The Use of Interactive Whiteboards by Prince Edward Island High School Teachers

A Thesis

Submitted to the Faculty of Education
In Partial Fulfillment of the Requirements
for the Degree of
Master of Education
University of Prince Edward Island

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Charlottetown, PE
December 2, 2015

Abstract

This Masters of Education thesis used a questionnaire to examine Prince Edward Island high school teachers' self-reported practices related to interactive whiteboards in their classrooms and the factors influencing their interactive whiteboard use. Despite research suggesting that interactive whiteboards have the potential to improve student academic achievement, the extent to which this technology can actually achieve these claims was likely dependent on many factors. Factors identified in this thesis as hindering teachers' interactive whiteboard use and by extension, students' learning, were the understanding of what interactivity with an interactive whiteboard is, teachers' attitudes towards using interactive whiteboards, and the theoretical and practical training provided to teachers.

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Dedication

My wife Kristin and my children Patrick and Keegan have suffered through many Daddy-less nights while I was writing this thesis. For this, I say thank-you from the bottom of my heart.

To Kristin, you were always right beside me offering unconditional support and I would not have completed this work without your help. You believed and trusted in my choice to write a thesis and together, we accomplished it.

To my boys, Patrick and Keegan, I hope someday that you both will benefit from teachers who believe in improving their craft through research, knowledge and practice. One of the most repeated questions in our house from 2013 to 2015 was, "Daddy, are you done your thesis yet?" Well, boys, I am. Let's go play...

Acknowledgements

Dr. Alexander (Sandy) McAuley: I would like to thank you for everything. This process has been a long one and throughout it, you have been very patient with my growth and have held steadfast in your high expectations for my work. I look forward to continuing our conversations about technology as future innovations make their way into classrooms on Prince Edward Island and abroad. Thanks so much.

Dr. Tess Miller: At heart I am not a risk taker. I am organized by facts and what I can and cannot do with those facts. Your help on the numbers in this thesis was invaluable to my success and allowed me to see education in a measurable way that theory is unable to match. You also held me a high standard and for that I am truly appreciative.

Principals of High Schools in the English Language School Board: My gratitude goes out to all of you for allowing me to survey your staff members. Through knowledge we can continue to build on our experiences and create better learning environments for Island students.

Dr. Takayoshi Ikeda: Since I have known you, I have always admired your leadership and dedication to learning. The way in which you responded to my questions shows that you have not changed one bit over the years. I wish you continued success in your career.

My family and extended family: I am fortunate to have the Caseys in Nova Scotia and the Vesseys here on Prince Edward Island to surround me at all times. I am grateful that you have all been there to offer advice, listen to my ideas, take care of the boys when needed, and so much more. These pages are blank without your help.

Participants: You remain anonymous in this study but at the same time, you have your fingerprints all over it. Please continue to grow with the tools in your classrooms. Thank you all, whoever you are.

Chapter I

Arguably, one of the greatest challenges facing teachers today is how and why they adapt to changing technologies in their classrooms. For generations, teachers have had to react to new classroom tools placed there by others making decisions on their behalf. For example, some authority must have thought that chalk slates were no longer necessary and instead students and teachers should use paper and other writing tools. Later, some authority decided that 8-track cassettes were obsolete and in lieu of this technology, schools were going to transfer visual and audio learning resources onto VCR tapes and thereafter, DVD's and digital downloads. More recently, teachers have students with smartphones in their pockets, through which they are able to access the Internet, email, and complete word processing assignments (Cortesi, Haduong, Gasser, Aricak, Saldaña, & Lerner, 2014). In short, as technology changes, teachers have had to react and adapt to the changes for many years. As recently as five years ago, Prince Edward Island high school teachers had to adapt to a similar change in technology. When they returned to their schools in September 2010, they came face-to-face with a new piece of technology provided to them by the provincial government. This new technology was a device called a Smartboard, commonly referred to as an interactive whiteboard.

An interactive whiteboard is a touch-sensitive device that acts as a receptor of projected digital images from a source computer and can be controlled by touching the board with a finger or a specially designed electronic pen (Cutrim Schmid, 2009). Specialized interactive whiteboard software provides teachers with the capacity to create interactive opportunities for their students (Saville, Beswick & Callingham, 2014). Once

considered rare in classrooms because of the high cost, interactive whiteboards have steadily become more popular (Northcote, Mildenhall, Marshall & Swan, 2010). However, interactive whiteboards require operators with specific skills to enable them to be used effectively within a classroom (Glover & Miller, 2007). The challenge for teachers is that the specific skills required to operate an interactive whiteboard, unlike those required for a tool such as a pencil, are new and cannot be taken for granted. Before using interactive whiteboards, teachers require dedicated training on the hardware because instead of using a mouse to operate the computer at a desk, they are able to manipulate a projected image on their computer screen by touching the interactive whiteboard with their hands or peripheral tools (Türel & Johnson, 2012). Other functions of the interactive whiteboard include the ability to record and copy directly to the hard drive of the computer any manipulations made to the projected image that a class does through the software. Also, according to SmartTech.com, the proprietary software that ships with an interactive whiteboard comes complete with hundreds of templates and pre-programmed lessons for different grades and subjects (2015).

To suggest that this represents a simple shift in occupational strategies for teachers is inaccurate as the process that teachers experience is more complex than simply standing up and moving from a desk to an interactive whiteboard to operate a computer. Rather, the process requires that teachers develop operational skills to use an interactive whiteboard while simultaneously recognizing curricular outcomes in the classroom lessons so that students can improve academically (Sessoms, 2008).

Another concern is the pressure that teachers may experience when transitioning to a technology that has been bought through government decree for the purpose of

improving student learning and achievement. Cuban (1986) argued, for example, that for generations, authorities decided which technologies to provide in classrooms based in part upon the popularity of current trends with respect to technology and how it could change student learning. In other words, as authorities heard explanations that a certain technology could improve learning for students, with or without any concrete evidence to support the claim, the authorities would purchase examples of the technology with public funds and put them in a classroom for teachers to use. As a result of these decisions, a hypothetical expectation that teachers were going use the devices which would result in improved academic achievement for students, was thrust upon teachers either willingly or by way of systemic pressure.

In the Prince Edward Island context, interactive whiteboards have been in high school classrooms (i.e., grades 10 to 12) for five years giving teachers time to gain experience using them. This thesis will explore the extent to which teachers have developed skills using the interactive whiteboard and the factors that led to the development of those skills.

