught strategies to monitor their comprehension while they are reading and what to do to read and understand unfamiliar words. In Adams' model, the distinction between print-based and digital media would not influence the cognitive functions involved in reading and the actual process of reading would remain unchanged. (Adams' model is explained more fully in the Literature Review). Although Adams' model explained the process of reading, other theories focus on explaining how the brain makes meaning of the symbol system that comprises written language. Adams' model stated that the brain monitors meaning, but others such as Dual Coding Theory (DCT) by Sadoski and Paivio (2004) have detailed how the brain is thought to create meaning from the print.

DCT (Sadoski & Paivio, 2004) is a cognitive theory of memory that was adapted to describe how the brain interprets visual and auditory language in the context of reading and speaking. DCT assumes comprehension while reading is based on mental representations of the concepts being read and these

representations are based on concrete sensory experiences. According to DCT, the brain differentiates between concepts represented linguistically by a verbal code, such as written and oral language, and concepts represented by a nonlinguistic or nonverbal code, such as images, environmental sounds, and memories of tastes and smells.

Sadoski and Paivio (2004) proposed verbal and nonverbal codes are complementary, but function differently in how information is accessed and processed. The verbal code is hierarchical and sequential. For example, letters are organised into words, words are organised into phrases, and phrases are organised into paragraphs. In addition, the verbal code is meant to be accessed sequentially. In English, words are read from left to right and lines of print are read from top to bottom. To do otherwise would compromise readers' understanding of the authors' intended meaning. Sequential organisation is equally important in oral language because word order and conventions of oral language similarly affect listeners' understanding of the spoken message. In contrast, the nonverbal code has a nested hierarchy wherein various levels of sensory images may be present, but the levels are not easily separable. The authors used the example of a baseball bat. Reading the words "baseball bat" might call to mind images of the bat, the ball, the swing of the bat, the sound of the ball hitting the bat, the players, the roar of the crowd, and the taste of a hotdog while watching a baseball game. These images are interconnected and some focus on general sensory phenomena, such as the roar of the crowd, but some are very specific, such as the feel of swinging the bat. The nonverbal code supports the verbal code. In the example presented

above, reading the words called to mind a web of interrelated sensory concepts surrounding baseball and baseball bats, which would allow readers to understand the concept of a baseball bat when they read those words.

Human brains process verbal and nonverbal codes on three levels (Sadoski & Paivio, 2004). The first level, *representational processing*, occurs when the reader encounters print and identifies the features of the print that are familiar, such as letters and words. The second level, *associative processing*, involves the recoding of visual information into verbal codes and the attachment of meaning to those codes by the activation of related concepts that fit the context of the passage. Sadoski and Paivio use the example of the word "single", which has many associated meanings, but in the case of a sentence about baseball, these other meanings are discarded and the appropriate meaning is selected. At this point, the nonverbal code is activated to support the verbal code by offering associated sensory images to support the meaning of the word. The authors refer to this final level of processing as *referential processing*. Thus, associative processing occurs within the verbal code and selects appropriate word meanings, and referential processing occurs between codes and fits the word within the context of the passage being read.

The use of DCT (Sadoski & Paivio, 2004) to describe how the human brain processes linguistic and nonlinguistic information is pertinent to explaining claims that are made about the superior capacity for digital print to enhance decoding and comprehension over the use of traditional print. Anderson-Inman and Horney (1998), McKenna (1998), and others have advanced claims that

digital pronunciations, graphics, and animations available in digital print make it more supportive for teachers to instruct beginning or struggling readers to decode and comprehend print. In DCT terms, these supportive features might be said to offer alternate verbal (digital pronunciations) and nonverbal (graphics and animations) information to support the processing of linguistic and nonlinguistic information readers gather from their reading of the print. Although they acknowledge the capacity for multimedia representations (or multimodal to use DCT terminology) to support comprehension, Phillips, Norris, and Macnab (2010) cautioned that the use of multimedia support should be examined in light of its appropriateness for the objectives of instruction. If the goal of instruction is for students to gain a more thorough understanding of the concept being studied, then the use of multimedia support may allow students to gain a more complete understanding of the concept. However, if the goal of instruction is to improve students' reading abilities, providing multimedia support may be inappropriate, because students may not learn to process and access verbal and nonverbal information independently when the supportive text is not available. The use of an IWB may, in fact, compound this problem with failing to learn to process verbal and nonverbal information independently. Both Anderson-Inman and Horney (1998) and McKenna (1998) emphasized students could access the features of supportive texts independently on an as-needed basis. In whole class contexts such as instruction with an IWB, the teacher would typically access the supported text and students might not learn when it is appropriate to access these features in their own reading (i.e., when experiencing difficulties decoding and

understanding a specific word).

**Effective Reading Instruction**

Teaching and learning are maximized when teachers intend to teach and children intend to learn (Hirst, 1973; Olson, 2010). The formal act of teaching begins with a focus on a goal or outcome. In behavioural terms, this goal might be a perceptible change in students' observable behaviour, for example, an increase in reading rate. Yet, in cognitive terms, this goal might be extended to include a perceptible change in students' current beliefs, attitudes, or understandings. For example, one understanding children might learn is print is read and pictures are viewed. In reading instruction in the primary grades (K-3), the end goal is typically the attainment of basic literacy, defined by Olson (2009) as the ability to read and write, although many short-term and cumulative goals are set and worked towards in the attainment of basic literacy. For effective formal instruction to occur, the teacher must purposefully and intentionally organize instruction that could reasonably be expected to help students achieve the goals of instruction.

The fundamental principles and components of effective reading instruction in the early grades (K-3) are well known and based on a substantive body of research. Students must read at a level appropriate for their abilities (i.e., Brailsford, 2003) and have quality interactions with texts and other materials that interest them. Students who experience success in reading tasks, or in any learning task, experience enjoyment, are motivated to read more and learn more, and have improved self-confidence in their overall abilities (Cameron & Pierce,

1994). It is important instruction be structured and systematic and organized around the attainment of clearly-defined instructional goals (Hirst, 1973; Tams, 2002), but the way in which instruction is structured varies (Greene, 1986) depending on the teaching situation. Eisner (1998) stressed the importance of teachers' judgement in assessing and responding to students' educational needs and planning or adapting instruction to meet those needs. Thus, teachers must have knowledge both of their students and their students' educational needs and of the characteristics of learners in general (Shulman, 1987) in order to organize instruction to effectively meet the educational needs of their students.

Pressley, Wharton-McDonald, Allington, Collins Block, and Morrow (1998) conducted a comparative study of 30 first-grade teachers' literacy teaching practices. At each of 15 research sites, one typical and one exceptional literacy teacher was selected, typically from the same site, and their teaching practices were observed and compared. Pressley et al. highlighted nine characteristics that, in their view, differentiated effective literacy teachers from typical literacy teachers. The exceptional teachers maintained

(1) high academic engagement and competence,
(2) excellent classroom management,
(3) positive, reinforcing, cooperative environment[s],
(4) explicit teaching of skills,
(5) [a] literature emphasis,
(6) much reading and writing,
(7) [a] match of accelerating demands to student competence, with a great deal of scaffolding,
(8) encouragement of self-regulation, [and]
(9) strong connections across the curriculum. (p. 11)

Pressley et al.'s characteristics align well with what is known about effective language arts instruction. Effective literacy teachers expect a high standard of

performance from their students, maintain reinforcing and motivating environments that encourage cooperation and interaction, teach skills explicitly to students, have students practice their reading in authentic contexts, and provide support and encouragement. These characteristics of effective literacy teaching are not specific to print-based literacy; each of these characteristics is attainable through the use of digital texts and digital media.

**Effective Instruction with Technology**

Much is known about the characteristics of effective literacy instruction. For example, the presence of well-defined goals (Hirst, 1973), explicit instruction, frequent practice, and high teacher standards for student achievement (Pressley et al, 1998) characterize good teaching. The use of technology and technological media present novel challenges for teachers, such as lack of teacher facility, training, and comfort with technology that present specific barriers to technology use and integration (i.e., Becker, 1998; Lee, 2002; Moore-Hayes, 2011).

Aside from facility with technology, research has identified qualities and practices of effective teachers who use technology. For example, Eristi (2012) used a questionnaire to poll 46 gifted students in order to determine their degree of agreement with statements about the role of the ideal teacher in a classroom. Six constructs were chosen: teacher as information provider, maintainer of discipline, shaper of students, supporter of students, guide, model, and facilitator of goals. Student responses were analyzed and students most strongly indicated that ideal teachers were guides and providers of information.

Ottestad (2010) examined Nordic teachers' pedagogical orientations and

practices and found innovative teachers value life-long learning and connectedness over traditional goals such as assessment and evaluation. Specifically, they attempt:

- To provide activities that incorporate real-world examples/ settings/ applications for student learning;
- To individualize student learning experiences in order to address different learning needs;
- To foster students' ability and readiness to set their own learning goals and to plan, monitor, and evaluate their progress;
- To foster students' collaborative and organizational skills for working in teams;
- To provide opportunities for students to learn from experts and peers from other schools/countries;
- To foster students' communication skills in face-to-face and/or online situations; [and]
- To prepare students for responsible Internet behaviour. (p. 482)

The qualities of effective teachers identified by Ottestad (2010) value problem-solving, goal-setting, collaboration, communication, and applicability to the world outside the classroom. These qualities are particularly relevant to the use of the IWB because it can serve as one point of contact between the classroom and other schools, and countries by way of the Internet.

**Interactive Whiteboard Use in Reading Instruction**

Despite the well-established body of empirically-supported research explaining how children read and construct meaning and how teachers best instruct them to read, many children continue to experience difficulties in learning how to read effectively. Some proponents of the use of technology to support instruction perceive IWB use to be one solution for supporting and motivating young readers as they develop their skills with reading. Often, theorists, such as the New Literacies group (Leu et al., 2004) focus on the act of reading as an

information-gathering activity for fluent readers and do not address both how technology use influences the act of reading for young, emergent readers and how reading research explains the reading act from a cognitive and developmental perspective.

My study emphasizes the use of technology as a tool to support the teaching of reading. In theory, it seems reasonable to presume that IWBs, used in a manner that complements effective reading instruction, can be effective tools in the teaching of reading. This presumption aligns with the TPCK model (Mishra & Koehler, 2006) which advocates for the consideration of the complementary relationship between and among teachers' knowledge of technology use, pedagogy, and content. In terms of general benefits for students, existing claims about the potential value of IWBs to teaching and learning point to the enhanced engagement, motivation, and interactivity inherent in IWB use (see Haldane, 2007; Mohon, 2008; Quashie, 2009). For example, researchers have highlighted the "slickness of presentation" (Haldane, 2007, p. 261) of information on the IWB as a feature that enhances student engagement. Claims of the beneficial nature of IWB use in instruction are based on a socio-cognitive perspective of language learning wherein the premise is that when students engage in social interactions with peers and literate adults (Labbo & Kuhn, 1998) they practice and internalize reading behaviours and ultimately come to understand what they are reading. Specific claims as to whether and how IWB use benefits reading instruction are not made. However, if IWB use promotes interactivity, engagement, and motivation, and most importantly if IWBs are used in a manner that bolsters the

teaching and learning of specific aspects of reading, then it is logical they should be used in instruction. Thus, understanding how IWB use affects teacher pedagogy in reading in the primary grades is an area of increasing interest. Children who become proficient readers have a good foundation in emergent literacy skills, often learn these skills in the home prior to formal reading instruction (Ferreiro & Teberosky, 1982), and often have shared many formal and informal reading experiences with their parents or caregivers who teach them about the properties of print (Sénéchal & LeFevre, 2002). Examination of how teachers use the IWB to support emergent literacy skills as students transition towards the development of more sophisticated literacy skills is consequently of great importance, especially in the absence of a formal theory explaining how IWB use enhances reading development.

As stated in the introduction to this chapter, the purpose of my study is to examine how IWBs are integrated into reading instruction and changes that occur in teachers' pedagogy in reading instruction. Thus, the focus of study is on reading instruction and the secondary focus is on how teachers use the educational tool (the IWB) to enhance their teaching. The purpose of the study is neither to critique teachers' pedagogy nor to provide an argument for or against teachers' use of the IWB as an educational tool to support their teaching of reading. Instead, teachers' use of the IWB is documented and explained, specifically the duration and types of use and a comparison of occasions where the IWB was used and not used for instruction.

There is limited research literature available that addresses pedagogical changes thought to occur with IWB use, and much of the research is limited in scope or contradictory. Likewise, empirical research about how IWB use supports reading development is lacking, although many claims about the benefits of technology use and IWB use in general are made. Chapter 2 provides a review of the literature surrounding reading and the literature surrounding technology (and IWB) use. My purpose is to explain what is known about reading development and to discuss whether and how the literature on technology and IWB use supports what is known about reading and reading development.

# Chapter 2: Review of the Literature

The research reviewed is relevant to the central concepts of reading instruction, technology use, and pedagogy addressed in my study. The review is presented in five sections. The first, Literacy Development, provides a review of definitions of literacy and theoretical perspectives about how children learn to read. The second, Reading Instruction in Contemporary Language Arts Classrooms, provides a description of reading instruction in the instructional programs used at the participating school. The final three sections are arranged to align with topics pertinent to the three research questions: teacher pedagogy, benefits to pedagogy claimed through IWB use, and teacher training.

## Literacy Development

Traditionally, literacy has been defined as the ability to read and write fluently. In Canada, schools are responsible for formal reading and writing instruction, and literacy instruction typically begins during the first grade. In the current section, I speak to both literacy and reading, two terms that at times are used interchangeably by others. First, I discuss literacy and conceptions of literacy as the skills required to interact with print in a meaningful way, and which might include reading, writing, and other skills. Then, I discuss theoretical models of the reading process, the role of technology in reading instruction, and the role of the teacher in teaching reading with technology.

In recent times, researchers have described various types of literacy, with a particular focus on skills required to read and write fluently in different contexts. For example, Olson (2009) differentiated between basic and advanced

literacy in his discussion of schools' literacy policies. Most students attain basic literacy, or the ability to read and write, in the primary grades (K-3). Olson wrote, "… If we define literacy strictly in terms of the ability to read and write and ignore fixed standards and content, school literacy programs are successful. By the fourth grade, most children can read and write to some basic level" (p. 567) as long as students are able to master the relationships between print and sound. Olson argued this definition of basic literacy ignores how well (i.e., to what standard) and what (i.e., the content) children should be able to read in order to be considered literate. He proposed literacy development continues into adulthood as students learn more advanced literacy skills. Advanced literacy may be defined as an "acquaintance with literature" (p. 568), meaning students become familiar with many different genres of writing and types of writing conventions as well as with specialized literate traditions. For example, literacy skills required to read and understand a legal treatise differ from literacy skills required to read and understand a medical textbook. Advanced literacy skills are, "… reflective skills with language that allow one to express thoughts that are largely or uniquely associated with literacy and a literate tradition. [Advanced literacy] involves a grasp of conventions, only some of which are marked in the orthography that have evolved over time" (pp. 568-569). Thus, advanced literacy incorporates basic literacy, but extends beyond basic literacy skills to a more sophisticated understanding of written language and writing conventions that allow greater participation in the literate society.

Olson (2009) identified several conventions of reading and writing highly

valued in Western literate societies which schools are responsible for teaching to students. The first convention is the relationship between oral and written language. Specifically, speech may be written down and what is written may also be spoken, however; written language often utilizes more complex grammar than oral language. Another convention is written language is a symbol system that represents language about objects and does not represent objects. In Olson's view, the conventions of literacy and language use help to make language predictable and to hold literate society together (p. 572). Since schools are the main institutions responsible for teaching basic literacy skills to children in Canada and in many countries world-wide, international studies of basic literacy often use years-of-schooling as a variable for comparing literacy levels in various countries around the world (p. 568).

Literacy is an important skill in contemporary society and the benefits of adult literacy to society have been cited for many years. Wagner (2009) explained, "For several centuries, it has been variously claimed that literacy – a key (if not *the* key) product of schooling – would lead to economic growth, social stability, a democratic way of life, and other social 'good things'" (p. 548), yet nearly 50% of adults have inadequate literacy skills. The social and cognitive benefits of literacy for children are many and may be covered by the phrase "literate thinking" (Olson, 1996). Literate thinking affords a sophistication of thinking about language that is not specific to print-based literacy and may also incorporate cultures with oral language traditions. However, for the purposes of this study, I examine literacy in the context of the reading of print. Literate

individuals have a deeper understanding of and ability to use oral and written language than individuals who are illiterate. An example Olson used to demonstrate the differing levels of complexity of understanding of language between literate and illiterate individuals was that people who know the alphabet tend to think of sounds in oral language as being composed of letters, and this thinking allows literate individuals to manipulate sounds in order to form words (pp. 146-147). Literate individuals are also better able to make inferences, consider implications of what they read or hear, and make judgements about the validity of arguments than their illiterate peers (p. 148). In reviewing Olson's conclusions, it is clear literacy alters the very way in which individuals think and how they process and use both oral and written language.

**The Reading Process**

Many theories have been advanced to explain how children read and how they learn to read, but no unified theory of reading has been proposed (Sadoski & Paivio, 2007). Most theories of reading acknowledge the central role of the process of meaning-making to reading. Theories differ on the role and relative importance of knowledge from the print and from the reader's experiences, knowledge, and background all of which are relevant to the construction of meaning in the context of the text and to the meaning of the passage being read. Reading is a complex skill and in many cases, theories of reading acquisition focus on discrete aspects of the reading process, not on the entire process of reading. For example, neuroscientists, such as Petersson, Ingvar, and Reis (2009), seek to understand how reading is experienced in the brain and how literate

individuals differ from illiterate individuals in their brain development. Other researchers, such as Olson (1996), investigate and compare literate individuals' reading comprehension and language use against the comprehension skills and language use of illiterate peers. And, still others focus on teaching children decoding skills without emphasizing reading as a meaning-making activity, particularly for children who struggle with learning to read (e.g., Juel & Minden-Cupp, 2000). In this section, I review three differing theoretical positions related to reading in order to highlight the debate amongst researchers about how readers read.

Adams (2004) proposed a model of reading to explain the central role of word recognition in the reading process. Adams' model attempted to explain fluent readers' behaviour, specifically how skilful readers seem to recognize familiar words as wholes while, at the same time, they visually process the letters in the words they read on a subconscious level. If words they read are misspelled, however, readers become consciously aware of the letters they are reading. While readers are reading, they sift through the various meanings of the words they read and select the most appropriate meaning for the context of the sentence. This process also occurs at a near subconscious level, and readers closely attend to multiple word meanings only when they encounter unexpected words while reading. Finally, fluent readers often translate written words into sounds as they read.

In her model, Adams (2004) proposed that four processors work together to monitor meaning as readers read. The processors are interrelated and work

together to process cues from written language. First, the *orthographic processor* processes the written language. This processor is responsible for decoding the printed word in a systematic manner. In English, reading proceeds from left to right as readers read from word to word and from line to line. Adams asserted the eye is able to recognize approximately three letters at once but also scans ahead to look for known patterns of letters in words, particularly patterns that indicate syllable breaks in words. More capable and practiced readers recognize longer patterns in words and read more efficiently. If no unexpected patterns are encountered by the orthographic processor, the *context processor* monitors the meaning of the words in an attempt to "construct a coherent, ongoing interpretation of the text. In particular, [the context processor] is responsible for priming and selecting word meanings that are appropriate to the text" (p. 1230). The context processor selects word meanings that fit the context of the sentence and may revise the interpreted meaning of the sentence when unexpected words are encountered. The context processor supports the orthographic processor and makes reading quicker and more efficient, but the function of the orthographic processor (i.e., decoding printed words) overrides the function of the context processor (i.e., the creation of meaning through using sentence context) in cases where the reader encounters unexpected words. In these cases, readers decode the word, rather than rely on sentence context.

The meaning processor is central to understanding print, and is supported by the orthographic, context, and phonological processors (Adams, 2004). The *meaning processor* uses the meanings of familiar words and patterns within words

to identify the meanings of words, particularly longer words that incorporate prefixes and suffixes, by breaking words into smaller units of meaning and comparing the meanings to word patterns already known. The *phonological processor* translates written symbols into sounds as readers are reading. The phonological processor acts as a redundant back-up system for the orthographic processor and helps improve readers' running memory as they read. Readers' running memory enables them to remember words and meanings of the words read, in order to increase overall comprehension of the passage. Far from being unnecessary, the phonological processor is important because it works with the orthographic processor to establish the familiarity of the word.

> To the extent that any word is both orally and visually familiar, this process ensures that the meaning processor will receive activation from *both* the phonological and orthographic processor. As these contributions support and interact with one another, they serve to ease and speed recognition of the word. (pp. 1235-1236)

When words are familiar and their meanings are known, reading proceeds efficiently. When unexpected words or meanings are encountered, these processors work together to identify words and resolve the meaning of the passage.

In contrast to the model of reading proposed by Adams (2004) that focused on the recognition of words and word meanings, Goswami (2009) used evidence from neuroscience studies to propose a theory of reading acquisition across languages, with an emphasis on phonological awareness and the development of readers' cognitive skills. According to Goswami's theory, beginning readers focus heavily on their understanding of phonology. Goswami

asserted children's phonological awareness, or ability to detect and manipulate the component sounds of words at the syllable, onset – rime, and phoneme (individual unit of sound) levels was the strongest predictor of how well children learn to read and spell. Although phonemes correspond to alphabetic characters in languages with complex orthographies, such as English, syllable-level phonological processing is used more often in most languages in order to read words (p. 136). Children often learn syllable-level phonological awareness skills prior to formal reading instruction, but typically do not develop phoneme-level phonological skills or the ability to represent individual sounds in spoken language with letters from the alphabet until formal reading instruction begins (p. 136).

Once children have a basic understanding of phonological awareness and begin reading instruction, their phonological awareness becomes much more sophisticated and they use their grapheme-phoneme knowledge (i.e., knowledge of the correspondence between letters and the sounds they represent) to read new words they encounter, particularly in languages with consistent orthographies (Goswami, 2009, p. 138). In languages such as English, where orthographic patterns are often inconsistent and syllable structures are complex, learning to read may be a more difficult task than in languages with consistent orthographies. In addition, Goswami reasoned:

> it is … difficult to learn a set of grapheme-phoneme relationships as a basis for decoding new words because the relationships that must be learned are rather variable. English is particularly ambiguous with respect to both spelling-to-sound and sound-to-spelling relationships … because in English, a single letter or letter cluster can have multiple pronunciations. (p. 138)

In orthographically consistent languages, the rules governing the relationship

between symbols (grapheme) and sounds (phoneme) are less variable and are therefore easier to learn. If, as Goswami asserted, phonological awareness at the syllable and phoneme levels is the strongest predictor of later reading acquisition, it is logical to assume that in languages such as English, where the grapheme-phoneme correspondence is more variable, learning to read is more difficult.

In addition to theories and models of reading that emphasize the role of word recognition for understanding (Adams, 2004) and phonological awareness (Goswami, 2009), a third perspective emphasizes the role of decoding in the reading process. Decoding is the process by which children use letters to read words, similar to Adams' orthographic processor. In their study of four first grade teachers' instructional methods for teaching reading, Juel and Minden-Cupp (2000) noted the types and frequencies of activities each teacher used to teach low, medium, and high achieving readers. Instructional methods varied greatly between the four classrooms. In one classroom, the teacher emphasized group reading and direct word instruction. In another, students read in groups and worked on phonemic awareness activities. In the third, students moved around the classroom, selected their own books and read individually or in pairs, and the teacher used peer coaching to teach word recognition. In the fourth classroom, the teacher differentiated instruction between lower, medium, and higher achieving readers: less proficient readers engaged predominantly in phonics and decoding instruction (39% of the time) and read from texts 17% of the time. In contrast, proficient readers predominantly read from texts (42% of the time) and received phonics instruction 8% of the time.

Juel and Minden-Cupp (2000) found the least proficient first grade readers in the four classrooms (in September of first grade) were unable to identify all of the letters of the alphabet, demonstrated a poor understanding of the concept of words, showed poor phonemic awareness, and could not read any of the words in the assessment instrument. By May of their first grade year, the least proficient readers in the fourth classroom, who initially received the most instruction in phonological awareness and decoding strategies, showed significantly greater improvement in their reading skills than similar students in the other classrooms. On the May assessment, the lowest achieving readers in classroom four were reading, on average, at a level of skill consistent with children at the end of second grade as measured by the assessment instruments. Children in classroom three were reading at a level consistent with the middle of second grade, children in classroom two were reading at a level consistent with the end of first grade, and children in classroom one were reading at a level consistent with the preprimer, or early reading level. Unlike children in the other classrooms, who read more frequently from texts, the children in classroom four were instructed in phonics and used letters to read the words. However, by May, children in classroom four were reading words more accurately than similar students from other classrooms who received different types of instruction.

Juel and Minden-Cupp (2000) argued their results provide evidence for two important findings. First, directly teaching phonics and decoding skills to struggling readers at the beginning of first grade may help these students to improve their reading skills significantly. The children in the fourth classroom

were not reading words in context, nor was the instructional focus on reading for meaning. Instead, the teacher focussed on words and how to decode them. Second, differentiated instruction is vital to supporting readers' development. Students in classroom four who named all or most of the letters of the alphabet, had a concept of a word, and read some of the words in the initial assessment, received instruction focussed on reading in context because they did not require intensive phonics training to decode words.

The work of Adams (2004), Goswami (2009), and Juel and Minden-Cupp (2000) confirms reading is a very complex cognitive and sociolinguistic process. Adams' focus on the complementary roles of decoding and word recognition for meaning-making contrasted Goswami's focus on phonological awareness and Juel and Minden-Cupp's focus on decoding words. None of these researchers differentiated between different types of text children read, whether traditional paper-based texts or electronic texts. New Literacies proponents, such as Leu et al. (2004), claim the medium influences how children read. Leu et al. (2008), for example, demonstrated readers of electronic texts rarely proceed in a more or less linear manner as one might read a book, and instead, may search for information on a search engine, read part or all of the pages they find, and use hyperlinks to visit other sites related to what they originally were reading. Leu and his colleagues claim the process of reading electronic media (such as on computers) is fundamentally different from the process of reading traditional paper-based texts because reading using electronic media is predominantly a non-linear, information-seeking activity rather than a linear activity. However, it is important

to note Leu and his colleagues studied children in seventh grade who were most likely fluent readers. Canadian Programs of Study, such as Alberta Learning (2000b) and Prince Edward Island Education and Early Childhood Development (2010), expect all students to locate, evaluate, and utilize information gathered from electronic sources, not only those students who are proficient readers.

Teachers' perceptions about how children learn to read influence their instructional practices regardless of the medium such as the IWB or paper-based books. Thus, having an understanding of what teachers think or claim about how children learn to read is helpful in understanding their pedagogy and practice when they teach their students to read, especially since this is the focus of my study.

**Technology and Reading Development**

Computer technology has a long history of being used to teach or drill young children on reading skills (Becker, 1998). The use of technology in reading has recently been the focus of increased research, particularly with the advent of the New Literacies theories (for example, Leu et al., 2004). New Literacies studies address reading, but they also address writing and other modes and methods for communicating information. Thus, in this section the term literacies is used in place of reading when addressing the range of skills, including reading, addressed by New Literacies and other studies of literacy with the use of technology. Burnett's (2010) meta-analyses of 36 recent studies of technology and literacy instruction was organized around three categories to reflect the ways in which researchers portrayed the role of technology within literacy instruction.

Approximately two thirds of the studies described the use of software to support print-based literacies, and Burnett labelled this category *Technology as a Deliverer of Literacy*. Two less frequently used roles for technology focussed around *Technology as a Site for Interaction around Texts*, reflecting a socio-cultural model of literacy that highlighted collaboration between young readers and writers, and *Technology as a Medium for Meaning-making*, reflecting the topics of motivation, community, and identity.

**Technology as a deliverer of literacy**. Burnett (2010) criticized what she perceived as the scarcity of research into technology and literacy at the youngest ages and the predominance of psychological-cognitive models of literacy in the little research available. The studies categorized as psychological-cognitive studies by Burnett focused on using computer technology to teach traditional paper-based literacy skills. Often these studies focused on using software to drill or assess students on isolated skills, although some studies offer descriptions of how software is used in classroom teaching. Software used in psychological-cognitive studies address skills such as phonological awareness (Bishop & Santoro, 2006; Fasting & Lyster, 2005; Littleton, et al., 2006), letter names (Connell & Witt, 2004), vocabulary use and development (Gill, 2007), and reading fluency and comprehension (Sorrell, Bell, & McCallum, 2007). Many studies employ quasi-experimental methodologies, such as Fasting and Lyster (2005) and Sorrell, et al. (2007). Quasi-experimental studies focus predominantly on the degree to which programs are effective in teaching the selected skills by measuring achievement on pre-test and post-test measures. Other researchers

provide descriptive accounts of students' use of software (for example, Gill, 2007) or help teachers to select appropriate software by evaluating how well the programs address instructional goals (for example, Bishop & Santoro, 2005, 2006).

In their analysis of the 47 software programs authorized by the Ministries of Education from across Canada for teaching reading and writing to young children, Lovell and Phillips (2009-10) found of the 13 programs available for purchase, only three addressed reading skills. These programs, *A to Zap!* (Sunburst Technologies, 1998), *Bailey's Book House* (Riverdeep Interactive Learning Ltd., 1995), and *Reader Rabbit I Deluxe* (The Learning Company, 1994), were designed for commercial use, not for use in educational settings. They adapted Bishop and Santoro's (2005, 2006) criteria for assessing *interface design*, *content*, and *instructional design*. All three reading programs adequately met or exceeded expectations in interface design, that is, the interfaces were easy for children to use independently, interactive, and offered appropriate support for children to learn how to perform the activities. The programs directly addressed the reading skills they claimed to address, and adequately met the expectations for content. However, some programs, particularly *A to Zap!* addressed numerous unrelated skills and did not deal with any skill thoroughly. The programs scored lower on instructional design, particularly in the areas of informing students about learning outcomes, assessing and tracking students' performance, planning for instruction, and offering remedial assistance when children made errors. Lovell and Phillips concluded these programs were non-instructional tools used to assist

students in practicing reading skills they already possessed.

Grant, Wood, Gottardo, Evans, Phillips and Savage (2012) developed a taxonomy of reading skills based on existing research in the area of early literacy. They identified 9 reading skills and 45 sub-skills and placed these in order of approximate age of acquisition for children, beginning with *Print Knowledge* (2.5 to 5.5 years of age) and ending with *Text Comprehension* (7 to 12 years of age). Grant et al. then applied their reading taxonomy to 30 commercially-available software programs intended to teach reading skills to young children (10 preschool programs, 13 kindergarten programs, 7 first grade programs) in order to determine whether skills being taught were appropriate developmentally. Additionally, they evaluated the quality of the programs and the opportunities for scaffolding afforded by each. Overall, few of the 45 sub-skills were addressed in the software titles and coverage of the various skills was inconsistent. Those skills that were addressed followed a general developmental progression, although not all skills presented were appropriate developmentally for the recommended ages of users. Lower level skills such as phonics and letter knowledge were trained more frequently than higher level skills like comprehension. The quality of instruction in these programs varied considerably and most received poor ratings. Some programs, typically phonological awareness programs, offered increasing levels of difficulty if children performed well, although this feature was not available for many skills such as concepts of print, fluency, and text comprehension. Additionally, only 5 of the 30 programs were designed to move automatically across levels of difficulty in response to children's progress. In the

summary of their taxonomy, Wood, Gottardo, Grant, Evans, Phillips, and Savage (2012) suggested parents and by extension teachers, if they use these programs in schools, should be aware of the shortcomings of individual software programs in instructional content, program design, and potential for scaffolding. Furthermore, they suggested that the use of multiple software programs at different ages might provide more comprehensive instructional support for the development of early literacy skills than would be possible with only one program.

The research of Lovell and Phillips (2009-10), Grant et al. (2012), and others (such as Bishop and Santoro, 2006) into the nature and efficacy of reading software for teaching reading skills highlight several important points. First, these programs deal with reading skills in isolation. In contrast, Adams' (2004) model of reading was premised on the understanding the reading process is extremely complex and requires that readers use many different skills simultaneously to read effectively. Specifically, readers use visual recognition of letters and patterns of letters within words, consider word-level meaning and overall context, and sound out words using phonological awareness skills and knowledge of grapheme-phoneme correspondences. Hence, software programs, such as the drill and practice programs analyzed by Lovell and Phillips or the letter recognition program used to teach letter names to 5-year-old students in the work of Connell and Witt (2004) address only part of the reading process and the skills may not generalize to reading in other contexts. These programs are not intended for instruction in a whole-class situation. Either the software are games meant for individual use and entertainment (Lovell & Phillips, 2009-10), or for intervention

or experimental studies (Connell & Witt, 2004).

Burnett (2010) criticized studies that treat technology as a mere delivery system for traditional literacy skills. In particular, she was critical of the assumptions made about the students' learning of literacy in psychological-cognitive studies that approach literacy learning as a set of skills to be mastered:

> Designed to support particular skills, they position literacy learners as passive recipients in the learning process and, in so doing, may influence how children (and their teachers) see the process of literacy learning and their role within this. (p. 262)

Burnett offered no research evidence to support her assertion that using software to deliver instruction in isolated literacy skills would lead to students being passive recipients in the learning process. Certainly, students using the reading games reviewed by Lovell and Phillips (2009-10) or those used by teachers in Gray, et al.'s (2005) study of second language teachers' use of the IWB would not be considered passive. Although the appropriateness of the instructional design of these software programs was questionable, especially those reviewed by Lovell and Phillips, these programs were designed to hold students' interest while they worked to solve problems related to the skills being practiced and required students' active input and participation.

The relevance of the use of technology as a delivery method for traditional literacy skills (Burnett, 2010) is apparent in my study. In the early years of formal reading instruction, teachers often use direct and explicit teaching of isolated skills and strategies. For example, in Brailsford's (2003) *Balanced Literacy* program, skills such as sight-word identification, decoding, and phonological awareness are taught in isolation and only some are practiced in reading contexts.

These skills are associated with Olson's (2009) concept of basic literacy. Juel and Minden-Cupp (2000) found low-performing students who received direct, explicit, and intense instruction in phonics at the beginning of first grade out-performed low-performing students who received other types of instruction on measures of reading, even those students who experienced student-directed learning, peer coaching, and frequent practice reading books. Juel and Minden-Cupp's findings call into question Burnett's assertion that traditional modes of instruction and, specifically, the use of technology to teach traditional print-based literacy skills, is detrimental to students' reading development. If teachers of young students use IWBs in reading instruction, typically at least some of their instruction will focus on teaching isolated skills using the IWB.

**Technology as a site for interaction around texts**. Burnett's (2010) preference for the socio-cultural emphasis of her final two categories was evident. She highlighted students' active role and the role of their prior knowledge and experiences in the collaborative experience of using computers to read digital texts:

> A focus on the computer as a site for interaction highlights the materiality of technology in the classroom, the physical relationship between the children and screen. Here, the *computer* can be seen as acting through its material presence. Designed for individual use, it holds the children in a particular relationship with itself and each other; as they gather round they must negotiate how to manage keyboard, screen, and mouse within the shared space. However, again interactions are acted upon by children who may draw on experiences from beyond the classroom in managing such encounters. (p. 263, emphasis in the original)

Burnett focussed on the role of collaboration and background knowledge and experiences in the act of using the computer to collaboratively read digital texts.

Unfortunately, only one of the studies Burnett (2010) reviewed addressed the use of the IWB for literacy instruction and the study was not included in this category. Thus, it is unclear whether the image of students crowded around a screen, negotiating the use of the keyboard, screen, and mouse as they read together is appropriate for discussing how the IWB is used in reading instruction. However, the potential of the IWB to be an interactive (whether directly or vicariously) and collaborative tool has been highlighted in the work of several researchers, such as Haldane (2007), Mohon (2008), and Quashie (2009), although these researchers were not addressing beginning reading instruction using the IWB.

Burnett (2010) explained when viewed as a site for interaction with digital texts, technology use reflects "… a socio-cultural model of literacy, seeing children's engagement with digital texts as patterned by and contributing to the classroom culture" (p. 257). Students participating in the studies selected for the Technology as a Site for Interactions around Text category were actively engaged in collaboratively reading texts and constructing meaning of what they had read.

The use of Burnett's (2010) category of Technology as a Site for Interaction around Texts is problematic when discussing how the IWB is used in reading instruction in the primary grades. First, unlike using a classroom full of computers in a lab, it is difficult for all students to have regular tactile interaction with the IWB, because the IWB will respond to one touch only at a time. For example, in order to use the IWB most efficiently in her classroom, Mohon (2008) often used didactic, teacher-centered instructional methods in opposition to

her socio-constructivist stance and in 10 of the 39 lessons, students had no tactile interaction with the IWB. Second, the use of computers and IWBs in meaningful, collaborative ventures presumes students have some understanding of how to read the information displayed. In a program like *Balanced Literacy* (Brailsford, 2003) that emphasizes using reading materials based upon students' independent and instructional reading levels and using teacher-directed activities, it is possible to use the Interactive Whiteboard as a medium for independent practice and whole-class instruction. It may be Burnett's focus on technology as a means for collaboration and interaction with digital texts is possible with IWB use in reading instruction even though teacher-centered and teacher-mediated instruction is frequently reported (i.e., Mohon, 2008; Quashie, 2009).

**Technology as a medium for meaning-making**. Burnett's (2010) third category focussed on the use of digital text to create meaning that goes beyond the text and the classroom context and included such concepts as community and identity. This third category appears to deal with the nature of reading as an information location, gathering, and communication tool, especially with the advent of the Internet. Burnett commented on the nature of knowledge (as gained through reading) in the age of Internet use:

> The Internet brings with it assumptions about the nature and location of knowledge which may not sit well alongside notions of fixed knowledge associated with traditional models of literacy provision. This raises questions about what happens as bounded classrooms are connected to diverse and fluid networked spaces with new possibilities for presenting, exchanging, and making meaning. (p. 263)

Burnett's comments addressed the very nature of knowledge, particularly where the information children read originates and how children use information to co-

construct meaning with others. It is unclear whether her comments were meant to imply the Internet changes how humans perceive the nature of knowledge, or, in fact, whether she was referring merely to how humans access information and the quantity of information available. In some ways, Burnett's comments align with the wider concept of advanced literacy Olson (2009) described as a familiarity with and ability to understand various specialized writing genres and conventions characteristic to different literary traditions. If digital information, particularly texts written for and accessed from the Internet, is considered a literary tradition with its own genres and traditions, then Burnett's category could, indeed, be considered to address advanced literacy as it pertains to digital information accessed from the Internet. However, there is little evidence in New Literacies research that digital stories, for example, are considered to be a distinct genre. A few case studies, such as Littleton et al. (2006) have examined digital storybooks, however the use of these books with IWBs is largely unexamined in research literature.