Context of the Study

Prince Edward Island is Canada's smallest province and is located near the east coast of the country. Connected to other provinces by seasonal ferry, bridge or air travel, it has a population of approximately 141,000 people (Statistics Canada, 2011) with approximately 14,000 students in the public school system (English Language School Board, 2013). For the purpose of this thesis, the term “Prince Edward Island high school” refers to the 10 publicly funded, predominantly English speaking high schools on Prince Edward Island with students in grades 10 to 12. As well, the term “Prince Edward

Island high school teacher(s)" refers to certified teachers of students in grades 10 to 12 in Prince Edward Island high schools and who, at the time of the research, were working on a short-term basis, probationary contract, or as tenured teachers at the start of the 2013-14 school year.

My interest in interactive whiteboard use comes from my experience as a teacher on Prince Edward Island for 11 years. As a teacher, I have had the opportunity to teach with an interactive whiteboard from time-to-time, but not to the extent that I would consider myself fluent in its capabilities. Unlike Prince Edward Island high schools that have interactive whiteboards installed in every classroom, my intermediate school of 21 classrooms has four interactive whiteboards in total and there is not one in my own personal classroom. However, despite not having my own interactive whiteboard, as the Site Technical Contact (STC) for my school, I am well aware of the availability of this specific technology throughout the Prince Edward Island school system. Of my many duties as STC, one duty entails being a contact in the school through whom the computer technicians at the Government of Prince Edward Island communicate. Periodically I attend meetings to discuss the progress of technology in all levels of the public school system across Prince Edward Island and over the past seven years I have had the opportunity at these meetings to talk with other STC's, in particular those at the high school level. Our discussions have led me to believe that although the interactive whiteboards are being used in high school classrooms, they are not being used as interactive tools but rather in manners that could be replicated by the teacher using less current, less sophisticated and less expensive technologies. This would imply that teachers may either have interactive whiteboard skills and choose not to use them in their

classrooms, or that they may not have the skills to use the interactive whiteboards in ways that promote interactivity. To date no study has tested these anecdotal observations to determine whether interactive whiteboards are being used as designed in Prince Edward Island high schools.

Statement of the Problem

How interactive whiteboards are being used may provide insight into whether they have a significant impact on improved learning. In two separate reports written for interactive whiteboard supplier, Promethean, over the span of two years, the Marzano Research Laboratory evaluated the use of interactive whiteboards and the Promethean ActivClassroom system on student achievement. The reports were published respectively in 2009 and 2010.

Marzano and Haystead's (2009) first study offered quantitative evidence as to why interactive whiteboards should be considered valuable tools in the classroom. Using a quasi-experimental design, they measured differences between pre- and post-test results from different groups of students to measure their academic achievement after one collection of students was taught without using the Promethean ActivClassroom system (the control group) while another collection of students was taught using the Promethean ActivClassroom system (the treatment group). Teachers, aware of the quasi-experimental design, were instructed to teach the same outcomes to both groups of students. In 85 independent treatment/control studies there were 1,622 students involved in the control group and 1,716 students in the treatment group.

The 2009 research had two phases. Phase I involved analyzing student learning with and without Promethean ActivClassroom as it related to the demographic

information and self-assessments of teachers with respect to the technology used in the classroom. Phase II of the research project involved analyzing student learning with and without Promethean ActivClassroom based on teacher behaviours determined with video taping and analysis.

The results of the research completed in Phase I of the 2009 report indicated that those groups of students, who were taught using Promethean ActivClassroom, saw average gains of up to 17 percentile points in overall student achievement due to non-random factors specific to the parameters of the study. Meta-analytic findings suggested that the increases in percentile points for students could be linked to (a) the experience of the teacher, (b) the extended period of time that a teacher had used Promethean ActivClassroom, (c) teachers who use Promethean ActivClassroom in their room extensively but not beyond 80% of their available teaching time, and (d) the confidence a teacher had in their interactive whiteboard. Among these 4 reasons, there was also a moderate multiple correlation of r=.443 (p=<0.05). This means that as the mean results of one grouped variable positively increase along the scale, so would the results of the other variables in the same direction.

The research completed in Phase II of the 2009 study reported on the analysis of student learning when using and not using Promethean ActivClassroom from the perspective of the teachers' behaviour that was evaluated through observations recorded on videotape of teachers using the Promethean ActivClassroom technology in the classroom. With respect to the analysis of Phase II, it was suggested that the Promethean ActivClassroom had a positive effect on student learning when teachers (a) organized their lessons into small parts that would be easy for students to learn from (chunking), (b)

organized their lessons into logical orders that built on the previous lesson (scaffolding), (c) paced the lessons according to the learning patterns in the classroom (pacing), (d) performed formative assessments (monitoring), (e) retaught what was misunderstood (clarity of the interactive whiteboard), and (f) ensured all students had the opportunity to respond to questioning throughout the process (student response rate). A multiple correlation of these six variables resulted in r=.821 (p<0.01).

In the second report, Marzano and Haystead (2010) again offered quantitative evidence as to why interactive whiteboards should be considered valuable tools in the classroom. Using the same quasi-experimental design, they measured differences between pre- and post-test results from different groups of students to measure their academic achievement after one collection of students was taught without using the Promethean ActivClassroom system (the control group) while another collection of students was taught using the Promethean ActivClassroom system (the treatment group). Teachers were again aware of the quasi-experimental design and were instructed to teach the same outcomes to both groups of students. Similar to the first report, and because students could not be randomly assigned to treatment and control groups, conditions related to non-equivalent group design was implemented. This research also had two phases.

Phase I of the second report involved analyzing student learning with and without Promethean ActivClassroom as it related to the demographic information and self-assessments of teachers with respect to the technology used in the classroom. Phase II of the research project involved analyzing student learning with and without Promethean

ActivClassroom with respect to teacher behaviours identified through video taping and analysis.

The results of the research completed in Phase I of the 2010 report indicated that the treatment groups, or those groups of students who were taught using Promethean ActivClassroom, also saw improvements in students' achievement; however, this time that number was an increase of 15.2 percentile points in overall student achievement in classrooms when the interactive whiteboard was used in classrooms as opposed to where interactive whiteboards were not used (2010). Unlike the 2009 report, no factors or strategies were listed that explained the improvements of student achievement with teacher behaviour aside from the use of the Promethean ActivClassroom itself. However there was a significant correlation of r=0.57 (p<0.01) between teachers' self-reported confidence in their use of Promethean ActivClassroom and how long, in months, they had used Promethean ActivClassroom (2010). This statistic suggests that both variables would move in the same positive direction if one variable saw an increase in its mean value.

The research completed in Phase II of the 2010 study reported on the observed behaviours of teachers whose students experienced gains in their academic achievement. Captured on videotape and analyzed, these observations suggested that students who experienced academic improvements did so in classrooms where teachers used the Promethean ActivClassroom to present content through chunking, scaffolding, pacing, monitoring, retaught what was misunderstood, and allowed every student an opportunity to be heard in the classroom. These results were very similar to the results presented in the 2009 report.