Burnett's (2010) comments align most closely with the theories surrounding New Literacies, such as those advanced by Leu and his colleagues (2004). Although they spoke briefly about the basic literacy skills associated with reading (and writing), Leu et al. have promoted the view reading in a digital environment is primarily an information location, evaluation, synthesis, and communication activity. According to this view, the most important reading skills that students must possess for accessing digital information are the ability to search for appropriate information for the task and evaluate the trustworthiness of

that information. Provincial Programs of Study also support the use of technology as a medium for gathering, evaluating, and communicating information (i.e., Alberta Learning, 2000b; British Columbia Ministry of Education, 2006; Ontario Ministry of Education, 2006).

With its socio-constructivist stance emphasizing the social nature of reading through the co-construction of both meaning and reader identity, Burnett's (2010) third category is at odds with the emphasis on psychological-cognitive theories of reading that dominate the studies she analyzed. Whereas most studies dealt with teaching skills and strategies useful for reading using either paper-based or digital media, the studies in the third category dealt with skills unique to digital media, such as accessing the Internet and being part of online communities outside of the classroom through email. Similar to the category Technology as a Site for Interaction around Texts, students must have some proficiency with reading print in order to locate information independently (especially information from the Internet), synthesize and analyze the information, and communicate with others. The methods through which students who have not mastered basic literacy skills could effectively access information on the Internet independently, for example, were unclear. In the context of studies such as my study, with teachers at the earliest grades (K-3) who instruct students that have not mastered basic literacy skills, it is unclear to what degree students could use the IWB independently to locate, evaluate, synthesize, or communicate information as advocated by Leu et al. (2004). Even in the unlikely event that these types of reading activities did occur in the early grades, it is likely only the

teacher and a few students would be engaged directly with this activity on the IWB, whereas most students' interaction with the IWB content would be vicarious from their seats (Quashie, 2009).

**The Role of the Teacher in Teaching Literacy with Technology**

Olson (2010) criticized much educational research for ignoring the role of teachers and teaching and focussing on students and learning. Indeed, Burnett's (2010) categories focus on and promote the role of students as active learners and not passive participants of literacy education, yet the role of the teacher is not explained. In classrooms using IWBs, however, some researchers report teachers have the most frequent physical contact with the IWB (see Mohon, 2008; Quashie, 2009). Thus, it is important to understand the teachers' role in the teaching of literacy using technology.

Schmid, Miodrag, and Di Francesco (2008) examined how young children interacted with both software and adult tutors when they were using a software program designed to teach beginning decoding and phonological awareness skills, specifically letter sounding, sound blending, and sound segmentation. The study was designed to be an intervention study for young children deemed to be at-risk for not learning how to read. Schmid et al. asserted, "Today's schools are moving away from traditional, didactic classroom applications and towards the use of sophisticated, computer-based approaches that utilize the Internet and educational software to support learning" (p. 64). The researchers used an electronic performance support system (EPSS) to observe whether and how the use of this software influenced the tutoring process while tutors worked individually with

eight five-year-old children for twenty minutes daily over the course of two weeks. The tutors' role was to assess the children, plan lessons to meet needs identified in the assessment, and to provide instruction, support, and guidance during the lessons.

The main themes arising from Schmid et al.'s (2008) data were *rapport*, *motivation*, and *instructional scaffolding*. The tutor was always in control of how the lesson proceeded, especially through following the lesson plan and redirecting children's focus to the activity when required. The researchers described how tutors established *rapport* with children through greeting them, offering encouragement and acknowledgement, and adapting feedback to address areas of the lesson where individual children encountered difficulty. The researchers claimed tutors helped provide *motivation* for learning. Children were generally excited to engage in the activities with the computer, but the tutor helped foster and sustain motivation by offering praise and instructional support and by varying motivational strategies to suit children's individual needs for affective support. Tutors' rapport with the children was the main method by which they helped motivate students to persevere when they experienced difficulty. Of importance to my study, Schmid et al. remarked:

> No EPSS can detect and intervene when a child needs that additional, inventive form of help; clearly, this can only be provided by human interaction. In several instances, children would turn to the tutors to ask for clarification despite already hearing the program's instructions. Tutors judged what they needed to do in order for the child to understand instructions, such as repeat words slowly, change their tone of voice, and simplify language. Other times, children who were clearly not mastering the activities and merely guessing at answers were observed trying harder when the tutor provided additional words of encouragement. (p. 75)

Schmid et al.'s observations highlight tutors' judgement as one area where teachers are more effective than technology for instructing students. In an instructional context (such as my study) where students are young, have limited proficiency with reading and technology use, and are less able than older students to articulate what type of instructional support they need, a tutor's or a teacher's judgement on how to orient students to the task, modify instruction to meet individual needs, and offer task-specific feedback and support is vital. Schmid et al.'s third theme was *instructional scaffolding*. Specifically, although children relied on the software to monitor and adjust instruction to support their learning of the cognitive tasks (i.e., sound identification, blending, and segmenting), they relied on the tutor for task orientation and intervention when necessary.

Clearly, human support (a teacher or tutor) is required when using technology to teach, even for programs designed to be used independently by students. Teacher intervention, feedback, and support may be needed in these situations to adjust the activity to meet student needs. Thus, as Hirst (1973) observed, even the most sophisticated and well-programmed teaching machines cannot replace the teachers' role in teaching. Research such as that conducted by Schmid et al. (2008) has highlighted how important teachers' intentions and intuitions are in increasing the efficacy of instruction. Schmid et al. did not conduct their research with an IWB, instead, they examined one-to-one tutoring with a computer software program. However, the IWB is another technological tool used to facilitate reading instruction, but in a whole-class teaching context, and thus the teacher has a similar, if not more central, role in determining how the

IWB is used as an instructional tool and ultimately how content is learned.

## Language Arts Instruction in Contemporary Language Arts Classrooms

The nature and practice of reading instruction is undergoing change. Varying and contradictory ideologies and practices such as those explained later in the current section and new technologies such as IWBs and iPods compete within the current educational market. Thus, it cannot be assumed reading instruction is uniform throughout the country, the province, or even within a school. Before highlighting ways in which teachers' pedagogy has changed, it is important to examine and describe classroom practice prior to IWB instruction or without the use of IWB.

The setting for my study is primary grades (K-3) Language Arts classrooms in central Alberta. Teachers in Alberta are required to follow the *English Language Arts (K-9) Program of Studies* (Alberta Learning, 2000a) in which learning outcomes address six language arts: reading, writing, speaking, listening, viewing, and representing. The program of studies does not mandate specific pedagogies, however, two competing instructional programs, the *Balanced Literacy* Program and the *Cogito* Program, both developed within Edmonton Public Schools and shared with other jurisdictions in Alberta, were used in the participating school.

### Balanced Literacy

The *Balanced Literacy* program (Brailsford, 2003) is one of the most influential instructional programs for literacy in central Alberta. Classroom teachers in many school boards are encouraged or required to use the *Balanced*

*Literacy* program to teach reading. Implementation of the program varies and some teachers adapt or select parts of it as a basis for their language arts instruction in conjunction with the *English Language Arts (K-9) Program of Studies* (Alberta Learning, 2000a) and thus, *Balanced Literacy* in whole or in part, may be considered to be the norm for schools in central Alberta and particularly in the school division where the participating school is located. Brailsford designed her program to balance direct phonics instruction and literature-based approaches to reading and incorporate research-based, effective teaching practices.

Brailsford (2003) identified twelve tenets for the *Balanced Literacy* program that outline the important and desirable principles of teaching to occur in classrooms. Specifically, the goal of Language Arts instruction is to assist students to become independent learners. Diagnostic assessment of students' reading and writing progress is used to determine how students are grouped for instruction and which instructional strategies and materials teachers select to meet students' educational needs. Students read every day both as part of guided reading groups and individually at their independent reading levels. Teachers provide direct and "incidental teaching" (p. 5) of spelling, word recognition, reading comprehension, and writing on a daily basis through teaching generally applicable strategies during whole class instruction and specific strategies, chosen to address the needs of each group during small group instruction. (Further discussion of the specific activities and strategies used in the *Balanced Literacy* program follows under the heading, The Block Approach to Balanced Literacy).

Routines and timetables are used to ensure all aspects of direct and indirect instruction are addressed daily. Parental involvement through home practice is encouraged and teachers' continued training through professional development is expected. In summary, teachers in *Balanced Literacy* classrooms use diagnostic assessment to determine the appropriate level of support to offer students during the guided portions of lessons and to determine what students are capable of doing independently. Over time, students develop more sophisticated reading and writing skills which they practice during the independent portions of the lessons.

**Diagnostic assessment within *Balanced Literacy***. Diagnostic assessment is central to the *Balanced Literacy* program and is one of the twelve basic tenets (Brailsford, 2003). The purpose of assessment is to determine students' independent and instructional reading and writing levels. Criteria for establishing the independent reading level are 95% or greater accuracy in word recognition and with 90% or greater accuracy on comprehension measures. If these criteria are used in the selection of reading materials, it is expected students should be able to read the materials without assistance. Criteria for establishing students' instructional reading level are 90% to 95% accuracy in word recognition and 70% or greater accuracy on comprehension measures. Knowledge of students' instructional levels is crucial for the *Balanced Literacy* program because students make the best progress in their reading at the instructional level as long as teachers provide appropriate supports and strategies. When teachers establish students' independent and instructional levels and identify areas of need, they then select suitable reading materials, instructional strategies, and student

groupings to address each student's instructional needs. Reading materials for the *Balanced Literacy* program are levelled (using criteria from Fountas and Pinnell, 1996) and become more difficult as students progress through the levels.

Brailsford (2003) advocated frequent, ongoing assessment of students' reading and writing progress to guide instructional decisions that most effectively meet the needs of students. For example, teachers use checklists, surveys, anecdotal comments, and records of words that students experience difficulties reading to adjust programming to target specific areas where direct teaching is needed. Assessment questions are provided to help teachers reflect upon students' progress in developing reading and writing strategies over time. For example, for Guided Reading, the questions provided are, "What is the student's Instructional Book Level? How does this change over time? How do I know if the book I selected is suitable for this student? What progress is the student making in acquiring strategies for word recognition and reading comprehension" (p. 269). These questions are intended to help teachers determine how well strategies taught have worked and how to modify instruction to be more effective.

**The block approach to *Balanced Literacy***. To be used as intended, the *Balanced Literacy* program (Brailsford, 2003) requires 140 minutes of instructional time daily. Activities are grouped under three main "blocks": Working with Words (35 minutes), Reading (70 minutes), and Writing (35 minutes). By devoting daily instructional time to the components of *Balanced Literacy* in the proportions recommended, teachers ensure students receive daily exposure to direct instruction in phonics and word patterning strategies (Working

with Words block), to reading activities at their instructional and independent reading levels (Reading block), and to writing strategies (Writing block). Brailsford explained 140 minutes of instruction in Language Arts exceeds the recommended daily time allocation for Language Arts instruction in Alberta, and warned integration of Language Arts with other curricular areas is necessary to accommodate the time requirements of *Balanced Literacy*. A description of the major activities in the three blocks follows. Although Brailsford provided lists of alternate activities, the activities described represent the recommended instructional sequences for *Balanced Literacy* instruction.

**Working with words.** The purpose of the Working with Words block is to teach students to recognize and spell high frequency words, use predictable patterns within words to identify decodable words, use knowledge of phonics and phonological awareness, and generalize knowledge of word patterns to words containing similar patterns (Brailsford, 2003). Working with Words activities are meant to be fast-paced, whole-class activities. Major tasks for the Working with Words block include using the Word Wall (10 minutes) and Making Words (25 minutes). During Word Wall activities, practice five new high-frequency words each week by saying the words aloud, clapping while spelling them aloud, using the words in sentences, and writing them. The aim of practicing the target words daily is to build automaticity in recognizing, reading, and writing the words. Each week, students are quizzed on the five words, the teacher adds the words to the word wall, and students write the words in their personal dictionaries. For Making Words activities, the teacher selects letters that make a longer target word. The

teacher and students systematically make two-letter and longer words until students discover and spell the word that uses all of the letters.

**Reading.** The largest block of time in the *Balanced Literacy* program is devoted to Reading (Brailsford, 2003). The purpose of the Reading block is to give students guided and independent practice reading materials at appropriate levels of difficulty. Four activities comprise the Reading block. First, during the Read Aloud activity, teachers read to the entire class for 15 minutes to model fluent reading, expand students' background knowledge and vocabulary, expose students to the structure of written language, and engender a sense of enjoyment of reading. Teachers introduce and make explicit verbal references to new reading strategies and topics and integrate content from other curricular areas into Language Arts. The second activity is Shared Reading where students and the teacher read together for 15 minutes from a wide variety of genres and written structures with the support of with other readers. Typically Shared Reading includes reading big books (narrative or expository text) aloud, discussing and making predictions, retelling stories, and choral reading. During Shared Reading, the teacher introduces students to new vocabulary, reading strategies, and story concepts.

Guided Reading activities occur for 40 minutes daily (Brailsford, 2003). Each group reads a common text at their instructional reading level and the teacher models and teaches comprehension and word recognition strategies selected to meet student needs identified by diagnostic assessment for each group. Students progress from easier to more difficult reading material as they master the

strategies demonstrated by the teacher. Teachers work with two groups for twenty minutes each day while the other students read independently. The goal of Guided Reading instruction is to foster the use of appropriate reading strategies so students can attempt to read more difficult texts independently. Books and other reading materials in the *Balanced Reading* program are levelled according to difficulty levels adapted from Fountas and Pinnell's (1996) work with guided reading. Fountas and Pinnell provided a list of books assigned levels from A to S in order of increasing difficulty. The levels provide a rough guideline of the books appropriate for kindergarten (levels A through E), first grade (levels A through J), second grade (levels C through P), and third grade (levels J through Q) students. Levels are based on criteria such as breadth and depth of the work; genre; content, format, and length; use of illustrations; enjoyment; and multicultural representations.

While the teacher works with small groups on Guided Reading activities in *Balanced Literacy*, the other students read independently. By focussing on reading materials students can read with 95% or greater accuracy and 90% or greater comprehension (the benchmark for determining the independent reading level), students practice reading strategies learned during Guided Reading with material that will not exceed their reading abilities. Brailsford recommended teachers use literacy centres where students do other activities such as listen to books on tape, read in pairs, work on CD-ROM activities, recite poetry, or write in journals instead of reading silently for the entire 40 minutes. Activities are done with limited teacher supervision and intended to teach accountability for learning.

**Writing.** The Writing block is organized around a writing conference approach and also includes daily writing demonstrations by the teacher and the use of graphic text structure organizers to help students structure their writing (Brailsford, 2003). The purpose of the Writing block is to model writing techniques and organizational structures, provide guided and independent practice, provide feedback, and share students' completed writing. Writing topics and genres are selected by the teacher during the Writing block to expose students to a variety of text structures and genres. The goal of writing instruction is to promote the development of independent writers through the direct instruction of strategies designed to meet needs identified through ongoing dynamic assessment of writing progress. Brailsford wrote,

> Within the *Balanced Literacy Program*, writing moves from total teacher support through scaffolded, supported activities towards independence. It follows an apprenticeship model of learning, wherein the student learns from demonstrations and is always encouraged to write at her 'learning edge' (Vygotsky's *zone of proximal development*). (p. 180)

Similar to the structure of the Reading block, the Writing block includes Write Alouds, Shared Writing, Guided and Independent Writing, and Sharing.

During the Write Aloud, teachers demonstrate writing strategies, talk to students about what they are writing, and explain strategies they are using (Brailsford, 2003). For Shared Writing, students and their teacher may compose a class story, use scribed writing, or use examples of others' writing to generate stories together. The Write Aloud and Shared Writing activities last for approximately 10 minutes combined. The purpose of the activities is to model strategies proficient writers use and explicitly link strategies to the current activity

by use of oral language explanations.

Guided Writing activities (20 minutes daily) are the major focus of instruction and are designed around a Writers' Workshop Approach (Brailsford, 2003). Writing proceeds in five stages and includes Planning (Prewriting), Writing, Revising, Editing/Conferencing, and Publishing. The teacher and students use a graphic organizer to plan a whole-class story, then write a draft together while focussing on the target strategies. The teacher teaches mini-lessons about writing strategies using a whole class plan, and then students write using their individual plans. Afterwards, the teacher meets with individual students about their drafts. During the Publishing stage, one or two students share portions of their writing with the whole class.

Independent Writing is where students initiate and write independently on topics of their own choosing. Brailsford (2003) listed examples of students' independent writing across a variety of genres such as the creation of labels, notes to classmates, individual stories, diary entries, and written comments about books. Although emphasis for the *Balanced Literacy* program is placed on Guided Writing, Brailsford explained some opportunity for Independent Writing should be provided. However, she cautioned students must have sufficient practice with shared writing and exposure to demonstrations by proficient writers before they are able to write independently. Thus, students in kindergarten and first grade classrooms would not engage in Independent Writing until they gained a level of proficiency where they were able to write with minimal teacher support.

The *Balanced Literacy* program (Brailsford, 2003) emphasizes the use of

graphic organizers for organising ideas prior to writing. Brailsford explained,

> It is anticipated that, over time, some students may not require formal graphic organizers. They will have internalized the text structures and be able to plot their own writing without needing an organizer. This will occur most readily with the familiar text structures such as narratives, sequence, and descriptive paragraphs. (p. 257)

Similar to the goal of activities provided for reading practice, the goal of activities provided for writing practice is the development of independence in writing. In keeping with the tenets of the *Balanced Literacy* program, guided practice increases slowly in difficulty and complexity, coupled with explicit modelling and teaching of writing strategies, is the method by which teachers assist students to become independent writers.

**Summary of the *Balanced Literacy* program.** *Balanced Literacy* (Brailsford, 2003) was designed to be a comprehensive program addressing spelling, word recognition and analysis, comprehension, and writing strategies. Frequent diagnostic assessment of students' reading and writing is used to ensure students are grouped appropriately for instruction with others at similar instructional levels and ensure that reading materials are at appropriate levels of difficulty for each student. The strategies chosen for whole group instruction are meant to be applicable to the whole class and the strategies chosen for small group instruction are selected based on needs identified from on-going diagnostic assessment. Brailsford provided numerous sample strategies, activities, and lesson plans to help teachers administer the program correctly and evaluate student progress in reading and writing. The main tasks such as Making Words, Guided Reading, and Guided Writing are well described for teacher use, however the

alternate activities necessitate consultation of the *English Language Arts (K-9) Program of Studies* (Alberta Learning, 2000a) to understand the appropriateness for and sequence of outcomes from the reading strategies list.

*Balanced Literacy* is a structured program directed by the teacher who selects materials, topics, and strategies appropriate for students' reading and writing levels; assesses progress through diagnostic assessments; and monitors progress over time. The program emphasizes the role of routine, guided and independent practice, and incremental increases in the difficulty of materials. Instruction is multi-levelled in order for teachers to provide instruction at students' differing levels and particularly through the use of small group activities during guided practice.

**The *Cogito* Program**

The *Cogito* Program is an alternative program designed to enrich the standard Program of Studies and provide academic challenge for students in a highly-structured, whole-group, teacher-directed setting. The *Cogito* Program is a hybrid developed by Edmonton Public Schools in consultation with parents in 1995, and is currently one of the most popular alternative instructional programs in central Alberta. Teachers use unpublished program supplementary documents (Edmonton Public Schools, 2008, 2010) and accompanying teacher guides (Hunter & Robinson, 2002) to plan lessons and sequence instructional concepts to adhere to a prescribed scope and sequence. In the participating school, both *Cogito* and the regular program (that typically followed the instructional methods outlined in the *Balanced Literacy* program) were offered as alternatives. The

*Cogito* Program was the more competitive of the two for enrollment due to the popularity of the program and the limited number of spaces available.

The *Cogito* Program differs from the regular program in both the use of prescribed teaching methods and in the provision of scope and sequence taught in addition to the standard Program of Studies. Alberta students, including those in the *Cogito* Program, are assessed based on the standards set forth in the Program of Studies, not on the *Cogito* scope and sequence. Thus, although the *Cogito* curriculum is considered by teachers and parents to be more challenging than the regular curriculum, students' report card grades reflect their levels of attainment in the regular curriculum only. Anecdotal notes are added that pertain to students' progress in learning the enhanced curriculum components. *Cogito* Program Alignment Document (Edmonton Public Schools, 2008) established 11 foundational principles for the *Cogito* Program's instructional methods and practices claimed to be supported by research on effective schools (although no research was referenced in the document). These principles highlight the importance of academic excellence and the use of measurable outcomes to assess progress; order and discipline to academic success; and the provision of a solid foundation in English and mathematics. The *Cogito* teacher uses whole-group instruction, focuses on the prescriptive curriculum, maintains order and discipline, and avoids distractions to teaching inherent in "assum[ing] the role of parent, nurse, or social worker" (p. 4).

**Definitions of literacy within the *Cogito* program**. The creators of the *Cogito* Program emphasized the central role of literacy acquisition in the

following statement of philosophy (Edmonton Public Schools, 2008):

> In the Cogito alternative program the development of literacy and reading comprehension is a primary aim and focus at all levels. This will include a great deal of reading from a variety of fiction and/or non-fiction sources in every subject. Particularly in the early grades, schools should emphasize reading, reading and more reading. Cogito strives to inspire the appreciation of language, increase subject-specific knowledge and develop meaning and understanding through what others have called Primary Literacy, Mature Literacy, and Moral Literacy. (p.5)

No mention is made of who the "others" are. In 2010, this statement of philosophy was expanded to include an emphasis on the ability to read at grade level and express ideas in a reasoned, precise, and creative manner (Edmonton Public Schools, 2010). The main instructional strategy is direct instruction in basic skills followed by extensive written practice closely monitored by the teacher for accuracy, correctness, and legibility.

The *Cogito* program supplements define three types of literacy. Primary Literacy refers to the ability to decode and comprehend text. Direct phonemic awareness and phonics instruction begins in kindergarten, much earlier than in the regular program. The rationale for early, intense instruction is that phonemic awareness and phonics instruction assists young readers to be able to decode better, which increases their reading fluency and, "allows students to focus their mental energies on comprehension" (Edmonton Public Schools, 2010, p. 1). Students read extensively to increase reading fluency. Thus, in the *Cogito* Program, a student who has primary literacy is one who uses well-developed phonemic awareness skills to decode text effortlessly and fluently and who understands what is read, despite reading challenging texts.

Mature Literacy refers to the ability to read, understand, and comprehend

diverse works of literature. Mature literacy develops by having students read various well-written works (Edmonton Public Schools, 2010). Vocabulary deficits are cited as one reason students lag in reading because students may lack the vocabulary and background knowledge (domain knowledge) required to read challenging literature. *Cogito* stresses direct vocabulary instruction, content-knowledge instruction, and etymological study to overcome vocabulary deficits and build the word and world knowledge necessary to read and understand a wide variety of material. Mature literacy instruction begins in kindergarten with the introduction of texts at a higher level than those used in regular programs and increasingly sophisticated texts are introduced over time. Literature is carefully selected to build content-area knowledge, showcase rich uses of language, and encourage reflection on human nature and the human condition. Thus, a student who has mature literacy is one who has adequate vocabulary and content-area knowledge to carefully read, analyze, and comprehend a variety of challenging texts.

Character education is also a focus in the *Cogito* Program. The listed virtues, "honesty, compassion, integrity, perseverance, courage, and responsibility" (p. 2), are taught through teacher modeling and the careful selection of literary works wherein the virtues are demonstrated. The main objective is to teach students to identify with positive character traits and good citizenship. Thus, a student who has moral literacy is one who "recognize[s] the virtues, … understand[s] what they are in practice; and develop[s] a desire to do what is right" (p. 2).

**Literacy instruction within the *Cogito* program**. Two required resources were listed for use with primary students (K-3) in the *Cogito* Program (Edmonton Public Schools, 2010). The first, *Literacy M.A.P. Meaningful Applied Phonics* (Hunter & Robinson, 2002), outlines a scope and sequence for teaching letter-sound correspondence through direct and explicit instruction. In a report of their findings in a longitudinal study of the use of *Literacy M.A.P.*, Phillips, Norris, and Steffler (2007) referred to this approach to teaching phonological awareness and phonics as "High-Dose Phonics". The second resource, *Collections for Young Scholars* (Open Court Publishing, 1995), is a basal reading series. A list of suggested resources accompanies the required resources and is intended to address the areas of reading comprehension, writing, grammar, spelling, phonics, idioms, and poetry.

*Literacy M.A.P.* (Hunter & Robinson, 2002) sets forth a highly-structured program for teaching phonemic awareness and phonics beginning in kindergarten. The *Cogito* Program follows the teacher-directed, whole-group instructional model described by Hunter and Robinson. First, the teacher reviews previously taught skills and knowledge, then explains the goals of the current lesson. The teacher breaks larger tasks into smaller steps and guides students through the steps explicitly by reciting the steps or rule under study while performing the action. Students recite the steps or rule while performing the same action. The process of "see it, say it, hear it, write it" (p. 5), is intended to promote multisensory learning and active participation by students. The teacher uses whole-group and individual questions to check for understanding, then offers guided practice of the skill or

rule. Students practice independently while the teacher circulates to offer immediate feedback on student work.

**Phonemic awareness and phonics instruction**. The primary focus of the *Literacy M.A.P.* for kindergarten and first grade is phonemic awareness training and phonics instruction (Hunter & Robinson, 2002). Students are expected to master 54 one- and two-letter sounds (graphemes) in kindergarten and 70 in first grade. Instruction begins with teaching the rules for proper formation of the first 26 graphemes (letters of the alphabet) through a system of lines and positions "on the clock" that describe the pencil positions and movements required. For example, when the letter "a" is formed:

> Begin at 2 on the clock. Without lifting the pencil, go up and around, just touching the dotted middle line. Curve over to the 10, round down to the bottom base line, back to the 2. Without lifting the pencil pull a line back down to the bottom base line. (p. 91)

Next, students learn the various sounds that the letters represent in order of their frequency of occurrence. For example, the letter "a" has three sounds, "ă/ā/ah" (p. 91) and the ă sound is most common. When students write letters that represent more than one sound, they recite the list of possible sounds and write a number above to indicate whether the letter is representing the first, second, third, or fourth sound. Precise letter formation and rules for remembering letter sounds are emphasized in kindergarten and first grade. Once kindergarten students master the first 26 graphemes, they are taught 28 two- and three-letter graphemes using the same instructional method, and then advance to spelling instruction. In first grade, students are taught 70 graphemes and then begin spelling instruction.

The *Cogito* program places an early emphasis on phonemic awareness

training and phonics instruction through the use of the *Literacy M.A.P.* resource (Hunter & Robinson, 2002). The rationale given for this focus is that systematic phonics instruction

(1) makes a more significant contribution to reading growth than unsystematic or no phonics instruction,
(2) has been shown to be most effective in kindergarten and first grade, and
(3) is most effective when integrated into a balanced reading program where emphasis is placed on teaching children to apply phonics knowledge to reading and writing.

Although a National Institute of Child Health and Human Development (1999) study was cited by way of justification for the early emphasis on phonics, their stated position aligns with researchers such as Juel and Minden-Cupp (2000) and Stahl and Yaden (2004) who have found early, systematic focus on phonics instruction is beneficial for children's early reading achievement. It is claimed early, systematic phonics instruction helps students acquire greater fluency and automaticity which, in turn, assists them to focus their mental energies on comprehension (Edmonton Public Schools, 2010). Thus students are expected to be proficient readers who score at or above average in reading and comprehension. Phillips et al. (2007) referred to the *Literacy M.A.P.* as a "high-dose" phonics program because the length and duration of phonemic awareness training and phonics instruction exceeded by far the 5 to 18 hours of instruction recommended by research.

**Spelling and writing instruction**. The *Cogito* Program also uses the *Literacy M.A.P.* (Hunter & Robinson, 2002) to teach spelling beginning in kindergarten after the first 54 graphemes have been taught. The teacher and students sound out words and write the letters. The teacher then asks students a

series of questions about the words intended to help them to identify vowel diagraphs, silent letters, and other spelling patterns. Students place markings on the words to indicate which spelling pattern is present in the word. The *Literacy M.A.P.* (Hunter & Robinson, 2002) situates spelling instruction in a writing process that begins with grapheme instruction, moves to spelling instruction, then to dictated sentences, original sentences, connected sentences, and finally, to original text production. Thus, instruction begins with word parts, then words, and then, finally meaningful sentences. This view of the sequence of writing instruction fits with the view put forth in the *Balanced Literacy* program (Brailsford, 2003), whereby students do limited independent writing until they master basic skills such as phonological awareness.

**Reading instruction.** Aside from writing and spelling instruction, a secondary focus is on reading instruction. Not surprisingly, since The *Literacy M.A.P.* (Hunter & Robinson, 2002) claims the Spaldings' *The Writing Road to Reading* (Spalding & Spalding, 1957) as its philosophical base, writing instruction and basic skills development in writing are seen as important precursors for reading acquisition. In the early grades, reading instruction follows the same trajectory as writing instruction (Hunter & Robinson, 2002), that is, reading instruction begins with learning graphemes and decoding simple, phonetically regular words, then progresses to sight words. Next, students write and read dictated sentences, read reproducible books that contain the markings that identify spelling patterns and sounds, and progress to reading literature. Students are expected to read independently by first grade, and the focus of reading instruction

is to build fluency because it is claimed when students master the sounds and rules of written language, they build automaticity and then their mental focus can move to comprehension. The reciprocal role that comprehension plays in assisting with decoding is not addressed except for a brief explanation that words not in students' oral vocabularies will not be recognized in print.

Since the *Cogito* Program emphasizes whole-group, teacher-directed instruction, reading instruction takes place in a whole-group setting. Thus, it is not surprising a common basal reader, *Collections for Young Scholars* (Open Court Publishing, 1995), is a required resource. Although *Collections for Young Scholars* is used in some parts of the United States, it has drawn recent criticism. For example, Maniates and Mahiri (2011) cited lack of program flexibility, lack of support for English Language Learners, poor support for writing development, lower student achievement scores, and high costs as reasons why the reading program was recently dropped in the State of California.

The *Cogito* Program documents (Edmonton Public Schools, 2010) also place focus on the selection of quality children's literature for independent reading and reading instruction to promote mature and moral literacy. They claim the selected literature has "stood the test of time" (p. 2), is challenging academically, and addresses either the human condition or the values promoted in the program. Choral reading and monthly recitations are other core strategies for building reading fluency and expression. Students memorize new poems each month from the list provided in the *Cogito* documents (Edmonton Public Schools, 2010) by authors including T. S. Elliot, Robert Frost, and Dr. Seuss. Students

recite the poems to the class and the teacher assesses accuracy and expression.

**Summary of the *Cogito* program**. The *Cogito* Program authors claim to provide a challenging curriculum taught in a highly-structured and disciplined setting. Whole-group, teacher-directed instruction is used exclusively and promoted as beneficial for learning because instructional time is increased, distractions are decreased, and high standards of performance are expected. Little is left to chance in the *Cogito* Program. Direct and explicit instruction in the basic rules and structures of language is intended to lead to student mastery. Once students master basic rules and structures, they are taught increasingly complex structures and, eventually, begin to write and read independently. The scope and sequence document (Edmonton Public Schools, 2010) and the core resource, the *Literacy M.A.P.* (Hunter & Robinson, 2002), are systematic in their reading instruction. Like *Balanced Literacy* (Brailsford, 2003), the *Cogito* Program emphasizes routine, teacher direction, and incremental increases in the difficulty of content. Yet, unlike the *Balanced Literacy* emphasis on multi-level small-group instruction, the *Cogito* emphasis is on whole-group instruction with independent practice.

## Pedagogy and Teaching

In order to understand whether and how teachers have experienced pedagogical change, it is important to review the literature to establish both what pedagogy is, the relationship between pedagogy and teaching practice, and how educational technologies are claimed to influence pedagogy and practice. David Olson (2010) wrote, “Pedagogy, the enterprise of turning teaching into a

psychological theory, died early in the twentieth century when theories of teaching gave way to the theories of learning" (p. 223). In Olson's view, teachers should focus on how concepts and skills are taught effectively and not only on measuring whether and to what degree these concepts and skills have been learned. According to Olson, teaching involves teachers' intention to align the learners' behaviour with a certain goal or standard (the learning objective) and the learners' intention to meet the goal or standard. Teachers may choose from a variety of teaching methods or practices to help students achieve the goals and standards. An explanation of the basis for Olson's definition of teaching follows in the next section,What is Pedagogy?

Studies examining technology and the ways in which technology use enhances teaching rarely specify how the use of technology improves teaching. Typically, general claims as to how technology use improves student learning are made, such as technology use increases time on task and student motivation (Norris, et al., 2003), yet rarely do researchers support claims with evidence from research. In addition, the teacher's role and the role of appropriate pedagogy are often ignored. It may be that an analysis of good pedagogy is seen to be too difficult to perform adequately. Olson (2010) commented,

> The inability of philosophers to … provide any guidance as to how teachers are to achieve their goals, has left psychologists and educators … to abandon altogether the analysis of teaching, to focus rather on learning. Indeed, in its most extreme form, behaviourists claimed that if there was no learning there was no teaching, a mantra sometimes taken over by educators themselves. (p. 235)

Olson explained instead of focussing on analysing teaching, researchers turned to analysing learning because learning is more easily assessed and expressed in

quantitative terms. For example, a teacher may design a test to see if students can read various passages without error. Several assessments could be performed over time to track students' performance by determining which words were read correctly and students' reading rate. This type of assessment is commonly used in the *Balanced Literacy* program (Brailsford, 2003). Although these assessments might be used to determine how well students have progressed in learning to read and how they perform against expected standards, the assessments give little insight into how well the teacher taught the material or whether the teaching methods used might be successful in other teaching contexts.

**What is pedagogy?**

Pedagogy is the theory or theories that explain the act of teaching (Olson, 2010). Thus, to understand what pedagogy is, it is vital to understand what teaching is. Olson's work on pedagogy built on the work of Hirst (1973), who distinguished between the act of teaching and the generic uses of the word, "teaching" (i.e., the profession of teaching or all of the activities that take place throughout the course of a school day). Hirst defined a teaching activity as:

> The activity of a person, A (the teacher), the intention of which is to bring about an activity (learning), by a person, B (the pupil), the intention of which is to achieve some end state (e.g. knowing, appreciating) whose object is X (e.g. a belief, attitude, skill). (p. 171)

According to Hirst's definition, teaching involves at least two people (the teacher and pupil), the intention of the teacher to teach the pupil, the intention of the pupil to learn what is being taught, and the objective of the learning (i.e., a change in belief, attitude, or skill). In this definition, each condition is dependent upon the others. For example, in order for teaching to take place, teachers must plan

activities designed to help their students learn the intended outcomes. Learners must also want to learn the material. The key point of this definition is the focus on intentionality. The teacher's intention is to help students learn the outcome, but in order for teaching and learning to occur, the students' intentions must be to learn the outcomes. Hirst did not dismiss the role of incidental teaching or learning, though his model addressed formal teaching activities only.

Not all activities that take place in a classroom are teaching activities. Jackson (2007) wrote, "… it is tacitly assumed by most observers that not everything a teacher does while on the job is teaching, though most of it probably will be. Many of the actions to be excluded are easily agreed upon" (p. 338). Although much of what happens in a classroom is teaching, some activities, such as classroom management, defy easy categorization as either teaching or non-teaching. Jackson categorized activities as teaching or non-teaching depending upon the purpose of the observer; for example whether the observer is evaluating the teacher's ability to prepare the class for instruction or whether the observer is observing how the teacher teaches content. Jackson's distinction between teaching and non-teaching activities is problematic because it relies on an observer's purposes for observation and not on the teacher's purposes for the activity. In contrast, Hirst (1973) distinguished between teaching and non-teaching activities based on the teacher's intention to address learning outcomes and this criterion is much clearer for deciding which are teaching. Activities that take place in school, such as sharpening pencils, to use Hirst's example, or turning on a computer, are part of a normal school day, but are not teaching because they are not designed to

advance understanding of the material. Hirst criticized the educational methods literature of the time because they described generic activities and ignored the significance of how teaching was meant to address specific outcomes. Olson (2010) extended Hirst's criticism to include the present emphasis on assessing learning rather than analyzing good teaching.

Neither Hirst (1973) nor Olson (2010) dismissed the importance of learning; on the contrary, according to Hirst's definition, teaching is dependent upon learning occurring. Hirst explained, "The intention of all teaching activities is that of bringing about learning" (p. 168) and, "If one is not going into the classroom to bring about learning, if that is not the intention, then one cannot, logically cannot, be teaching" (p. 168). Thus, learning and teaching are closely related. The intention of learning is to achieve some end state or specific achievement and a great variety of learning outcomes exist, which may be beliefs, skills, or attitudes. Olson wrote about the responsibilities of the learner and teacher: "Contrary to conventional educational wisdom, it is the learner, not the teacher, who is responsible for his or her own learning. No one can do the learning for the learner. It is the student who must do the learning" (Olson, 2009, p. 572). The teacher's responsibility is two-fold. First, teachers enable students to learn by offering direction, support, and materials suitable for the learning task. The teacher's second responsibility is to hold students responsible for learning by monitoring and evaluating performance against criteria for successful performance. This set of criteria might include that the student reads a passage with intonation and pacing that approximate fluent readers' intonation and pacing,

for example.

In order for learning (and teaching) to occur, teachers must be mindful of the learning outcomes and plan teaching activities that represent and are related to the outcome, or are "indicative" (Hirst, 1973, p. 173) of the outcome. Hirst used the term indicative to mean, "… that the activity must, either implicitly or explicitly, express or embody the X to be learnt, so that this X is clearly indicated to the pupil as what he is to learn" (p. 173). The main activities identified by Hirst as being excellent for teaching, and which are used in schools today, are *demonstrating*, *telling*, and *proving*. In Hirst's view, these activities are considered indicative of the outcomes they are used to teach. For example, demonstrating and telling how to write a paragraph can both be used to teach how to write a paragraph, as long as students understand the objective of the activity, wish to learn how to write a paragraph, and have the ability (i.e., appropriate understanding, experience, and skills) to learn how to write a paragraph. Other researchers have sought to categorize teaching activities. For example, Durkin (1981) reviewed teaching strategies mandated in basal reading series of the time. She presented six categories to describe the teaching acts found therein:

1) Instruction, when teachers were directed to provide procedural information;
2) Review, when teachers were directed to review past content;
3) Application, when teachers were directed to have students apply the skill (i.e., exercises and teacher questioning);
4) Practice, when teachers were directed to have students perform a skill (i.e., independent practice on worksheets);
5) Preparation, when teachers were directed to provide information in advance that will be used for an activity such as to introduce new vocabulary prior to reading a story; and
6) Assessment, when teachers were directed to question or otherwise assess student understanding of the material presented.