Taken together, the two studies demonstrated significant correlations around the variable of time. For example, comparing the results from Phase I, between teachers' self-reported confidence in their use of Promethean ActivClassroom and how long Promethean ActivClassroom was used (reported in months), a moderate strength positive correlation of r=.50 ($p < .001$) was found. Also between teachers' self-reported confidence in their use of Promethean ActivClassroom and the percentage of time Promethean ActivClassroom was used in the classroom, a moderate strength positive correlation of r=.45($p < .001$) was found. With respect to the combined results of Phase II from the two reports, the variables suggested by each report, exhibited correlations with corrected effect size that was greater than r=.60. A multiple correlation of r=.789 ($p < .0001$) was found using results from these 6 variables: chunking, scaffolding, pacing, monitoring, clarity of interactive whiteboards, and student response rate.

Although both of these reports were commissioned by interactive technology company Promethean and the results might be considered suspect, Marzano and Haystead nevertheless suggested that the use of interactive whiteboards in classrooms can positively affect student learning, at least if the term *percentiles gained* can be equated with student learning. Marzano and Haystead did not define the term percentile gains nor did they elaborate on the assessments used to suggest positive percentile improvements. In the first report, Marzano and Haystead (2009) indicated, "The control condition in this study was not a specific program or instructional strategy. Rather, the control condition represented the aggregate strategies and materials used by the teachers to facilitate instruction without the use of the Promethean technology. Surveys submitted by the teachers indicated that they were quite diverse in the approaches they used" (p. 15). What

this means is that teachers were not using a definitive and established list of suggested strategies for teaching students that would have enabled a consistent evaluation of what worked in the classroom and what was not successful during the study. As there were inconsistencies in the aggregated strategies presented in the classrooms and as a result, Marzano and Haystead (2009) focused their research on the relationships that exist in the class, (e.g., Student interactive whiteboard skills and positive versus negative effects for use of Promethean ActivClassroom and student independent use of the interactive whiteboard and positive versus negative effects for use of Promethean ActivClassroom).

These results are relevant to Prince Edward Island because interactive whiteboards were legislated into every Prince Edward Island high school classroom by virtue of being listed as an item in the provincial budget (Sheridan, 2010), presumably on the assumption that when coupled with teachers' practices, they would improve teaching and learning. However, unlike Marzano and Haystead's reports which focused on student achievement (2009, 2010), this study will focus on the skills and practices associated with teaching with the interactive whiteboard that would presumably contribute to similar results and, more specifically, whether Prince Edward Island high school teachers used their interactive whiteboards as devices to create interactive learning opportunities. The decision to study teachers' practices as opposed to student achievement as Marzano and Haystead did was made for two reasons: (a) I was interested in understanding what teachers were doing with their interactive whiteboards. While cognizant of the learning opportunities associated with knowing what students thought of the interactive whiteboard, researching their impressions and experiences went beyond my interest at time of research. (b) Further, I did not have a baseline measurement of student

achievement prior to the installation of the interactive whiteboards to compare with results following the installation of interactive whiteboards. I do acknowledge that there are results available from PISA and literacy examinations that have been gathered from high school students on Prince Edward Island, but specific teaching strategies, which would presumably be factored into a comparative study, were not defined for that purpose prior to teachers using them.

Therefore, as previously mentioned, this thesis focused on how high school teachers on Prince Edward Island used their interactive whiteboards under the assumption that certain practices and pedagogical strategies can contribute to improved academic achievement for students. Further, it will help identify factors that have been influencing the decisions of Prince Edward Island high school teachers to develop and practice interactive whiteboard skills. Lastly, this thesis will test the hypothesis suggested by my personal observations that a substantial portion of Prince Edward Island high school teachers were not using interactive whiteboards as interactive devices at the time the data was collected. Consolidating these concerns, this thesis asks two specific research questions:

1. To what extent are interactive whiteboards being used in Prince Edward Island high schools as *designed*?
2. What factors lead to the use or non-use of interactive whiteboards as *designed*?

The word *designed* is italicized deliberately to emphasize the possibility that teachers may have their interactive whiteboards turned on and used for projection purposes, but the activities they present may not meet criteria to facilitate interactive learning opportunities with the device. The characteristics of interactive learning and

interactive learning with the interactive whiteboard are discussed in the following chapter as the relevant literature examines challenges associated with using interactive whiteboard technologies in classrooms.

Chapter II: Review of the Literature

A review of the literature on the use of interactive whiteboards by teachers revealed a range of studies on interactive whiteboard use in classrooms around the world. For example, a Turkish study by Celik (2012), said that 252 primary teachers at 13 primary education settings using interactive whiteboards in their classrooms reported low self-efficacy when it came to developing interactive whiteboard lessons on their own. Using data that was collected from a Likert scale study, Celik linked the low self-efficacy result to the teachers' lack of understanding of common interactive whiteboard practices and suggested that teachers required specific training on the devices to assure quality education opportunities for students in classrooms. Further, Celik reported that teachers' self-efficacy with respect to classroom use of non-interactive technologies such as laptops and tablets was stronger statistically (2012).

Offering similar results, Isman, Abanmy, Hussein, and Al Saadany, (2012) studied teachers' attitudes and competencies towards interactive whiteboard use in five Saudi secondary schools and students' perceptions on the benefits of interactive whiteboards in classrooms in 2011-2012. The research was completed using three instruments that included an online survey for teachers, an observation skill card for teachers and a structured interview for students about their perceptions of the benefits of interactive whiteboards in classrooms. The results for teachers, which were derived following the random selection of 100 of the 300 responses returned to the researchers, suggested that teachers in Saudi secondary schools lacked the necessary skills to operate interactive whiteboards in ways that would lead to student achievement. Furthermore, the teachers were teaching with their interactive whiteboards in the same manner that could

have been achieved without an interactive whiteboard in the classroom. Training and professional development were considered factors in the results. Regarding the students' perceptions, the results of Isman et al. (2012) suggested that students' attitudes towards interactive whiteboards would improve if their teachers used them in effective manners in the classroom and that this would happen only through a change in the school culture with respect to classroom strategies and the development of their teachers' skills.

In a third study, Abuhmaid (2014) said that in four Jordanian private schools, interactive whiteboards were installed without the forethought of administration to consider processes for their implementation. Using a Likert scale to evaluate the perceptions of 167 participants, the data suggested that the perceived emphasis of the installation of the interactive whiteboards was on the merits and physical attributes of the technology itself and not the instructional and learning possibilities that can be realized using the technology.