Durkin highlighted several problems with the instructional directives given teachers in the basal series reviewed. For example, teachers were told to do something but not told how to do it, as when they were instructed to provide procedural information, but not told which steps they should tell students so they could successfully complete the task. Directives were vague, brief, and poorly organized with little consistency.

Dewitz, Jones, and Leahy (2009) built on and adapted the work of Durkin (1981) when they reviewed the comprehension strategies instruction mandated in contemporary core reading programs. They presented ten categories to describe the teaching acts mandated therein:

1) Skill mentioned, when teachers tell students to perform a skill but do not provide procedural information;
2) Skill + explanation, when teachers mention and describe the procedure for the skill, but do not model the skill;
3) Modeling, when teachers demonstrate how to perform the skill;
4) Information, when teachers give information about the content of the selection to be read;
5) Questions, when teachers ask questions to the students;
6) Question + model, when teachers ask questions then model the strategy while answering them;
7) Guided practice, when the students practice the skill with teacher support;
8) Direct explanation, when teachers explain a skill and provide procedural information;
9) Independent practice, when students practice the skill without teacher support; and
10) Discussion, when the teacher and students ask questions and discuss ideas.

Both the Durkin (1981) and Dewitz et al. (2009) categories describe teaching activities that, when used appropriately, are indicative of the skills or strategies they intend to teach (Hirst, 1973), but are more specific than Hirst's three activities (demonstrating, telling, and proving). Additionally, both reflect

contemporary language used in the teaching field, and particularly in programs such as *Balanced Literacy* and *Cogito*. However, the Dewitz et al. categories are better suited to fit Hirst's definition of teaching, because they refer to strategies to instruct students in new content, that is, to teach new content, rather than other elements such as assessment.

**The role of technology in pedagogy**. Hirst (1973) and Olson (2010) focused on the role of teachers' and students' intentions to meet the intended outcomes. Teachers select activities designed to teach specific outcomes and are mindful of how the teaching activities relate to the outcome and why they are used. In this framework, a machine, whether a teaching machine from the 1970s or a computer today, is seen to be an instrument for teaching, but cannot truly be said to teach because a machine cannot have intentions to teach students (Hirst); rather, the programmer of the machine creates the intention and selects the learning outcomes. In the educational technology field, researchers often adopt the Technological Pedagogical Content Knowledge (TPCK) model (Mishra & Koehler, 2006) to describe the interrelated roles of technology, pedagogy, and content knowledge in teaching.

In contrast to Hirst (1973), Olson (2010), and Mishra and Koehler's (2006) focus on pedagogy and teaching, many contemporary studies purport to address pedagogy and pedagogical change in a technology context, yet are atheoretical and vague with regards to how teachers teach using technology. For example, Mohon (2008), an experienced Language Arts teacher, sought to understand how her pedagogy changed with the introduction of an IWB into her

seventh grade classroom. Over a five-month period, she logged her IWB use and reflected on her own pedagogy. Mohon chose to adopt the definition of pedagogy as being "any conscious activity by one person designed to enhance learning in another" (p. 307). This definition lacks the specificity of Hirst's and Olson's definition (involving the intentions of both the teacher and the student to modify the learner's behaviour to align with the goals of instruction), and although it is an adequate definition of pedagogy, activities excluded as non-teaching by Hirst such as sharpening pencils or turning on the computer could conceivably be included as teaching activities because they assist student learning.

Mohon (2008) highlighted the role of interactivity, in this case students' physical interaction with the board, and its effect on lesson pacing. Although didactic (teacher-centered) teaching is at odds with Mohon's social constructivist stance, she found didactic methods were necessary when she wanted to increase lesson pace or demonstrate information to her students. Based on her observations, it may be "... IWB lessons ... encourage more whole-class teaching at the expense of individual or group work" (p. 304), particularly when teachers are concerned with improving lesson efficiency. Many of her students identified benefits to their learning stemming from teacher-centered activities, rather than student-centered activities. After interviewing her students about the advantages of IWB use in the classroom, Mohon reported "only two students responded by referring to direct student involvement with the IWB, others referred to generic advantages [i.e., enjoyment of the lesson] ... while over half referred to the advantages of teacher-directed activities" (p. 305) such as using the IWB to

project visual images to support teacher lectures or to display questions while reviewing exams together. Mohon's findings aligns with Hirst's (1973) position that although machines are instruments for teaching, the activities teachers choose to do are most important for the act of teaching because of teachers' intentions to teach the students and their ability to choose activities related to the learning outcomes.

**Types of Pedagogy**

Olson (2010) differentiated between individual and group teaching. In individual teaching, the teacher may closely monitor student learning. In contrast, most contemporary teaching situations involve group teaching. It is more difficult for the teacher to monitor students' individual learning during the act of teaching a group because the teacher must teach while also being sensitive to how well, or indeed whether, 20 or 25 students learn the content. In this situation, the teacher cannot efficiently check for understanding of each student at the time of teaching and, thus these methods "leave more responsibility to the learners to regulate their own behaviour and to make sense of the instruction" (p. 228). In a typical classroom where teachers are responsible for teaching many students at the same time, it would be nearly impossible for individual teaching methods to be used. Teachers organize their classrooms and their instruction in ways intended to meet children's educational needs most efficiently. For example, Brailsford's (2003) *Balanced Literacy* program uses a mixture of whole class and small group instruction and the *Cogito* Program uses whole class instruction exclusively. In *Balanced Literacy*, students are taught skills and strategies directly as part of the

whole or small group instruction and then practice skills independently. The teacher assesses students and coordinates small group instruction so students receive instruction that addresses their specific learning needs in a group small enough for the teacher to work with individual students if needed. While the teacher works with the small groups, the other students work independently with little teacher supervision or assistance. In the *Cogito Program*, students are taught skills and strategies directly as part of whole-group instruction. The teacher demonstrates the skill and provides procedural information and students recite the procedure as they perform the task. Extensive written practice is used, and the teacher circulates to observe and correct student work and offer feedback.

Olson (2010) identified two basic forms of instruction from which other pedagogical theories and methods have been derived. The first type, the *lecture*, is teacher-directed, very similar to the *Balanced Literacy* and *Cogito* programs. The second type, the *seminar*, permits more student direction through the use of student knowledge and experience. The purpose of the lecture is for a teacher to teach knowledge students cannot deduce independently using what they know or can determine through discussion and reflection. Olson divided the lecture into two types: the expository method, where teachers present and explain the knowledge to be learned in a systematic way, and the interactive method where teachers use questioning to bring the desired knowledge to students' understanding. Olson identified the lecture-based, interactive method as the predominant method used by classroom teachers to impart knowledge to students.

In contrast to the lecture method, the seminar method focuses on

knowledge originating from students' experiences (Olson, 2010). According to this tradition, some knowledge cannot be deduced through reason alone and it is necessary for students to learn either directly through experiencing the phenomenon or vicariously through being told about the phenomenon. The seminar method may be divided into teacher-led seminars, where the teacher is the authority who monitors the discussion to ensure it does not deviate from the learning outcomes, and student-led seminars, where students arrive at understandings through discussion.

In traditional pedagogies, the seminar was often used to complement the lecture as a method of checking for students' understanding of concepts presented in the lecture (Olson, 2010). Olson suggested in contemporary practice, teachers separate pedagogy from content and search for generally applicable methods to address multiple objectives, yet the methods chosen derive either from the lecture or seminar method or both. Many modern curricula address both the learning of facts and the building of theory (Olson, 2010). For example, at the primary level, students are required to "apply terminology appropriate to the technologies being used at this division level" (Alberta Learning, 2000b, p. 11). The learning and use of appropriate vocabulary is a fact learning activity. For example, primary students might be taught the names for and uses of the various hardware they use, such as the keyboard, monitor, and mouse. Teachers could also teach terminology related to tasks students complete on the computer, for example that a cursor is the name of the arrow indicating on-screen position. Learning these vocabulary words is important, because students will encounter them in various programs. In

addition, students must "access and retrieve appropriate information from electronic sources for a specific inquiry" (p. 5) which is a theory-building activity, because children develop their understanding of the types of information available and how to determine whether information is appropriate for the situation. For this activity, students might be taught how and where to access information from an online dictionary to define terms they do not understand when reading. Learning how to use online references helps students to understand there are resources available to help them comprehend information they read on the Internet, provided that they know how to use and critically evaluate the information they find.

**The Purpose of Reflection for Teachers' Pedagogy and Practice**

During my study, participant teachers were asked to reflect upon their pedagogy and practice. Thus, it is important to understand the role reflection can play in helping teachers to better understand their pedagogy and classroom practices. Terence McLaughlin (2007) criticized the concept of teacher as "reflective practitioner". McLaughlin's criticism centered on the ambiguous nature of claims made about the role of reflection. He raised several critical questions. First, he questioned how explicit and systematic reflection should be, how reflection relates to action (i.e., classroom practice), and about which matters teachers should reflect. Then, he questioned the value of reflection itself. If, for example, the value of reflection is simply to be reflective and reflection does not lead to changes in practice, the process of reflection is not useful for enriching teachers' pedagogy and practice.

McLaughlin (2007) proposed two continua for examining teachers' reflections. The first addressed the nature of the reflection. At one end of the continuum, reflection is *explicit* and *systematic* and teachers examine the technical aspects of their teaching in a systematic way and examine the application of theory to their teaching. Although explicit and systematic reflection allows teachers to examine how their practice relates to educational theories, the process may be inadequate for educational purposes. For example, since education involves a variety of goals that are sometimes ambiguous, explicit technical reflection may be inadequate to understand practice or solve unique pedagogical or practical problems not addressed by formal theories. At the other end of the continuum, reflection is *implicit* and *intuitive*. Although reflection at this end of the continuum may not be as systematic or technical as at the explicit end of the continuum, flexibility and intuition allow teachers to gain insight into their pedagogy and practice.

The second continuum addressed the content, or what McLaughlin (2007) termed the *scope* and *objects*, of reflection. At one end of this continuum, McLaughlin used the terms *specific* and *proximate* to discuss teachers' reflections about their present concerns, including reflection on specific, concrete examples from their daily practice. For example, teachers might reflect upon various methods they use to help raise student achievement. At the other end of the continuum, reflection is *general* and *contextual*. When teachers reflect on their overall practice, the purpose of education, and other general themes, their reflections are general and contextual.

My study involves the use of reflection as a medium for stimulating teachers' understanding of and ability to talk about their pedagogy in a way that emphasizes the roles of the teacher, student, content, and intentionality (Hirst, 1973; Olson, 2010). McLaughlin (2007) stressed it is important to understand the purpose for and appropriate use of each type of reflection. The ambiguity in the use of reflective in the term 'reflective practitioner', which McLaughlin criticized early in his chapter, occurs because, in his view, proponents of the term often do not specify what they mean by the term and what the purpose of reflection should be. In other words, reflection often lacks direction, depth, and criteria for determining what constitutes good reflection. Other researchers, such as Mouza (2009) found changes to teachers' practice require time and support for teachers to reflect on changes to their practice.

The purpose of reflection in my study was to provide an opportunity for participants to examine their pedagogy and how their pedagogy relates to classroom practice when they taught using the IWB. Teachers were encouraged to reflect on the technical aspects of their teaching, specifically how the IWBs were used in the lesson, why they were used, and on the implications of their pedagogical decisions for their classroom practice. In their reflective journals, teachers described a variety of situations in which they used the IWB for instruction as well as reflected more generally on how they use technology in the classroom. However, reflection must be used with caution as a source for data collection. In her study comparing how teachers perceived they implemented a new instructional program with how they actually implemented the program,

Nichols (2010) found perceptions do not always match practice. Attitudinal factors such as the degree to which teachers supported the program, knowledge factors such as incomplete understanding of the program, and external factors such as pressure to raise achievement on standardized tests affected teachers' perceptions of their classroom practices. Thus, classroom observation is required to understand whether teachers' perceptions match their practices.

## Claimed Pedagogical Benefits of Interactive Whiteboard Use

Numerous benefits are claimed for IWB use, particularly that IWB use improves interactivity and increases student motivation, engagement, and learning. These claims were addressed generally in chapter one to highlight claims made about IWB use in case studies, and particularly in three representative case studies of IWB use (Haldane, 2007; Mohon, 2008; Quashie, 2009). In the current section, I briefly examine research in the areas of interactivity, motivation, engagement, and learning that provide support for analysing the claims and the theories upon which the claims are based.

### Interactivity and the Interactive Whiteboard

The use of the term *interactive* in *interactive whiteboard* may be confusing. In the context of the IWB, *interactive* refers to the capability of the screen to respond to touch. In research, the term *interactive* is used to refer to the degree of interaction between teachers, students, and the lesson content. For example, students in Quashie's study (2009) manipulated objects in a diagram on the IWB to demonstrate their understanding of concepts taught. Increased interactivity is also claimed by manufacturers (i.e., Sadler Jones, 2012). For

example, a search of the promotional literature or "case studies" on the lead manufacturer's website (SMART Technologies, 2012) reveals 32 of 53 IWB-related customer testimonials mention the capacity for increased interactivity. Thus, claims for increased interactivity have been made frequently by this manufacturer.

Researchers analyze and report upon the interactivity of IWB in many different ways. In one case study, Haldane (2007) posed three questions, "Who is interacting with whom (or what)? How are they interacting? (What are they doing?) What is the effect" (p. 263)? She identified several forms of interaction present in the lessons observed:

1) verbal interpersonal interaction between students and teachers;
2) visual interaction between students and the symbols on the IWB;
3) cognitive interaction between students and the symbols on the IWB;
4) interaction between the teacher, the content on the IWB, and student responses; and
5) "interaction with the content via the technological facility of the medium" (p. 269).

Haldane categorized interactions between the teachers and students (mainly verbal); the students and the IWB (visual, cognitive, and sometimes tactile); and the interactions between teachers, students, and content (presumably verbal, visual, cognitive, and tactile). Haldane did not comment upon which forms of interaction were most prevalent, however, she did give examples of times when the class directed the actions of a teacher or student at the IWB vicariously.

Quashie (2009) categorized the interactions she observed into four types based on the interactions between people or objects. In Type 1 interactions, students discussed their thinking with peers and the teacher through pair and

group work. In Type 2, students manipulated the IWB independently, and in Type 3, the teacher manipulated the IWB content under student direction (vicarious interaction). In Type 4, students offered opinions verbally and non-verbally about the topics under discussion, particularly when students were asked to demonstrate agreement or disagreement with a given answer. Quashie found some teachers did not use Type 2 or Type 3 interactions at all, but most used Type 1 and Type 4 to varying degrees in all lessons observed. Thus, most interaction was between the teacher and students (verbal) or between the teacher or a single student and the IWB while other students watched (vicarious).

The categorization schemes for interactivity presented by Haldane (2007) and Quashie (2009) highlight confusions inherent in the use of the term *interactive* to describe teaching with the IWB. In both case studies, much of the interaction was verbal between teachers and students, and not tactile interaction with the IWB. Teachers had greater tactile interaction with the IWB than students, and most student interaction with the IWB was vicarious. Additionally, it is unclear whether and how the ability to move screen objects increases the level of cognitive interaction as Haldane reported. Thus, in reporting increased interaction, case studies might mean tactile interaction of a few students with the IWB, vicarious interaction of the class with the IWB through another's actions, or verbal interaction between teachers and students that occurs regardless of the presence of the IWB.

Smith, Higgins, Wall, and Miller (2005) sought to reduce the confusion surrounding the use of the terms interactive and interactivity to describe IWB

interactions. In the context of their review of studies of IWB implementation and the claimed benefits of IWB use, Smith et al. identified two categories of IWB studies. Some studies addressed the benefits of flexibility and versatility, multimodal presentations, efficiency, planning, ICT skills, and interactivity and participation, which are benefits claimed for teaching. Others addressed the benefits of motivation and multi-sensory presentations, which are benefits claimed for learning. Looking specifically at interactivity, the authors attempted to clear some of the confusion surrounding the term by categorizing claims for increased interaction as *technical* (i.e., tactile) or *pedagogic*. They found although technical interactivity might be limited, studies pointed to greater opportunity for pedagogic interactivity between students and teachers through discussion (Smith et al., 2005). Smith et al. questioned the quality of interaction that occurred during discussion because discussions were teacher led, and the teachers used questions to shape (or "funnel" as Hennessy, Deaney, Ruthven, & Winterbottom, 2007, called it) students' responses to an expected answer, and thus, the benefits to pedagogical interaction were limited.

In one example that highlights the potential for pedagogic interaction with IWB use, Maher (2012) reported on the interactions that occurred over the course of three school terms in two primary school classrooms where the IWB was used to facilitate whole group discussions. Maher kept record of who interacted with whom, how long they interacted, and the content of their interactions. Maher was most interested in dialogic interactions, which he coded as:

- collective (teachers and children address learning tasks together);
- reciprocal (teachers and children share ideas);

- supportive (children articulate their ideas freely and help each other to come to common understandings); and
- cumulative (teacher and children build on their own and each other's ideas).

Initially, most interaction was between the teacher and students, where the teacher did most of the talking and children provided brief responses, similar to the funneling phenomenon reported previously by Hennessy et al. (2007). It was not until after an intervention in which teachers were taught about dialogic interaction, that researchers began to witness student-student interactions, use of the IWB for dialogic discussions, and collaborative learning. After the intervention, the teachers became facilitators who assisted students as they used the IWB for their discussions.

***Implications of interactive whiteboard use for interactivity***. When reviewing the research on IWB use and interaction, the use of the term interactive is inconsistent and refers variously to both the capacity for technical (tactile) and pedagogical interactivity. Many studies are positive towards the potential of IWB use to improve either technical or pedagogical interactivity, or both. However, it is equally apparent many instances are reported wherein *technical* interaction with the IWB by students is found to be limited due to the capacity to support one point of contact (touch) at a time and *pedagogical* interaction is limited because many teachers are observed using the IWB to funnel students' responses to the desired (correct) response. Thus, it is equally possible to conclude IWB use supports traditional teacher-centered instruction wherein student interaction with the IWB and with each other is limited.

**Motivation, Engagement, and the Interactive Whiteboard**

Case studies of IWB use (such as Gray et al., 2005; Haldane, 2007; Quashie, 2009) report on student motivation and engagement with IWB use. In these case studies, motivation is often reported as enjoyment and engagement is frequently reported as time spent "on task", that is, time spent paying attention to the lesson. Often engagement and motivation are used interchangeably, or treated as an afterthought and none of the case studies reviewed reported using measures of motivation or engagement to determine whether either increased with IWB use. Increased motivation and engagement are also claimed by the manufacturer (i.e., Sadler Jones, 2012). A search of the customer testimonials on the lead manufacturer's website (SMART Technologies, 2012) reveals 41 of 53 IWB-related testimonials mention the capacity for increased motivation or engagement, although motivation and engagement were not defined and the ways in which either affects student learning was not explained. In contrast, research on both motivation and engagement is clear on what motivation is, what engagement is, and what effects both have on student learning.

***Motivation***. Motivation is best described as the factors that affect a person's desire to complete a task. Researchers differentiate between intrinsic and extrinsic motivations (Cameron & Pierce, 1994; Cameron, Pierce, Banko, & Gear, 2005). Intrinsic motivation comes from within the individual and is measured by differences in attitude and behavioural factors such as willingness to perform a task on free time without promise of reward. When a person feels internal motivation, he or she is interested and enjoys the task, feels competent, and feels in control of his or her actions (i.e., internal locus of control). External motivation

comes from the application of reinforcing agents and rewards that result in increased performance of the task. Unlike intrinsic motivation, the use of external reinforcing agents to motivate participants to perform certain behaviours is often reported to lower feelings of enjoyment, self-determination, and competency once the reinforcing agents are removed and to negatively affect participants' intrinsic motivation to perform the task without rewards. However, when reinforcement is contingent upon task success (Cameron & Pierce, 1994) and when students feel competent to achieve the task (Cameron et al., 2005), intrinsic motivation may not be negatively influenced when reinforcement is used.

The use of educational technology is often reported as highly motivational for students (for example, Norris et al., 2003) yet few studies examine motivation in a measurable way. There are few studies in which researchers measure and categorize student motivation when using educational technologies, such as the IWB. One example is Passey, Rogers, Machell, McHugh, and Allaway (2003), who administered questionnaires to 1206 elementary and secondary students in schools noted for using educational technology in motivational ways. Responses to questionnaires were used to form categories of technology (ICT) motivation. Motivational factors were categorized as a desire for personal understanding or competence, to receive praise, or to avoid negative feedback. Furthermore, they examined students' academic efficacy, intrinsic motivation, extrinsic regulation, and identification with group values. Positive motivation in learning competence, academic efficacy, identification with group goals, and intrinsic motivation, were identified by the authors as fitting the ideal profile of intrinsic motivation for

technology use. Students were, on average, motivated to use technology. However, results were mixed because some students reported higher than expected incidences of external factors (such as desire to receive praise) and *amotivation* or "a lack of any particular reason for engaging with" technology (p. 2). Many of the benefits claimed for technology use are claimed for IWB use as well. Smith et al. (2005) reported, "The most widely claimed advantage of IWBs is that they motivate pupils because lessons are more enjoyable and interesting, resulting in improved attention and behaviour" (p. 96). Yet support for the motivational effects of IWB use is often anecdotal and mixed. For example, Quashie (2009) noted instances where students reported less motivation to use the IWB, particularly when it was used as a static projector.

***Engagement***. Engagement is often referred to in the research literature as attention to the learning task and is measured by the amount of time during a lesson students spend doing the assigned tasks (for example, Norris et al., 2003). However, in the case of reading tasks using digital media, for example, New Literacies theorists such as Leu and his colleagues (Leu et al., 2008) demonstrated students make many seemingly unrelated searches and move back and forth between tasks. In the context of IWB use, student engagement is generally reported to be high. For example, Haldane (2007) described whole-class lessons where students were engaged in the lesson both while at the IWB and in their seats. Haldane provided possible reasons for students' attention to tasks using the IWB:

> High production values of IWB content and the speed and slickness of presentation compare well with those of other media with which pupils

> engage in their leisure time and the observed practice plus pupil and teacher interviews suggest high levels of attention. However, the stability of the IWB as a medium appeared to have benefits over and above the pace and quality of the audio-visual symbol systems it displays. (p. 261)

Haldane claimed that the aesthetic value of the multi-media information presented on the medium held students' attention to the task in a way that, supposedly, traditional media would not. Unfortunately, the researcher did not compare instances of engagement when using the IWB to instances where the IWB was not used and thus it is unclear whether or how any of the features described influenced student engagement. Reports of student engagement when IWBs are used are mainly positive, however there are some reported instances where engagement was lower with IWB use. For example, Quashie (2009) shared a quote given by a year 9 student, "When you are being told by a teacher you can put up your hand and ask questions but on the IWB it's more like its [sic] being shown to you so I don't feel like I can ask" (p. 36). This quote would seem to indicate that, at least for this student, the IWB resulted in less engagement and participation in the lesson.

Recently, Sad and Ozhan (2012) acknowledged even though the research literature shows positive attitudes towards the IWB, claims made as to the motivational power of IWBs are controversial because the initial gains in motivation and engagement are often short-lived. They surveyed 50 students from middle years' classrooms to determine which features or uses of the IWB were deemed most motivational and engaging. Features mentioned by students included: the IWB was practical and easy to use, offered better visual presentation, facilitated reviewing for tests, was more hygienic than chalkboards

and static whiteboards, and made instructional time more efficient. Students also mentioned multimedia features and improved learning, however these were least frequently mentioned. Their findings counter Haldane's (2007) claim that the aesthetic affordances of the IWB such as slick presentations are what hold students' attention to the IWB.

Northcote, McQuillan, and Beamish (2012) observed seven primary classrooms wherein teachers used the IWB to teach mathematics concepts. They observed instances of teacher-centered, teacher- and student-centered, and student-centered activities. Students reported higher incidents of participation in lessons when the IWB was used than when it was not. In regards to levels of engagement in teacher- and student-centered activities, Northcote et al. reported prolonged use of either teacher- or student-centered activities led to the eventual lowering of student engagement over time. However, when teachers switched more frequently between teacher- and student-centered activities within lessons, engagement remained high.

***Implications of interactive whiteboard use for motivation and engagement***. Research support for claimed benefits to motivation and engagement from IWB use is mixed. Although IWB use is claimed to be highly motivational and engaging, as evidenced by reports of many students appearing to enjoy the lessons and pay attention, few studies report on levels of motivation and engagement or explain which affordances of the IWB are motivational and engaging. The studies reviewed that examined motivation and engagement quantitatively or with an eye to providing categories to explain student motivation

and engagement (Northcote et al., 2012; Passey et al., 2003; Sad & Ozhan, 2012) have demonstrated although most students are motivated (Passey at al.) and engaged (Northcote et al.) when using the IWB, there are circumstances under which both motivation and engagement wane. In addition, Sad and Ozhan demonstrated commonly held conceptions about the engaging and motivating features of IWBs such as the high aesthetic and multimedia values (Haldane, 2007) reported, may not be the features students find most motivational and engaging.

**Student Learning and the Interactive Whiteboard**

IWB use is often claimed to improve student learning in general (Sadler Jones, 2012). For example, on the lead manufacturer's website (SMART Technologies, 2013), there are many customer testimonials in which IWB use is claimed to have raised students' achievement on standardized tests and improved their report card grades, or to have improved student understanding. None of these claims mention improvements in learning to read or in the use of the IWB to read digital texts, which might be supported by the Dual Coding Theory (Sadoski & Paivio, 2004, 2007) or the work of the New Literacies Theorists (Leu et al., 2008). The testimonials do not report instances where experimental designs with control groups were used to determine which features of the IWB, if any, help improve student understanding and test grades. Likewise, few case studies report on or compare achievement when the IWB was used and when it was not used.

Claims of improved understanding are often supported by claims IWB use addresses multiple learning styles (particularly visual and kinaesthetic) ignored by

traditional (predominantly auditory) teaching methods. The topic of learning styles became prominent in the 1970s and 1980s in the work of researchers such as Rita Dunn (1979). However, because of the lack of independent research support, learning styles have been the target of ongoing criticism in educational psychology (Kampwirth & Bates, 1980; Kavale & Forness, 1987) and particularly in the teaching of reading (Snider, 1992; Stahl, 2002; Tarver & Dawson, 1978). Nevertheless, despite these criticisms and the prominence of more recent and comprehensive cognitive-based theories of learning such as Dual Coding Theory (Sadoski & Paivio, 2004), learning styles continue to be promoted by Dunn and others.

Dunn (1979) proposed students have multiple learning styles which affect how they learn in the classroom. For example, when students' styles match the method of instruction, students likely will be successful, yet when their styles do not match the method of instruction, students likely will find it much more difficult to be successful in learning a skill or performing a task. Dunn noticed slow learners, or those unsuccessful with learning tasks, often had similar characteristics. For example, many were from less affluent homes. In addition, many seemed to learn in the same ways, that is, from multisensory approaches not supported in traditional schooling. Thus, Dunn advocated differentiated instruction for students to address their learning styles so students would be more successful in learning new content.

The idea of learning styles has persisted from the 1970s and has popular appeal amongst some educators. For example, in an interview with Shaughnessy

(2002), Dunn advocated for testing to determine children's learning styles in accordance with 23 factors categorized as environmental, emotional (such as motivation and persistence), sociological (preference for working alone or with others), physiological (preference for auditory, visual, tactual, or kinaesthetic learning), and psychological (global or analytic processing inclinations). Dunn provided profiles for gifted and at-risk students and highlighted the differences in their learning styles. Gifted students tended to prefer kinaesthetic (active and experiential) and hands-on instruction, but unlike lower or typically-achieving students, they were more flexible because they could learn in other styles if necessary. On the other hand, at-risk students were found to require frequent mobility, choice in the style and content of instruction, varied instruction rather than routines, flexible timetables where they could learn later in the day, informal seating, soft illumination, and visual and hands-on or active learning resources. Most were found to have poor auditory memory, yet auditory teaching methods prevailed in most classrooms and thus, the educational needs of at-risk students were not being served.

Learning styles were introduced to reading by Marie Carbo and branded as reading styles (Carbo, 1987). Carbo claimed if reading instruction was matched to reading style, students would read better, enjoy reading, and score higher on reading tests. She criticized the emphasis on phonics instruction and stated not all students benefited from phonics instruction. Furthermore, she criticized basal readers and reading instruction for focussing on skills in isolation and for failing to validate the need for all of the skills on the list. She claimed most primary

children are global/tactile/kinaesthetic learners who require holistic reading instruction, yet the reading programs of the day, including remedial pull-out programs, were not matched to the needs of primary readers and were, in fact, creating less proficient readers. She advocated for greater variety in reading instruction, decreased emphasis on phonics, increased use of holistic methods, and greater focus on interest and enjoyment in reading instruction. In 1997, Carbo reiterated her position and advocated for greater emphasis on global, tactile, and kinaesthetic methods to match the reading styles of primary and struggling readers. For example, she claimed students needed frequent opportunity for movement. She provided a continuum of levels of movement in the classroom. At the first level, movement provides a physical break from learning, such as sharpening the pencil or distributing papers. At the second, students are permitted to move as they work, such as standing while reading or reading at the carpet rather than the desk. At the third level, students work with manipulatives and games as part of their learning. At the fourth, they engage in simulated experiences such as role-playing or using puppets. Carbo observed most classrooms operated at the first level only and she saw this practice as detrimental to primary readers, who require movement and hands-on, active activities while reading. In 2009, she published another article, wherein she passionately stated reading instruction was continuing to fail most students and urged teachers to adopt more global and tactile methods to balance the analytical and phonics-based instruction occurring in schools.

***Implications of interactive whiteboard use for student learning***. IWBs

have the capacity to display information visually and permit tactile interaction. In the context of Dunn's learning styles (as she discussed in Shaughnessy, 2002) the hands-on experiences of touching the IWB would be considered tactile whereas learning by performing activities would be considered kinaesthetic learning. Although the distinction between tactual and kinaesthetic learning is rarely addressed in research and promotional literature and both hands-on learning and active learning are referred to as kinaesthetic, kinaesthetic learning presupposes the activity performed is indicative of the activity being learned, for example, learning to dance by practicing dancing, rather than reading about dancing or learning to cook by cooking, rather than by touching a cookbook. In terms of the IWB, learning may be tactile, but it is rarely kinaesthetic. For example, students may touch the IWB and move screen elements into an order that matches a story plot, but true kinaesthetic learning might involve a dramatic recreation of the action from the plot. In terms of Carbo's (1987) reading styles, IWB use can promote tactile activities because students can touch the IWB to advance the pages or hear words spoken when reading a digital story. Carbo maintained most young children in the primary grades require tactile methods because they are global, tactile, and kinaesthetic learners. She also advocated for the creation of interesting teaching activities to foster young readers' interest in reading. As Haldane (2007), Quashie (2009), Gray et al. (2005) and others report, many young children are observed to enjoy IWB use, thus reading on the IWB may help to maintain student interest in reading, but the potential effect of IWB use on students' reading interest has yet to be confirmed by research.

## Teacher Training

In their 2001 review of preservice and inservice teacher training, Richardson and Placier outlined two approaches to inservice teacher training, *empirical-rational* and *normative-reeducative*. In this section, the qualities of effective training from each approach are explained. The qualities provide two frameworks through which the effectiveness of the inservice training offered to teachers in this study were analyzed.

*Empirical-Rational* approaches to inservice teacher training take a traditional view of teacher training where change is imposed externally, objectives are often behavioural and intended to change teachers' classroom behaviours, and the training is short-term with little or no follow-up training. Richardson and Placier (2001) summarized the qualities of effective staff development training programs frequently addressed in research from the empirical-rational approach:

- The program should be schoolwide and context-specific.
- School principals should be supportive of the process and encouraging of change.
- The program should be long-term with adequate support and follow-up.
- The process should encourage collegiality.
- The program content should incorporate current knowledge obtained through well-designed research.
- The program should include adequate funds for materials, outside speakers, and substitute teachers so that teachers can observe each other. (pp. 917-918)

The empirical-rational model for teacher training has been used traditionally for training teachers to use new programs or methods. Unfortunately, empirical-rational programs often have low rates of implementation unless teachers' beliefs

about teaching match the assumptions about learning inherent in the training program (Richardson & Placier, 2001).

*Normative-Reeducative* approaches to inservice teacher training emphasize personal growth and development and attempt to change teachers' attitudes and practices in order to develop their skills as teachers (Richardson & Placier, 2001). Normative-reeducative inservice training is characterized by an internal decision to work in collaboration over time to develop a new method or practice. In contrast to empirical-rational approaches that are behaviourist, normative-reeducative approaches follow a social constructivist model. Richardson and Placier found studies of effective normative-reeducative staff development training demonstrated five main qualities. These are:

- Impetus for change is internal, not external.
- Responsibility for change rests with the teachers. The process empowers teachers to make deliberate and thoughtful changes in their classroom practice.
- Change is long-term and ongoing. New approaches and strategies are tried in response to challenges encountered during staff development.
- The program emphasizes collaboration and dialogue between teachers.
- Changes in practice lead to but also follow from changes in underlying beliefs about teaching. (Summarized from Richardson & Placier, p. 921)

Although teachers may receive inservice training, having attended training does not guarantee teachers adopt the training in their own practice. Mouza (2009) reported on her study of professional development designed to demonstrate new educational technologies and promote technology integration in teachers' practice. Over the course of one school year, twenty teachers participated in weekly introductory and advanced workshops, meetings, and in-class supports. Similar to *Empirical-Rational* approaches to inservice teacher

training (Richardson & Placier, 2001), the professional development was designed to focus on teachers' knowledge, address needs identified by the teachers, have extensive duration, and require collective participation. Seven teachers were selected for study to highlight the learning process and whether and how teachers' fidelity to the learning persisted for two years after the initial training. Mouza was most interested in discovering whether teachers sustained their training or built on their training to create new practices. She found teachers increased their understanding of how to use computer applications and although all teachers tried out at least a few new programs not taught in the professional development program, some teachers learned how to use a wide range of hardware and software tools in the two years after training. Additionally, all teachers were able to demonstrate awareness of how to use technology to address lesson objectives and two of the seven created frequent opportunities for technology integration. After two years, most teachers maintained the pedagogical practices taught in the program, however their degree of integration varied. Some, particularly those who had limited access to computers in the classroom, used technology for mundane tasks such as word processing. Most, however, integrated technology to some degree in their teaching, although only two of the seven developed new practices outside the scope of those taught in the professional development program. Mouza concluded teachers followed a cyclical pattern of change, where new knowledge stimulated changes in practice and these changes, in turn, stimulated new knowledge and practices. Without access to resources, and based in part on teachers' comfort or discomfort with the

technology, some teachers did not incorporate the technologies meaningfully into their practice. Most simply used the resources they were taught to use and did not experience further innovation in their pedagogy and practice.

## Summary

The preceding review of the literature highlights gaps that exist between theories of literacy development, pedagogy, motivation, engagement, learning, and theories of technology use (particularly IWB use) in the classroom. Although formal theories of literacy, pedagogy, motivation, engagement, and learning exist, they are rarely used as a basis of explanation for how or why IWB use is claimed to change or improve the educational experience. Case study research and customer testimonials that promote the use of IWBs in order to increase sales often take a simplistic, vague, and uncritical viewpoint of IWB use in the classroom. The theories reviewed in the preceding chapter provide criteria to critically examine and analyze changes to teachers' pedagogy in order to ascertain whether and how teachers' pedagogy changed through their IWB use.

## Chapter 3: Methodology

This chapter details the methodology for the preparation and conduct of data collection, data analysis, and interpretation procedures. Initial procedures for data collection were adapted from Gray et al.'s (2005) study of second language teachers' pedagogical change with IWB use. They used classroom observation to provide support for and to triangulate data collected from teacher journals, interviews, and participant meetings. Additionally, multiple classroom observations of each teacher were made over several months as well as teacher interviews after each observation. All observations were videotaped and all interviews and meetings were audiotaped. Similarly, I observed teachers on several occasions and interviewed them after each observation about topics that arose from my observations. IWB use was recorded by way of a screen capture program that more easily recorded IWB use than a video camera. Gray et al. analyzed their data sources separately (interviews, observations, and journals) and then made comparisons across these data sources for each teacher and across teachers. A similar procedure was followed in my study.

The use of a mixed methodology for data collection and analyses raises questions about the researcher's background and qualifications to conduct the research in a manner consistent with established educational research practice. The construction of appropriate themes from the qualitative data and the use of descriptive statistics to interpret the quantitative data were made possible by my academic preparation and expertise as well as my research and publications in the areas of literacy and technology. As a classroom teacher, my experience was

predominantly in the primary grades (K-3), the focus of the study reported herein. My interest in technology use in education predates the current *Information and Communication Technology Program of Studies* (Alberta Learning, 2000b). This document influenced my thinking about how technology may be used to instruct students, as well as my understanding of the competencies deemed important for students. My combined background as a primary teacher and as a technology enthusiast was invaluable to my understanding of literacy instruction and technology use in the classrooms in which I conducted my research

**Permission to Conduct Research and Ethical Considerations**

Permission for the study was granted by the *Education, Extension, Augustana, Campus Saint Jean Research Ethics Board* (EEASJ REB) and an urban school division in central Alberta. The main ethical considerations addressed in the research applications were participants' informed consent and confidentiality. This study adhered to the *University of Alberta Standards for Protection of Human Research Participants* (University of Alberta General Faculties Council, 2011) and the *Tri-Council Policy Statement* (Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, Social Sciences and Humanities Research Council of Canada, 2010).

**Informed consent**. An information letter and consent form outlining the study purpose and procedures, the participant confidentiality agreement, and the right for participants to withdraw from the study at any time without penalty was given to participating teachers. Teacher consent forms, when signed, indicated agreement to participate in the study. If a teacher was not comfortable signing the

consent form, a different teacher would have been selected for study. Access to the consent forms and to any other personally identifying data were restricted to the researcher and her supervisor and consent forms were kept in a secure location at the University of Alberta during the course of the study and after completion. As per EEASJ REB requirements, all data and identifying information will remain secured for a period of five years after study completion.

**Confidentiality**. Participants' confidentiality is important. The purpose of this study was to explain how IWBs are used in the teaching of reading. The purpose was not to evaluate specific teachers' practices or knowledge. Thus, it was important teachers' identities be protected. Personal identifying information has not be included in the study nor was it used in other contexts outside of the study, whether in written or oral communication. The name of the school site has not been shared and each teacher or student mentioned in the study was identified with a pseudonym or descriptor and number to protect his or her identity (i.e., Kathleen, Student Two). Teacher pseudonyms were assigned to signal the grade each taught. For example, Kathleen and Krystele taught kindergarten, Olivia taught grade one, and Therese taught grade three. Also, French names (Krystele and Therese) were used to signify teachers who taught in classrooms in the French Immersion and Regular Programs. English names (Kathleen and Olivia) were used to signify teachers who taught in the *Cogito* program.

**Identification of Potential School Sites**

A list of potential school sites was generated from the schools that focus on the use of technology in instruction and have IWBs installed in their

classrooms. It was expected that selecting a school from this list would allow for an examination of teachers' pedagogy and practice in an ideal setting where they have access to and are trained to use technology, and are part of a school culture that promotes the use of technology in instruction. Such an ideal school setting would not suffer the drawbacks of limited access to technology (Becker, 1998; Judge et al., 2006; Norris et al., 2003) and limited teacher training or experience (Dwyer, 2007; Wozney, et al., 2006) identified as common barriers to technology use and integration in schools. Selection criteria were developed to ensure that potential school sites would most likely be able and amenable to support my study. Particularly, the school administration and staff

(1) explicitly supported and encouraged the use of technology in instruction,
(2) had sufficient access to technology; specifically that each classroom had a functional IWB and accompanying computer with appropriate software,
(3) had administrators and teachers willing to commit to a research project of approximately eight weeks in length that required the researcher to have daily access to and observation of reading classes, and
(4) had four primary teachers (K-3), who met the participant selection criteria (in the next section) and were willing to participate.

After the potential school site was identified, the lead technology teacher (the teacher librarian) was contacted to confirm interest in and willingness to accommodate my study.

**Participant Selection**

The primary grades (K-3) were selected because formal reading instruction begins during these grades and these are the years during which students first encounter IWB use in instructional settings. The lead technology teacher and the vice-principal identified four primary teachers (K-3) who met the

specified selection criteria. Selection criteria were developed to ensure teachers were frequent users of IWBs in mainstream Language Arts classrooms. Thus, the lead technology teacher and vice-principal were asked to identify teachers who

(1) taught in mainstream primary classrooms;
(2) used a functional IWB regularly; and
(3) integrated IWB use into at least half of the Language Arts lessons per week, particularly for reading instruction.

Bauer and Kenton (2005) described technology integration where technology was in "…full-time, daily operation within lessons" (p. 535). Thus, in order to fulfill the third selection criterion of integration of the IWB into Language Arts lessons, teachers must have had regular access to a functional IWB and used it frequently.

An introductory meeting was held with the four participants to discuss the proposed research and to acquire their consent for the study. Participants signed teacher consent forms that were kept in a secure storage area for the duration of the study, accessible only to the researcher and her supervisor. Additionally, letters were sent to the parents and guardians of the children in the participating classrooms in order to describe the research and explain that student names and identifying information would not be used as part of the data collection.

**Description of the Research Site and Study Participants**

All participating teachers in this study taught at the same elementary school which had approximately 575 students between Kindergarten and grade six. Multiple classes were present at each grade level. Three instructional programs were taught in the school: the regular program, the French Immersion program, and the *Cogito* program. (Please see Chapter Two for a description of the *Cogito* program and its instructional focus and procedures). Most students in

the regular program were local to the area, but many of the French Immersion and *Cogito* students travelled from other parts of the city in order to attend the programs which had limited positions available and thus, competitive enrollment with waiting lists. Technology use was a school-wide instructional and professional development focus and the school had completed a pilot program two years prior to wide-spread adoption of the IWB throughout the school. All classrooms in the school had IWBs installed prior to January of the previous school year (January, 2011) and all teachers had at least one full year of IWB use prior to the commencement of the study. Technology oversight was given to the lead technology teacher (the teacher librarian) and vice-principal who oversaw technology integration, training, and mentorship within the school.

Table 3.1 provides a summary of the demographic information of the four teacher participants selected for the study. Although some teachers taught in the French Immersion program, only lessons taught in English as part of English Language Arts were observed for the study.

Table 3.1
*Demographic Information on Teacher Experience, Grade and Program, and IWB Use*

| Grade and Program Placement | Kathleen | Krystele | Olivia | Therese |
|---|---|---|---|---|
| Teaching Experience (total years) | 27 | 12 | 13 | 3 |
| Grade Placement | K | K | 1 | 3 |
| Program Placement | C | R/F | C | F |
| Experience in Current Grade and Program Placement (years) | 2 | 3 | 2 | 3 |
| IWB Use (total years) | 1.5 | 1.5 | 4 | 1.5 |

Note. C = *Cogito* Program, F = French Immersion Program, R = Regular Program

**Kathleen**. Kathleen was an experienced Kindergarten teacher for 27 years who, in the previous year, had moved to the participating school to begin teaching Kindergarten in the *Cogito* program. Although she was familiar with and had used the *Balanced Literacy* approach to teaching for several years, Kathleen had not taught previously in the *Cogito* program so she chose to modify some *Balanced Literacy* practices to fit the *Cogito* instructional model. She had some prior inservice training to use the IWB, however she had never used an IWB before receiving one in the previous school year. Kathleen described herself as having a low level of comfort with technology use.

Kathleen had 23 students in her class. Many students spoke English as their second language. The classroom was oblong and arranged so that the right half contained the entry and carpet area, and the left contained the desk area (i.e., the carpet area was to the right of the IWB). Desks were arranged in five rows with the IWB at the center in front of the students. The IWB was connected to the teacher's computer that sat on a small table to the left of the IWB. This arrangement required that the teacher turn her back to the students if she worked on the teacher computer.

**Krystele**. Krystele had been a teacher for 12 years and was most experienced with teaching French in high school and adult education settings. Two years previous, Krystele moved to the participating school to begin teaching Kindergarten in the French Immersion (morning) and regular (afternoon) program. She had no prior training to use the IWB, however she described herself as being highly comfortable with technology use in general. Krystele utilized

some instructional practices that were consistent with *Balanced Literacy*, although her students were not yet reading and she did not teach decoding.

Krystele's afternoon class was observed for the study (regular program). Twelve students were enrolled. Most students were native English speakers, however one had immigrated recently from a country where English was not spoken and had limited English proficiency. The teacher had one teacher assistant who worked with two special needs students. The classroom was oblong and arranged so that the back half contained the entry, carpet area, and centers' area, and the front contained hexagonal tables. The IWB was in front of the table area and was connected to the teacher's computer that sat several meters away behind the teacher's desk. This arrangement often resulted in loss of connection between the IWB and the computer. Frequently, Krystele was required to reset the IWB between her morning and afternoon classes in order for the IWB to work correctly throughout the day. The IWB was visible from the carpet area, though it was distant.

**Olivia**. Olivia was a teacher for 13 years and was most familiar with teaching second grade in the *Cogito* program. In the previous year, Olivia moved to teaching grade one in the *Cogito* program. Olivia participated in the original IWB pilot program for the school and described herself as being highly comfortable with technology use in general. In the previous year, Olivia and her students wrote a proposal as part of a contest held by the IWB manufacturer and received a class set of the *Senteo Response Systems* (Smart Technologies), individual hand-held units that permitted students to interact with the IWB by

pressing buttons to respond to multiple-choice questions.

Olivia had 27 students in her class. Most spoke English as their second language. The classroom was oblong and was arranged with desks in rows. The IWB was in front of the desks and was connected to the teacher's computer that sat on the teacher's desk to the right of the IWB. The desks were pushed back from the IWB to allow for a gathering area between the IWB and desks where the teacher would do calendar activities on the IWB or read to students from storybooks.

**Therese**. Therese was in her third year of teaching in the French Immersion program. Although most of her instruction was in French, the grade 3 students were required to have weekly English Language Arts instruction as well. She described her teaching practice in Language Arts as focussed mainly on skills development and grammar, although she was working towards including more *Balanced Literacy* activities such as guided reading in the coming year. Therese described herself as having a low level of comfort and experience with technology use.

Therese had 25 students in her class. Most spoke English as their first language, although there were a few who spoke English as their second language. Student desks were arranged in four long horizontal rows where the desks touched on each side. The IWB was in front of the student desks and was connected to the teacher's computer on a small table by her desk that sat to the left of the IWB. In this configuration, the teacher's corner was separated from the student desks and the teacher's computer formed a barrier between the teacher, the IWB, and the

students. Additionally, students at the end of the rows were located several meters to the right or left of the IWB.

## Data Collection Instruments and Procedures

There were two phases of data collection. Data collection began at the end of November, 2011, and proceeded until the end of February, 2012. During this time, each classroom was observed eight times for their English Language Instruction: once in November, twice in December, three times in January, and twice in February. Data collection was extended past the original eight-week period due to the occurrence of winter holidays, Teachers' Convention, and other unforeseen events at the school. Krystele, Olivia, and Therese invited observation of other classes or activities such as centers' (Krystele), Health quiz using the *Senteo Response System* (Olivia), and French Language Arts (Therese), and although these observations provided a basis for understanding teachers' comments about differences in their IWB use across curricular areas, the activities were outside the focus of study (i.e., reading instruction) and were not included in the analysis.

### Phase One

The initial phase of data collection commenced during the first week of the study and continued through the eighth week. Teacher journals, observations, and interviews were the primary methods used for data collection. Data gathered during the first four observations was intended to provide a description of how the IWBs are used in daily reading instruction in the classrooms under study and specifically, who used the IWB, how it was used, and what instructional methods

teachers used to teach reading. This information provided a descriptive understanding of how the IWB was used in each classroom and who used the IWB. Data gathered in the final four observations was intended to address the first and second research questions:

(1) How do teachers perceive their pedagogy has changed through IWB use and are these changes manifested in teachers' practice?
(2) What are teachers' perceptions of the pedagogical value of IWBs and how do teachers' perceptions affect their use of IWBs?

Thus, the focus of teacher reflection was on teachers' perceptions of their pedagogical change and of the pedagogical value of IWB use, and the focus of observation was on observing whether and how these changes were manifested in teachers' practices.

**Teacher journals.** Beginning with the first week of the study, teachers logged their IWB use and reflections on their IWB use in journals. The purpose of the log was to record lesson plans, lesson outcomes, hardware and software used, and technical issues encountered. Teachers were provided a binder that contained the template for keeping the logs. Teachers used the journal portion to reflect upon their pedagogical decisions and how those decisions affected classroom practice, and to evaluate the utility of the IWB in the lesson. Most participants chose to respond in writing via email, although one teacher did provide printed copies of her reflections. McLaughlin's (2007) continuum characterizes the objects of teachers' reflections on their practice. Teachers' reflections may be *specific* and *proximate*, that is, reflecting upon present concerns including examples that illustrate concepts, or *general* and *contextual*, reflecting on their overall practice and on the purpose of education. The two types of reflection in

my study address both the *specific* and *proximate* (logs of daily IWB use) and the *general* and *contextual* (journal reflections on IWB use and reading instruction) ends of McLaughlin's continuum of reflection. Topics for reflection arose from teacher comments during interviews, from observations of their practice, and from questions specific to the research questions for the study. Teachers were encouraged to add reflections from outside the central focus of the weekly reflection questions if they chose. A template for responses is included as Appendix A.

Teachers emailed their reflections weekly and these were used to determine whether teachers responded as expected to the topics, to identify areas where teachers did not respond as expected, and to help set the topics for further questions and observations. For example, preliminary themes or issues arising from teacher reflections in the first weeks became topics for discussion during the last four weeks of research. The information gathered from the journals was used to

(1) identify common themes, if any, amongst participants' reflections and identify themes unique to each participant,
(2) compile a list of software and hardware used and discuss how teachers used these software and hardware in their practice,
(3) examine how frequently IWBs were used in the classrooms and which instructional methods were commonly used,
(4) describe how IWBs were used in these classrooms when the researcher was not present.

**Teacher observations.** Teacher observations were scheduled once per week for each classroom. Observations took place during the scheduled Language Arts' periods. Teachers' use of the IWB for instruction was observed and recorded for later transcription. Specifically, the focus of observation was on:

(1) which instructional methods were used with the IWB, such as whole-class discussion, small group instruction, a mixture of these, or other,
(2) whether instructional methods changed when the IWB was not in use, and
(3) how teachers interacted with students both with and without IWB use.

Teacher observations were audio-taped and transcribed. In addition, a digital screen capture program, *Camtasia Studio* (TechSmith, 2010), was used to record the information displayed on the IWB to have documentation of the software used, the information accessed, and the ways teachers or students interacted physically with the IWB. Screen capture programs record the information displayed on a computer screen in a movie format. Field notes, transcripts, and the screen capture data were analyzed on an ongoing basis to identify or verify themes emerging from observations and journals and to provide focus for discussion during interviews. The purpose of frequent observations was to allow for a more accurate analysis of whether teachers' perceptions of their pedagogical change (as recorded in their journal reflections) related closely to their practice (as recorded during teacher observations).

**Teacher interviews.** Teacher interviews were scheduled weekly. Interviews were short, lasting no longer than half an hour, and occurred after each teacher observation, typically on the same day, although at times the interview occurred on a subsequent day. The purpose of the interviews was to explore teachers' thinking about their pedagogy and to clarify issues arising from their journal entries or observations. The interviews were audio-recorded and transcribed. A semi-structured interview format was used and teachers were encouraged to provide examples to support their pedagogical thinking. Teachers

were asked to discuss why they decided to use the IWB for the lesson, how technology and reading objectives were addressed, and how their pedagogical decisions were reflected in their classroom practice.

Appendix B provides examples of questions asked during teacher interviews about teachers' daily use of the IWB in instruction in order to understand their pedagogical decision-making and practice. Questions 4 through 7 pertain to teachers' background using the IWB, including how long they have used IWBs, the training they received, and their reflections about the effectiveness of the use of the IWB for reading instruction. Other questions arose from reading their journals and observing teachers' use of IWBs during reading instruction in their Language Arts' classes.

Data arising from teachers' interviews were used to confirm or build on themes and patterns that arose from journals and observations or to establish new themes and patterns unrelated to the journals and observations. Some themes and patterns were common to several teachers, and some were unique to individual teachers, depending upon their experiences, their program placement, and their comfort with technology. Journals and transcriptions of observations and interviews were coded and used to compare what teachers say about their pedagogy (i.e., through journals and interviews) and how they used IWBs in their practice (i.e., through teacher observations). The coding schemes are described further under Data Analysis and Interpretation.

**Phase Two**

Throughout the data collection period, teachers were asked to gather

copies of training materials they received since they began using the IWB. Training materials originated from various sources, including school- or district-based professional development activities, manufacturers, and outside agencies. In the last week, these materials were collected and evaluated for appropriateness for instructing primary teachers on how to use the IWB using the questions found in Appendix C. Criteria for evaluation included whether the resource supports pedagogical thinking and links practice to instructional outcomes for technology and reading. These questions examine the intended focus of the resource, whether and how pedagogy and classroom practice are addressed, and whether and how the resource supports reading instruction. The purpose of analyzing the training resource materials was to assist in understanding where instructional practices may have originated (i.e., in activities suggested during training) and whether and in what ways teachers' training emphasized pedagogical thinking.

## Data Analysis and Interpretation

Polkinghorne (1995) wrote, "Many qualitative research studies employ a paradigmatic type of analysis. ... Paradigmatic analysis is an examination of the data to identify particulars as instances of general notions or concepts" (p. 13). Thus, both during and after data collection the researcher reads and rereads the data, identifies preliminary themes or patterns, and provides support for these themes or patterns by using specific examples from the data. Data collected during the study were primarily qualitative, in the form of teachers' written reflections, field notes and transcriptions of observations, transcriptions of teacher interviews, and descriptive comments from the Training Materials Evaluation

Templates (Appendix C). Some data were quantitative, including the frequency and duration of IWB use, frequency and duration of tactile interaction with the IWB for teachers and students, frequency of use of software programs, and frequency and type of technical problems encountered. Data collected were subjected to initial analysis during the course of the study in order to provide focus for further data collection (Merriam, 2009). Specifically, information from journals and teacher observations were coded to establish preliminary themes, patterns, and categories as a basis for discussion in teacher interviews.

**Qualitative Data Analyses**

Initially, teacher journals and field notes and transcriptions of teacher observations were analyzed separately. Journals were read and preliminary codes and themes were generated by identifying key words, phrases, or longer passages that related to the focus of research (Merriam, 2009), namely teacher pedagogy, classroom practice, IWB use, and reading instruction. Other themes that arose from data collection were interactivity, learning styles, engagement, and motivation. Next, field notes and transcripts of teacher observations were analyzed and key words and phrases were identified. Illustrative examples of concepts that arose from journals and interviews were identified. At this point, teacher journals and observations were analyzed together in order to identify complementary or contradictory themes to be discussed with participants during interviews. At the end of data collection, the themes and patterns identified throughout the eight weeks were organized and analyzed to identify the main themes and concepts that addressed the research question, “How does primary

teachers' IWB use influence their pedagogical practice?" The emphasis of interpretation was on the identification of changes in teacher pedagogy and of instances where teachers' perceptions of their pedagogical changes were supported in their reading instruction.

Member checking of emerging themes was done informally as part of the interview process. Teachers were questioned in subsequent interviews about themes arising from their interviews and reflections and my observations. Additionally, transcripts of all interviews were provided to the participants for their review. Themes arising from the qualitative data were subjected to a match-mismatch reliability procedure whereby another reviewer examined the qualitative themes and the related excerpts from the interview transcripts to check for agreement. The reliability was .98 and differences were resolved through discussion.

**Quantitative Data Analyses**

Descriptive statistics were used to analyze the frequency and duration of IWB use within lessons, teachers' and students' interaction with the IWB, and software use. Quantitative frequency data were used where possible to determine whether there was support for themes that arose in the qualitative analyses.

**Frequency and duration of interactive whiteboard use within lessons.** Duration of the total time the IWB was in active use during lessons observed was determined using the transcripts of the observations and the *Camtasia* (Techsmith, 2010) transcripts. Active use was determined to be the times during which either the teacher or the students watched or interacted physically with the IWB and

excluded times when teachers and students did not focus on the IWB as part of their work. The codes assigned were either "IWB used" or "IWB not used". This value was compared to the total observed time for each teacher to establish a percentage of usage time. The mean values for IWB use and for lesson length were calculated for each teacher. These values were then used to determine whether the IWB was in active use for more than half of the time during observed lessons, as per the selection criteria for teacher participation in the study.

Next, the extent of IWB use during instructional times was determined. Observational transcripts were recoded with codes related to instruction, that is, whether the teacher taught new content, reviewed previous content, provided extensions to current content, or engaged in non-instructional activities. As per Hirst's (1973) definition of pedagogy, only activities which had clearly identified instructional goals to teach new content were included as teaching activities. Reviews of previous content such as quizzes and activities to extend learning past the current learning objectives were not counted, and these activities were not frequent. Non-instructional activities included breaks and transitions between activities where the teacher was not instructing students in content. The mean durations of IWB use or non-use for instructional and non-instructional activities during each observation were calculated. These means were used to determine whether IWB use was the predominant instructional activity (i.e., used for more than 50% of instructional time).

**Perceived pedagogical change**. Hirst (1973) and Olson (2009) included the actions of the teacher, the actions of the student, and the learning objectives in

their definition of pedagogy. If, as is often claimed in promotional and case study literature, teachers' use of the IWB changes their pedagogy, then the patterns of instruction between when the IWB is used and when it is not used should vary considerably. For example, many innovative, student-centered practices should be observed when the IWB is in use and traditional, teacher-centered practices should be observed when the IWB is not used. Thus, the examination of activities undertaken by both the teachers and students as well as the content of instruction is required to examine whether and how pedagogical change occurs or has occurred.

In the course of analysis, teachers' actions were examined first. A summary of each observed lesson was created in which teacher and student statements were organized by activity and by IWB use or non-use. Each instructional activity was assigned an instructional code. Instructional codes were adapted from the categories of instruction used by Dewitz et al. (2009) in their examination of comprehension instruction in core language programs: skill mentioned, skill + explanation, modeling, information, questions, question + model, guided practice, direct explanation, independent practice, discussion. A category was added, information + question, to encompass times when teachers provided information about a topic and then asked students questions about that information. This code was used most frequently for read-alouds where teachers read a story aloud and paused throughout to ask comprehension or vocabulary questions. An additional code was added to account for non-instructional activities, and these were excluded from analysis. The durations of IWB use and

non-use for each instructional activity were calculated for each teacher. Instructional activities were assigned a rank based on duration. Patterns in ranks between teachers were examined based on factors such as grade and program placement, length of experience using the IWB, length of experience with teaching, and reported level of comfort with technology.

Students' activities were examined second. The transcript summaries were revisited and recoded to reflect activity type. Initial codes assigned based on activity type were: game, holiday activity, morning routine, quiz, readers' theatre, reading, recitation, spelling, video, worksheet, writing, break, drawing, printing practice, cross curricular activity, kinaesthetic response activity, and centers' activity. Activity codes were collapsed and then aligned with the six language arts addressed in the *Alberta Program of Studies for Language Arts* (Alberta Learning, 2000a). Final codes were: Reading (by student independently, by student guided by teacher, by teacher to students, or by IWB or computer) and reading games; Writing (by student independently, or by student guided by teacher) and writing assessments; Speaking (oral recitations); Viewing (videos); and Representing (drawing or kinaesthetic response to literature). Listening activities were not represented on their own, but were part of the read-alouds by the teacher and the IWB. Letter recognition activities, as performed in the kindergarten classrooms, were both reading (letter recognition) and writing (printing) activities. A code of Other was assigned to cross-curricular (often mathematics as part of the morning routine) and in-class transitions between activities. The duration of IWB use and non-use for each student activity was calculated for each classroom. Student

activities were assigned a rank based on duration for each classroom. Patterns in ranks between classrooms were examined.

The student activities related to reading were re-examined to establish whether and how the IWB was used to support reading instruction. First, the act of reading was analyzed, whether through practicing reading or through teacher modeling of reading. The summaries were examined to determine which types of texts were being read by or to students (digital or paper-based) and who read each type of text. Digital texts were those that were created specifically for use on the IWB or computer such as digital stories from websites. Paper-based texts were those created to be read from paper, such as storybooks and novels, and also included scanned copies of paper-based texts that were displayed on the IWB. Next, response to literature activities were examined. These included activities that occurred prior to or after reading, but not during the act of reading. Finally, instruction in reading strategies was examined. These activities were not connected to the reading act, but encompassed decoding and comprehension strategies taught without a text, typically through worksheets or videos. The durations of IWB use and non-use for reading instruction, reading response activities, and reading strategies instruction were calculated and compared for each teacher to determine the purposes for which the IWB was used during reading instruction and to identify the types of text for which the IWB was used to read.

**Perceived changes to interactivity**. Smith et al. (2005) differentiated between technical (i.e., tactile) and pedagogical interactivity. Quashie (2009)

wrote about "vicarious interaction" with the IWB, meaning that most students' interaction with IWB content came not from touching the screen, but from offering oral directions to the teacher or other students who interacted with the IWB. Hennessy et al. (2007) wrote about the "funnelling" phenomenon where the IWB is sometimes used to funnel student responses to an established correct answer rather than to support discussion. In the course of data analyses, both technical and pedagogical interactivity were examined quantitatively. The purpose of determining the mean duration of teachers' and students' use of the IWB (technical interactivity) and the duration of teacher- and student-centered activities (pedagogical interactivity) was to determine whether IWB use during reading instruction in primary Language Arts classrooms supports teacher-directed, lecture-style pedagogy or student-directed, seminar-style pedagogy, or both (Olson, 2010).

In order to determine the durations and types of technical interactivity, the observation summaries were revisited and recoded to analyze the type and duration of interaction with the IWB by both teachers and students. Types of interaction were categorized according to proximity with the IWB: tactile interaction, interaction through peripheral devices, and no interaction (IWB used for display or mentioned only) and by either teacher or student use. Students' use of the IWB was further divided into supervised and directed use or independent use. Interaction types were assigned a rank based on duration for each teacher. Patterns in ranks were examined based on factors such as grade and program placement and reported level of comfort with technology.

Pedagogical interactivity was determined through reanalysing teacher activity codes and collapsing the Dewitz et al. (2007) categories into teacher-only activities such as information provision or modeling where students were not active participants; student-only activities such as independent practice where the teacher's role was to observe or assist individual students; and teacher and student activities like guided practice, questioning, and discussion where there was active interchange between teachers and students. The durations of IWB use and non-use during teacher, student, and teacher and student activities were calculated and used to determine overall whether IWB use was predominantly for teacher- or student-led activities or more for activities where teachers and students interacted. Additionally, in each category of teacher, student, or interactive activities, it was determined whether the IWB was more often used or not used.

**Integration of Qualitative and Quantitative Data**

Although qualitative and quantitative data were analyzed separately, quantitative data were used, whenever possible, to offer support to qualitative themes arising from teachers' journals and interviews. For example, teachers' perceptions of their change in teaching methods (and pedagogy) were examined qualitatively through their stories and examples and quantitatively through comparisons between the frequency of IWB use for each teacher or student activity. Teacher perceptions related to increased interactivity were also examined qualitatively through stories and quantitatively through comparing the durations and types of interaction with the IWB by teachers and students. Thus, conclusions drawn from the data in regards to pedagogical change, interactivity, and other

topics are supported with evidence arising from observations in the classroom. Improvements to student motivation, engagement, and learning were not measured and verified through the use of observational data. These perceived benefits would most effectively be measured in an experimental study and were outside the scope of the measures set forth for my study. Thus, in these cases, support for teachers' perceptions was anecdotal only.

## Summary

The preceding chapter outlines the procedures used to gather and analyze data in my study. Qualitative and quantitative data were gathered separately and wherever possible, quantitative data (from observations) were used to support or refute themes that arose from qualitative data gathering (interviews and journals). Chapter four presents the results of my analyses and interpretations followed by discussion surrounding the three research questions. Since the research questions addressed multiple areas of IWB use and the topics arising from data collection were varied, the results, discussion, and implications are presented together for each question before moving to the next topic or question.

# Chapter 4: Findings and Discussion

This chapter presents an in-depth analysis of participating teachers' Interactive Whiteboard (IWB) use, their pedagogy, and observed changes in their pedagogy that occurred with IWB use. Descriptive statistics that detail the duration of observation and of IWB use are presented first, followed by analyses and discussions related to each specific research question.

## Duration of Interactive Whiteboard Use

The four participating teachers in this study stated they used the IWB for most or all of their instructional time. They further stated their use was consistent across content areas and especially in mathematics. Olivia (grade 1, Cogito) explained how the IWB was in use for the entire day, much more than the 50% selection criterion specified in the methodology.

> ML: About how much of your day is your SMART Board on?
> O: Oh, all the time, all the time. I shut if off when I'm not in the room, and I shut it off at recess or when we were in library, so I wasn't going to use it. ... So, it's on all the time. I use it constantly.
> ML: Do you use it about the same [amount of time] for all of the subjects? Or is there one subject where you use it more than others?
> O: Um no, I think pretty much the same. (Olivia, December 16, 2011)

With few exceptions (particularly when teachers experienced technical glitches), the IWB was switched on for the duration of all eight lessons observed for each teacher. Krystele had frequent technical glitches which occurred because her IWB was one of the oldest and was located too far from the teacher computer. The IWB worked during her morning class but unless she rebooted it between classes, it often stopped responding to touch by the afternoon because the connecting cables were too long and connectivity to the computer was lost. Additionally, if

her students chose not to use the IWB during centers' time, she would turn it off. With the exception of technical glitches, each of the teachers stated that the IWB was turned on for most of the lesson or was in use for most of the lesson. Often, their uses of *on* and *used* were synonymous. Yet, although Kathleen, Olivia, and Therese had their IWBs switched on for 100% of the observed lessons and Krystele for the majority, it was observed that the IWB was not in active use for the entire time it was switched on. Non-use activities occurred either when the IWB was switched off or when it was switched on but neither the teacher nor students interacted with it, read from it, or viewed content on it. Table 4.1 provides a summary of the mean and duration of the eight observed lessons per teacher and duration of teachers' active use of the IWB within these lessons. The teachers were observed for their entire English Language Arts (ELA) period but the length of the ELA period varied by day and with the school's instructional timetable.

Table 4.1
*Mean and Total Duration of IWB Use and of Observation Time During Eight Observed Reading Lessons Per Teacher (in minutes)*

| Breakdown of IWB Use | Kathleen | Krystele | Olivia | Therese |
|---|---|---|---|---|
| Mean Duration of Lessons | 51.16 | 67.47 | 82.01 | 55.98 |
| Mean IWB Use during Lessons | 21.91 | 32.19 | 43.98 | 31.50 |
| Total Duration of Observations | 409.25 | 539.73 | 656.05 | 447.58 |
| Total Duration of IWB Use | 175.27 | 257.55 | 351.80 | 252.00 |

Although the IWB was switched on for the duration of observations for all

participants, with infrequent exceptions for Krystele (Kindergarten, Regular Program), participants' range in duration of active use varied between a minimum of 7.40 minutes (during a 26 minute lesson for Krystele) to a maximum of 65.12 minutes (during an 81 minute lesson for Olivia). This finding is inconsistent with teachers' perception that they used the IWB "all the time" (i.e., Olivia, December 16, 2011). Multiple examples of non-use activities were observed and these included much of the non-instructional, transition time within lessons (all teachers) and also times when

(1) Kathleen and Krystele did calendar activities at the carpet area;
(2) Kathleen, Krystele, and Olivia read to their students from storybooks;
(3) Kathleen, Krystele, and Olivia taught oral phonological awareness or spelling activities;
(4) Kathleen and Olivia scheduled poetry recitations or Readers' Theatre; and
(5) Therese assigned students to read novels in small groups and complete worksheets.

Teachers' mean use of the IWB ranged from 42.83% per lesson (Kathleen) to 56.30% (Therese). Olivia (grade 1, Cogito) and Therese (grade 3, French Immersion) had mean usage that exceeded 50%, Kathleen (Kindergarten, Cogito) and Krystele (Kindergarten, Regular Program) had mean usage that did not exceed 50%. Thus, although grade level may account for the differences in mean usage (i.e., between Kindergarten and the other primary grades), instructional program type and teacher comfort with technology (Krystele and Olivia expressed comfort, Kathleen and Therese expressed discomfort) did not appear to influence whether teachers used the IWB for more than 50% of their lessons. Each teacher's active use also varied widely from lesson to lesson, even amongst the teachers who on average used the IWB for more than 50% of the lesson time. The range of

active use was: Kathleen (28.21% to 64.56%), Krystele (26.51% to 64.38%), Olivia (26.05% to 80.49%), and Therese (28.17% to 86.09%). Across the 32 lessons observed in total, IWB use exceeded 50% in approximately half the lessons and at no time during the observations was the IWB in active use for an entire lesson.

It was observed that not all activities that took place during the ELA lessons were instructional. In other words, they did not have clearly identifiable learning objectives and the teacher did not intend to teach new content and thus these activities did not satisfy Hirst's (1973) definition of teaching. In determining whether teaching with the use of the IWB was the predominant teaching method, it is important to establish whether the IWB was used predominantly for instructional or non-instructional uses, such as activity breaks or showing videos for entertainment purposes. Table 4.2 provides a summary of teachers' IWB use and non-use during instructional and non-instructional activities that occurred during eight observed lessons per teacher.

Table 4.2
*Total Duration of Instructional and Non-Instructional Activities During Eight Observed Reading Lessons Per Teacher (in minutes)*

| | Kathleen | | Krystele | | Olivia | | Therese | |
|---|---|---|---|---|---|---|---|---|
| Instructional Activity | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used |
| Teach New Content | 125.33 | 131.03 | 215.97 | 187.25 | 298.61 | 198.19 | 231.70 | 168.17 |
| Review Content | 24.00 | 8.32 | 15.88 | 6.15 | 30.63 | 22.75 | 18.17 | 3.42 |
| Extend Content | 1.75 | 3.73 | 3.78 | 4.27 | 5.97 | 30.80 | 0.00 | 1.02 |
| Non-Instructional | 24.00 | 88.98 | 32.78 | 72.40 | 16.60 | 52.52 | 2.12 | 22.98 |

Krystele, Olivia, and Therese's IWB use exceeded 50% for activities with

clear instructional goals and where the teachers intended to teach new content (53.6% for Krystele, 60.1% for Olivia, 57.9% for Therese). Thus, the IWB use was the predominant tool used for instruction in these classrooms. The IWB was used for 48.9% of instructional time in Kathleen's classroom, which is more or less approximately half of the time. The IWB was also frequently used during review of previously learned content (74.3% for Kathleen, 72.1% for Krystele, 57.4% for Olivia, 84.2% for Therese). Considerable time was spent in all classrooms on transitions such as moving to and from the carpet area or setting up and logging onto computers and peripheral devices, and on activities without clear instructional objectives such as singing breaks (112.98 minutes of 27.7% of total time for Kathleen, 105.18 minutes or 19.5% for Krystele, 69.12 minutes or 10.5% for Olivia, 25.10 minutes or 5.6% for Therese). Although the IWB was used for some non-instructional activities, it was typically idle.

Mean usage statistics allow for an understanding of whether instruction with the IWB was the primary method of instruction in the classrooms but are insufficient to understand whether or how teachers' pedagogy has changed. Instead, it is important to understand the types of activities for which the IWB was used and the types of teacher or student interaction with the IWB. The following section compares and contrasts teachers' perceptions of their pedagogical change and their observed pedagogical change in lessons during activities where the IWB was used.

### Perceived Pedagogical Changes with Interactive Whiteboard Use

Research question one: *How do teachers perceive their pedagogy has*

*changed through IWB use and are these changes manifested in teachers' practice?* Initially, all participants reported their pedagogy had changed, particularly their teaching had become more interactive. For example, Olivia (grade 1, Cogito) made the following statement about changes to her pedagogy with IWB use (referred to here as a SMART Board):

> Before I used the whiteboard it was, because we have booklets and worksheets to get through, it was, "Ok from this booklet I might bring in some literature to read to the kids, or I might..." So, it was much tougher to get the lesson across before I had the SMART Board. Now I can go on the [Internet] I can Google things, and I can show them on the SMART Board and then I can bring a SMART Board lesson in and I can get the kids to be interactive with it and it just makes a huge difference. I think they understand so much better than just me, you know, the teacher, being the one teaching. Now the SMART Board is doing some of the teaching, right? They are figuring things out by themselves by manipulating things on the SMART Board. (Olivia, January 12, 2012)

Olivia outlined two activities that changed in her lessons, the use of the IWB to look up information online and to create lessons where students could manipulate information on the screen. She claimed IWB use improved her students' understanding of lesson content and, by extension, they learned more effectively through IWB use than through her teaching alone. When reading this example, one could conclude that Olivia identified one example of pedagogical change, namely the use of new techniques to present content, and deemed this change to be positive. However, a closer examination of this example reveals similarities in activities with and without IWB use. In both instances, the teacher used an informational text to introduce her ideas (paper-based literature or online information) and she provided independent practice (paper-based worksheets or IWB lessons where students manipulated content, such as moving words on the

screen to complete a cloze activity). From a critical perspective, the key differences between the lessons are the medium used to access or present information, the perceived increase in interactivity with IWB use, and the perceived effects of the medium and interactivity on students' understanding of lesson content. Thus, with the exception of the inclusion of some interactive activities, little pedagogical change occurred because most activities performed by the teacher and students were either the same or similar to those performed prior to the installation of the IWB.

Kathleen (Kindergarten) and Olivia (grade 1) taught in the Cogito Program which mandates direct instruction through a *lecture* style of pedagogy (Olson, 2010) that includes information transmission and teacher questioning. The lecture pedagogy was a requirement of the program, and thus, could not be changed by the teachers. Krystele (Kindergarten) taught in the Regular Program and Therese (grade 3) in the French Immersion program. Both the Regular and French Immersion programs follow the *Alberta Program of Studies for Language Arts* (Alberta Learning, 2000a), wherein the meaning-making processes inherent in language learning are emphasized but specific teaching strategies or models are not mandated. Krystele and Therese could use either *lecture*-based pedagogies that privilege activities where knowledge is transmitted from teacher to student, *seminar*-based pedagogies that privilege activities where knowledge is derived from students' experiences (Olson, 2010), or a mixture. Thus, Krystele and Therese had more freedom than Kathleen and Olivia to modify their pedagogies. Some principles and instructional strategies from *Balanced Literacy* were used by

both teachers. *Balanced Literacy* provides opportunities for both teacher-directed and independent or small-group learning, although limited small-group work occurred during lessons observed (once in Therese's class).

Although the division between lecture- and seminar-based pedagogies is a useful distinction, a finer analysis of teachers' pedagogy is needed in order to determine whether change occurred. Also, in order to analyse teachers' perceptions of pedagogical change, it is important to be mindful of what pedagogy entails. According to Hirst (1973) teaching (and thus pedagogy) is

> The activity of a person, A (the teacher), the intention of which is to bring about an activity (learning), by a person, B (the pupil), the intention of which is to achieve some end state (e.g. knowing, appreciating) whose object is X (e.g. a belief, attitude, skill). (p. 171)

Hirst concluded that a machine (IWB is a machine/tool) cannot teach students because it does not have the capacity to have the intention to teach students. The results presented in the analysis of teachers' perceived pedagogical change in the following section are organised around the components of Hirst's definition of pedagogy that were extended by Olson (2010); namely teachers' actions intended to bring about learning, students' actions intended to bring about learning, and the learning objectives.

**Teachers' Actions Intended to Bring About Learning**

Table 4.3 provides a breakdown of teachers' instructional activities with and without IWB use during eight observed lessons per teacher. Non-instructional activities such as transitions are excluded from Table 4.3, because they do not have clearly identifiable learning objectives.