These three studies demonstrated that there are teachers struggling with the skills necessary to operate their interactive whiteboards, although one cannot assume that what occurs across different grade levels and educational institutions in other parts of the world is necessarily the same as what is happening in one's own teaching environment.

A literature search found no results based on the terms Prince Edward Island, interactive whiteboards, and Smartboards. Nor did any specific research speak to interactive whiteboard use at the high school level across Canada, although Andrus (2013) published a mixed methods Masters of Education thesis on the use on Promethean ActivClassroom systems in the Yukon Territory in which she found that Yukon teachers were generally using and appreciating the flexibility offered by the Promethean

ActivClassroom system in their classrooms. Further, based on a purposeful sample of 16 teachers across all grade levels, Andrus' research recommended that the Yukon Department of Education purchase and install Promethean ActivClassroom systems in more Yukon classrooms for teachers and students to use. Accompanying this recommendation was evidence from sampled teachers who stated that professional development of specific Promethean ActivClassroom skills was required if and when more devices were purchased.

Andrus' (2013) recommendation to install more interactive whiteboards in classrooms echoed the positive results reported by Marzano and Haystead (2009, 2010). However, whereas Marzano and Haystead offered vague descriptions of strategies employed by teachers using the Promethean ActivClassroom, Andrus offered testimonial evidence suggesting how teachers in the Yukon Territory were using their Promethean ActivClassroom systems during lessons in the hopes of enhancing student achievement. Some examples of their pedagogical choices included (a) having students at the Promethean board manipulating images, (b) creating learning opportunities with more accessible media between the teacher, the content and the students, and (c) developing smooth transitions between lessons and topics while maintaining a teacher centered position at the interactive whiteboard.

To summarize, examples of challenges associated with interactive technologies exist globally and subsequently, the reviewed literature in this thesis has been grouped to reflect two key themes: (a) what is interactivity and how can interactive whiteboards can be used to support it and (b) what factors affect how teachers use interactive whiteboards?

According to Anderson (2003), "Interaction has long been a defining and critical component of the educational process and context. Yet it is surprisingly difficult to find a clear and precise definition of this multifaceted concept in the education literature" (p. 1). Published definitions of interactivity with respect to interactive whiteboards are equally difficult to find, although the literature provided suggestions of what interactivity as a theme might look and sound like.

To begin, Moore (1989) argued that there were three types of interaction; learner-content, learner-instructor and learner-learner. Moore further argued that effective educational interaction required the teacher to include learning opportunities that encompass examples of each type. Though Moore's typology was designed for the distance education context, it is a good starting point for the discussion of classroom interactions in general, including those involving interactive whiteboards under consideration for this thesis. Moore's typology was also applicable to the development of this literature review as the three types of interaction can be used as a framework to identify teaching strategies that might have contributed to Marzano and Haystead's claims that interactive whiteboards can lead to improvements in student achievement.

Having said that, the research of Moore (1989), Anderson (2003) and Marzano and Haystead (2009, 2010) on interactivity was not a new theme for study as researchers have studied the merits of interactivity and how people learn together and from each other for decades. Dewey (1923) argued that teachers should foster social interactions in the classroom to help students develop their understandings of curriculum and in a larger sense, their individual roles in society. The benefits and rationale for students communicating in their respective classrooms with their teachers and with other students

to solve problems is as relevant today as it was in Dewey's time. However, unlike Dewey's theorizing about social interaction, students in Prince Edward Island high schools today have the possibility to foster these social interactions with a range of new technologies that were not available in the 1920's. Combined with the themes presented by Dewey and Moore, today's teachers with today's students can explore curriculum by creating interactive relationships, not only with each other, but also through the functions and operations available with a device such as the interactive whiteboard.

Solvie (2007) pointed out with respect to the use of the interactive whiteboard in her elementary classroom, that however straightforward it may seem to integrate an interactive whiteboard into a lesson, developing activities that reflect the types of interactions outlined in Moore's (1989) typology that lead to discussion and learning can be complex. Solvie went on to explain that it is easy to get caught up in the desire to present lessons that are geared towards grabbing students' attention as opposed to having students focus on the materials being taught. Solvie identified a content-first approach to the interactive whiteboard, which signifies a potential pedagogical strategy for teachers in that they need to build their interactive whiteboard lesson around the content to be learned:

> As a result of reading, study, and reflection I believe my initial use of the electronic whiteboard as a tool to gain and maintain students' attention, rather than engage them in the lesson, may have developed notions about literacy and learning that were not part of my intended goal. (p. 738)

In other words, use of the technology as the medium to engage students with material as opposed to an object of attention did not happen automatically for Solvie.

Developing the control of the classroom interactions to create an environment in which the teacher could be confident in creating productive learner-instructor and learner-content interactions that focused on outcomes and not operations took time, reflection, and experimentation. Solvie's work demonstrated the difference between the students' engagement with the novelty of the interactive whiteboard used to present material in the classroom and their engagement with the material presented.

As well, Solvie (2007) suggested from earlier research that (a) student manipulation of text in word studies, (b) teacher modeling of reading and writing processes during shared and guided reading and (c) shared and interactive writing were effective examples of planning with the interactive whiteboard that focused on the content and the outcomes before considering what interactive whiteboard capabilities would be used. Solvie also suggested teaching using visual displays in the form of diagrams, webs, and pictures as well as shapes and colors to highlight text as they proved to be interesting to students and drew their attention to phoneme/grapheme connections in text and the conventions of print. As a result of putting the content first, Solvie's research suggested that students were responsive to the outcomes being taught when they interacted with the interactive whiteboard through activities such as moving text around the board with their fingers and palms of their hand, sweeping colors, drawing lines, and circles, and writing letters, words, and sentences in response to lesson questions, discussion, and inquiry (Solvie, 2003).

Similarly, Cutrim Schmid's qualitative research (2008) into her role as teacher leading international students at Lancaster University in the United Kingdom provided an example of what the integration of learner-learner and learner-content interactivity might

look like using an interactive whiteboard in the classroom. With similar results to the pedagogical suggestions of Solvie (2003), her research documented that having students at the interactive whiteboard and allowing the flow of the class to be directed by student involvement helped engage students in their own learning and direction of the lesson. Through videotaped observations and field notes, Cutrim Schmid determined that having her students at the interactive whiteboard allowed for equal access to learning among all the different learning styles in the classroom. While not removing Cutrim Schmid from her duties as a facilitator, this strategy allowed her to release control over various aspects of classroom pedagogy in order that students could decide what information to use in order to make critical judgments relevant to curriculum outcomes.

Although Cutrim Schmid's research provided no evidence about training on the interactive whiteboards or how she developed the pedagogical strategies used, she did note that that she had developed the lessons herself and that field notes taken by six of her colleagues observing her teaching verified her perceptions of the success of her approach. Similar to Solvie, Cutrim Schmid concluded in part that interaction between teachers, students and content was facilitated when the teacher and students shared the classroom and developed the learning together.