Table 4.3

*Duration of IWB Use and Non-Use by Type of Instructional Activity During Eight Lessons per Teacher (in minutes)*

| | Kathleen | | Krystele | | Olivia | | Therese | |
|---|---|---|---|---|---|---|---|---|
| Instructional Activity | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used |
| Provide Information | 14.63 | 42.33 | 59.27 | 26.12 | 16.07 | 22.39 | 72.50 | 8.48 |
| Mention Skill | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Direct Explanation | 0.00 | 0.00 | 0.00 | 0.00 | 4.15 | 1.38 | 2.32 | 0.00 |
| Model Skill | 0.00 | 0.00 | 2.50 | 0.00 | 22.21 | 1.40 | 8.43 | 0.00 |
| Ask Questions | 3.35 | 15.60 | 21.40 | 41.13 | 5.87 | 2.90 | 14.13 | 34.67 |
| Discussion | 0.00 | 0.00 | 1.55 | 10.78 | 0.00 | 0.00 | 0.00 | 1.20 |
| Guided Practice | 91.73 | 26.80 | 13.90 | 19.20 | 129.35 | 70.21 | 64.23 | 0.00 |
| Independent Practice | 0.00 | 22.65 | 106.40 | 67.07 | 46.55 | 84.41 | 9.25 | 81.32 |
| Mention + Explain | 0.00 | 0.00 | 0.00 | 0.60 | 8.49 | 0.28 | 7.98 | 0.00 |
| Question + Model | 4.60 | 0.00 | 3.20 | 15.05 | 50.55 | 1.30 | 12.03 | 0.00 |
| Information + Questions | 11.02 | 23.65 | 7.75 | 7.30 | 15.37 | 13.92 | 40.83 | 42.50 |
| Total | 125.33 | 131.03 | 215.97 | 187.25 | 298.61 | 198.19 | 231.70 | 168.17 |

*Note*. Instructional Activity codes were adapted from Dewitz et al. (2009)

With the exception of Kathleen, the IWB was used more frequently than not during activities with clear instructional goals (215.97 minutes of use and 187.25 minutes of non-use for Krystele, 298.61 minutes of use and 198.19 minutes of non-use for Olivia, 231.70 minutes of use and 168.17 minutes of non-use for Therese). As expected, due to the differing nature of the programs in which they taught, there is a distinct difference between the nature of the teaching activities in which Kathleen and Olivia engaged (Cogito) and those in which Krystele (Regular Program) and Therese (French Immersion) engaged.

**Kathleen and Olivia.** The primary teaching activity in which Kathleen

and Olivia (Cogito Program) engaged was guided practice (46% of instructional time for Kathleen and 40% for Olivia). IWB use far exceeded non-use for guided practice. One of the most common ways the IWB was used for guided practice in reading was as a medium for teaching decoding skills. Kathleen, who had recently moved to the Cogito program from a traditional Kindergarten program, used the IWB to replace small-group guided reading from the *Balanced Literacy* program (Brailsford, 2003) because small-group instruction was prohibited in the Cogito Program. She explained the benefits of using the IWB for guided reading type activities with the whole class in the Cogito Program.

> Ka: First of all, being able to view that text. And, it's big enough for them to see. Especially in those little readers - you don't have to have all those little readers in the class because we don't have them for the kids, we don't have them in there. It's a money saver and it takes the place of small group reading which I can't do in the Cogito program anyways. But it's the same kind of a guided reading activity that we go through together so it allows me to do that. Because even when you have a big book, they're hard to manipulate and hold and with a group that big they can't see it. So, I guess it's just the fact that it makes the exposure to the words and the texts available to all of the children and I've actually started turning my computer screen for the kids that sit right at that one corner and if I'm writing and stuff so they can see it on my computer. Because sometimes they can't see what I'm doing you know, I have to stand somewhere.
>
> ML: That's one way you've adapted around the restrictions of "the teacher has to be at the front"?
>
> Ka: Or within, you know, but not sitting with a small group. I just think that if kids can't see that and they're just kind of listening and not really being able to see it, they're not as tuned in to the teacher. (Kathleen, December 12, 2011)

From Kathleen's perspective, the IWB was preferable to the traditional big book as a medium for reading as a group during skills instruction because all students could see the IWB. Similarly, Olivia used the IWB for decoding and reading skills instruction.

The second most frequent instructional activity for Kathleen and Olivia was the provision of information, either with or without questions (36% of instructional time for Kathleen and 14% for Olivia). The most frequent activity during information provision was when the teacher read a book to students at the carpet area (Kathleen) or at the front of the classroom (Olivia) and asked questions about vocabulary or story action while reading. The IWB was most frequently idle during information provision activities, particularly during this reading activity. Both Kathleen and Olivia used the IWB to teach decoding skills but used paper-based storybooks to read aloud with the class for vocabulary and comprehension instruction although neither teacher mentioned the difference in reading practices when asked whether some activities were better with or without IWB use. Typical information provision activities for which the IWB was used were to show videos for singing practice (Kathleen), to teach reading strategies (Olivia), or to read informational or fictional passages together (Olivia). Olivia explained her decision to use the IWB to display a story for Readers' Theatre:

> That was simply, I thought, another way for them to be able to see when they had to read. As you saw, the story is quite a complicated story and it's tough for the kids to read these kinds of stories in grade 1, especially because I have from non-readers all the way up to children who are quite adept (like, they're quite good readers). So it's kind of difficult, we do a lot of group type of reading, either it's echo reading. This was the first week that we were trying this Readers' Theatre thing. I thought, this group would work ok with Readers' Theatre, so they're getting it but again if I have a row, I never foresaw that, if I have a row of non-readers then we're in trouble because none of them can read it. Maybe if I arranged it differently, made sure there was a good reader in each row, so that at least they were able to read the bulk of it. (Olivia, November 28, 2011)

Olivia's primary concern was that students be able to see the content on the IWB. She did not elaborate upon the pedagogical implications, including that it was

easier to model finger tracking using the IWB particularly for non-readers and struggling readers because students could watch her track the words on the IWB while they read. The story read together for Readers' Theatre came from the basal reading series that was required in the Cogito classrooms in the school (Open Court Publishing Company, 1995). Olivia explained that the stories in the reader were very difficult for most first grade students and particularly for non-readers. In response, she typically spent two weeks on each story and her students practiced reading the story for a week prior to the Readers' Theatre.

The third most frequent instructional activity for Kathleen and Olivia was independent practice (9% of instructional time for Kathleen, 26% for Olivia). Independent practice, particularly written work and worksheets, was highly emphasized in the Cogito program documents (Edmonton Public Schools, 2010). Unlike guided practice, independent practice was primarily (Olivia, 46.55 minutes with and 84.41 minutes without IWB use) or exclusively (Kathleen, 0.00 minutes with and 22.65 minutes without IWB use) done without the IWB. The primary independent practice activities were worksheet completion, completion of writing assignments, and poetry recitations. Olivia used the IWB to support independent practice. She projected copies of students' assignments for visual reference and to assist them to find the page in their duotang or paper-copy workbook. She read the directions from the displayed page and then left the image on the IWB while students worked. She explained students needed the visual:

> Cogito it is a very worksheet-driven program so it is a very product-driven program where the kids are expected to produce a product from something that they've learned. So, I scan all the time. Everything that they have, that they're doing in their books, I scan to that SMART Board and display it.

> Which is great in grade 1 when they are still so dependent on the teacher. They can't read so I have to read everything with them. So that has been very helpful. (Olivia, December 16, 2011)

Although the IWB was used to display student assignments in case they were needed for visual reference, Olivia and her students rarely made further reference to or looked at the IWB during independent practice activities.

**Krystele and Therese.** Neither Krystele (Regular Program) nor Therese (French Immersion) taught in a program that was highly prescriptive like the Cogito program. Thus, although some of their primary instructional activities were similar, their methods and their IWB use patterns differed according to individual teaching styles and grades taught.

The primary teaching activity in which Krystele engaged was the provision of independent practice (43% of instructional time) such as worksheet completion, independent reading, and centers' time. IWB use exceeded non-use for independent practice (106.40 minutes with, 67.07 minutes without IWB use). Krystele often used the IWB as a learning center for her students (individual student use) or projected information on the IWB for students' visual reference (display) while they completed worksheets and writing assignments on paper at the table area. Non-use time during independent practice included when no student chose to use the IWB for centers and when students read silently at the carpet area. Her second most frequent instructional activity was the provision of information either with or without questioning (25% of instructional time) and this was predominantly done on the IWB (67.02 minutes with, 33.42 minutes without IWB use). Like Kathleen and Olivia, Krystele read traditional storybooks

to her students at the carpet area and asked questions about vocabulary and comprehension. However, on two occasions, she read scanned copies of storybooks that were being used for a school-wide character education focus because limited paper copies were available. Krystele preferred to read stories to her students rather than computer-read because she read with more intonation than the computerized voice and was able to keep students' attention better. Yet, even when she was reading or working from the IWB, there were additional challenges to student attention:

> Kr: Well look at reading stories on the computer. Or, at some point if you're doing activities, you're teaching them as a whole group setting, even using the SMART Board, especially for my kids because of the SMART Board placement and the fact that they have to be on chairs or sitting down, but if they're sitting down, then their neck is fully tilted back. Then, yeah they can get off track. But, my kids also have a very low attention span.
> ML: So then, would that be the same if you were reading a story to them on the carpet?
> Kr: Pretty much yeah. Yeah it would be similar. But, of course, it depends on how the story is read. So it depends on the story. If it's a story where you can have lots of intonation, my class will be focused because they like that. But, let's say it's reading on the computer and the voice is not very interesting, then they'll get off track. And also the interest of the activity to them. How interesting is that to them? The more interesting it is, the more focused they will be. (Krystele, February 13, 2012)

Krystele had previously explained that using the IWB was like turning on a television because her students enjoyed watching videos or playing games, but when she planned interactive activities that required student input and thought and not passive attention, her students' attention to task waivered.

The primary instructional activity in which Therese engaged was the provision of information with and without questions (41% of instructional time) which included reading novels (IWB not used) and showing videos (with the

IWB). Information provision was more frequently done with the IWB than without (113.33 minutes with IWB, 50.98 minutes without) although she almost exclusively used the document camera to display paper resources on the IWB. The two most frequent activities in which students engaged in Therese's classroom were answering questions on worksheets and reading together aloud from novels under the document camera. Therese occasionally used the IWB to show videos or display writing prompts for students, although these activities were far less frequent. Both the videos and the writing prompt displays used the IWB without the document camera, although, on one occasion, the sound cable for Therese's IWB broke and she displayed the video on her cellular telephone under the document camera, but the sound quality and volume were compromised. Her second most prevalent instructional activity was independent practice (23% of instructional time). Independent practice was typically done without the IWB (9.25 minutes with, 81.32 minutes without IWB use). Independent practice generally consisted of paper-copy worksheet completion, but also included one instance where students read together in groups and two instances where they composed letters and comics using Netbook computers that were not connected to the IWB. Although Kathleen, Krystele, and Olivia expressed reservations about using the Netbook computers because Kindergarten and first grade students were unable to use the mouse and keyboard to input information effectively, Therese's third grade students were capable of typing in information and navigating to websites with assistance and modeling. Unfortunately, not all students used the Netbook computers independently and

technical glitches occurred that reduced the efficiency with which students were able to compose.

> It's hard in grade three. They don't have that much experience with it [student use of Netbook computers to compose text] but it is something that I do try to make a little bit more common so I would say definitely not as many times as... maybe I would say once every two weeks or maybe twice a month would be a fair estimate. So they're still learning to log on and get on the website. But that particular time, I have to admit, the connection was very slow. Normally the connection is right away, and I was talking to another teacher and I'm not sure if that cart had been used that day. So, if they're warmed up and have been used when they get onto it, it kind of happens right away that they're able to log on and get into [the school Intranet], but that particular time was especially slow. (Therese, December 9, 2011)

When the Netbook computers were used by students, Therese used the IWB to display the writing prompt or the webpage students were to access. At times, she would use the IWB to model procedures such as logging in or saving documents, but this was rare occurrence and the IWB was often idle during students' independent practice on the Netbooks.

**Pedagogical implications of teachers' actions with and without the IWB.** Olson (2010) observed that lecture-based pedagogies are prevalent in contemporary classrooms and his observation is consistent with my findings. Additionally, the IWB, as used in the classrooms under study, can be used to reinforce lecture pedagogies that promote information transmission and teacher questioning. Lecture pedagogy was most apparent in the Cogito program because it was mandated in program documents. For example, in Kathleen and Olivia's classrooms, the IWB reinforced the lecture-based pedagogy because it simply replaced the overhead projector and was ideal for information transmission (through the use of slides with information on them, digital stories, instructional

videos, and copies of student assignments) and teacher questioning. Neither teacher engaged in discussion with their students in which students' ideas might enter into the instruction, instead, activities where teacher knowledge was transmitted to students prevailed: such as information provision, questioning, and guided and independent practice. With the exception of story reading, these activities were completed often with IWB use either as a static display for student assignments, a projector for videos and stories, or an interactive medium for playing educational games or answering questions presented on a slide. Information transmission and teacher questioning were both prevalent in Krystele and Therese's classroom as well. Discussion, where teachers and students exchange ideas, was less commonplace than questioning, where teachers ask questions and students reply. Krystele used the IWB for centers' time, but students often performed drill-and-practice type games where they practiced writing letters or sorted words by beginning sound. Therese used the document camera with the IWB almost exclusively during her observed lessons. She completed worksheets under the document camera or used the camera to magnify the print in books while reading aloud and thus, she used the IWB exactly like an overhead projector. Although the Internet was used by all teachers, the capacity of the Internet to search out new information and follow students' lines of inquiry was not used by any of the teachers during the observed times. Additionally, with the exception of centers' time for Krystele, the IWB was used exclusively for whole-group, teacher-directed instruction, regardless of whether it was used in Cogito, Regular Program, or French Immersion classrooms.

**Students' Actions Intended to Bring About Learning**

Table 4.4 provides a breakdown of students' activities with and without IWB use during eight observed lessons per teacher.

Table 4.4
*Duration of IWB Use and Non-Use by Type of Student Activity During Eight Lessons per Teacher (in minutes)*

| | | Kathleen | | Krystele | | Olivia | | Therese | |
|---|---|---|---|---|---|---|---|---|---|
| Activity and Activity Type | | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used | Active Use | Not Used |
| Reading (Student) | R | 0.00 | 0.00 | 7.65 | 48.90 | 19.20 | 14.92 | 0.00 | 24.20 |
| Reading (Guided) | R | 26.68 | 2.32 | 2.88 | 3.03 | 9.22 | 0.00 | 37.82 | 26.82 |
| Reading (Teacher) | R/L | 0.00 | 65.57 | 47.80 | 29.73 | 9.37 | 37.32 | 42.85 | 24.97 |
| Reading (IWB) | R/L | 2.82 | 0.00 | 0.00 | 0.00 | 7.55 | 2.98 | 0.00 | 0.00 |
| Reading Games | R | 12.43 | 7.33 | 0.00 | 0.00 | 44.30 | 2.20 | 0.00 | 0.00 |
| Letter Recognition | R/W | 10.10 | 14.52 | 81.95 | 55.35 | 0.00 | 0.00 | 0.00 | 0.00 |
| Spelling | W | 31.63 | 40.85 | 0.00 | 0.00 | 48.93 | 112.05 | 0.00 | 0.00 |
| Writing (Worksheet) | W | 0.00 | 0.00 | 43.63 | 9.08 | 83.90 | 36.33 | 94.78 | 25.50 |
| Writing (Student) | W | 0.00 | 10.68 | 0.00 | 0.00 | 5.23 | 22.25 | 40.30 | 44.27 |
| Writing (Guided) | W | 8.95 | 8.50 | 0.00 | 0.00 | 0.00 | 0.00 | 3.37 | 1.45 |
| Assessment | W | 0.00 | 0.00 | 0.00 | 0.00 | 33.35 | 0.45 | 0.00 | 0.00 |
| Oral Recitation | S | 0.00 | 11.97 | 0.00 | 0.00 | 0.00 | 0.52 | 0.00 | 0.00 |
| Viewing (Video) | V | 0.00 | 0.00 | 0.00 | 0.00 | 6.02 | 0.00 | 32.88 | 14.47 |
| Drawing (Guided) | Re | 5.33 | 9.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Kinaesthetic | Re | 0.00 | 0.00 | 13.25 | 6.53 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cross-Curricular | O | 77.32 | 58.00 | 60.38 | 129.38 | 84.73 | 71.03 | 0.00 | 18.68 |
| Class Transitions | O | 0.00 | 4.95 | 0.00 | 0.17 | 0.00 | 4.20 | 0.00 | 15.23 |
| Total | | 175.27 | 233.98 | 257.55 | 282.18 | 351.80 | 304.25 | 252.00 | 195.58 |

*Note*. Activity type codes represent the six language arts as set forth in the *Alberta Program of Studies for Language Arts* (Alberta Learning, 2000a): Reading including Decoding and Comprehension (R), Writing/Composing (W), Speaking (S), Listening (L), Viewing (V), Representing (Re), Other/None (O).

With the exception of Therese, the most predominant use for the IWB for student learning activities during the ELA classes was for cross-curricular activities (135.32 minutes or 33.1% of total time for Kathleen, 189.77 minutes or 35.2% for Krystele, 155.77 minutes or 23.7% for Olivia). Cross-curricular activities were those in which learning objectives from other curricular areas were addressed in addition to or instead of Language Arts objectives, such as: morning routines (mathematics and science); holiday and thematic activities (social studies and health); and play centers, activity breaks, or singing breaks (physical education and music). Thus, much of the Language Arts period was not, in fact, filled with instruction or practice of Language Arts skills such as reading and writing. The largest contributor to the cross-curricular category for Kathleen, Krystele, and Olivia was the morning routine (62.30 minutes or 15.2% of total time for Kathleen, 69.82 minutes or 12.9% for Krystele, and 96.83 minutes or 14.8% for Olivia). Even though the morning routines included elements of reading and writing, they were intended to address predominantly mathematics or science outcomes such as counting and regrouping, reading the calendar, and observing and charting changes in the weather. Observations in Therese's classroom took place only at the end of the day, so her morning routines were not observed. Another factor that contributed to the prevalence of cross-curricular activities during Language Arts periods was that several observational days fell on specialty or holiday events that were not part of normal instruction such as Christmas Concert practice (twice for Kathleen), Groundhog Day (Krystele and Olivia), Hundred's Day (Kathleen and Olivia), and Valentine's Day (Olivia).

When learning activities that are not related directly to teaching or practicing reading, writing, listening, speaking, viewing, or representing skills are removed from my analysis, various patterns emerge as to the types of Language Arts instruction or practice activities that occurred in each classroom. First, reading instruction or practice (students' independent reading including Readers' Theatre, guided reading, teachers' reading, computerised reading, and reading-based games) occurred frequently in all classrooms (117.15 minutes or 28.6% of total time for Kathleen, 140.00 minutes or 25.9% for Krystele, 147.05 minutes or 22.4% for Olivia, 156.65 minutes or 35.0% for Therese). Second, writing instruction or practice (students' independent or guided writing, printing practice, responses on paper-copy worksheets, and quizzes) was prevalent in the Cogito Classrooms (Kathleen and Olivia) and in classrooms with the oldest students (Olivia and Therese). The total duration of writing instruction or practice exceeded the duration of reading instruction or practice in these three classrooms. Writing (composition) was done via pencil and paper, keyboard, and *Senteo Response Systems* and occurred for 125.23 minutes or 30.6% of total time for Kathleen, 342.50 minutes or 52.2% for Olivia, and 209.67 minutes or 46.8% for Therese. Phonological awareness activities (such as letter sound) were often blended with letter recognition and printing practice. Learning activities involving letters and sounds occurred only in the Kindergarten classrooms (Kathleen and Krystele), because most students were reading independently in the first and third grade classrooms. Learning activities that focussed on instruction or practice in the other four language arts (listening, speaking, viewing, and representing) were

far less frequent than reading and writing.

Despite general patterns in reading and writing instruction or practice that occurred in the classrooms, the prevalence of specific student activities showed no consistency between teachers, likely due to the differences in the structure of their programs and in the ages of the students, as noted in the previous paragraph. The most prevalent student activities in each classroom and the duration of IWB use for each are presented next. Cogito classrooms (Kathleen and Olivia) are presented first, Regular Program classrooms second (Krystele), and French Immersion third (Therese).

**Kathleen and Olivia.** Participation in spelling instruction (which combined spelling, letter recognition, phonological awareness, and printing instruction), was the most prevalent student activity for both Cogito Teachers (97.10 minutes or 23.7% of total time for Kathleen and 160.98 minutes or 24.5% for Olivia). Spelling instruction, practice, or assessment occurred daily in the Cogito Program classrooms. Teachers paired IWB use with non-use during the activity. First, they would introduce orally the target "grapheme" to be learned and students would practice reciting the rule for when the grapheme was to be used and then practice pronouncing its sound, such as the " /r/ the /r/ of nurse" (Kathleen, Classroom Observations, January 19, 2012) rule, that was meant to cue students to write the *ur* grapheme. Then, teachers would use the IWB to model writing the letters while reciting the rule, the sound, and adding special marks to indicate which rule was being followed. Finally, students would practice writing the grapheme while reciting the rule and sound and then adding the marks. Often

teachers would provide a word or sentence to accompany the grapheme and would model how to sound out and write the words and students would copy. During spelling and grapheme instruction, the duration of IWB non-use exceeded the duration of IWB use due to the initial oral modeling and students' independent practice without IWB use (41.73 minutes of use and 45.37 minutes of non-use for Kathleen, 48.93 minutes of use and 112.05 minutes of non-use for Olivia).

The second most prevalent student activity in Kathleen's classroom was to be read to by the teacher (65.57 minutes of 16.0% of total time). This activity included times when the teacher read a story to the students and asked vocabulary or comprehension questions, but not times when the teacher and students read together during reading strategies instruction. Kathleen never used the IWB when she read stories to students. Instead, once or twice during each class, she seated students at the carpet area and read a paper-based storybook to them. Olivia also read paper-based storybooks to her students, usually at the front of the class, but this occurred less frequently (7.1% of total time observed).

The second most prevalent student activity in Olivia's classroom was the completion of structured responses, usually in the form of paper-copy worksheets or workbook pages (120.23 minutes or 18.3% of total time). This activity included times when a structured (usually single word) response was required and where a single correct response was expected. Olivia explained the Cogito Program had a reputation for being a worksheet program: "As I said, in Cogito we do a lot of paper-pencil stuff, and it's tough because it's known as a worksheet program" (Olivia, December 6, 2011). She further explained she tried to do some

of the assessment on the IWB that traditionally would be done by paper-copy worksheet (for example, she used Senteo quizzes or slides with multiple choice questions) but it was more difficult to communicate the results of these assessments to parents, so she usually had students complete paper-copy worksheets as well because parents expected a tangible record of their children's achievement. The IWB was used frequently while students completed paper-copy worksheets or workbooks (83.90 minutes of IWB use, 36.33 minutes of non-use), but this was nearly exclusively as a data projector to display assignments while students worked independently at their desks. Sometimes, the teacher would use the IWB to annotate over the displayed assignment to demonstrate how to complete the worksheet or would use annotation to model so students could correct their work.

**Krystele.** Students in Krystele's classroom participated in a variety of activities. The most prevalent activity was letter recognition instruction (often paired with phonological awareness instruction and letter formation instruction). Letter recognition instruction occurred for 137.30 minutes or 25.4% of instructional time and exceeded the 25.62 minutes of similar instruction that occurred in the other Kindergarten classroom (Kathleen). However, instruction in the Cogito program was accelerated in relation to the regular program; students were finished letter recognition instruction before Christmas and moved to two-letter graphemes after Christmas and to spelling simple decodable words by the end of Kindergarten. In Krystele's classroom, instruction in letter recognition occurred throughout the whole year. The IWB was used frequently during letter

recognition instruction (81.95 minutes of use, 55.35 minutes of non-use), and it was used in a variety of ways. For example teacher used the IWB to display words that began with the letter under study, similar to a word wall. She also modeled games and other activities from educational websites and then let individual students play the games or activities during centers' time or during times when other students worked on paper-based worksheets. Part way through the series of observations, Krystele ordered a program to help teach phonological awareness and letter recognition through songs and actions, and she used the IWB to play the recordings for her students while they sang along.

Similar to Kathleen, the second most prevalent student activity in Krystele's Kindergarten classroom was being read to by the teacher (77.53 minutes or 14.4% of total time). Often, this activity took place with the IWB (47.80 minutes of use and 29.73 minutes of non-use), however, in these cases, the IWB was used to display scanned copies of paper-based storybooks that were being used school-wide as part of character education. Few copies of the paper storybooks were available, and thus, one solution to the demand was to scan the stories and display them on the IWB. As with Kathleen and Olivia, teacher reading tended to include questions about vocabulary and comprehension and exclude decoding instruction. Unlike Kathleen and Olivia's students, however, Krystele's students spent time daily reading independently (56.55 minutes or 10.5% of total time). Independent reading time occurred at the beginning of the day while the teacher took attendance and prepared for the planned activities. Independent reading was done predominantly without the IWB (7.65 minutes of

use, 48.90 minutes of non-use). During independent reading, the IWB was used briefly by the students to find their names on the IWB and touch the picture of the balloon to signal their attendance.

**Therese.** By far, the most prevalent student activity in Therese's classroom was the completion of paper-based worksheets (120.28 minutes, or 26.9% of total time). Students completed worksheets on English grammar and in response to their novel studies. These worksheets were usually completed as a class or corrected with the teacher who annotated a paper copy under the document camera (94.78 minutes of IWB and document camera use, 25.50 minutes of non-use). She asked individual students to provide the answers, and then she wrote them in the blanks on her paper copy while students copied at their desks. Therese explained that her students spent so much of their English Language Arts time engaged in grammar and worksheet completion because English Language Arts time was limited in comparison to French Language Arts and because her students had missed portions of their English grammar instruction in previous years:

> I would say that my instruction for language learning is way more variant in French. Like, in English, it's just an hour at the end of the day. I have grammar that they should have been learning since grade one to cover still. It's kind of a catch up game in French Immersion so, we're focussed on the grammar, and the writing and the reading. There's not a lot of time, I feel, to experiment with things right now. I started last year, a poetry unit that I do in March and that's a little more technology and writing things online and reading things online, but I would say in French, because everything is in French, I have a little more flexibility, I think, to experiment with things. (Therese, January 17, 2012)

Students in Therese's classroom were required to write Provincial Achievement Tests in both English and French, and she reported that she prioritized grammar,

reading, and writing instruction in order to prepare her students to write the exams.

Since her emphasis was on grammar, reading, and writing, it is not surprising that the second most prevalent activity for students was independent writing (84.57 minutes or 18.9% of total time). Students wrote letters in response to a prompts displayed on the IWB and they created comics on a website. Both writing activities took place with the use of Netbook computers not connected to the IWB. The teacher displayed and read the writing prompt on the IWB. At times, she showed students how to log in and use the word processing program or website, but aside from this, the IWB sat idle or was used for display (40.30 minutes of use, 44.27 minutes of non-use). Reading and reading response activities were also prevalent; teachers' reading to students occurred for 67.82 minutes or 15.2% of total time and guided reading, or reading with students, occurred for 64.63 minutes or 14.4% of instructional time. Typically, the teacher read to students from a paper-copy storybook or novel placed under the document camera, or students took turns reading aloud from paper-copy novels while she displayed the pages with the document camera. Students at the front of the classroom who were closest to the IWB often read along off the IWB as Therese tracked with her finger. Some of the students in the middle row and students in the back row followed along in their individual novels. Therese surmised that the difference in reading behaviour might be due to the placement of stronger readers in the back rows and struggling readers in the front rows, or perhaps due to limitations of eyesight for following dense print on the IWB.

> It just depends on the day I think too, sometimes. Like, strong readers, I find, feel more confident with a book, like it's not unfamiliar to them, if they lose their spot, they can most of the time easily find it. They might glance at the SMART Board to find their spot, but you know, the strong readers, I think, are pretty comfortable with a book in their hand, but some of them, even [student name removed], he's made a lot of improvements, but still not on the high side by any means, he likes to also look at the SMART Board, so I don't know. I suspected at first that it might be, you know as I said, ability, but I don't know, it could really be a combination of things. (Teacher 4, February 14, 2012)

Initially, Therese was not aware of the difference in reading behaviours between students at the front of the classroom and those at the back. However, she surmised that some students, particularly those in the front, needed visual reference to find their places when reading, and the document camera permitted her to model finger-tracking easily.

**Pedagogical implications of students' actions with and without the IWB.** From the perspective of the student learning activities that occurred in the classrooms under study, the types of activities were very similar to those done in traditional classrooms. They listened while their teachers read; they read aloud with the group or silently; they learned about letters, letter sounds, and spelling; and they responded to worksheets. Sometimes, these activities were facilitated by the IWB, such as when teachers displayed scanned stories or scanned copies of paper-based worksheets, but in many instances they were not. Few interactive activities where students manipulated information on the IWB occurred, and these were most prevalent during centers' activities (Krystele), during holiday or special events (Olivia), and in support of mathematics and science objectives during the morning routine (Kathleen and Olivia). An analysis of students' IWB interaction will follow in the discussion for research question two, however, it is

clear even from examining their learning activities, most student interaction with the IWB was as a *deliverer of literacy* (Burnett, 2010) because teachers used the IWB to teach and reinforce traditional paper-based literacy skills (in this case, reading novels, completing worksheets, or writing stories). Students were seldom engaged in using technology as a *site for interaction around texts* (using collaboration and background knowledge to access digital texts from a socio-cultural perspective) or as a *medium for meaning-making* in contexts beyond the classroom, which Burnett viewed as more sophisticated uses of technology in the teaching of literacy.

**Learning Objectives Related to Reading**

The current study focusses on reading instruction that occurs while the IWB is used. Thus, it is important, from the perspective of Hirst (1973) and Olson's (2010) definitions of pedagogy to understand what types of reading outcomes students are expected to learn in the course of their reading instruction. As stated in the previous section, reading instruction or practice occurred for approximately one quarter to one third of total observed time in all classrooms (28.6% of total time for Kathleen, 25.9% for Krystele, 22.4% for Olivia, and 35.0% for Therese). Most teachers used general statements related to decoding, vocabulary, or comprehension to refer to the objectives for reading instruction and did not reference specific objectives from the *Alberta Program of Studies for Language Arts* (Alberta Learning, 2000a). For example:

> ML: What [were] the language arts objectives that you addressed in the morning?
> Ka: I think in that part, it – vocabulary is probably the biggest thing in there, listening, following instructions. (Kathleen, January 11, 2012).

Kathleen and Olivia did make specific reference in their objectives to skills listed in the Cogito scope and sequence documents. For example:

> I'm doing synonyms tomorrow and you know, there's just nothing [no IWB lesson resources from the manufacturer's sharing site] on synonyms. So, I'm going to have to try to make something for synonyms because, again in grade one, synonyms are not in the curriculum. But that's part of our scope and sequence. (Olivia, January 12, 2012)

Olivia explained that the Cogito scope and sequence was meant to enhance the curriculum set forth in the Program of Studies, and although these skills were assessed, they were not included in report card grades. Despite the lack of clearly-stated or specific reading objectives, reading instruction was divided into three types of activities: reading print (decoding, fluency, vocabulary, comprehension), responding to print (comprehension), and completing worksheets or other activities that provided instruction or practice in specific skills such as the completion of cloze activities on the IWB to reinforce comprehension strategies.

**Reading instruction through modeling and practice.** Reading, as modeled by teachers or practiced by students, was a daily activity in most classrooms over the eight observation sessions. Teachers used both digital and paper-based texts with their students that included digital stories and informational passages; paper-copy short stories, storybooks, basal readers, and novels; and other paper-based texts such as poetry and scripts for Readers' Theatre. Table 4.5 provides a summary of the types and duration of digital and paper-based text use by teachers and students during eight observed lessons per classroom. Totals include times during which the text resource was in active use including teachers' introduction of the text, the reading time, and any discussion

or teaching that occurred throughout the reading; however, activities that occurred after reading such as the completion of paper-based worksheets, interactive lessons on the IWB, and kinaesthetic response activities are excluded from the totals.

Table 4.5
*Duration of Digital and Paper-Based Reading by Teachers and Students During Eight Observed Reading Lessons Per Teacher (in minutes)*

| Text Type and The Reader | Kathleen | Krystele | Olivia | Therese |
|---|---|---|---|---|
| Digital (Guided) | 27.78 | 2.85 | 4.15 | 0.00 |
| Digital (Teacher Read) | 0.00 | 5.92 | 0.00 | 0.00 |
| Digital (Computerized Voice) | 2.82 | 0.00 | 14.68 | 0.00 |
| Paper-Based (Student Read) | 0.00 | 56.55 | 10.90 | 24.20 |
| Paper-Based (Guided) | 0.00 | 0.00 | 0.00 | 64.63 |
| Paper-Based (Teacher Read) | 64.49 | 24.95 | 36.63 | 67.82 |
| Paper-Based (Scanned to IWB) | 0.00 | 40.37 | 0.00 | 0.00 |
| Other: Poetry (Scanned to IWB) | 2.58 | 0.00 | 9.22 | 0.00 |
| Other: Script (Paper-Based) | 0.00 | 0.00 | 23.22 | 0.00 |
| Other: Informational Text (Digital) | 0.00 | 0.00 | 24.50 | 0.00 |
| Total (Digital Text) | 30.60 | 8.77 | 43.33 | 0.00 |
| Total (Paper-Based Text) | 67.07 | 121.87 | 79.97 | 156.65 |

Reading time in the four classrooms was overwhelmingly paper-based. Kathleen used digital print for 30.60 minutes and paper-based for 67.07 minutes, Krystele 8.77 minutes digital and 121.87 paper-based, Olivia 43.33 minutes

digital and 79.97 minutes paper-based, and Therese 156.65 minutes paper-based only. Most print was fiction, although Olivia read informational passages with students during Groundhog's Day and Valentine's Day activities.

Kathleen and her students spent a total of 30.60 minutes reading three digital books, although she had planned to read five digital books during the observed lessons. Unfortunately, technical glitches prevented her computer from loading two digital books, and she read paper-based storybooks instead. Her discussions about each book and her attempts to load the webpage are included in the total for digital books, and thus the mean time spent with each digital book was 6.12 minutes. She read nine paper-based storybooks to her students and on one occasion, she and her students practiced reading poetry from a scanned copy of various winter poems (67.07 minutes total, mean 6.71 minutes per paper-based resource). Krystele and her students spent a total of 8.77 minutes reading two digital books (mean 4.38 minutes per digital book). She spent 65.32 minutes reading two paper-based storybooks and two scanned storybooks to her students (mean 16.33 minutes per paper-based book). The scanned stories were used in place of the storybooks because there were not enough copies for all teachers to use the paper-based storybooks for the school-wide theme. Her students spent 56.55 minutes of independent reading with paper-copy storybooks (mean 7.07 minutes per class). Olivia and her students spent a total of 43.33 minutes reading two digital books and two digital informational passages (mean 10.83 minutes per digital resource). They spent a total of 79.97 reading one short story, two storybooks, a readers' theatre script, and winter poetry (mean 15.99 minutes per

paper-based resource). Therese and her students spent a total of 156.65 minutes reading one paper-copy storybook and four chapters of a novel (mean 31.33 minutes per paper-based resource). Although Therese used the document camera to magnify the print on the storybook and novel for her students, it was a paper-based resource and her students read along from individual paper copies of the novel.

The purposes for which teachers used digital and paper-based texts were quite different, although, as stated earlier in the discussion of Teachers' Actions Intended to Bring About Learning, none of the teachers identified or explained these differences during their interviews. Teachers read paper-based stories to students to model fluent reading, teach new vocabulary, and monitor student comprehension, similar to the Read-Aloud approach in *Balanced Literacy* (Brailsford, 2003). Paper-based stories were longer than digital stories (typically several hundred words in length), complex, and the print was typically densely-packed on the page. For example, the following interchange between Kathleen and her students when she read *One Snowy Night* (Butler, 2005) is typical of interchanges between the teachers and their students when they read paper-based books.

> Ka: (reads) One Snowy Night
> Ka: Does anybody know what this little creature is? What kind of an animal it is? [student name removed]?
> S: A porcupine?
> Ka: No. You're close.
> S: Hedgehog.
> Ka: Hedgehog, yeah. That's smaller and not quite so spikey. Ok? Some people have hedgehogs for pets.
> Ka: (whispers) Ok, let's listen here. We have a little hedgehog stuffy up here.

> Ka: (reads) The cold wind woke little hedgehog from his deep winter sleep.
> Ka: So, he must have been doing what? If he was in a deep winter sleep?
> S: Hibernating.
> Ka: Yes hibernating. But he woke up.
> Ka: (reads) It blew his blanket of leaves high into the air and he shivered in the snow. He tried to sleep again, but he was much too cold. Suddenly, something fell from the sky. Thud! It landed right in front of his nose. It was a present, and it had his name on it.
> Ka: It says, "To little hedgehog, with love, from Father Christmas".
> Ka: Sometimes that's what people call Santa. (Kathleen, Classroom Observations, December 14, 2011)

Throughout this interchange, the teacher read portions of the story, but she also stopped to ask questions and explain the story action or challenging vocabulary words.

Digital texts were (typically) used by Kathleen, Krystele, and Olivia for reading together, where students would take turns reading with the teacher and the teacher would monitor their reading and offer corrective feedback (what Brailsford, 2003, termed Shared Reading). Digital texts were much shorter than the paper-based stories, less complex, and had few words on each page. The exception occurred during the reading of one digital story where many words were present (Olivia) and the computer highlighted words while they were read (Read-Aloud approach, rather than Shared Reading). Digital print was also larger on the screen so students could see it more easily than big books or other paper-based media that might have been used for Shared Reading (Kathleen, December 12, 2011). The following interchange between Kathleen and her students highlights her emphasis on decoding instruction and word recognition strategies during shared reading with a digital story from a website (*My Friend Ben* from www.literactive.com, 2009).

Ka: Now remember, we're on level two books now. They're much more difficult. We have to look at all of the words, don't we? Can anyone read the name of this story for me? You know this word. We've written it many times. What is this word, [student name removed]?
S1: My friend
Ka: This one right here. Sound it out. My friend….
S1: /b/ /ĕ/ /n/
Ka: Put it together. /b/ /ĕ/ /n/
S1: /b/ /ĕ/ /n/
Ka: /b/ /ĕ/ /n/
S1: Ben
Ka: Ben! Good job! My friend Ben. How did you know the word friend?
S1: Friend?
Ka: Yeah, how did you know that word?
S1: Friend.
Ka: Ok, so you looked at the picture? You looked at the sounds? Awesome.
All: My friend Ben.
Ka: Try and look at all of the words first before you put up your hand to come and read for me. … [student name removed] would you like to come and read first for us?
S2: Ben and I go out in the sun.
Ka: Good job. Thank you. Let's read together.
All: Ben and I go out in the sun. (Kathleen, Classroom Observations, January 19, 2012)

Although her students were not yet reading independently, Krystele also modeled word identification strategies during her reading of digital books with her students. Olivia taught strategies for decoding words and improving comprehension when she read digital books and informational passages with her class. Students in Therese's classroom read independently from novels, so although she displayed the novel on the IWB, most students read from their individual paper copies. She took turns reading aloud with students, monitored and corrected their miscues, and discussed story action and challenging vocabulary throughout.