Also suggesting that the interactive whiteboard can be used as a valuable pedagogical tool with respect to the teacher exercising a different type of control over the direction of class, Betcher and Lee (2009) presented in their book, *The Interactive Whiteboard Revolution*, that interactive whiteboards were flexible instruments that teachers can use to create interactivity for their students in the classroom. To accomplish

this, Betcher and Lee suggested that teachers must understand the capabilities of the interactive whiteboard, stating:

> To get the most from the school's interactive whiteboards, the ultimate goal is to have all the teachers and students in the school using them as a normal part of quality teaching and learning. Implementation will be successful only when the boards are used seamlessly and easily by all staff – as much a part of the classroom as pens and paper. (p.14)

Further, Betcher and Lee (2009) said that schools needed leadership to support interactive whiteboard use, adequate and effective training designed to help teachers develop lessons in their own teaching environment, adequate monetary investment to ensure the technology worked and, patience that the level of use of the interactive whiteboard would not improve easily and the development of teachers skills would take time.

Similar to Cutrim Schmid (2008), Betcher and Lee (2009) maintained that regardless of teachers' environments and skill sets, the key to interactivity rested in teachers' abilities to allow students to interact physically and mentally with the interactive whiteboard while addressing grade level outcomes. They said, "without quality teaching and learning based around a solid understanding of sound pedagogical principles, interactive whiteboards will just be another piece of hardware in the classroom" (p. 13). Speaking to the potential for interaction on the teacher-learner and the learner-content levels set out by Moore (1989), this means that a teacher has to reflect on how the students will interact with the material being presented with the interactive whiteboard while developing their lessons.

This is not necessarily a requirement solely restricted to the use of the interactive whiteboard, however. Based on a mixed methods approach that used case studies to collect data about interactive whiteboard use by teachers in 21 primary schools in England, Haldane (2007) noted that the opportunity for student interactivity was not based upon the presence of the interactive whiteboard in the classroom, nor was interaction the result of the teachers' decisions to prepare interactive lessons with the interactive whiteboard. Rather, the opportunity for student interactivity depended on a partnership in the classroom between the teacher and the students' willingness to respond and interpret the lessons that teachers provide in the classroom, with or without the interactive whiteboard (Haldane, 2007). Recalling Solvie (2007), Haldane noted that the interactive whiteboard was not to be relied upon in itself to create student interaction in the classroom because an interactive whiteboard was, "merely a medium through which interactivity may, to a greater or lesser extent, be afforded" (p. 259).

Despite this, Haldane did note that students recognized that the interactive whiteboard was a flexible tool and one that provided momentum in the classroom if teachers' development and identification of skills matched curriculum outcomes and a combination of listening and participation activities that helped students acquire knowledge. Specifically, Haldane said that the software associated with interactive whiteboards enabled teachers to instantly recall previous lessons for classroom activities, visit relevant sites on the Internet and easily allowed for the manipulation of displayed content. Haldane recognized that these affordances mirror an instructor-dominated relationship with students and may not result in having students at the interactive whiteboards. Nevertheless, these examples do illustrate approaches through which

classroom relationships could evolve towards the types of interactivity argued for by Dewey in 1923.

Despite similarities, Haldane and Solvie (2003) differ considerably about the specifics of interactive whiteboard lessons. For example, Haldane stated that activities such as having a student come to the interactive whiteboard to manipulate text or a passage on the interactive whiteboard is "time consuming and clumsy" (p. 260) whereas Solvie recognized these sorts of activities as being helpful. As well, unlike Solvie's (2007) study which stressed that the interactive whiteboard could become the object of attention and a distraction from educational outcomes, Haldane maintained that the multimedia features of the interactive whiteboard afforded teachers and students the opportunity to connect and dialogue freely through their interactions and, as a result, promoted interpretations and discovery linked to Moore's (1989) three forms of interactivity.

Missing from Haldane's article was any demonstration that students' academic achievement did or can improve as a result of a teacher's decision to use an interactive whiteboard. While Haldane's work suggested that an interactive whiteboard could provide opportunities for learning through the hardware and software applications, it ignored the question of whether student learning improved as a result. In summary, it spoke to the creation of interaction at the learner-instructor level, but stopped short of any suggestion of a learner-content relationship (Moore, 1989) that resulted in enhanced learning.

The discussion of literature to this point suggests that students' physical and intellectual engagement with content and concepts presented in a lesson using interactive

whiteboards are intertwined and occur at the discretion of the teacher creating the lesson. Successful interactive lessons using the interactive whiteboard therefore require that teachers understand how the interactive whiteboard can be a tool that helps deliver learning opportunities on at least two levels: (a) the physical level and (b) the intellectual level (Solvie, 2007; Haldane, 2007; Cutrim Schmid, 2008; Betcher and Lee, 2009). How the physical use, (e.g., the touching of the interactive whiteboard) and the intellectual use, (e.g., the learning that occurs while using the interactive whiteboard), are strategically integrated determines the extent to which the teacher and the students have engaged in an interactive learning environment. The literature also suggested that although teachers may not have students at the interactive whiteboard learning from exploration and discovery, some pedagogical strategies in the classroom that use the interactive whiteboard as a teacher-centered tool can promote interactivity on different relationship levels. Moving beyond the simplistic view of the interactive whiteboard as a binary device that does or does not contribute to interactive lessons, additional literature identified two groups of factors that are necessary for teachers to use their interactive whiteboards despite the challenges of identifying unique interactive practices: (a) knowledge and skills and (b) training and professional development.

In a qualitative study of six teachers, two from primary schools (students aged 5-12) and four from secondary schools (students aged 10-18), Winzenried, Dalgarno and Tinkler (2010) concluded that teachers were generally enthusiastic about the notion of using interactive whiteboards in shared partnerships with students as long as there was a healthy balance of teacher-centered and student-centered activities in the classroom. The study also noted that interactive whiteboards were responsive tools, but that interactive

whiteboard use mirrored the technical competency of the end users. In other words, and recalling Solvie (2007), Winzenried et al.(2010) suggested that use of interactive whiteboards in a classroom depended on the skillsets of the teachers involved. Some teachers used their skills to find new ways to introduce the interactive capabilities of the interactive whiteboards while other teachers used their interactive whiteboards to revitalize older materials. Winzenried et al. noted that the ongoing use of interactive whiteboards contributed to continuous development of pedagogical skills necessary to create interactive lessons over time. They did not, however, address how teachers came to understand advanced interactive whiteboard skills or why they chose the techniques they used.

Also with respect to knowledge and skills, Hall and Higgins' (2005) qualitative study asked 72 level six students in the United Kingdom, three groups of six and three of 18, what they thought about their teachers' uses of interactive whiteboards and how the classroom presence of interactive whiteboards affected their learning. Three groups of students stated that they were aware that their teachers' skills on interactive whiteboards were still developing and that the teachers needed more support in order to be able to teach effectively with the devices. Which groups of students these were was not available in the article. Recalling the work of Haldane (2007), the students indicated that the versatility and multimedia functions of the interactive whiteboards were welcome additions to the classroom despite the teachers' lack of skills. At the same time, they noted that their teachers did not adapt well to technical problems with their interactive whiteboards.

Although the responses of students reported by Hall and Higgins (2005) may partially address teachers' concerns about the potentially detrimental effect of their lack of skills with interactive whiteboards, Slay, Siebörger, and Hodgkinson-Williams (2007) cautioned that teachers should be careful delivering classroom lessons with the interactive whiteboards with limited knowledge of how to operate them. Based on quantitative observations and reviews of classroom activities at three post-apartheid South African schools, five teachers, one from a primary school and four from secondary schools documented that they (a) spent a lot of time trying to get the technology to work as opposed to teaching curriculum to students and (b) were at a disadvantage due to the technological limitations of their understandings of Information Communication Technologies (ICT). These results followed a process that brought the five teachers together and provided eight hours of training on the interactive technology before returning to their classrooms to teach with the skills and knowledge they had learned. The teachers said with respect to using the interactive whiteboard as a teaching tool that ill-informed use due to lack of skills and the ability to make pedagogical decisions with the technology could detract from student learning. While teachers did not need to be experts with their interactive technologies, they did need to be literate users in that they could be expected to know how to operate the interactive whiteboard without major interruptions. According to Slay et al. (2007), an interactive whiteboard could encourage student learning but introducing materials with inadequate preparation and depth of understanding could be risky.

The work of Slay et al. (2007) could be considered both a push for adequate training for teachers to develop the skills necessary for success and recognition of the fact

that adequate training takes time. In that, they recalled the importance of adequate time to successfully implement interactive whiteboards reflected in the work of Solvie (2007) and Winzenried et al. (2010). Lee (2010), also pointed out that time directly related to developing important user skills was necessary if interactive whiteboards are to improve student achievement. Using a meta-analysis that chronicled a historical presence of interactive whiteboards in classrooms, Lee (2010) confirmed that teachers initially used their interactive whiteboards in manners that reflected their existing pedagogy but that over the span of a year, and due to factors such as, "teacher acceptance, classroom availability, ongoing in-house support and development, quality infrastructure, funding and most importantly quality leadership" (p.138–139), teachers reached a point at which their skills began to match expectations for the interactive whiteboard and enhanced student achievement. However, while Lee (2010) brought forth an argument for training with interactive whiteboards, he provided little insight into what productive training may consist of or where time for that training may come from.

A meta-analysis by Al-Qirim (2010) also addressed the issue of training for teachers on interactive whiteboards, pointing out that constantly developing skills and staying aware of current trends, as well as taking advantage of training available on interactive whiteboards were ways to improving pedagogical skills. Rooted in higher education, Al-Qirim's (2010) study argued that teachers needed to respond to difficulties encountered with interactive whiteboards by way of resources such as tutorials and videos that show the advantages of interactive whiteboards. According to Al-Qirim, seeing the positive aspects of using interactive whiteboards, even at times of frustration, could alleviate fears or disappointments associated with negative experiences with them.

Missing from Al-Qirim's study were concrete examples of what a teacher should do with the interactive whiteboard; the main focus was on positive reinforcement of what an interactive whiteboard could bring. Despite this omission, Al-Qirim stressed the importance of developing skills and facing challenges with respect to use of the interactive whiteboard and pointed out that interactive whiteboard skills "cannot compensate for the teacher's lack of subject content mastery" (p. 837).

Further to how teachers might go about developing the skills imperative to the classroom use of interactive whiteboards, Desantis (2012) suggested three elements of professional development planning: (a) technical efficacy, (b) a collaborative technology culture and (c) positive student-centered supervision. From a meta-analysis of other studies, Desantis suggested that these factors were critical to establishing an environment in which teachers could present interactive lessons with the interactive whiteboard. With respect to technical efficacy, and as presented by Celik (2012) and Isman et al. (2012), teachers needed to be able to understand the features of the interactive whiteboard. Without knowing how an interactive whiteboard works and how to use the tools associated with it, they will not be able to use it appropriately. Desantis suggested that one professional development session was insufficient to provide teachers with the requisite skills and, instead, training that built skills upon skills over longer periods of time and enabled teachers to reflect on their learning was required (2012).

With respect to a collaborative technology culture, Desantis (2012) suggested that teachers would benefit from having access to examples of lessons that other teachers have tried in the classroom and also that they would benefit from discussions with peers regarding the theories behind using interactive whiteboards and what interactivity could

potentially bring to their classrooms and students. A culture in which teachers better understood the technology with which they were teaching might include time for teachers to consult with each other about their skills, their interpretations of theory, and student responses. These types of collaborative opportunities would allow learning to evolve from basic understanding to more advanced techniques. Desantis specifically mentioned teachers working with mentors or having access to professional-development designers who could organize partnerships in schools between novice users of interactive whiteboards and those who were more skilled.

Finally, Desantis (2012) argued that teachers had to learn about the advantages of using an interactive whiteboard and the roles that teachers and schools play in student-centered classrooms. As teaching practices are often the subject of evaluations, supervisors would have to become aware of the possibilities of the student-centered classrooms in order to encourage teachers to teach through interaction with the interactive whiteboard. This could be accomplished by changing teacher assessment procedures for teachers who used an interactive whiteboard in their classroom. By focusing on how students responded to curriculum outcomes through exploration and discovery at the interactive whiteboard under the facilitation of the teacher, as opposed to a formal assessment of the teacher that may come from reading a lesson plan, the administrator might better understand how an interactive classroom can be successful.

Chapter Summary

The available literature determined that the practices associated with the development and use of interactive whiteboard reflected two key themes: (a) what is interactivity and how interactive whiteboards can be used to support interactivity and (b)

the factors that affect how teachers use interactive whiteboards. With respect to those themes, interaction has long been studied by educational researchers (Anderson, 2003). Dewey (1923) suggested that interaction was a strategy used in classrooms by teachers to develop well rounded socially conscious students while Moore (1989) argued that interaction does not happen only at instructor-learner level, but also at the learner-learner level and the learner-content level.