Guided Reading, as described in Brailsford (2003), did not occur during

any of the classroom observations. Teachers in Cogito (Kathleen and Olivia) were forbidden to use small group instruction (Kathleen, December 12, 2011) and thus Kathleen used the IWB to simulate Guided Reading practices with which she was familiar from previous teaching assignments in regular program Kindergarten classrooms. Kathleen did not instruct her students in decoding skills because they were still learning how to identify letters. Therese, whose students were reading independently, preferred whole-class novel studies, although she did state she planned on doing more Guided Reading with her students in the future. For example, Therese was asked whether her teaching of reading would change if she had no IWB. She responded:

> I think we would be doing lots of similar activities, like for me, I think reading, yes they do do a lot of things with technology, but reading would remain essentially the same. Like right now, I do novel studies, but I'm trying to get more into guided reading but I'm finding it difficult to make that jump right now. Because it's going to take a little more work and I think I'm going to need another presence in the classroom. So, for novel studies, it's the same novel and I assume guided reading would be similar. You would have a book in front of you and you would be talking about it, answering questions. (Therese, January 17, 2012)

Therese had previously stated that although some students read from the IWB screen as she displayed the novel, her confident readers really liked the feeling of holding a book. By implication, confident and capable reading was seen to occur when reading novels and reading novels required students to each have a paper copy, particularly for reference when responding to questions on worksheets. Thus, even in a guided reading situation, Therese would likely not use technology, such as digital novels, to teach reading skills.

Students' independent reading, where students read silently without

teacher intervention or teaching (Brailsford, 2003) occurred only during Krystele's silent reading time (approximately seven minutes daily). Although no independent reading time was assigned by Olivia or Therese, there was one instance where students read together in small groups (Therese) and two instances where students read aloud as a group without decoding or comprehension instruction for Readers' Theatre (Olivia). All student independent reading took place with paper-based texts, whether storybooks (Krystele), basal readers and scripts for Readers' Theatre (Olivia), or novels (Therese) were used.

**Reader response activities.** Activities where students responded to literature they had been read were largely informal and infrequent. For example, students responded to questions where teachers asked what they might do in a situation that was similar to one that occurred in a story, such as when Krystele read her students a story as part of the school-wide focus on character education. Many of these informal response activities were included in the preceding section, because they occurred while the teacher was reading the book or novel. Six reader response activities, where students responded to a story they read (excluding answering questions while reading), occurred during the 32 lessons observed. One activity was observed in Krystele's classroom, two activities in Olivia's classroom, and three activities in Therese's classroom. No reader response activities were observed in Kathleen's classroom.

Separate reader response activities occurred once in Krystele's classroom (19.78 minutes total). The teacher read a paper-copy storybook to the students and afterwards, they moved picture representations of the animals in the story onto a

storyline (IWB used, 3.35 minutes), watched short videos that showed what the animals in the story looked like in the wild (IWB used, 2.78 minutes) and completed a graphing activity about their favourite storybooks written by the author (IWB used, 3.77 minutes). The teacher then asked questions to confirm the order that the animals were introduced in the story then had students move to the carpet area and recreate the storyline with paper representations of the animals (IWB not used, 9.88 minutes). This activity was coded as kinaesthetic response in Table 4.4, because students' responses were not written or drawn.

Separate reader response activities occurred twice in Olivia's classroom (35.10 minutes total). On one occasion, students wrote and drew a series of instructions for building a snowman after reading a story about snowmen (27.48 minutes total, IWB used for 5.23 minutes to display assignment). On the other occasion, students responded to multiple choice questions about Groundhog's Day by manipulating elements displayed on the IWB (7.62 minutes).

Separate reader response activities occurred three times in Therese's classroom (79.80 minutes total). On two of these occasions, students responded in writing to questions about the story (27.98 minutes total, document camera used for 3.37 minutes by the teacher). On the third occasion, students responded to a video representation of a fairy tale by writing letters to one of the characters in the story (51.82 minutes, document camera used to display prompt throughout, students wrote responses using Netbook computers and a word processor).

**Reading strategies instruction.** Reading strategy instruction occurred mostly while reading when teachers would cue students and ask questions.

However, some direct reading strategy instruction did occur outside of story reading. Most of the strategy instruction occurred through the use of games such as those that required students to decode words and identify the missing letters, or videos such as those used to teach prediction strategies. Videos were also used to teach parts of speech such as conjunctions (Therese) from the perspective of use of conjunctions in writing, not identification of conjunctions in reading. Some letter recognition and decoding instruction occurred as part of spelling instruction (Kathleen, Krystele, and Olivia), but this instruction was paired with printing practice and phonological awareness training and thus was not solely a reading activity.

Direct reading strategies instruction in Kathleen's classroom occurred once when the teacher and her students played a website game where the teacher and students sounded out words and identified the missing letter (12.43 minutes total). The teacher asked students to identify the name of the pictured object, then sound out the word, and guess the missing letter. Students recorded the letter on individual chalkboards and then took turns telling the teacher which letter to press on the IWB.

Krystele did not teach decoding or reading strategies. The most prevalent student learning activity was letter recognition paired with phonological awareness and printing practice. However, on one occasion, the teacher showed a video that was linked to a new phonological awareness program she had recently purchased for her students. The video contained a series of songs that described actions that represented the sounds for each letter in the alphabet. She played the

video for 34.40 minutes (IWB used). Initially, Krystele paused the video at the beginning of each song, asked students to identify the letter, and described the actions. The IWB became unresponsive part way through so she played the video through without pausing for questions or instruction and students coloured pictures that represented the actions described in the video. Thus, the video activity ceased to be used in an instructional manner.

Eight direct reading strategies instruction occurred in Olivia's classroom. Seven of these activities were vocabulary activities and one was a prediction activity. In three of the vocabulary activities (total of 49.27 minutes, IWB used for display), students completed paper-copy worksheets, workbooks, and single-response written activities. Three vocabulary activities were games where students were asked to guess letters, decode words or choose the correct word that matched the clue. These games were played on the IWB and were created with the manufacturer's proprietary presentation software (total of 46.50 minutes, IWB used). The final vocabulary activity was a quiz that was created with the presentation software. Students answered multiple choice questions using the *Senteo Response System* and then the teacher discussed their responses afterwards (total of 33.80 minutes, IWB and peripheral response hardware used). The prediction instruction activity consisted of a video that explained and demonstrated how to make different kinds of predictions while reading books (12.25 minutes, IWB used).

Direct reading strategies instruction occurred on one occasion in Therese's classroom when students completed a paper-copy worksheet that detailed how to

read dictionary entries (39.90 minutes, document camera used). On two occasions, the teacher showed a video about the use of conjunctions to join words, phrases, and clauses, however, this video was then paired with paper-copy worksheet completion about the use of conjunctions in writing sentences and thus was used as writing instruction.

**Pedagogical implications of reading with and without the IWB.**

Students in the primary grades (Kindergarten to Grade Three) are typically engaged in the acquisition of *basic*, rather than *advanced*, literacy (Olson, 2009). Typical to instruction in basic literacy, teachers in the classrooms under study focussed reading instruction on decoding and word recognition strategies and on reading comprehension, regardless of whether digital or paper-based texts were used. Acquisition of literate behaviours across genres and meaningful response to literature were not emphasized. New Literacies Theorists (such as Leu et al., 2004) focus primarily on fluent readers (typically students in grade seven or higher), but they do promote the use of digital texts with younger students. Leu et al. view digital reading as a series of inter-related activities for information gathering and evaluation. Other researchers such as Burnett (2010) promote the use of socio-cultural methods for determining meaning and evaluating or communicating through the use of technology and digital texts. The digital stories read in the classrooms under study were short and simplistic. Students did not discuss deeper meanings or evaluate the reliability of what they read, and they were not asked to communicate personal connections to most of the stories read, whether digital or paper-based. Response activities, where students reacted to, re-

enacted, or extended what they had read beyond the story, were infrequent. These activities were also predominantly, though not exclusively, written on paper. Students' responses to questions on worksheets (Therese) and on IWB lessons created with the manufacturer's proprietary presentation software (Olivia) were both bound by the concept of a "correct" answer. A cloze activity or multiple choice activity done on the IWB (Olivia) is thus no different than the traditional paper worksheet, because students are not using the IWB to explore and build new knowledge, but rather, to arrive at the correct answer. Hennessy et al. (2007) referred to teachers' tendency to expect a certain correct answer to their questions as *funnelling,* and the process of funnelling is incompatible with socio-cultural and new literacies perspectives that promote digital literacy as a vehicle for exploring new perspectives and locating, evaluating, synthesizing, and communicating information (Leu et al., 2004).

The affordances of digital stories, namely, for print to be highlighted while reading and spoken by the computerized voice, for the story to be read entirely by the computerized voice if preferred, and for animations and sound effects to support the illustrations and story action, were largely ignored or thought to be distracting by the teachers. The computerized voice on the site used most frequently by Kathleen and Krystele did not model fluent reading. Computerized voices were thought to read too fast for kindergarten students, and to be choppy and without intonation. Students in Kathleen's classroom referred to the computerized voice as "The Funny Lady" and laughed when the voice played. Students in Kathleen's classroom were observed to touch certain words displayed

on the IWB screen when they read digital books. When touched, the computerized voice modeled how to blend the sounds together to form the word, however, more frequently, the teacher helped the students to blend the sounds instead. Instead of passively watching and listening to the computer model the blending process, Kathleen had her students take an active role by identifying each of the sounds first and then working with her to shorten the pauses between sounds and eventually blend the sounds into the target word. The benefits of sound effects or animations were raised by only one teacher. When asked whether words or pictures in digital stories were more important for English Language Learners to decode new vocabulary words, Kathleen responded:

> ML: So is it more [helpful] to see the word while you say it, or [to be] able to see a picture?
> Ka: A picture. Putting the picture with the word. I think it does make a difference. And like with reading with *Recycle* [a digital story from www.literactive.com, 2009], they might start making some of those connections in their own language to what's going on. You know, then hopefully they'll start putting the English word to it when they can see it. Like "bottle". Once they saw her throwing it in and they could hear the glass breaking and stuff, then, instead of just seeing the word "bottle" and not knowing what it is ... right?
> ML: Especially when you couldn't see much of the picture.
> Ka: But, and I noticed if I would have put on the motion, she throws it into the bin and you hear it crashing, so you do, but I didn't have that on in the morning, the motion. Whereas I did in the afternoon, and I just turned off the voice. Right? But you still get the sound effects and everything, but I didn't have that on this morning. So, this afternoon they could see it and they knew. And, you actually see her take one out and put it in, so I think they see more of it. So, that was just a mistake this morning. I tried to bring up Literactive [website] this morning, I tried on my computer last night at home and it was so slow going through my desktop from at home that I just got frustrated with it. So then today, but it took me, like I kept trying it, trying it, trying it during my prep time then at recess it finally [loaded], just before recess came up so I didn't have time to play around with it at all. I just knew what it did because I checked it at home. (Kathleen, February 15, 2012)

In this one case, the teacher found that the animations and sound effects helped cue her students to recognize challenging words when reading. Other than in this instance, however, the benefits to decoding or comprehension afforded by sound effects or animations were largely not addressed by the teachers.

Direct instruction in reading strategies was mostly done through game-type activities. The website games (Kathleen and Krystele) and games made with the manufacturer's proprietary presentation software (Olivia) that were used to teach letter recognition, decoding, and vocabulary. These games are just some of the activities that teachers used to support the assertion that the IWB promotes interactivity (the perceived benefits of IWB use for lesson interactivity are discussed in the next section). Computer software, and particularly drill and practice style games are often non-instructional (Lovell, 2008; Lovell & Phillips, 2009-10). Bishop and Santoro (2006) provide an excellent template for determining whether computer programs are instructional. Unfortunately, the games and game-type activities that the teachers in my study used are neither *systematic*, in that they do not progress hierarchically through increasingly difficult blocks of content and skill sets nor *instructionally supportive*, in that they do not offer feedback or instruction in the skill being tested (Bishop & Santoro, 2006). The programs serve an *assessment* function, however they neither track student performance nor offer recommendations for instruction. Thus, according to the Bishop and Santoro criteria, the games used or created by the teachers for their students were not instructional. In many ways, the games functioned like worksheets in that they reinforced drill and practice activities (an assessment, not

a teaching activity) where there was one correct or expected answer. Often, they were used in conjunction with paper-copy worksheets (particularly by Olivia) or other structured response activities to support the learning outcomes addressed in the worksheets.

## Perceived Pedagogical Value of Interactive Whiteboard Use

Research question two: *What are teachers' perceptions of the pedagogical value of IWBs and how do teachers' perceptions affect their use of IWBs?* The claimed benefits of IWB use to student motivation, engagement, and achievement are widely advertised (Sadler Jones, 2012) and challenged (Lovell & Phillips, 2012). Similarly, claims of increased effectiveness and efficiency of teaching are made (i.e., Haldane, 2007). Teachers' IWB use has been compared to traditional classrooms. For example, customer testimonials proclaim: "Gone are the days when teachers talked at children sitting silently in rows" (SMART Technologies, 2008, p. 2) as if, by implication, students are passive and disengaged in their learning in classrooms where IWBs are not used.

From a pedagogical perspective, teacher participants in the current study expressed the perception that IWB lessons are more interactive, motivational, and engaging for students. Teachers perceived that use of the IWBS helped students learn core subject material better and helped students learn necessary technology skills and attitudes. Teachers also concluded IWB use was increasing the efficiency of their teaching. Teachers' reported perceptions of the pedagogical value of IWB use to teaching and learning are analyzed next. Perceptions related to lesson interactivity are examined first, followed by those related to

improvements in student learning, and improvements to teacher efficiency.

**Perceived Improvements to Interactivity**

During the interviews, there were 42 instances in which teachers mentioned the potential for interactivity afforded by IWB use or provided examples of student interaction with the IWB (8 by Kathleen, 6 by Krystele, 14 by Olivia, 14 by Therese). In 16 of these instances, teachers shared positive stories of interactive IWB use or made claims for the benefits of IWB use to interactivity; in 17 instances, teachers mentioned barriers to interactivity posed by the IWB or other circumstances such as program or time constraints; and in 7 instances, support was mixed. For example, Krystele explained that the IWB was an excellent tool for use in elementary classrooms:

> I think that it [the IWB] increases interactivity in elementary. I think that when you look at the SMART Board in junior high or high school, from the teachers that I've talked about it with I know a lot of teachers and they're completely different. But, in elementary, definitely because they can go to the board, it can be interactive, they can do activities on there just like they were doing yesterday and that's great for them. That helps them learn because they need to do to learn, they can't just hear. So, I think that helps a lot in elementary. But as the kids get older of course, they're more susceptible to what others are thinking and so therefore they don't want to go to the board anymore. That's bad to be called to the board to do an example because everyone's watching and there's all that peer pressure, right? So, I don't think that in junior high and high school it's as useful in that way than it is in elementary. (Krystele, February 3, 2012)

In this example, Krystele mentioned two core beliefs about students and learning: first, that students need to "do" (participate in hands-on activities) in order to learn rather than passively listen, and second, that the IWB is an ideal tool for increasing the interactivity of lessons, presumably because it can be used for hands-on lessons. Although the other teachers did not express these beliefs as

overtly as Krystele, there was general agreement in their interview responses that students must actively participate in lessons to learn most effectively, particularly through kinaesthetic or hands-on activities, and IWB use increases interactivity in lessons. Unfortunately, in contrast to teachers' reported support for interactive or hands-on lessons using the IWB, most students were afforded limited opportunities to physically interact with the IWB. Specifically:

(1) Few students interacted with the IWB. For example, in classrooms where students had tactile interaction with the IWB (Kathleen, Krystele, and Olivia), it was typical that only one or two students were given turns at the IWB during a lesson unless the teacher allowed students to play a game or do an interactive activity on the IWB, in which case as many as five or six additional students might have turns.
(2) Students' interaction with the IWB was time-consuming. For example, only one instance occurred when a teacher gave all students a turn to interact with the IWB during instruction in a whole-class setting (Krystele, December 5, 2011). After she modelled how to write the letter J, the teacher gave each of the eleven students present the opportunity to practice writing the letter J on the IWB while she provided feedback on letter formation. Since the IWB was only able to register one point of contact (touch) at a time, students performed this activity one after another. The entire exercise took 10 minutes. Early in the activity, several began to misbehave, get off-task, and complain of boredom. As a result, the teacher interrupted her feedback on the letter formation task several times to correct student behavior and instructional time was wasted. After 7 minutes, the teacher sent those students who had already completed their turns to their desks to work while the last few students completed the task.

The duration and type of students' interaction with the IWB is explained and analyzed in the next section on Technical Interactivity.

Krystele identified the social stigma associated with being singled out to have tactile interaction with the IWB as being a barrier to IWB use by students in the older grades. Her assertion contradicts researchers such as Gray et al. (2007) and Quashie (2009) who have reported mostly positive perceptions of IWB use by students in the upper grades. Researchers such as Haldane (2007) have also

reported that students in the younger grades are excited to use the IWB. Olivia (grade 1), however, shared the story of one student who did not enjoy or participate in IWB use:

> O: The star of the week is always excited because they get to go up and do all the things on the calendar and that's kind of a privilege. So, I think that's where it stems from, that they just like to go up there and use it.
> ML: Even if they're wrong?
> O: Well, yeah I think so, like ... because I pull pencils [choose random names], I find with the SMART Board that it's very difficult to just put your hands up and I'll call on you because there are always kids that their hands will all be up. But, there's also always those kids that will sit back. Regardless, I think, of the SMART Board. So, I've got my little XXX that is really shy. This is her second year doing grade one with me, and she's very withdrawn. Very withdrawn. And, she wouldn't put her hand up. She would sit there, she'd be fine. Because, that's just kind of her personality. She doesn't want to, she's not a risk taker at all. So even, I don't think for her, thinking of her in particular, I don't think even the motivation of using the SMART Board is enough for her to go ahead and take that risk of being wrong.
> …
> ML: Is that a common thing that you're finding in your class?
> O: No, it's not. Most of the other kids, even ability aside, even if they're struggling with the concept, they'll go up there and take a risk. Because they get to touch that SMART Board, right? It's about being able to use that SMART Board, right? It's not about necessarily always making sure I'm right. So, and when they're wrong, I do take the time to sit there and say "Ok, so why is it wrong?" Don't just go sit down, let's figure it out. Figure out why or how we made that mistake. So, I try and create an atmosphere in the classroom that is comfortable enough for them to make a mistake and to be that risk taker. (Olivia, February 14, 2012)

Despite Olivia's conscious attempt to create an atmosphere where students were comfortable to make mistakes in front of their peers, IWB use was deemed to be too risky by this first grade student who struggled with reading and was very shy. Thus, even though frequent claims are made IWB use is motivational and exciting for students of all ages because it is highly interactive, Kathleen and Olivia clearly identified instances where some students may choose not to interact with the IWB

such as older students or those performing at a level below that of their peers.

Lesson interactivity may be divided into *technical* interactivity and *pedagogical* interactivity (Smith et al., 2005). The former refers to physical contact with the IWB and the latter is more complex and refers to interaction that occurs between the teacher and students with regard to the lesson content. Support for claims of improved technical and pedagogical interactivity are analyzed next.

**Technical interactivity.** The duration of technical interactivity with the IWB is measurable. Table 4.6 provides a summary of duration of activities wherein interaction occurred with the IWB during the eight lessons observed for each teacher. The duration of activities where direct physical contact (tactile) and the use of secondary devices such as clickers and document cameras (peripheral) by both teachers and students is presented. Additionally, there were times when the IWB was simply viewed (display) or mentioned during an activity without tactile interaction.

Even when frequent student interaction occurred, these interactions were often limited to a small number of students who either pressed a button, wrote a letter, or moved a screen element. In Kathleen and Krystele's classrooms, all students were given the opportunity to do attendance activities (in 3 lessons for Kathleen and all 8 for Krystele), but these activities occurred in the background during other instructional activities. When attendance activities are omitted, Kathleen had 4 lessons during which no students had tactile interaction with the IWB, three where 1 student had tactile interaction (often the student of the day), and one where 5 students had tactile interaction during a read-aloud of a digital

storybook (mean 1.0 or 4.3% of the 23 students in class). Krystele had 5 lessons where no students had tactile interaction with the IWB, one lesson where 9 students had tactile interaction during centers' time, and two class periods where 11 students had tactile interaction (once for centers' time and once for a whole-class printing practice), and her mean was 3.9 or 32.5% of the 12 students. Olivia had 5 lessons where only the student of the day had tactile interaction with the IWB, one lesson where 20 students interacted during a holiday activity, and two lessons where 22 and 24 students had tactile interaction during game activities (mean 8.9 or 32.9% of the 27 students in class). Therese's students never had tactile interaction with the IWB during any of the lessons.

Table 4.6
*Duration and Type of Student and Teacher Interaction with the IWB During Eight Observed Reading Lessons Per Teacher (in minutes)*

| Interaction Type | Kathleen | Krystele | Olivia | Therese |
|---|---|---|---|---|
| Tactile (Student Independent) | 5.47 | 58.20 | 0.00 | 0.00 |
| Tactile (Student Directed) | 12.88 | 16.52 | 100.45 | 0.00 |
| Tactile (Teacher) | 73.68 | 30.80 | 84.33 | 11.78 |
| Peripheral (Student) | 0.00 | 0.00 | 30.45 | 0.00 |
| Peripheral (Teacher) | 0.00 | 0.00 | 0.00 | 70.90 |
| No Interaction (Display) | 67.42 | 134.70 | 133.17 | 164.65 |
| No Interaction (Mentioned) | 15.82 | 17.33 | 3.40 | 4.67 |

There was little consistency in the patterns of student and teacher interaction with the IWB across the four classrooms. Krystele (Kindergarten,

Regular Program) and Olivia (grade 1, Cogito) permitted the most student interaction with the IWB. Students in Krystele's classroom participated in 58.20 minutes of independent use, mostly where they played teacher-created or website games during centers' time, and 16.52 minutes of directed use (guided practice) prior to independent use (29.0% of total IWB use). In comparison to her students, Krystele had only 30.80 minutes of interaction with the IWB (12.0% of total IWB use). Students in Olivia's classroom participated in 100.45 minutes of directed use where the teacher called students to do calendar activities, play teacher-created games where they attempted to decode vocabulary words related to the story or theme being studied, or answer questions on the IWB and 30.45 minutes of peripheral interaction through the use of clickers students used to enter responses to multiple-choice questions displayed on the IWB (37.2% of total IWB use). In comparison to her students, Olivia had 84.33 minutes of interaction with the IWB (24.0% of total IWB use).

Kathleen (Kindergarten, Cogito) and Therese (grade 3, French Immersion) permitted much less student interaction with the IWB. Students in Kathleen's classroom participated in 5.47 minutes of independent use where they moved their names for attendance during a non-instructional portion of the lesson and 12.88 minutes of directed use, where individual students were invited to come to the front of the class to read aloud from digital books (10.5% of total IWB use). Digital books were used in place of paper-copy readers or little books. Most contained six pages of decodable print with one line per page. The teacher asked for volunteers to read each page and she helped to decode problematic words.

After individual student volunteers read each page, the class read the story together. In comparison to her students, Kathleen had 73.68 minutes of interaction with the IWB (42.0% of total IWB use). Students in Therese's classroom never interacted with the IWB but their teacher had 11.78 minutes of direct interaction where she annotated information displayed on the IWB and 70.90 minutes of peripheral interaction where she completed paper-copy worksheets under the document camera (32.8% of total IWB use).

Despite claims made in SMART Technologies (2008) that IWB use increases interactivity, the primary use of the IWB by Krystele, Olivia, and Therese was to display information in the form of videos, digital books, and scanned paper-copy storybooks or worksheets. Krystele used the IWB as a static display for 134.70 minutes (52.3% of total IWB use), Olivia 133.17 minutes (37.9%), and Therese 164.65 minutes (64.3%). Kathleen's use of the IWB to display information (67.42 minutes, 38.5%) was less frequent than her tactile use (73.68 minutes, 42.0%), but was still one of the most frequent uses of the IWB. Whenever the IWB was mentioned merely in passing and whenever the teacher used the IWB while students watched, students were seated and not taking part in the hands-on activities teachers indicated they supported. Students' non-use of the IWB greatly exceeded their use (89.5% of IWB non-use for Kathleen, 71.0% for Krystele, 62.8% for Olivia, 100.0% for Teacher 4). Yet, even when instances of student use are considered, few students had tactile interaction with the IWB. Student use of the IWB was usually directed by the teacher when individual students were called to the front to perform a task while the others watched. Thus,

most students' interaction was *vicarious* (Quashie, 2009). Krystele and Olivia were the only teachers to arrange for all students to have the opportunity to interact with the IWB during at least one lesson either directly (Krystele) or through peripheral devices (Olivia), although Kathleen did permit all students to move their names for attendance during a non-instructional part of one lesson.

**Pedagogical interactivity.** In addition to offering praise for the increased technical interactivity afforded to lessons by the IWB, participating teachers provided a few examples of the benefits of IWB use to *pedagogical interactivity* (Smith et al., 2005). Olivia provided an example that highlights the beneficial nature of an interactive IWB lesson and the teachable moment that resulted when she discovered her students were having difficulty with identifying words that rhyme:

> Tuesday we did rhyming words. … I thought "Rhyming words, well rhyming words are easy and we'll get through this no big deal" and I had a SMART Board lesson set up. But prior to that, if I didn't have a SMART Board I would have done a little bit of oral stuff with rhyming. This time, they had pictures, so "cat" and they had to find a picture that rhymed with the word cat. They didn't have the word, they had the picture, because, again some kids are still non-readers, so they had to rhyme the picture "cat" with "rat" and find the word rat and put it there. I pulled pencils [selected a random student name] and they each got to come up one at a time "cat" and they'd put "cow" and they'd put it in there. And I'd say "cowwwww" and "cat" do those two rhyme? Because they were thinking of the initial sounds and not ending sounds. So, again it was a bit of a learning curve for me because I went, "Ok there are some kids that can't rhyme in this classroom", but prior to that, I don't know I may have not known that because it would have been very auditory. We would have done a little bit of activity, maybe we would have read a book about rhyming, a rhyming book where I got the kids to find the rhyming words and then we would have done the workbook pages. (Olivia, January 12, 2012)

In this example, Olivia showed examples of both technical interactivity

when students were manipulating screen elements on the IWB and pedagogical interactivity when she interacted with her students to demonstrate the concept of rhyming. Furthermore, she credited the interactive IWB activity as enabling her to deduce quickly that her students were having difficulty with rhyming. Previously, she would have read a paper-copy book (modelled) and had student volunteers find the rhyming words in the story, and then have students complete a paper-copy worksheet individually (independent practice). Olivia frequently circulated through the class when students were completing work at their desks, and it would have been at that point when she discovered that her students were having difficulties with rhyming. With the IWB lesson, she perceived she was able to intervene much earlier to demonstrate how to identify rhyming words. Unfortunately, it is not clear from Olivia's comment whether all students were given an opportunity to have a turn during the course of the rhyming activity. It is likely that there were not enough questions for all 24 students in the class to have a turn, hence the practice of choosing random names to ensure that although not all students would have a turn, every student had an equal chance to be selected to have a turn. It is unclear whether Olivia would have identified student difficulties with rhyming through the IWB activity if she had randomly selected students who were able to rhyme.

One measure of pedagogical interactivity is the prevalence of activities where teachers interact with students through questioning (Smith et al., 2005) but other activities such as guided practice and discussion also include teacher-student interaction. Table 4.7 provides a reanalysis of Table 4.3 in which the duration of

teachers' instructional activities with and without the IWB (using the Dewitz et al., 2009 categories) have been re-categorized as either Teacher Only activities where the teacher presented information to students, Student Only activities where students worked independently, or Teacher + Student activities where teachers and students interacted through the use of guided practice, questioning, and discussion. As with Table 4.3, only instructional activities that had clear instructional outcomes, including but not limited to reading, have been included in the totals. Non-instructional times such as breaks, transitions, and activities where students were not being instructed in new content have been excluded. Thus, although Kathleen was observed for 409.25 minutes, 256.36 minutes of instruction occurred when breaks and transitions were excluded. Krystele was observed for 539.73 minutes (403.22 minutes of instruction), Olivia for 656.06 minutes (496.80 minutes of instruction), and Therese for 447.58 minutes (399.87 minutes of instruction). It is clear that much class time was spent on non-instructional activities such as transitions (calling students to the front or the carpet area, sending students to their seats, loading programs onto the computer, fixing technical glitches) and activity breaks (in the Kindergarten classes) or on classroom activities where teachers were not instructing students in content (i.e. quizzes, reminders of quizzes, taking attendance, and classroom routines). The accumulation of non-instructional time significantly reduced the available instructional time in some classrooms. In one classroom, 40% of class time was spent on activities that have been excluded as non-instructional because they did not have clear instructional goals to teach new content (Hirst, 1973).

Table 4.7
*Duration of IWB Use and Non-Use by Teacher-Only, Student-Only, and Teacher-Student Activities Across 8 Lessons per Teacher (in minutes)*

| | Kathleen | | Krystele | | Olivia | | Therese | |
|---|---|---|---|---|---|---|---|---|
| Activity Interaction Type | Active Use | Non-Use | Active Use | Non-Use | Active Use | Non-Use | Active Use | Non-Use |
| Teacher Only | 14.63 | 42.33 | 61.77 | 26.72 | 50.92 | 25.45 | 91.23 | 8.48 |
| Teacher + Student | 110.70 | 66.05 | 47.80 | 93.46 | 201.14 | 88.33 | 131.22 | 78.37 |
| Student Only | 0.00 | 22.65 | 106.40 | 67.07 | 46.55 | 84.41 | 9.25 | 81.32 |
| Total | 125.33 | 131.03 | 215.97 | 187.25 | 298.61 | 198.19 | 231.70 | 168.17 |

Interaction between teachers and students through questions, guided practice, and discussion was more prevalent than instances where activities were performed mainly by teachers or students separately (176.75 minutes or 68.9% of instructional time for Kathleen, 289.47 minutes or 58.3% for Olivia, 209.59 minutes or 52.4% for Therese). Teacher-student interaction occurred for 141.26 minutes (35.0% of instructional time) for Krystele but Student Only activities were more prevalent (173.47 minutes or 43.0%) largely due to the inclusion of independent reading and centers' activities not present in the other classrooms. For Kathleen, Olivia, and Therese, IWB use exceeded non-use during interactive activities (110.70 minutes of use and 66.05 minutes of non-use for Kathleen, 201.14 minutes of use and 88.33 minutes of non-use for Olivia, and 131.22 minutes of use and 78.37 minutes of non-use for Therese). Yet, for Krystele, IWB non-use exceeded IWB use for interactive activities (47.80 minutes of use and 93.46 minutes of non-use). Many of these interactive activities where the IWB was not used included answering questions about paper-copy storybooks and

about the calendar or weather during the morning routine and the teacher chose not to use the IWB for these activities because they occurred at the carpet area and away from the IWB.

**Barriers to interactivity posed by IWB use.** Teachers experienced several barriers that impeded their ability to use the IWB in a way that was highly interactive for students. One important barrier to *technical* interactivity was the restriction of the IWB to accept input from one touch at a time. This barrier was identified by teachers who had frequent student interaction with the IWB (Krystele and Olivia) and those who had infrequent student interaction (Kathleen and Therese). For example, Olivia (frequent interaction) stated:

> Because the SMART Board is one child up there and it's not the whole class, and you know, I've said many times it would be great if the SMART Board could be able to have multiple touches. So that you could have three kids up there or whatever the case may be. (Olivia, February 14, 2012)

Kathleen, (infrequent interaction) stated:

> Ka: They have a hard time with that one, waiting their turn so that only one person is touching the SMART Board at a time.
> ML: If you were using a normal whiteboard then...
> Ka: Yeah, you could have 6 kids up there writing on it.
> ML: … When you have a large class like yours of 23, 24, do you find it's really difficult to have time for all of them to use it?
> Ka: Yeah it is, especially because of the Cogito program because we don't have small group work. The focus is teacher-directed large group instruction. (Kathleen, February 1, 2012)

For these teachers, the restriction on multiple touches negatively influenced their ability to accommodate several students at the IWB. For example, in Kathleen's response, if six students were writing on the static whiteboard, the activity would take a fraction of the time necessary for all twenty-four students to write on the IWB individually. Kathleen (and also Krystele) stated that the limited attention

span of kindergarten students led to difficulties with turn-taking when all students were given opportunities to perform tasks. Thus, kindergarten students' limited attention spans were perceived to be detrimental to interactivity when all students interact with the IWB. Similarly, Mohon (2008) identified slowed lesson pacing when all students were given opportunities to interact with the IWB as being detrimental to lesson interactivity.

A second barrier some teachers' perceived to limit their *pedagogical* and *technical* interactivity was the restrictions of the program in which they taught. For example, the Cogito Program emphasis on teacher-directed instruction was seen by Kathleen to restrict opportunities for interaction with the IWB by students.

> Because we don't have center time, so it's not like I can set up the SMART Board and have small group work there because there is no small group instruction in Cogito, it's teacher-directed whole group instruction. … I could see in a regular kindergarten I would have this game that they are doing now as a centre because it's self-correcting. You have two or three kids doing it and then they get more turns, but we because we don't have that, I don't use it in those kinds of ways. For the children to actually be physically interacting with it as much. (Kathleen, November 28, 2011)

Kathleen compensated for the perceived restrictions to interactivity by doing activities together as a group such as when she had tactile interaction with the IWB while students directed her actions (for games) or where individual students came to the IWB to read to the class (for guided reading). Surprisingly, despite the restrictions of the Cogito Program to have only teacher-directed activities, Olivia had the longest duration of activities that permitted student interaction with the IWB. Although students' use was never unsupervised, students' supervised IWB use comprised a large portion of the total IWB use time, nonetheless. During

her interviews, Olivia chided herself on one occasion for having tactile interaction with the IWB during an interactive game on the IWB and only remembering part way through to allow her students to interact with the IWB. Olivia had taught in the Cogito Program for thirteen years and Kathleen had taught in the Cogito Program for two years, although she had taught Kindergarten for 23 years. Thus, it may be that Olivia's greater experience with the Cogito Program afforded her greater comfort to include more interactive opportunities for her students while staying within the program mandate to use only teacher-directed instruction.

Although the mandated teaching methods of the Cogito Program were a barrier for students' interaction with the IWB, the divide between those teachers whose students used the IWB frequently and those whose did not frequently did not lie between the restrictive Cogito Program and the more open Regular and French Immersion Programs. Rather, teachers' personal comfort levels with technology appears to have influenced the degree of technical interactivity afforded to students. Krystele and Olivia expressed the most comfort with technology use and had the most student use; Kathleen and Therese expressed the least comfort and had the least student use. It could be, similar to Bauer and Kenton's assertion (2005), teachers who are least comfortable with technology use are most concerned with simply making sure the technology is used and teachers who are more comfortable and confident expand their use and try new methods (more pedagogical variability). For example, Krystele attributed the increased interactivity in her lessons to a combination of her personal philosophy that lessons should be interactive and to the affordances of the IWB to be

interactive. Thus, the third barrier to overall interactivity was some teachers' discomfort with technology.

**Implications of IWB use and non-use for interactivity.** Teacher participants were overwhelmingly positive in their reports about the benefits of IWB use for interactivity, despite their acknowledgement of barriers to interaction such as the restrictions on the points of contact (touches) the IWB recognized simultaneously. Teachers' comments about interactivity were often vague and did not distinguish between the potential for technical and for pedagogical interactivity (i.e. stating "It's more interactive"); however, their comments were typically related to the potential for increased technical interactivity. Yet, the analysis of activities in which teachers and students interacted with the IWB has shown that in most of the classrooms, students spent much of their time passively watching the IWB (display) or watching their teachers interact with the IWB. Even in classrooms where students had frequent interaction with the IWB, rarely did all students have physical contact with the IWB during any lesson. For example, Kathleen and Olivia selected weekly helpers who interacted with the IWB during the morning routine or chose students randomly, but this practice limited other students' interaction with the IWB. Thus, most students' interaction in the current study was vicarious as reported by Quashie (2009). It thus seems that little has changed by way of student interaction with IWBs in the past five or more years.

Examples of pedagogical interactivity are more complex to identify and define than examples of simple technical interactivity. Pedagogical interactivity

refers to the interaction between the teacher and students during instruction and is often reported as teacher-pupil interaction through questioning (Smith et al., 2005). However, Smith et al. and others such as Hennessy et al. (2007) have questioned the quality of the pedagogical interaction that occurs with IWB use, particularly when teachers' questioning is intended to elicit one "correct" response. Discussion, where there was an interplay of ideas between teachers and students, rather than teacher questions and student responses, was nearly non-existent in the four classrooms under study (Table 4.3). Guided practice was prevalent, but even so, teachers were guiding students to one "correct" method of performing a task. Thus, even though interaction between teachers and students was frequent (Table 4.7), the nature of the interactivity and interchange of ideas was circumscribed by the teachers' transmission of knowledge and skills to students and this model is no different than the interaction that reportedly occurred between teachers and students in so-called traditional classrooms without IWB use.

**Perceived Improvements to Students' Learning**

During teachers' interviews, there were 91 instances in which teachers mentioned student learning or provided examples of student learning. If these 91 instances, 84 included references to the IWB (16 by Kathleen, 32 by Krystele, 14 by Olivia, 19 by Therese) and 7 were unrelated to IWB use such as explaining how a particular paper resource was used in the classroom. Teachers' references and examples were overwhelmingly positive as to the benefit of IWB use for student learning (61 positive, 5 negative, 18 mixed). Positive references were

those in which teachers said the IWB supports student learning or shared examples of how IWB use resulted in improved understanding of lesson content. Negative examples included instances where teachers stated traditional methods and materials better supported student learning or shared examples where students did not learn lesson content, despite IWB use. Mixed examples included instances where teachers said IWB use was beneficial only for certain students or in certain contexts and instances when teachers mentioned multiple factors that might also be responsible for improved student learning.

Teachers noted examples of improvements to students' understanding of reading, technology skills, and content in other subject areas, particularly mathematics, when they used the IWB. They attributed improvements in student learning to various factors including the capacity of the IWB to support multiple learning styles and to support improved student motivation and engagement. Several teachers expressed the belief exposure to technology (especially to the television and smart phones) has fundamentally changed how students' brains learn when compared to students of previous generations and that these changes necessitate differences in both the content and type of instruction offered to students today.

> I fought it tooth and nail, right? I was not... I didn't want a SMART Board. … But they're so used to that in everything else they do that it's (pauses) it's changing the way their little brains function I think and they just ... it's just expected and I don't know if we'd be able to go back to the paper and pencils and markers kind of stuff with them and keep them engaged and moving forward. It's just... you know, they get it at home, they get it on television, everything is just (snaps fingers) right now, it's instant, like they have a hard time waiting for something to come up on the Internet if the computer is a little slow. … I don't necessarily think it's a good thing. I think it's a fact of life that this is their life and their life is, you know…?