Building upon the typology of Moore, the work of Solvie (2007), Cutrim Schmid (2008), Betcher and Lee (2007), Haldane (2007) and Winzinried et al, (2010) all provided evidence to suggest that interactivity at various levels can be assisted or created with the help of the interactive whiteboard but that the interactive whiteboard should not be relied on to create interactivity in the classroom by itself. The research suggested that teachers had to be willing to welcome student participation through physical manipulation of the interactive whiteboard and through the intellectual development of classroom discussions.

Skills, knowledge and training as factors which help determine whether an experience with the interactive whiteboard was interactive were also explored in this chapter. Hall and Higgins (2005), Slay et al. (2007), Lee (2010), Al-Qirim (2010) and Desantis (2012) all said that teachers required specific training on interactive whiteboards to be able to use the devices appropriately. A lack of training and teacher skills can lead to distractions in the classroom and missed learning opportunities.

The literature reviewed suggested that interactive environments in which students can explore and discover with the interactive whiteboard were not easy to develop but at the same time, the use of interactive whiteboards in the classroom can create and foster

interactive relationships between teachers, students and the material being presented in the classroom but at different learning levels. On Prince Edward Island, interactive whiteboards are no longer a new technology in high school classrooms, but their presence still requires attention and evaluation. Lee (2010) contended that there are many pieces of the pedagogical puzzle that make a classroom a successful learning environment and that a teacher cannot rely on a single piece of technology to ensure student achievement. The next chapter will explore a theoretical framework that enables making sense of the puzzle that Prince Edward Island high school teachers have faced since 2010.

Chapter III: Theoretical Framework

Introduction

Every day high school teachers on Prince Edward Island must make decisions about how to teach their students the curriculum entrusted to them by the Government of Prince Edward Island (School Act, 2013). These decisions are determined by multiple factors. Some factors may originate with the teachers themselves through prepared lesson planning; others could be the result of a teacher having to react and adapt to a situation in the classroom out of their control but requiring a response. With respect to interactive whiteboard use in a classroom, the factors influencing teachers' decisions are virtually infinite. To better understand the interplay of factors that influence teachers' decisions, Activity Theory will be used as a theoretical framework.

Nardi (1993) described Activity Theory as a clarifying tool used to understand relationships that do not offer guaranteed predictions or data certainties. Rather, Activity Theory supports an understanding of the relationships between one's surrounding influences and the ability to make decisions in a particular activity. As the visual framework in Figure 1 illustrates, Activity Theory can be conceptualized as a triangle with arrows connecting six elements within it. This theoretical framework illustrates how six distinctive, yet interconnected elements affect decision-making and provides a tool for analyzing and investigating how decisions are made in a particular context. The context that will be explored by Activity Theory in this thesis is the potential influences Prince Edward Island high school teachers have to balance and weigh as they decide to use their interactive whiteboard in their classroom for pedagogical purposes.

For example, the decision of a teacher to use an interactive whiteboard to teach a single class or even a portion of a single class could be related to the experiences of the teacher with regards to their technological acuity, the expectations of students for flashy graphics, whether or not the interactive whiteboard works as expected, the particular outcome being taught in the classroom, the training the teacher had received on the interactive whiteboard, the light from outside the classroom reflecting off the board, the plug-ins working on their computer, the particular group of students in the classroom, and so on. In short, making use of a tool such as the interactive whiteboard is a matter of processing all the factors that surround and influence teachers' work habits and decisions. This chapter will explore Activity Theory as a theoretical framework that provides the opportunity to understand how possible influences and factors affect teachers' experiences and their decisions to use an interactive whiteboard (Cole & Engeström, 1993).

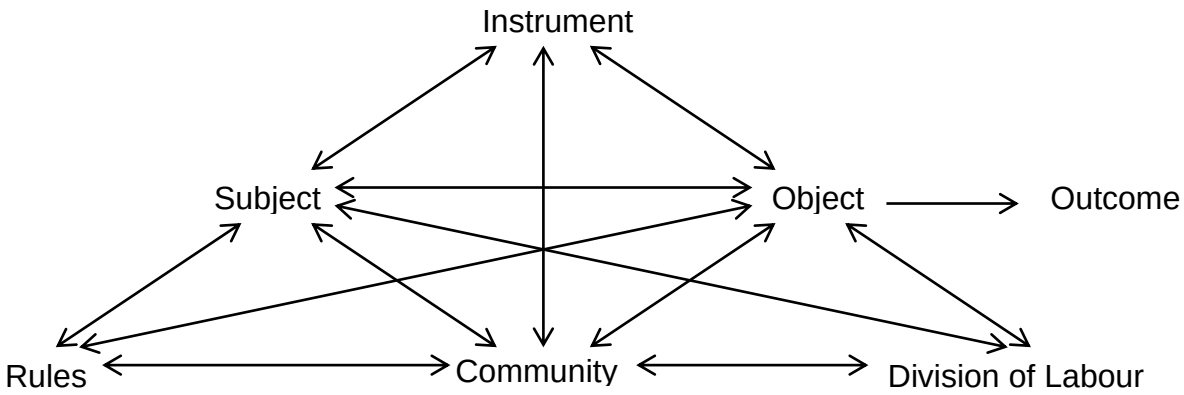

Figure 1. The visual framework of Activity Theory. Adapted from Cole and Engeström (1993, p. 22).

This framework can be broken down into two sections. The top three elements of the triangle (Subject, Instrument and Object) represent the heart of the model, as they

identify elements that can be controlled by the subject. In the case of this thesis, and as will be explained in more detail later in this chapter, the subject represents the teacher in the classroom. The bottom three elements of the framework represent factors that influence the subjects' abilities to make decisions through relationships but unlike the top elements, are not directly under the subjects' control. They do however, add to the complexity of the decision-making processes.

The final element of Activity Theory is the outcome. The outcome, shown outside the triangle, represents what happens as a result of all the elements in the Activity Theory triangle working together. In the context of interactive whiteboards in Prince Edward Island high school classrooms, the preferred outcome would be improved student achievement via teachers who use their interactive whiteboards as interactive devices. However, in the case that the result was not as hoped, in other words, that students in Prince Edward Island high school classrooms did not see academic improvement as a result of their teachers using their interactive whiteboards, an outcome would still result, but it would not be the kind supported by research such as that of Marzano and Haystead (2009, 2010).

Using Activity Theory to explore the factors that influence teachers' decision-making addresses the fact that no two situations in classrooms are exactly alike. Activity Theory allows for discrepancies between situations through a grounded model that explores and explicates different reasons for outcomes. In the case of teachers using interactive whiteboards, Activity Theory will help explain possible influences on teachers' decisions about their use of interactive whiteboards as interactive tools as outlined in the framework in chapter one and two.