> How many of these kids play games on their parents' telephones while they're in the car? And they don't know how to just ... I couldn't imagine a lot of these kids going on a trip with their parents in the car without a video game or the TV playing in the car and stuff. I think we've just inundated their little brains with this that they just… that's life now. (Kathleen, February 15, 2012)

The perception that students' brains and the ways they learn have changed was reinforced by professional development sessions offered to teachers in the district.

> Plus, a few years ago, I went at teacher's convention to a few seminars from this guy who was exactly talking about that how kids' brains are so different from our brains because of all the technology that they are exposed to. How they can multitask. How they can't do anything well like how they can't do one thing super well but how they can do a lot of things at the same time that our generation has a lot more difficulty with. And all sorts of stuff because how their brains are different because of what they're exposed to at a young age being technology, and how that works. (Krystele, December 16, 2011)

The perceived changes in students' brains and how they learn that stemmed from teachers' observations (i.e., the example given by Kathleen) or professional development (i.e., the example given by Krystele) were seen to create a disconnect between traditional methods of instruction and students' abilities to learn content successfully. For example, Therese related an example of how she attempted to use exercises from an old textbook to illustrate a concept in Mathematics. She stated her students were initially unable to do the exercises in the traditional manner to which she was accustomed (i.e., copy the problem to paper instead of writing in the book and then perform the operations). Additionally, her students were resistant to doing problems in this manner because they were accustomed to having printed sheets on which they could write, and also because they were more accustomed to having information presented on an IWB slide than in a textbook. Each of the teachers noted learning

had changed in some way and that although some changes might be deemed positive, some were not. However, rather than offering a judgement about whether students today learned better or worse than students in the past, the changes brought about by technology exposure were simply accepted and perceived to necessitate changes in methods (including IWB use) to remain relevant to students' interests and needs.

Teachers provided no examples of measures used to judge improvements to overall student learning, motivation, or engagement. They provided no examples wherein they compared achievement in language arts, technology skills, or other curricular areas on the basis of measures such as report card grades or test grades. Additionally, measures of achievement and understanding, motivation and engagement, reading and technology skills were not included in the data collection because they were not of primary interest in the analysis of pedagogical change in the classroom with IWB use. Thus, although each teacher made claims as to the benefits of IWB use for student learning, all support provided was anecdotal in nature. Teachers' perceptions and anecdotal reports related to improved student learning outcomes are presented next.

**Improvements to Students' Learning and Achievement.** On several occasions, teachers stated IWB use supported multiple learning styles: auditory, visual, and kinaesthetic. Each shared the perception traditional teaching styles were auditory in nature, but students today required visual and kinaesthetic teaching methods. In order to support "visual learners", for example, Olivia scanned copies of all student assignments to the IWB for visual reference.

Support for “kinaesthetic learners” was most apparent in responses given by Krystele who stated Kindergarten children, especially, required hands-on learning. When asked whether and how IWB use supported the concept of learning styles in reading, Krystele explained:

> Kr: Yes. Oh, yes, it does. Because it's very visual. You see a lot. It can be quite auditory. You know, because depending on what you do, where you go, you can have the voice recording or just the text being read, like on some of the websites I go on for children for teaching them how to read. And, very kinaesthetic because you can do a lot of hands-on things on the SMART Board: categorize and sort and whatever else, make patterns, or read or point at key words. There's so much that you can do that, yes I would think that it definitely appeals to these three main learning styles and probably more, you know?
> ML: Is it more strongly one or the other?
> Kr: Number one would be visual. Two would be kinaesthetic, three would be auditory.
> (Krystele, March 5, 2012)

In the preceding example, Krystele presented a hierarchy of support for the concept of learning styles, with visual learning being support best by IWB use. Although Krystele stated students in Kindergarten required hands-on, kinaesthetic learning and classified her teaching style as highly kinaesthetic, kinaesthetic learning was only second in her hierarchy of learning styles supported by IWB use. Krystele’s usage of the IWB over the course of the eight lessons observed supports her assertion that IWB use was more visual than kinaesthetic. Although she was one of two teachers who had most frequent tactile interaction with the IWB by students (74.72 minutes total), the IWB was used for display for nearly twice the duration (134.70 minutes). In fact, the primary use of the IWB by Krystele, Olivia, and Therese, and the secondary use by Kathleen, was for display (Table 4.6) and this finding supports Krystele’s perception visual learning was

supported more than kinaesthetic learning by IWB use.

Teachers gave three statements about how IWB use supports visual learners and mentioned nineteen examples related to the use of visuals to support learning. Of these examples, the most clear benefit to student learning mentioned by the teachers was that IWB use "gives them [students] a really good visual representation and it's good for being able to model things for them all to see at the same time" (Kathleen, February 7, 2012). Teachers provided no concrete examples of times when the visual affordances of the IWB helped students to learn reading objectives better than other methods of presentation. However, Olivia provided two examples from Social Studies. In one example, she stated district resources which contained artefacts for the unit on the Inuit peoples were limited and difficult to obtain so she searched the Internet to display pictures of artefacts as a substitute for the hands-on contact. Her reason for using the pictures was students would have some conceptualization of the artefacts even though it was not the tactile contact she would have preferred. The second example she provided was much more concrete as to the benefits to student understanding of using visuals on the IWB.

> In Social last year, and the kids in grade 1 in social they have to learn about these landmarks. It's a very vague thing for the kids to understand. They barely know their city, let alone all these landmarks. So, I had found pictures on the Internet I had made a SMART Board [IWB] lesson, you know "This is the landmark and these are all the important things about it" and I found that was the easiest, the best way. I could give them print outs of all these places, but for them to be able to sit at the SMART Board and we'd talk about them, and we'd look at the things, and we'd point to different things on that picture. I think that was the easiest way, and probably the most meaningful way for them to understand about [provincial] landmarks. And I could tell that because when I gave them the test about [provincial] landmarks, they could tell me a lot of things about

> those. Now, again that was my first year teaching it, so I don't really have any comparison to say "when I didn't use the SMART Board, these are the results." (Olivia, January 12, 2012)

Unfortunately, Olivia was unable to compare the results of her lesson with the achievement of students in previous years. However, based upon her knowledge of her students' understandings of their community and province, she determined the use of visual representations helped her students to successfully identify landmarks they likely would be unable to identify without IWB use.

Therese presented a counter-example from Science that demonstrated how she perceived realistic visual representations available on the Internet to be detrimental to students' learning. Although the IWB has the capacity to access realistic images of the object of study (in this case, the human ear), Therese preferred, instead, to scan the simpler diagrams provided in the district manuals even though the diagrams were not realistic:

> That's the difficulty. I go out and find a great picture of a human ear and really make it perfect, but then this is the one they have in their resource, that the kids have in their duotang, so it's like why complicate matters? I would like the image to stay consistent. I will use some other ones, [for example] this is an interactive lesson where they have to manipulate stuff and there's a test at the end. It's the same thing, but sometimes the image kind of catches them if you're using a different thing [resource], a little bit of different terms, it's good to show them this always, but I fear that they might get caught up in the details. (Therese, November 29, 2011)

Like Olivia's example of the provincial landmarks, Therese's example suffers from the lack of evidence on the basis of comparisons between test scores or other achievement measures. Since both teachers' examples are based solely on intuition and their perceptions about students' capabilities, they cannot be used to offer concrete proof for the benefits or detriments of visuals on the IWB to

student achievement. However, these examples are characteristic of teachers' perception that the IWB supports visual learning, and this perception guided their use of the IWB. For example, all teachers displayed assignments or visual representations of assignments on the IWB.

Teachers gave six examples of how IWB use supports kinaesthetic learners and made six mentions of the use of hands-on activities for learning. Few concrete examples of how the kinaesthetic affordances of the IWB improved student understanding of reading were given, instead, most teachers related the perception kinaesthetic or hands-on activities were highly engaging. Thus, it was implied highly engaging activities help students learn better. (Engagement is discussed further in the next section). However, Krystele, who spoke most frequently about kinaesthetic learning, explained she perceived the main benefit of the kinaesthetic properties of the IWB was that students could touch and learn about things. In this example, she related the benefits of kinaesthetic learning with the IWB to students' understanding of technology (primary benefit) and letter recognition (secondary benefit):

> I guess the main [advantage of IWB use] would be the hands-on experience because in kindergarten, they don't really go to … computer class, but they should be learning about computers a little bit, and that's a good way to learn about it and yet at the same time, they get that individual time at the SMART Board [IWB] where they do play games, and touch and learn about things, but at the same time, all the repetition is great for the rest of the kids, because want it or not, they're hearing these things, they're seeing the letter 'K' be played 23 times with all the words. So, it helps to sink in their brain the sounds, words that start with that letter, all that stuff. So, yeah I think repetition, hands on experience, are huge. (Krystele, December 16, 2011)

Like the examples given by Olivia and Therese to support or refute the benefits of

the visual affordances of the IWB to support student learning, the example given by Krystele is based upon her intuition and knowledge of her students, rather than on the basis of measurable outcomes such as grades or other assessments. In fact, although she states the hands-on nature of the activities supports learning, most of the support given within the example is to the repetition that students experience when they watch (visual) or listen to (auditory) other students perform activities.

In regards to the "hands on" nature of IWB learning, the quality of the kinaesthetic learning is suspect. For example, for objectives in Language Arts and particularly for printing, Kathleen and Krystele were the only teachers who permitted students to write on the IWB with the pens although opportunities for writing occurred infrequently. On one occasion, Kathleen invited students to come to the IWB and spell words for the sentence they were writing and, on five occasions as part of the morning routine, she asked students to write the number for the date on the calendar. On one occasion, Krystele invited students to practice forming the letter 'J' on the IWB while she offered feedback on letter formation. Thus, although students observed teachers writing on the IWB (Kathleen, Krystele, and Olivia), they rarely had opportunity to print on the IWB, which is a kinaesthetic activity that represents a real activity students would do in class (writing with a pencil on paper). Kathleen, Krystele, and Olivia stated it was difficult for students to print legibly on the IWB because they pressed too hard to form smooth letters, wrote too quickly for the IWB to read, or brushed the IWB with other parts of their body while writing and the IWB read that contact as an attempt to write.

IWB use in the classrooms observed offered no true kinaesthetic, hands-on learning because students did not manipulate real objects. For example, Krystele used the IWB to display a storyline and moved pictorial representations of the characters onto the line to represent the order in which they entered the story. With this activity, she was able to access video footage of the animals in the wild, however, this activity was visual. Afterwards, she gave students objects to represent the animals in the story and had them act out putting the animals in order and it is this part of the activity that was kinaesthetic because students manipulated the objects and placed them in order. In another example, Krystele ordered a program that paired auditory songs with visual reminders and kinaesthetic actions to cue students to remember letter sounds as part of phonological awareness instruction. Although the actions were kinaesthetic in nature and intended to serve as cues, the gesture of brushing ants off an arm, for example, has little to do with the sound /ă/. Often visual representations were used in place of kinaesthetic, hands-on activity, as with Olivia's example of the Inuit artefacts when students were unable to touch the artefacts, merely to view them.

Teachers mentioned auditory learners five times in their interviews. In two of these mentions, the comment was about how IWB use supports more than just auditory learners. In the other three comments, two contained references to teacher talking that accompanied IWB use as the method used to support auditory learners, and the third, mentioned in the introduction to this section (Krystele, March 5, 2012), was the only comment to give an example of how IWB use might benefit auditory learners. The auditory functions of the IWB were used by all four

teachers, however, the audio always accompanied a picture, animation, or video and it is therefore difficult to separate the auditory component from the visual component in order to evaluate the benefits of IWB use for auditory learners. On one occasion, Krystele played the video that accompanied the phonological awareness program. She had intended for students to learn and practice the gestures, but the IWB lost connectivity with the computer part way through and stopped accepting tactile input. Instead, she played the video in the background while students worked at their desks. In this case, the visual showing the page students were colouring was secondary to the auditory, however, the teacher used the audio for background noise not for teaching. Some students sang along with the video at times, however the teacher indicated the singing frequently distracted students from their work, even though she acknowledged they were hearing the target sounds.

**Improvements to Students' Motivation and Engagement.** Students' motivation and engagement were mentioned frequently by each teacher. Motivation and engagement were often mentioned together in the context of student learning. Specifically, there were 41 instances where teachers mentioned student motivation or gave examples of motivating activities and student learning was mentioned explicitly in 10 of these instances. There were 59 instances where teachers mentioned student engagement or gave examples of engaging activities and student learning was mentioned explicitly in 25 of these instances. In 12 instances, motivation and engagement were mentioned together and 6 of these were in the context of student learning. As with student learning in the previous

section, teachers did not discuss any measures used to judge student motivation or engagement and measures of motivation and engagement were not included in data collection. However, teachers perceived that IWB use improved motivation and engagement which, in turn, improved student learning. Student learning is part of Hirst's (1973) definition of pedagogy and teaching, and thus, teachers' perceptions of improvements to students' motivation and engagement are included in the analysis of the perceived pedagogical value of IWB use.

Overall, teachers spoke favourably of the motivational and engaging value of IWB use for students. Kathleen related the example of a website game she had played with her students on the IWB in the previous class. The website displayed three of four letters in a target word and players were given the option of pressing on a picture of one of three children holding an option for the last letter. If the correct letter was pressed, the child holding that letter slid down a slide.

> ML: What value is there for the SMART Board [IWB] in having students want to learn and participate? Do you think it's the SMART Board that does that? … Is it the SMART Board, the teacher, the climate?
> Ka: I think that part of it is the SMART Board because you know, when I put the wrong one and ... they like that. It's fun. They can watch it [the letter] slide down instead of just going "Yes, you're right". We check it and we see. So I think in that it's got some movement and the graphics are nice and bright and colourful, I think that's attractive to them. And they have the pictures to look at with the web or the car or the bus so we cannot just say, "Well what sound do you hear at the end of bus?" It's more interesting to look at the picture and talk about it. So, I think in that way it's the SMART Board, but these kids are also pretty keen. I found it interesting, though, the first couple we did, they had a hard time with the ending sound. But when they started to see it up there and we did it a couple of times, and then we started talking about it and it shows the word printed out with the ending sound, they started to get better at it. (Kathleen, February 15, 2012)

This example is representative of the types of responses teachers gave in regards

to motivation and engagement. Two problems are apparent with this response and with the teachers' responses in general. First, teachers often do not define or explain what they mean by the use of the terms engagement and motivation, and they use them interchangeably. Teachers often use or imply the use of the words fun and enjoyable when they speak of motivation. They use or imply the use of the words interest, attention, and on-task when they speak of engagement. Second, IWB features such as games, pictures, animations, or sounds are reported by teachers to hold children's interest and motivate them, but the way in which these features assist motivation, engagement, and ultimately learning are not explained. In the current example, Kathleen stated, "We cannot just say, 'Well what sound do you hear at the end of bus'. It's more interesting to look at the picture and talk about it", but she did not provide any reason why students need the picture and couldn't do the activity orally or without the pictures. In this activity, the teacher had students write the letter that represented their selection on individual chalkboards so that all students had an opportunity to guess the letter. She did not mention in her response how student participation with the chalkboards may have helped their engagement or motivation and instead, attributed their improved learning to the pictures and animation on the IWB.

***Motivation***. In the 41 statements made by teachers where they mentioned student motivation, 26 were positive with regards to the potential for IWB use to be motivational for students, 1 was negative, and 4 were mixed. Ten statements were unrelated to IWB use or were related to other subject areas such as mathematics. In their interviews, teachers did not explain the method by which

IWB use was perceived to increase motivation and improve learning, although they did make three unqualified statements where they claimed the IWB was motivational but offered no support. In terms of support given for the motivational qualities of the IWB, teachers mentioned IWB features they perceived to be motivational for students but the link to whether and how these features improved motivation was not made. Of the perceived motivational features, the visual affordances of the IWB were mentioned most frequently (13 instances) including the use of videos (5), animations (3) and pictures (3), and similarity to the television (2). Quality and size of image and use of colour were also mentioned as reasons why teachers perceived that the visual affordances of the IWB were motivational for students. The interactive affordances of the IWB were mentioned in 5 statements, particularly the ability to touch the IWB and to interact with peripheral devices. The auditory affordances of the IWB were only mentioned once, when Kathleen related a story about how her students found the computerized voice to be humorous.

Aside from the visual, kinaesthetic, and auditory affordances of the IWB, teachers mentioned other features or activities that were perceived to be motivational for students. These included the opportunity to model for peers (2 instances) or parents (2) which one teacher linked to increased confidence in students, to play games (2) and access the Internet (1), and to experience repetition as part of the learning task in a fun way (2). Another reason mentioned by teachers was relevance to students (3). When Krystele was asked what she perceived to be the main value of the IWB for student motivation, Krystele

responded:

> To me it's just that it's relevant and it's interesting to them. The SMART Board is interesting to them. But yeah it's the interest and the relevance that gets their attention. So it's like a TV, it gets their attention. They want to watch, they want to see, and it's big so instead of reading a book that is so small and tiny, and whatever, it's nice sometimes to have those images screen size. Right? They can really see a lot of detail in them and the language is bigger, so if you're pointing at it, and tracking it, it's a lot easier for them to see that language and slowly be able to associate which spoken word goes with which written word and that sort of thing. I don't know. The main value, relevance. (Krystele, March 5, 2012)

In this example, and also in one given by Kathleen, the teacher stated she perceived that the main value of the IWB for student motivation was that it was similar to other technologies such as the television and smartphones students used outside the classroom.

Interestingly, the one negative statement given as to motivation with the IWB was that interactive activities require much time to create and little time to actually use. In regards to using animations such as a swirling vortex animation that played whenever students chose a correct answer during sorting activities, Kathleen stated:

> The thing is that they're fun for the kids, but really? It takes you as long to put it together as it will for them to play it. They'll probably be done the activity faster than you were able to make it. And, so if you can find them premade it's great. But, once in a while there might be something that I could start developing along the way. (Kathleen, December 14, 2011)

Thus, Kathleen implied there was limited value in using the perceived motivational activity because the brief benefit to motivation of the game required greater preparation time. Kathleen was observed to include games and interactive lessons once in the course of the eight observed lessons, and that was the game to which she referred in the example in the beginning of this section. The game came from a website and was not an activity she created. However, Krystele was observed to use a sorting activity for math she created with Kathleen, and this was

the vortex activity to which Kathleen referred.

***Engagement***. In the 59 statements made by teachers where they mentioned student engagement, 33 were positive with regards to the potential for IWB use to engage students in learning, 2 were negative, and 17 were mixed. Seven statements were unrelated to IWB use, mentioned other factors besides IWB use or were related to other subject areas such as mathematics. In their interviews, teachers did not explain the method by which IWB use was perceived to increase engagement and improve learning. As with learning and motivation, teachers provided no formal measures used to determine whether students were engaged, however they did provide several methods by which they determined students were engaged and provided reasons why they perceived that IWB use was engaging for students.

Of the positive statements made regarding the IWB and engagement, in three statements teachers provided no justification but in most of their statements, teachers provided reasons why they perceived IWB was engaging and often gave multiple reasons in one response. These reasons included assistance in getting and keeping attention (15), promoting excitement with fun activities (14 mentions), supporting multiple learning styles (5), supporting students' familiarity with technology (4), and improving the flow and efficiency of lessons (2). The most prevalent reason given for why IWB use was perceived to be engaging was because it helped get and keep student attention through the use of videos, animations, sounds and graphics (11 mentions), and through its similarity to other media with which students were familiar such as the television and video games

(6). For example, teachers mentioned that they used videos to introduce lessons in order to get students' attention. The IWB was perceived to be easy for students to focus on because it was larger, closer, and easier to see (5 mentions) and because it incorporated several media into one area of focus (1) rather than needing to switch focus between the overhead, the television, and the static whiteboard, for example. Therese summarized the main reason why she felt that IWB use was engaging for students, especially the interesting features and visual stimulation. She stated, "They enjoy that, they almost need that visual stimulation in order to get that level of engagement" (Therese, November 29, 2011).

The second most prevalent reason given for why IWB use was perceived to be engaging was because students were excited to use it and found its use to be fun. Teachers mentioned certain factors for why they perceived IWB use was exciting for students including interactive activities like games (6 mentions). They said the IWB was exciting because it was new (2 mentions), students were excited to learn new things and do activities together (3), and because it was a special treat to be called to the front to interact with the IWB (4). They claimed that IWB use negated the traditional emphasis on auditory teaching and helped to reach more students because it supported multiple learning styles. They claimed that students were so familiar with new technologies that traditional methods, media, and materials were no longer relevant, and also that IWB use made lessons flow better so that students did not have to shift focus frequently. For example:

> I think the flow is better, and for some kids, that's what they need. They need that continuous flow rather than the stop-start, stop-start, "Oh now we're going to come over here, now we're going to come over here, now we're going to do this." It's all right there. (Olivia, February 7, 2012)

Olivia preferred the use of the IWB because her lessons were more fluid and students did not need to shift their attention between media. Thus, she perceived the IWB improved her effectiveness in keeping student attention. She and other teachers admitted that student engagement depended upon the activity whether the IWB was used or not (5 mentions) and that long and complex activities (3), distracting features (1), and student age and maturity (7) might cause students to pay less attention.

All teachers agreed that there were times when some students might not pay attention, no matter which medium was used for instruction. Teachers provided no formalized measures that they used to ascertain whether students were engaged. However, they gave examples of informal observational measures they used to determine whether students were engaged, including:

(1) students were quiet and watching the IWB,
(2) students appeared to be listening and following along with the teacher,
(3) students participated in the activity,
(4) students seemed excited to do the activity, and
(5) students talked to peers and parents about the activity and the IWB.

When teachers were questioned further about whether these observations indicated that children were simply following along quietly or whether they were engaged cognitively with the lesson content and how teachers knew whether students were cognitively engaged, several of the teachers had difficulty providing a response. Olivia observed:

> [Watching the IWB] That's not always an indication. They can be in la-la land. That's what I always tell the kids (laughs) "Some of you are in la-la land". And, engaged you can tell through your questioning, right? When you ask a question and the kids are not all responding and that's why I use those pencils. I pull a pencil, you better have the answers, so I can tell you

> were listening and you were engaged in the lesson. And, 90% of the time they are. But there is the odd child that is, you know, playing with straws instead. (Olivia, February 7, 2012)

Olivia used questioning to determine whether students were engaged cognitively in the lesson and she selected names randomly to ensure that students did not know who would be asked next. She reasoned that students would pay greater attention if there was a chance they might be asked the next question. Similarly, other teachers mentioned that measures of achievement such as responding to questions and performance on tests as well as their participation in activities demonstrated whether students were cognitively engaged.

**Implications of IWB use for Students' Learning.** Improvements to student outcomes such as improved learning, and increased motivation and engagement are frequently claimed by proponents of IWB use and the manufacturer (i.e., Sadler Jones, 2012). Teachers in the current study made similar claims such as the IWB improves student learning because its use supports multiple learning styles and the IWB improves student motivation and engagement. Unfortunately, the claims made by teachers in regards to student outcomes were made on the basis of teachers' perceptions and not on the basis of measurable outcomes, so it is unclear whether and to what degree students' achievement, engagement, and motivation were improved with IWB use.

Teachers' primary claim for the benefits of IWB use for students was that the IWB allowed them to teach to students' multiple learning styles. The idea there are multiple learning styles, in this case auditory, visual, and kinaesthetic, and children learn predominantly through one learning style or another, is widely

circulated in educational literature (for example, the Shaughnessy, 2002, interview with Rita Dunn who developed an inventory to determine students' learning styles). Proponents claim learning styles are biologically imposed since most of the indicators used to determine learning style are biological rather than motivational, and they claim when children's preferred learning styles are not addressed, "they do not achieve what they are capable of achieving" (p. 94). Yet, evidentiary support for the benefits of teaching on the basis of learning styles is limited (Kampwirth & Bates, 1980; Kavale & Forness, 1987) and particularly so for teaching reading (Snider, 1992; Stahl, 2002; Tarver & Dawson, 1978).

It is not surprising teachers in the current study had heard about and endorsed learning styles because of their prevalence in popular educational literature. For example, although learning and reading styles came to prominence in the 1970s and 1980s, early proponents of learning styles (i.e. Rita Dunn in 1979 and Marie Carbo, 1987) have continued to make claims for the benefits of teaching to students' learning styles (such as Dunn, Honigsfeld, & Shea Doolan, 2009; and Dunn in her interview with Shaughnessy, 2002) particularly in reading (for example, Carbo, 1997, 2009). In the context of their teaching with the IWB, teachers in the current study claimed the IWB can be used to reach students who "are visual" or "are kinaesthetic" because the affordances of the IWB permit teachers to show pictures and video and to allow tactile interaction by students. These classrooms contained many visual features aside from the IWB. There were posters reminding students about grammar and spelling rules and pictures on the walls. Thus the IWB was simply one more visual medium. In the past, the

teachers would have used the overhead projector and the television to perform the functions for which the IWB was used. For example, in the past, Kathleen and Olivia used overhead projectors to display copies of student assignments and now they used the IWB for the same purpose. The IWB had not served to make the teaching more visual; it merely improved the efficiency with which teachers could show visual images and likely improved the clarity of the images because the image on an overhead is often fuzzy. The overhead projector itself replaced paper-copy picture or photograph sets that would traditionally have been shown to students to reinforce concepts and promote visual aspects of teaching.

Additionally, from the kinaesthetic stance, students' interaction with the IWB was infrequent (Table 4.6) and when students were permitted to interact with the IWB, only a few of them were given the opportunity due to the constraint imposed by the recognition of one touch for input. Thus, few students had the opportunity for kinaesthetic activity and these students were chosen randomly, not by learning style. With the exception of the few times students wrote on the IWB with one of the pens, student interaction was confined to pushing buttons and moving items on the screen. Pushing buttons and moving items are not meaningful tactile activities. For example, students in Krystele's classroom had a kinaesthetic learning opportunity when they sorted buttons on a tray. When they moved representations of buttons on an IWB screen, they had a simulation of the kinaesthetic experience, but they did not touch or move the buttons in reality. Sometimes, such as in the example where Olivia used pictures on the IWB to replace the tactile experience with Inuit artefacts, the opportunities for tactile

learning were diminished by IWB use because IWB use (visual) was more efficient and the teacher did not need to order the pictures in advance in the same way she would have ordered the kit of artefacts (tactile). In the final analysis, the IWB was not used to support the tactile learning style, but rather to reinforce the visual (the pictures) and auditory (teacher's discussion). In contradiction to the teachers' perception that IWB use supports kinaesthetic learning, in the current study, opportunities for learning through "doing" as Krystele claimed, were limited and the visual mode was predominant.

Teachers in the current study were aware of the learning preferences of their students in a general way, that is, they did not identify specific students as being visual, auditory, or kinaesthetic and they did not use instruments such as those developed by Dunn and her colleagues (Dunn, Dunn, & Price, 1972) to assess students' learning styles. They perceived many students to be either visual or kinaesthetic and perceived a mismatch between their traditional teaching and the teaching activities made possible by IWB use. As a consequence of their perception, teachers in the current study used the IWB to supplement teacher talk (auditory) to address the visual and kinaesthetic dimensions of learning. Thus, teachers attempted to create multidimensional learning opportunities, although auditory (teachers' talk) and visual (IWB) were predominant with IWB use, much as they had been prior to IWB use with teachers' talk and the overhead projector or television.

Teachers' secondary claim was that IWB use improved student engagement and motivation. Technology use is widely claimed to improve

motivation and engagement (Norris et al., 2003) and IWB use is claimed to improve motivation and engagement (Gray et al., 2005; Haldane, 2007; Quashie, 2009). Motivation and engagement are complex constructs. For example, research in the field of motivation (Cameron & Pierce, 1994; Cameron et al., 2005) differentiates between intrinsic and extrinsic motivations. Intrinsic motivation is "measured by differences between groups on attitude, time spent on a task following the removal of reward (free time), performance during the free-time period, and willingness to volunteer for future studies without reward" (Cameron & Pierce, 1994, p. 394). In theory, when participants feel internal motivation to do a task, they experience "interest and enjoyment; ... feel competent and self-determining, and ... perceive the locus of causality for their behavior to be internal" (p. 364). Extrinsic motivation is often perceived to be motivation to perform a task due to a tangible reward. Thus, students who are motivated to learn or to perform activities should be positive about the task, perform the task during free-time periods, show increased competency, and attribute their learning to internal factors such as their competence. Motivation is measurable and involves many complex factors aside from fun or enjoyment, although fun and enjoyment may help improve motivation. Similarly, engagement is generally agreed to include complex behavioural, emotional, and cognitive factors (Ainley, 2012).

Teachers in the current study spoke most frequently about fun and enjoyment (motivation) and time on task (engagement). They provided examples of activities they perceived to be motivational for students and they spoke about behavioural factors such as being quiet, watching the activity, and participating in

the activity. Excitement to do the activity (a motivational factor) was also mentioned as a determinant of engagement. Yet, when teachers were asked about cognitive engagement, it was much more difficult for them to offer examples of how they knew their students were engaged cognitively in tasks. It is difficult, in the absence of measures of motivation and engagement, to determine whether IWB use resulted in increased motivation and engagement. Certainly, as other research on IWB use has reported (e.g., Gray et al., 2005; Haldane, 2007) students appeared to enjoy activities with the IWB particularly ones where students were able to interact with the IWB, and most appeared to be paying attention to the activities. Yet, teachers also provided counter-examples of times when students were not motivated to use the IWB (i.e., Krystele and Olivia) and of times when students' attentions were not on task despite IWB use (Kathleen, Krystele, and Olivia). Factors aside from IWB use that were perceived to influence students' motivation and engagement included animated teaching, task complexity, and students' attention spans. In addition, instances were observed where students chose not to use the IWB despite having free choice to play games independently (Krystele) and where one or more students were off-task during IWB activities (all teachers). Thus, in some instances, IWB use was not motivational for some students and in some instances and in the presence of certain factors such as overly complex tasks, IWB use was not engaging for all students. Conversely, students were also observed to have fun and enjoy activities and to pay attention and participate in activities even when the IWB was not used so in the absence of measures of motivation and engagement it seems simplistic to attribute perceived

improvements to motivation and engagement solely to IWB use and not to other factors such as type of activity and complexity of the task.

## Teacher Training in Interactive Whiteboard Use

Research question three: *What training do teachers receive to integrate Interactive Whiteboards into instruction in ways that support pedagogical decisions?* An initial inservice training session was hosted by the teacher librarian in January, 2011. She presented three tutorials from the manufacturer's website during a morning session and then teachers were encouraged to practice using the IWBs in their classrooms. Throughout the morning session, the teacher librarian reported she explained the slides and encouraged teachers to help demonstrate the toolkit functions of the manufacturer's proprietary software, *SMART Notebook 10* (SMART Technologies, 2011). Teachers received an instructional booklet to create lesson activities in the *Notebook* software (proprietary presentation software). The formal and informal training are described and analyzed for their support for pedagogical decision-making.

### Description of Teachers' Training

**Presentation slides.** The presented tutorials, *Novice SMART Board Tutorial* (SMART Technologies, n.d.), *Getting to Know Your SMART Board* (SMART Technologies, n.d.), and *Toolkit Training* (SMART Technologies, n.d.), were designed to demonstrate the basic hardware and software functions of the IWB and the *Notebook* software (SMART Technologies, 2011). Only *Novice SMART Board Tutorial* listed objectives: to ensure a basic understanding of the hardware and software, to encourage integration of technology into daily lessons,

and to use existing resources. The first outcome was addressed by slides that introduced the hardware components of the IWB such as how to orient the display, access the keyboard, draw on the board, and erase content. The majority of the slides in each tutorial used common classroom activities to demonstrate tools available in the *Notebook* software, such as the use of tables to make crossword puzzles and the pen to annotate written work.

The second and third objectives were not addressed directly. Although examples of typical classroom activities were provided such as labelling diagrams, no discussion of curricular fit was offered. It appears simple observation of examples of possible activities was intended to encourage teachers to integrate the IWB into their lessons but the reasoning for and benefits of integration were not detailed. Use of existing resources was encouraged in the final slides with topics that included how to access premade content, to search the Internet for lessons, and to copy existing documents into the software but the reasons for doing so were not explained.

**Instructional Booklet**. At the conclusion of the training session, teachers were given a booklet entitled "Creating SMART Notebook Lessons for Dummies" (Tittel & Lindros, 2010) and lists of online resources and tutorials to consult. The booklet explained how to create lessons with the *Notebook* software (SMART Technologies, 2011) and was intended for intermediate and advanced users of the manufacturer's software and hardware products who "want to find out how to jazz up [their] lesson plans and put these interactive tools to best use" (p. 1). The booklet used educational activities, similar to those found in the tutorials

presented in the morning session, to demonstrate possible uses for the tools available in the *Notebook* software.

**Informal Training**. The inservice training was Krystele and Therese's first training on the IWB. Krystele explained she did not seek prior training because she perceived no benefit to attending training before she had an IWB to practice the skills. Krystele's sentiment is supported by the experiences of Kathleen. Kathleen received training prior to her current placement where teachers practiced using the software on a computer without an IWB. She also reported that much of what she learned was not retained, because she did not receive an IWB for two years following her initial training.

**Opportunities for further training**. The initial inservice training was the only formal training offered to teachers, but the teacher librarian also offered informal training. She reported teachers were invited to observe her use of the IWB in the library or in their classrooms and encouraged them to observe other teachers' practices. Krystele and Olivia, the teachers most comfortable with technology use, made use of informal training opportunities within the school.

Although she was an experienced kindergarten teacher, Kathleen had not previously taught in the Cogito program. Thus, the teacher-directed, whole-class instructional model was unfamiliar. She also had limited experience with the IWB. Kathleen observed a more experienced Cogito teacher who integrated the IWB into daily instruction and then adapted her own instructional style to use the IWB in the same way. Olivia was one of the first teachers in the school to receive an IWB and taught with it for over a year prior to the formal training. Initially, she

attended sessions at the Teachers' Convention, but these focused on the toolkit applications for the software. Olivia characterized her training as "trial and error". She explored how to use the IWB independently and sought new activities from colleagues, the Internet, and sessions at the Teachers' Convention. In turn, she shared practices with colleagues to show them how the IWB could be used for instruction.

**Analysis of Teachers' Training**

In order to establish whether the training given to teachers to use the IWB and integrate it into their practice was effective, it is important to examine the criteria by which effective teacher training may be judged. Richardson and Placier (2001) conducted an extensive review of studies of preservice and inservice teacher training. They outlined two approaches, *Empirical-Rational* and *Normative-Reeducative*. The first approach, *Empirical-Rational*, takes a traditional view of teacher training, that is, impetus for change is external, objectives are given with a view to changing teachers' classroom behaviours, and training is short-term with limited follow-up. The second approach, *Normative-Reeducative*, emphasizes personal growth and development and collaboration between staff members that leads to collective change. Studies that have examined teacher training from a normative-reeducative viewpoint typically study the ways in which teachers adopt constructivist teaching attitudes and practices. The inservice model used in the current study, in which teachers were given one half-day training session and follow-up or support for further training was provided upon teacher request, fits closely with an empirical-rational stance to

teacher training.

Four of Richardson and Placier's (2001) six qualities of effective staff development from the empirical-rational approach were addressed, at least in part, by the inservice training offered to teachers in this study.

(1) *The program should be school-wide and context-specific*. The initial training session and follow-up informal training were intended to be school-wide but the emphasis was placed on classroom teachers and not educational assistants.
(2) *School principals should be supportive of the process and encouraging of change*. The school's administrative team, including the principal, vice-principal, and teacher librarian, offered release time, ensured teachers received required hardware and software, and encouraged follow-up training.
*(3) The process should encourage collegiality.* Teachers were encouraged to share practices and resources, and plan collaboratively.
(4) *The program should include adequate funds for materials, outside speakers, and substitute teachers so that teachers can observe each other*. Funding was provided for all required hardware, software, and release time.

Two qualities were not addressed; specifically *the program should be long-term with adequate support and follow-up* and *the program content should incorporate current knowledge obtained through well-designed research*. The only formal training offered was a short inservice, with no follow-up training offered to staff. Over the span of a morning, when teachers are struggling to learn how to use the new hardware, it is difficult to ensure meaningful pedagogical conversations. Any incidental training pursued by teachers was through trial and error and did not include the entire staff, thus differences in practices observed between and among the four teachers in the current study are not surprising. Additionally, no evidence of research was reported in any of the materials reviewed. Thus, teachers would not be given access to thoroughly researched reasons for IWB use or to analyses

of teachers' practices with the IWB that might inform their practices and make them more effective. Sadler Jones (2012) claimed that the barrier to improvements to teaching with the IWB appeared to be teachers' pedagogy, yet, the training materials and practices used by her employer addressed pedagogy only at the surface level (a collection of activities) and without the support of research as to the effectiveness of the suggested activities.

The training teachers in this study received addressed four of the five qualities of effective training from a normative-reeducative approach (as summarised from Richardson & Placier, 2001):

(1) *Impetus for change is internal, not external.* The previous principal and the teacher librarian initiated a pilot program to determine whether teachers wanted to adopt the IWB. The purchase decision came at a time when many schools in the division were purchasing IWBs for classroom use so, in part, the initial influences were external.
*(2) Responsibility for change rests with the teachers. The process empowers teachers to make deliberate and thoughtful changes in their classroom practice.* After initial training, teachers were able to pursue further training as their interests and needs permitted and encouraged to make changes in their pedagogical practices.
*(3) The program emphasizes collaboration and dialogue between teachers.* Teachers were encouraged to work collaboratively and time was provided to plan and develop activities cooperatively.
(4) *Changes in practice lead to but also follow from changes in underlying beliefs about teaching.* Although some teachers, like Kathleen and Therese (who were least comfortable with technology use), were initially apprehensive about the change to IWB use, all four expressed the view the IWB was beneficial and had been integrated into their daily teaching to the point where it would be difficult to teach without one.

Unfortunately, the fifth quality, *Change is long-term and ongoing. New approaches and strategies are tried in response to challenges encountered during staff development*, did not appear to be addressed. At the beginning of the second year, the lead technology teacher moved her focus to teaching Web 2.0 tools to

the students in elementary (grades 4 to 6) and away from instruction in IWB use.

Unfortunately, the drawbacks to the training, from both training perspectives included the limited length of formal training, the absence of research presented to highlight the efficacy of the IWB for teaching, and the failure to address the specific context of teaching. Richardson and Placier (2001) explained that short-term training is rarely effective:

> Many of the staff development programs in this category are relatively short term, involving teachers in several hours or days of workshops, with limited follow-up activities. … Such programs have only a chance of succeeding with those teachers whose beliefs match the assumptions inherent in the innovation, and, even still, these teachers might not try the new innovation. (p. 917)

Although teachers were encouraged to take part in incidental training, further training beyond the half-day inservice was neither required nor monitored. Thus, although teachers in the current study used IWBs in their instruction, the degree and methods of integration were different and based, in part, on their comfort with more advanced skills like the use of the *Notebook* software (SMART Technologies, 2011) to create lessons. Therese, for example, lacked the proficiency required to create lessons with the *Notebook* software. Therese downloaded and modified lessons for other subjects, particularly for mathematics, but no examples of "Notebook lessons" were observed for English Language Arts. Kathleen and Krystele used lessons they downloaded and also created a few simple lesson activities. Some lesson activities were selected from the manufacturer's sharing site to complement reading instruction. For example, Kathleen downloaded a lesson to help her teach about the vocabulary and structure of a story she read to the class. Kathleen and Krystele both discussed a

sorting activity they created collaboratively to teach sorting in mathematics. Olivia routinely created games, assessments, and lesson activities to supplement activities downloaded from the manufacturer's sharing site or the Internet. For example, she created a soccer-themed game to assess students' knowledge of synonyms and created quizzes that used the *Senteo Response System*. The variation in teachers' practices from those who self-identified as the least proficient in use of the software (Therese) to most proficient (Olivia) demonstrates that although teachers received the same initial training, their comfort and proficiency with the software and hardware tools (and with technology in general) varied widely from one another..

Further, if, as Richardson and Placier (2001) state, it is important for the success of new innovations that teachers support and align their thinking with the new innovation, it is vital teachers understand why the innovation is important, whether and how it helps their teaching and students' learning in general, and how it can best be used in different subject areas. Neither the literature provided by the manufacturer (the tutorials) nor the instructional manual discussed whether and how IWB use is beneficial to teaching and independent research evidence was not provided to support the claimed benefits of IWB use in the classroom. Therese stated although she considers the IWB to be an integral part of her teaching now, she felt initial resistance towards the IWB because its use required changes in her practice. Although Therese insisted the multimedia capacities of the IWB enhance learning for *21st century learners*, the training she received did not address the specific ways in which this enhancement was intended to occur and many of her

practices did not change. For example, she used the new medium to project the same paper resources she used previously and did not integrate *Notebook* features into her observed lessons. She reported and used Notebook lessons for Mathematics but rarely for Language Arts because more interactive activities were available for mathematics, such as activities that used manipulatives.

Fortunately, although the initial training was brief, especially when long-term change to teachers' pedagogy and practice are desired for lasting change (Richardson & Placier, 2001), the informal training and the atmosphere of support for change at the school helped several teachers such as Kathleen and Olivia to experiment with and change their practices over time. These teachers in particular reported changes in their practice that arose from the informal training opportunities they pursued. For these teachers, and for Krystele, the initial training and willingness to change practices over time influenced some of their classroom practices. Although she had the same initial training and follow-up opportunities, Therese continued to use many of the same practices she used prior to using the IWB. Thus, some of the drawbacks of the limited initial training were overcome by teachers who sought to enhance their formal training through follow-up training and personal experimentation. Therese claimed she sought these changes also, but her personal comfort level was much lower with the software tools than the other teachers. She expressed regret her practices did not match her view of ideal teaching with the IWB in which teachers deliver interactive lessons created with the *Notebook* software (SMART Technologies, 2011).

**Support for Pedagogical Decisions in Reading in Teachers' Training**

Research on the best practices for training teachers in the use of technology supports a balance between teaching technical skills and situating training in teachers' pedagogy and the specific content of their subject areas (Lewin, Scrimshaw, Somekh, & Haldane, 2009; Mouza, 2011; Sugar & Wilson, 2005). Mouza writes, "… the relationship among technology, content, and pedagogy results in … the ability to understand how technological tools can be combined with content and pedagogical strategies to produce meaningful student outcomes within specific contexts" (p. 4). Unfortunately, technology training typically focuses on technical skills and excludes pedagogical and content-area skills (Jones & Vincent, 2010; Mouza, 2011), and this conclusion aptly describes the formal training received by teachers in the current study.

The inservice training focused on how to use the features of the hardware and the accompanying software. All four teachers confirmed training centered on how to use the IWB, rather than on how to use it to teach Language Arts. The tutorial slides and booklet were intended for a general audience of teachers. Language Arts' objectives and the role of the IWB in teaching reading were not addressed. In fact, no explanation of how the IWB meets curricular objectives of any subject was provided, even technology outcomes. Thus, as Mouza (2011) suggested, teachers' understanding of how to integrate technology into their pedagogy and content was not supported. The "Foolish Assumptions" made about the users of their book by Tittel and Lindros (2010, p. 1) may explain the lack of attention paid to curricular fit and how to choose appropriate activities. It was

presumed readers were proficient with the use of both the IWB and its software (p. 1), familiar with lesson plans, and sought ways to make lessons more attractive and interactive (p. 3). Thus, it was presumed that teachers had sound pedagogical knowledge and the booklet offered examples of activities that could potentially make lessons attractive and interactive. The focus in the tutorials was on the technology and not on the curricular fit and appropriateness of activities.

Research points to the benefits of ongoing, informal training for teachers' confidence, technical skills, and pedagogical knowledge in their technology use, especially when mentors are used (Lewin et al., 2009). Similar informal training occurred at the school when the teacher librarian assumed the role of technology mentor. She visited classrooms, demonstrated IWB use, shared resources, and encouraged teachers to share their practices, although much of her focus was on the elementary classrooms (grades 4-6) and not the grades of interest (K-3) because she was introducing new technological tools to the students in grades 4, 5, and 6. Some teachers worked with external mentors such as teachers in other schools who were more proficient with IWB use. For example, Kathleen reported she used her mentor teacher's practices as a springboard for her own and continued to utilize many of the practices observed. These included the morning routine and activities to introduce electronic books to students (call upon individual children, read together as a class, and then listen to the computerized voice). Although Kathleen's observations changed her practice, Cogito's requirement activities be directed by teachers, occur only in whole-class contexts, and include extensive written work was also an important influence in this

change.

**Training and teachers' classroom practice.** If training does not provide a strong guideline for how or why IWBs should be used to support effective reading pedagogy, variations in teachers' practice are expected. Beginning with Durkin's work in 1981, effective teaching research (Dewitz et al.; Pressley et al., 1998; Wray, Medwell, Poulson, & Fox, 2002) consistently demonstrates that explicit instruction of skills, teacher modelling, and the application of skills in context are vital for the effective teaching of literacy. Accordingly, Olivia used the IWB to teach and model skills during interactive lessons. She guided students as they used the IWB, then discussed and modelled content from lessons (such as prediction strategies for reading), and at times, used peripheral hardware (the *Senteo Response System*) to assess learning. She reported she constantly experimented with ways to enhance the effectiveness of her teaching with the IWB and find ways for her lessons to be more interactive.

In contrast, Therese expressed concern her use of the IWB was not "as it was intended". Her perception of correct use was that teachers should use the *Notebook* software (SMART Technologies, 2011) to create interactive lesson activities. She expressed regret she did not have the level of comfort and proficiency necessary to create her own content and, instead, projected paper resources onto the IWB using the document camera. The interactive possibilities of the IWB emphasized in training, promotional literature, and research (Haldane, 2007; Quashie, 2009; Sadler Jones, 2012) as benefits of IWB use, were used infrequently and Therese continued to use existing resources and practices with

which she was comfortable.

Teachers in this study were given tools to create lesson activities. Guidance on why those tools should be used, when, or how they were meant to enrich student understanding was not provided. Thus, from the perspective of Hirst's (1973) definition of pedagogy, actions of the teacher (the showcased activities) were addressed, albeit in a vague manner, but neither subject matter nor technology outcomes were referenced, so it is unclear what students were meant to learn from IWB use and how they were to learn it. Certainly, much teacher talk or classroom discussion would have to accompany activities so that students are aware of what they are to do and know in order to complete them. Thus, the initial training and documents provided weak support for teachers' integration of the IWB into instruction in ways that were pedagogically appropriate.

Since the training did not provide a thorough examination of what effective teaching practices look like when using the IWB, it is not surprising teachers' pedagogy changed very little after their IWB training, unless they sought out further training like Kathleen or were committed to changing their pedagogy to incorporate the IWB in interactive ways like Olivia. Teachers whose pedagogies were highly interactive and who were comfortable with technology (Krystele and Olivia) continued to have relatively high levels of student participation and interaction whether they used the IWB or not, and teachers who had lecture-based pedagogies or were less comfortable with technology (Kathleen and Therese) continued to have lower levels of student interaction even when the IWB was used. This finding is not surprising, given that IWB use has the potential

both to encourage pedagogical change (Haldane, 2007) and to support and reinforce existing practices (Lewin, et al., 2009).

# Chapter 5: Review of Study, Conclusions, and Recommendations

This dissertation presents a description, analysis, and interpretation of changes to teachers' pedagogy in reading instruction resulting from Interactive Whiteboard (IWB) use. The field of educational technology has seen the proliferation of hardware and software claimed to alter, enhance, and improve the educational experiences of students. For example, in Alberta, the IWB is recommended for every classroom (Alberta's Commission on Learning, ACOL, 2003) and has become an increasingly common and accepted fixture in classrooms, thus it is important to understand whether and how classroom practices change as a result of IWB use. This final chapter begins with an overview of my study, and includes the major findings and conclusions that show only limited potential for pedagogical change resulting from IWB use. Next, I provide recommendations for teachers and administrators, an analysis of the study limitations, and recommendations for further research.

## Review of Study

The purpose of my study was to describe and analyze how teachers use the IWB to teach reading in the primary grades (K-3) in order to determine whether and how their pedagogy changed with IWB use. IWB use has been claimed by some researchers to improve teachers' pedagogy and to make teaching more effective. Thus, in order to judge whether pedagogical change occurred, I documented, analyzed, and interpreted teachers' pedagogy in reading lessons taught with and without IWB use, their perceptions of the pedagogical benefits of IWB use, and their training to use the IWB. The intention was to establish support

for the perceived occurrence of pedagogical change; it was not to judge teachers' practices, to compare their observed practices to their vision of ideal practices, nor to evaluate the suitability of the IWB as an educational tool for teaching reading in the primary grades.

The use of the visual medium of the IWB use to teach reading may be supported by Dual Coding Theory (DCT; Sadoski & Paivio, 2004). DCT assumes that the verbal code (spoken and written language) is supported by a nonlinguistic, nonverbal code in the form of images, sounds, and other sensory information that helps readers to form concrete mental representations of printed words while reading. From the perspective of DCT, the IWB's capacity to display images and animations and to play sounds adds deeper layers of meaning to the written words than are possible with traditional paper-based media that rely only on printed words with some pictures. Certainly, one frequent practice with IWB use for teachers in the current study was to display images or animations to support paper-based text. Another frequent practice was to access animations and sound effects during the reading of digital stories to help students to learn new vocabulary and decode new words. Thus, digital texts read from the IWB may be more supportive of young readers than traditional paper-based texts, and the IWB may be an effective medium for reading instruction if used in a way that uses nonlinguistic information to support the verbal code.

Four primary-grade teachers were selected to participate in the study based on the criteria that they represented the range of grades from kindergarten to grade three, taught in mainstream classrooms, and used the IWB frequently for

instruction. Participants represented a range of new to experienced teachers (3 to 27 years of teaching experience) and new to experienced IWB users (2 to 4 years of experience). Eight English Language Arts lessons were observed for each teacher (32 lessons total) over a period of 4 months. All lessons were recorded with a screen capture program, *Camtasia Studio* (TechSmith, 2010). At the end of each observation, teacher participants were interviewed about their use of the IWB for instruction, the nature of their pedagogical decision-making, and sources of their perceived pedagogical changes (such as their initial training and subsequent teaching experiences). Supporting documents such as logs of IWB use, responses to reflective questions in journals, and copies of training materials were gathered and analyzed to provide triangulation for interview and observational data.

Qualitative data from interviews and teacher journals were analyzed first to identify instances where teachers discussed pedagogical change and the pedagogical benefits of IWB use for teaching reading. Observational transcripts were coded second. In accordance with Hirst's (1973) definition of teaching and pedagogy, teacher actions, student actions, and lesson content were analyzed and interpreted. Support for pedagogical change was established by comparing the purposes and durations of activities with and without IWB use. Instances of support for the pedagogical benefits of IWB use reported by teacher participants were tallied and ranked in order of prevalence. Support for the most prevalent reported benefit, increased interactivity, was established by comparing the durations of teacher-only, student-only, and shared activities with and without the

IWB. Support for other prevalent reported benefits, including improvements to learning, motivation, and engagement, was established through anecdotal reporting and observation. Finally, whenever possible, data arising from observations were analyzed using descriptive statistics to confirm or disconfirm topics arising from anecdotal data from interviews and journals.

Little support for the occurrence of meaningful pedagogical change was apparent in my findings. In contrast to participants' stated ideal of highly effective lessons that utilized the interactive and multimedia capacities of the IWB, teachers most often used the IWB as a static display or to provide information and ask questions. The IWB has the capacity to provide interaction with the world outside the classroom including to perform online searches of the Internet, to video conference and communicate with others around the world, and to interact with textual and multimedia tools to create new media or information sources. In my study, however, the interactive capacities mentioned by teachers were limited to the use of the *Notebook* software (SMART Technologies, 2011) to create lessons where students manipulated screen objects as part of their instruction. Although there were times when teachers utilized the interactive capacities of the IWB and particularly the ability to press on or drag screen objects, their main IWB activities varied little from how a static whiteboard, picture set, or overhead projector was used prior to the IWB. Students used the IWB infrequently and, when they did, it was as a medium for shared reading or for answering structured-response questions on slides or in games similar to traditional paper-based worksheets and computer-based drill-and-practice games. Thus, the IWB was

used as a medium to deliver basic literacy instruction much like the basic literacy instruction traditionally afforded to primary students.

Advanced literacy skills such as using the IWB to explore the meanings of various texts and communicate with the world outside the classroom (Burnett, 2010); to comprehend multiple genres and types of information (Olson, 2010); and to locate, evaluate, synthesize, and communicate information (Leu et al., 2004) were not taught. Although these skills are valued by technology and New Literacies advocates, they are difficult, if not impossible, to teach in a meaningful way to students who are not yet fluent readers. The New Literacies' definitions of literate practices and skills in the digital era are aimed at fluent readers and consequently are too advanced for use in describing the practices and skills of beginning readers in the digital era. Surprisingly, although the IWB is an excellent medium for sharing digital stories with young students, only a few simplistic stories were used in the classrooms in my study in contrast to the greater complexity, depth of story, and range of topics present in the paper-based stories used in the classrooms. This difference may be indicative of an absence of comparable digital resources, but more likely reflects the different purposes for which teachers used digital and paper-based books in their instruction. Certainly, the substance and style of the teachers' literacy instruction changed little regardless of whether the IWB was used or not, and thus there is little evidence to conclude teachers experienced meaningful pedagogical change. Instead, IWB use replicated existing practices and often supported oral-teaching-based pedagogies and whole-group, teacher-directed instruction.

Similarly, there was little evidentiary support that perceived benefits to pedagogy with IWB use occurred in practice. Despite teachers' initial perception that IWB use improved lesson interactivity, students' interaction with the IWB was infrequent and generally vicarious. Pedagogical interactivity was also limited; the IWB was used mainly to transmit information and as a medium for questioning students to find the correct answer, and not as a medium to stimulate research and discussion. Teachers reported that IWB use supported multiple learning styles, particularly visual and kinaesthetic. However, opportunities for visual learning with the IWB were similar to traditional media such as the paper-copy picture set, overhead projector, television, and computer. There was minimal support for kinaesthetic learning because IWB use did not result in hands-on experience with concrete learning materials. Even when viewed from a purely physical activity perspective, students had infrequent opportunities to interact with the IWB. Additionally, although teachers spoke frequently about students' increased motivation and engagement with lessons taught with the IWB, they did not measure or compare motivation and engagement with and without IWB use and were less able to give examples of how they determined whether students were cognitively engaged in the lesson, rather than passively watching. Thus, support for the increased motivational and engaging features of the IWB was mixed and could not be confirmed.

Support for pedagogical change was not the focus of teachers' IWB training. Teachers were given initial training to use the IWB at a half-day inservice and encouraged to take further informal or formal training if they

wished. Training materials dealt exclusively with how to use the IWB and the functions available in the presentation software. The pedagogical suitability of instruction with the IWB for reading was not addressed in training materials and thus, no support for teachers' pedagogical change in the teaching of reading was provided in initial training. This finding is surprising, given Sadler Jones (2012), research manager for the leading IWB manufacturer, claimed teachers' pedagogy limited their effective use of the IWB and recommended better training in IWB use, yet no support for pedagogical decision-making was evident in training materials supplied to the teachers in my study. Most training materials used for teachers' initial training were downloaded directly from the manufacturer's website and it is not certain when or how teachers were intended to receive training to use the IWB to improve their pedagogy if materials provided did not address specific content-area pedagogical concerns.

## Conclusions

Consistent with case study literature reviewed (i.e., Haldane, 2007), there is little doubt the presence of an IWB in a classroom has the potential to change how education is delivered. For example, the IWB integrates the functions of an overhead projector, a television, a static whiteboard, and an Internet-capable computer into one medium, thus expanding the range of activities available for any one of these traditional media and leading to greater efficiency in teaching. However, the nature and scope of these changes and whether changes meaningfully affect teaching, learning, and teachers' pedagogy are questionable. The appeal of IWBs is such that use of the interactive and multimedia functions of

the IWB may overshadow the challenges of developing effective pedagogical materials for the medium. For example, although many literacy activities were taught using the IWB in the classrooms observed for my study, the nature of these activities and how they were performed had changed little since before the introduction of the IWB. Teachers in my study concluded the IWB was a tool to deliver and enhance instruction, similar to the Ontario Ministry of Education (2006) statement that technology can be used as a tool to enhance instruction. In its capacity as a tool, teachers in my study perceived the IWB made instruction more efficient and effective. Efficiency was increased by incorporating several traditional media into one presentation medium (i.e., a television, overhead projector, and teachers' computer). Effectiveness was increased, teachers claimed, by addressing visual and kinaesthetic learning styles and improving student achievement, although support for these claims was anecdotal.

Much of the case study literature reviewed documented pedagogical improvements with IWB use (such as Gray et al., 2005; Haldane, 2007; SMART Technologies, 2012), yet there was limited evidence in my study to conclude the nature of teachers' pedagogy changed with the introduction of the IWB into their primary-grade reading classrooms. Teachers accommodated IWB use into their existing pedagogies and IWB use frequently resulted in teacher-directed, whole class instructional strategies. Sadler Jones (2012) concluded limitations in teachers' pedagogy limit their effective and interactive use of the IWB. Yet, her conclusion presumes IWB use automatically leads to highly interactive, engaging, and effective lessons and by extension, places the blame for non-interactive and

traditional practices on teachers' pedagogical shortcomings. Yet, there was great diversity in IWB use among the teachers in my study, from those who created their own resources to those who used outside resources exclusively, and from those who had frequent student interaction with the IWB to those who had none. Various factors such as overall comfort with technology and program placement influenced how the teachers in my study incorporated IWB use into their pedagogy and practice. All teachers used the IWB in ways they had learned in their training, observed others using, or developed through trial and error. Each used varied instructional methods appropriate to lesson objectives regardless of IWB use. Thus, Sadler Jones' conclusion teachers' pedagogy limits the effectiveness and interactivity of their teaching with the IWB appears unfounded. In fact, it is clear that although teachers considered the IWB to be an important, convenient, and necessary tool to support their teaching, the evidence based on the findings of my study clearly shows they could do many of the same activities using traditional presentation media and thus experienced limited pedagogical change.

A question arose when examining the interactivity and student use data as to whether IWB use increases student access to technology in fulfillment of curricular mandates (i.e., Alberta Learning, 2000b) and ACOL (2003) recommendations. This question is secondary to findings regarding pedagogical change and the perceived pedagogical benefits of IWB use but nonetheless, raises an interesting debate about whether the mere presence and use of an IWB fulfills technology integration mandates. Conclusions related to support for curricular

technology mandates are presented next.

**Access to Technology and Support for Curricular Integration**

Less than ten years after the ACOL (2003) recommended installation of IWBs in every classroom in Alberta, the classrooms observed for my study bore little resemblance to those in the Norris et al. (2003) survey of educational technology in the United States, released the same year, wherein the authors found students had little access to educational technologies. The IWB is intended for whole-class use so, in theory, all students have equal and frequent access to the IWB technology. Thus, it could be argued students have increased access to technology with IWB use in keeping with curricular mandates. However, although each classroom had access to a functioning IWB that was integrated into every lesson, access to and use of the IWB by teachers and students was not equitable. In most classrooms, there were many students who never interacted with the IWB during observed lessons. The restriction of the IWB to accept input from only one touch was cited by teachers as a factor that limited opportunities for students' interaction with the IWB. Instructional program restrictions and comfort level with technology were other factors mentioned by the teachers. Thus, although in theory the presence of the IWB increased students' access to technology, in reality most did not have frequent use of the IWB to practice technology skills and their interaction was mainly vicarious.

The document outlining the requirements for technology instruction in Alberta classrooms (Alberta Learning, 2000b) stated technology instruction was to be infused into all core courses and programs. It is crucial to bear in mind that

the IWB functions as a presentation medium attached to an Internet-capable computer, so in theory IWB use supports curricular mandates because students can all see and access the IWB and one IWB can replace several student computers. Moreover, since the IWB is located in the classroom and not a central computer lab, teachers can more easily incorporate its use into daily lessons. The ACOL (2003) rationale for technology inclusion focused on the pervasiveness of technology and multimedia and on the importance of learning and using technology skills needed for the workplace, presumably through hands-on experience. Yet, although the IWB use replicated some technology practices from students' homes such as accessing games, videos, and digital books from popular educational sites on the Internet, little opportunity was afforded to practice technology use independently and to use the Internet for research.

The *ICT Program of Studies* in Alberta (Alberta Learning, 2000b) sets forth 42 specific learner outcomes for students in the primary grades (K-3). Fourteen of these fall under the general outcome "Communicating, Inquiry, Decision Making and Problem Solving". These specific outcomes deal with the processes required to access, use, and communicate electronic data to make decisions and solve problems. In the four classrooms observed, problem solving and decision making using electronic data were not observed and thus, none of these outcomes were met either individually by students or in a group led by the teacher. Likewise, twelve outcomes were included under the general outcome "Processes for Productivity". These outcomes dealt with the creation of individual texts that included print and graphics (such as word processing documents and

emails) as well as the ability to navigate hyperlinks. Using individual Netbook computers, students in Therese's third-grade classroom created original text using word processing software and comic-making websites and navigated the Internet and the school's Intranet. However, these were not functions for which any of the students used the IWB. Therese provided a short demonstration of word processing use for students that was displayed on the IWB, however the ICT outcomes require that students be the ones using the technology. Thus, none of the twelve Processes for Productivity outcomes were met with IWB use in the lessons observed.

Sixteen of the specific learner outcomes in the *ICT Program of Studies* (Alberta Learning, 2000b) were included under the general outcome "Foundational Operations, Knowledge and Concepts". These outcomes dealt with vocabulary use, appropriate and safe use of technology, and understanding of basic operations of technology. Of these outcomes, five were met partially by IWB use. These outcomes were related to appropriate vocabulary use (one outcome, all classrooms), following classroom procedures and safely using technology (two outcomes, all classrooms), appropriate care of technology (one outcome, demonstrated in Olivia's classroom through students' use of the *Senteo Response Systems*), and basic computer operations (one outcome, partially met in Kathleen, Krystele, and Olivia's classrooms when students clicked on buttons and moved screen objects on the IWB) although more complex functions were not observed. Three additional outcomes related to computer use were met in Therese's classroom, however these were met through students' use of Netbook

computers, and not the IWB. Thus, the curricular mandate to integrate the Information and Communication Technology (ICT) curriculum into core courses and programs (Alberta Learning, 2000b) was met partially because even though the IWB was frequently used to model technology use, only a handful of students were given the opportunity to practice skills independently, often no more than one or two students in the course of a lesson. Additionally, of the required outcomes from the ICT curriculum for the primary grades, only those related to vocabulary and general attitude towards technology use were met. Skills for technology use were not.

## Implications and Recommendations for Practice

IWBs in Canada and across North America represent a substantial financial investment. Numerous claims are made that IWB use improves teaching and learning, yet there is limited evidentiary support for claims of improved interactivity and student motivation, engagement, and learning. The teachers in my study benefitted from a school culture that was accepting of technology and from administrators and support teachers who provided time and funds for teachers to pursue training on the use of IWBs. Yet, even in this school culture, teachers' IWB practices varied considerably due to many complex factors including varying comfort levels and experiences with technology, teaching style, and program placement. Thus, it is important for school administrators to take a critical and objective look at claims made for the benefits of IWB use and consider their own school climates and requirements in order to ensure the greatest benefits from IWB use. Curricular mandates to integrate technology

(Alberta Learning, 2000b) and incorporate technologies such as the IWB (ACOL, 2003) may put pressure on school administrators to purchase IWBs without a full understanding of why and under which circumstances IWB use is beneficial. It is essential that claims be investigated and analyzed objectively, in order for administrators and school districts to make informed purchasing decisions. For example, teachers in my study used their IWBs for many instructional activities. They found the IWB allowed them to more efficiently present their lessons to students. Aside from efficiency, many of the benefits they perceived to their pedagogy and to student learning were not as apparent as teachers claimed. Thus, if administrators purchase the IWB based on unsubstantiated claims made in promotional literature, then the benefits they expect may not materialize. Nevertheless, the IWB is a useful tool to deliver content efficiently, and administrators must then determine whether increased efficiency is worth the financial investment.

The IWB is an inanimate presentation medium originally designed for business applications, and, as Hirst (1973) observed, machines lack the capacity and intention to teach. An IWB, used by a skilled teacher, has the potential to support innovative teaching and learning, yet, the teacher's knowledge, skills, and decisions play a greater role than the presence of the technology. It is important teachers be trained to use the IWB in a way that supports pedagogical decision-making if the types of pedagogical change deemed beneficial through IWB use are to be realized. Initial technical training, coupled with ongoing professional development focused on the supportive and appropriate use of the IWB to teach in

the subject areas is recommended. One of the findings from my study was a marked difference in the duration of IWB use between teachers who were comfortable with technology and teachers who were less comfortable. In addition, teachers who were more comfortable afforded more opportunities for students to use the IWB as well. Thus, ongoing training is important to build comfort and facility with the IWB. Even technology enthusiasts who have a high degree of facility with the IWB often do not vary their instructional activities much from their familiar activities and could benefit from training and professional development to experience and incorporate new techniques into their teaching. Teachers in my study each reported they used the IWB differently in different subject areas and particularly in mathematics where more interactive resources and activities were available. It is clear the nature of IWB activities and teaching methods is not the same in all subject areas, thus training must progress from how to use the IWB and the features of the software and hardware, to a reasoned discussion and investigation of how and under what circumstances IWB use is appropriate for teaching content unique to different subject areas and grades.

## Study Limitations

Although my study offers a significant refinement in methodology to the growing body of research that critically examines pedagogical changes that occur with IWB adoption (i.e., Mohon, 2008; Quashie, 2009; Smith et al., 2005), three limitations were noted. First, quantitative measures of students' motivation, engagement, and reading were not included in my research design and were thus unavailable to use when analyzing teachers' claims of improvements to student

learning because the focus of my study was on changes to teachers' practices, and not students' learning. My focus was in response to Olson's (2010) criticism of studies of pedagogy that ignore the actions of the teacher. However, measures could be included in future research to establish whether, how, and to what extent IWB use influences motivation, engagement, and achievement and to determine whether and to what degree students learn the intended lesson objectives through IWB use.

Second, like many case studies, my study has a small sample size and generalizability of the findings and conclusions outside of this original study context is limited, particularly because no baseline data were collected on teachers' pedagogy and practice prior to their initial IWB use. However, my findings and conclusions are similar to those of researchers such as Hennessy et al. (2007), Mohon (2008), and Quashie (2009), who demonstrated IWB use does not always result in improvements to pedagogy, particularly in improvements to pedagogical and technical interactivity. Third, teachers' perceptions of their pedagogical change are based upon their reported reflections. Nichols (2010) noted that teachers' reported practices may not match their observed practices. Certainly, there were times when discrepancies arose between teachers' reports of their practices and their observed practices in my study. It is also possible teachers' perceptions of their pedagogical change during the period in which they participated in this study may be different in retrospect from the first days of their IWB use when they underwent the most significant changes in their classroom practices. Thus, because the period of initial use was not observed, it is difficult to

analyze teachers' pedagogical change over time and to describe stages or milestones in their pedagogical thinking and decision-making over the course of their IWB use as was done by other researchers such as Beauchamp (2004).

## Contributions

The process of analyzing and determining the extent of pedagogical change is complex and requires consideration of all aspects and factors related to pedagogy in relation to both IWB use and non-use. Without a comparison between use and non-use of the IWB, the presence of change cannot be established. Notwithstanding this point, my study makes three important contributions: the first is to refine understanding of pedagogical change resulting from technology integration. The second is to provide a thorough, objective method for documenting and analyzing pedagogical change that up to now has been missing in the research literature. Finally, to extend the current adult model of technology use to a child-based model.

Specifically, through my thorough analysis of interview, observation, and documentary evidence, I established that IWB use reinforced teachers' existing pedagogy unless teachers chose to modify their pedagogies and resulting practices. In essence, the content and instructional methods were virtually the same, only the tool used for delivery changed. My results reaffirmed the important role teachers' pedagogical decision-making plays in their classroom practice, challenged the notion IWB use drives pedagogical change, and demonstrated teachers' limited use of the IWB capacities in favour of traditional, paper-based basic literacy practices.

Basic literacy acquisition activities and practices are developmentally appropriate for students in the primary grades, however, many of the activities observed on the IWB used only the most basic functions of the software and replicated traditional media and most notably the overhead projector. Further, my research demonstrated that interactivity, a key benefit claimed for IWB use, did not increase with IWB use and that claims for improved technical and pedagogical interactivity were unfounded. The four teacher participants presented a balanced picture of IWB use that contrasts the view set forth in some case study and promotional literature that the IWB should be used all the time for every topic and activity in the classroom. They made reasoned pedagogical judgements to determine when and which activities would be appropriate for IWB use. They used an assortment of instructional techniques that included times when the IWB was not used. Thus, in contrast to the IWB promotional literature, my study presents a realistic and objective profile of the ways the IWB was used for reading instruction by four teachers in the primary grades.

On the basis of the research publically available and accessible, my study outlines the first systematic, objective, and comprehensive method to document teachers' educational technology practices and to analyze and interpret evidence of their pedagogical change with technology use. The methodology for data collection, analysis, and interpretation addressed all components of Hirst's (1973) comprehensive definition of pedagogy by outlining a method to use quantitative data on duration and type of activity to document, analyze, and compare the actions of teachers and students and the lesson content both with and without

IWB use. Decisions about the occurrence of pedagogical change were made on the basis of comparisons between duration, type, and content of IWB use and non-use by teachers and students. Thus, this study addressed some of the shortcomings in recent and past research on pedagogy identified by Olson (2010) who concluded studies of pedagogy largely ignore the actions of the teacher and the object of instruction. Additionally, I used quantitative data to determine whether the IWB was used to improve interactivity, a commonly claimed benefit for IWB use. The methods used for data collection, analysis, and interpretation enabled thorough, systematic, and valid comparisons to be made between teachers' pedagogy and practice with and without IWB use and the results provided solid evidence to refute claims of substantial pedagogical changes asserted to occur in some case studies and promotional literature.

The current adult model of technology for problem-solving, information location, and digital communication cannot be transferred to primary classrooms where students are emergent readers and thus, not proficient enough to access and read Internet-based information. Rather, a child-based model of technology is needed to support children's emergent literacy development through teacher-mediated instruction to provide increased access to multi-modal reading resources at the children's level of difficulty, to people and experiences outside of the classroom, and to the world of opportunities afforded by familiarity with and use of child-appropriate technologies and their applications.

My research lays the foundation for a longitudinal study of a large sample of teachers' pedagogy with IWB use that encompasses the time prior to initial

IWB by teachers use to the time that they become proficient users. An intervention where teachers receive ongoing pedagogical and technical training over several years with the IWB would assist researchers to determine the conditions for optimal IWB training and use to support teachers' pedagogy and practice.

In closing, teacher pedagogical change in reading instruction in the primary grades through the use of an Interactive Whiteboard was at best superficial. Teachers capitalized upon their perceived strengths supported by existing reading research on effective teaching to inform their teaching with the Interactive Whiteboard and for this they cannot be faulted. This study pushes forward the need for ongoing technology training and pedagogical support for teachers, which in turn will advance the literacy learning opportunities for the children in our classrooms.

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## Appendix A

## Teacher Journal Template

Date of Lesson:

Lesson Objectives:

Language Arts Objectives:

Technology Objectives:

Description of Lesson Content: (may attach lesson plan)

Questions for Reflection:

1) What hardware and software did you use during the lesson? Did you use the IWB or other technology throughout the lesson or for part of the lesson? What part and why?
    a. Overall, how would you rate the effectiveness of the technology you used as instructional devices (very effective, somewhat effective, neutral, somewhat ineffective, very ineffective)? Please provide examples to illustrate how the technology was effective or ineffective in your lesson. Why?
    b. How did the use of technology help you to teach your lesson objectives in Language Arts and in technology? Please share examples of how your students demonstrated their learning.
    c. Would you teach the lesson in the same way next time? What would you do differently next time?
    d. How might you teach the lesson if you did not use technology? What would you do differently?
    e. Did you experience any technical issues with the hardware or software used during the lesson? If so, please explain what happened and how you dealt with the problem.
    f. Did you experience other issues such as behaviour disruptions or scheduling interruptions that changed your lesson? If so, please explain what happened and how you dealt with the

problem(s).

2) What do you see as the role of technology use, and particularly Interactive Whiteboard use, in your classroom?
3) Has your use of the Interactive Whiteboard changed how you teach reading in your classroom? Does technology change the way that children read in general or in your classroom? How do you know? What else has technology changed? Is that a good, bad, or neutral change? Why?
4) Is the Interactive Whiteboard an effective tool for teaching children to read? How? Why?
5) Please feel free to add other reflections that you see as relevant that I have overlooked.

## Appendix B

## Sample Interview Questions

1) How have you been using technology, particularly the IWB, in your classroom?
    a. What teaching methods have been successful when you have used the IWB? Please provide examples of when IWB use has been successful in your teaching of reading in your classroom. Why do you think it was effective?
    b. In what ways is the IWB an effective tool for teaching reading?
    c. Have you taught any lessons that were unsuccessful when you used the IWB? Why do you think these lessons were unsuccessful? Are there some aspects of teaching reading for which the use of the IWB seems to be inappropriate? Why?
2) Is there any difference in how you teach reading with the IWB and without the IWB?
    a. How would you have taught the lesson without the IWB?
    b. Was IWB use vital to the success of this lesson? How? Do you think the lesson would have had a different result without the use of the IWB? Why?
3) How does the use of the IWB and other technologies change the way that you interact with your students?
    a. In what ways does IWB use change the way that you group students for instruction or the way that students interact with each other in your classroom?
    b. How does IWB use change how you plan for instruction?
4) How long have you been using the IWB in your Language Arts classroom?
    a. How did you get started?
    b. How has the way in which you use the IWB changed over time?
    c. How was the decision made to put an IWB in your classroom and who made the decision? Were you involved in the decision making

process? If so, how?

   d. Has using the IWB in your classroom been a positive experience or a stressful experience? Why? Has your opinion changed over time? If so, how?
   e. How would you rate your overall comfort with using the IWB in an instructional setting? Why?

5) What training did you receive in using the IWB?
   a. What form did the training take?
   b. Who performed the training?
   c. What topics were addressed during the training? Did training address the ways in which IWB could be used as a tool for teaching Language Arts' outcomes? If so, how?
   d. Did the training you received prepare you to effectively use IWBs in your classroom for reading instruction? Why?
   e. Have you received further training in IWB use? If so, please describe what type of training you received.
   f. Would you like to have more training? On what and by whom?
   g. What other resources do you use to learn about teaching with the IWB? Do you consult online sites, observe how other teachers or students use the IWB?
6) What training or resources would benefit you in improving your effectiveness and the effectiveness of your teaching of reading using the IWB? (Hardware, software, training, etc.)
7) What advice would you give to other teachers or administrators who are considering installing IWBs in their classrooms?
8) Please feel free to add other reflections that you see as relevant that I have overlooked.

## Appendix C

## Training Materials Evaluation Template

Name of Resource: Year:

Type of Resource: ❒ Print, ❒ Multimedia (i.e., CD, DVD), ❒ Online, ❒ Other (specify)

Source of Resource: ❒ Manufacturer, ❒ School, ❒ District, ❒ Other PD, ❒ Other (specify)

Intended Audience: ❒ Beginning User, ❒ Intermediate User, ❒ Advanced User

❒ Teacher/Educator, ❒ General Audience, ❒ Other (specify)

1. What is the intended focus of this resource? Is it:
   - ❒ A technical guide on how to use the IWB
   - ❒ A guide to different activities that can be done with the IWB
   - ❒ An instructional guide (teachers' guide) to IWB use
   - ❒ Other (specify)
2. Is the resource intended for all ages of students or is it written specifically for primary grade (K-3) teachers?
3. What is the nature of the claims made by the resource for how IWB use improves or changes classroom practice? Are these claims supported with research evidence? If so, what is the nature of the evidence provided?
4. Is teacher pedagogy addressed in this resource (i.e., the role of instructional outcomes and teachers' planning to meet these instructional outcomes is emphasized)? If so, how?
5. How does this resource address how teachers should use the IWB in instruction? How does this resource address how teachers should teach using the IWB? Are students portrayed as having "vicarious interaction" (Quashie, 2009) with the IWB, or being active participants using the IWB? Explain.
6. Does this resource address Language Arts and, specifically, teaching children how to read? If so, in what ways? What theory of reading appears to be

supported in this resource? Explain.

7. What types of activities are suggested in this resource? What are the outcomes of these activities? Are activities linked to Language Arts or technology outcomes? How?
8. Other Comments

9. Overall, how appropriate is this resource for training primary teachers to use IWBs in their Language Arts classrooms in pedagogically appropriate ways?
    - ❒ Very Appropriate, linked strongly to teaching practice and pedagogy
    - ❒ Somewhat Appropriate, teaching practice and pedagogy are mentioned
    - ❒ Somewhat Inappropriate, teaching practice and pedagogy are not specifically addressed
    - ❒ Very Inappropriate, this resource has very little pedagogical value
    - ❒ Not Applicable, this resource is either not addressing teacher training or an evaluation of its appropriateness is unable to be made. (Explain.)
10. Which aspects of the training were available but not included in the manual or other literature (i.e., instructors' comments, advice, hands-on training)?