Top of Triangle Elements

Subject

The subject refers to the persons involved in the activity being explored (Cole &Engeström, 1993); for this thesis it refers to Prince Edward Island high school teachers. The characteristics and experiences of teachers vary within the Prince Edward Island high school system. For example, some teachers are new to the profession while others are veterans and this can affect their classroom decisions. It is quite plausible that younger, more technologically alert teachers may gravitate towards interactive whiteboards because they do not experience anxiety related with new technologies and can troubleshoot challenges relatively easy as compared to the stress such a situation might create for a more senior teacher. Or from a contrary perspective, more experienced teachers who understand their assignments may be equally eager to introduce a new technology to their teaching practices because they understand that if their lesson with an interactive whiteboard fails due to a lack of training or experience, they can easily transition to something that has worked for them in the past without risking the outcomes being lost in the confusion created in the classroom. In either case, Activity Theory encourages exploration into who the teachers are individually and what each one brings to their classroom decisions. Activity Theory enables the personalization of individual experiences as opposed to grouping subjects all into one group based upon their job title. Activity Theory provides an avenue that is robust enough to protect all possible teacher experiences so they can be recognized equally as the teachers make their decisions to use an interactive whiteboard in the classroom.

The Instrument

In this thesis, the instrument refers to the interactive whiteboard, the software available for the interactive whiteboard, and the supporting peripherals such as the computer to which the interactive whiteboard is attached. While variations in the subject, for example teachers' characteristics such as experiences and beliefs may be diverse and ever changing, the instrument in this study does not vary significantly. Although some interactive whiteboards are mounted on movable stands, most are physical devices that hang on the wall and do not move. To some degree, however, the associated software and peripherals can be manipulated in different ways. For example, some teachers may use the software to present notes to students using the fixed interactive whiteboard as a projection screen, whereas others may invite students to the front of the classroom to manipulate images found on the Internet projected on the interactive whiteboard. Some teachers may use the software associated with the interactive whiteboard to save their classroom notes so they can recall them at a later date, while others may simply use template activities to arrange students into collaborative groups while the students watch the random selection from their seats. Regardless of the activity, while teachers differ in terms of their backgrounds and the manners in which they are influenced to use an interactive whiteboard, the interactive whiteboards and supporting materials themselves provide a limited range of functions with which the teachers can engage. The functions a particular teacher chooses to use and their potential to contribute to interactive learning experiences depends on the teacher's individual characteristics.

The Object

The object is what the subject is trying to achieve with the instrument (Cole & Engeström, 1993) and in the case of this thesis, the object is the lessons designed by the teachers to improve academic achievement for students through physical, interpersonal, and intellectual interaction via the interactive whiteboard. Essentially, these are the things that teachers plan on doing in the classroom with their students and the interactive whiteboard. As Moore (1989) suggested, however, interactivity happens at three levels in the classroom. The object of the teacher using the interactive whiteboard should be to improve those forms of interactivity to improve student learning.

This challenge captures the complexity teachers face in the classroom when making the decision to use an interactive whiteboard. Arguably, because classes are always changing and teachers' decisions are always adapting to that, one could say that lessons that use the interactive whiteboard, within the Activity Theory framework are a result of all influences a teacher has to balance. Even when a teacher plans appropriately to use the interactive whiteboard in a lesson, any number of things could happen during that class to require the teacher to alter their plan, derailing their interactive whiteboard activities. Alternatively, something else might lead the teacher to recognize a possible opportunity for further in-depth interactive whiteboard use. Essentially, how a lesson is presented using the interactive whiteboard is the result of the multiple influences the teacher has to balance in the classroom at any given moment. Activity Theory brings a coherent conceptual framework to this complexity.

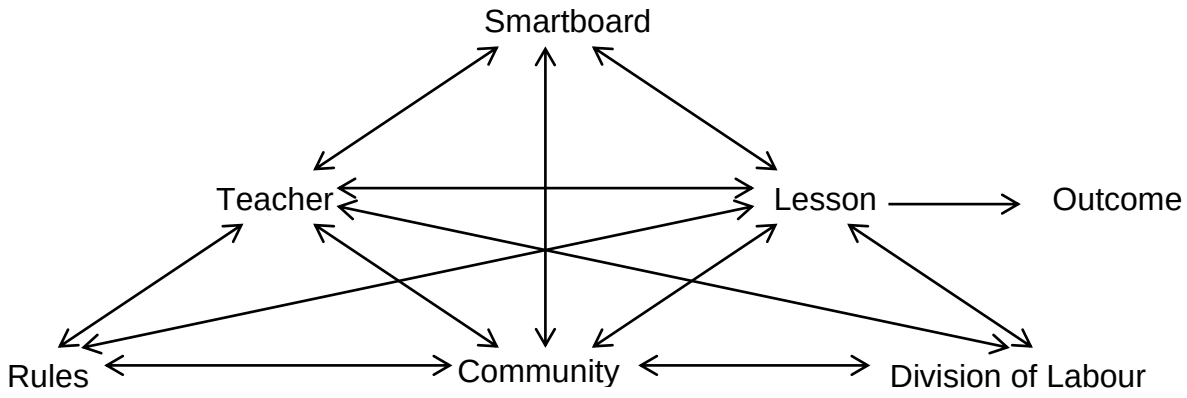

Figure 2. The updated visual framework of Activity Theory, which has the subject element, replaced with the teacher variable, the instrument element replaced with Smartboard and the object element replaced with lesson. Adapted from Cole and Engeström (1993, p.22)

Bottom Three Elements of the Triangle

If teachers had only to balance themselves, their equipment in the classroom, and what they were trying to achieve with that equipment, their jobs would be considerably less complex. The bottom three elements of the model identify the social factors beyond the control of classroom teachers and emphasize the influences from the extended environments in which teachers find themselves as subjects using instruments to achieve objects. Certain influences may aid the subjects in achieving the intended result with the designated instrument. On the other hand, if a social influence from the bottom part of the triangle is inadequate or inappropriate, then the overall object may be less achievable, if at all.

Rules

Rules are the conditions set out by the organizations for whom the subject works (Cole &Engeström, 1993). They are the guidelines that influence the subject's ability to

make decisions. The rules may make it easier or harder for the subject to use the instrument as designed because they may set limits on the subjects' decision-making. They may also obscure or highlight the desired product/outcomes. For example, according to a teacher's contract, the work completed in a classroom is expected to be curriculum approved and outcome oriented (School Act, 2013). This means that the teacher must above all else teach to specific guidelines as outlined by the government regardless of the instruments they use in the classroom. The use of specific instruments, such as interactive whiteboards to enable students' academic success is irrelevant as far as the rules of the teacher's contract are concerned. Therefore, because the curriculum guidelines say nothing about the use of the interactive whiteboard to achieve the mandated learning outcomes, some teachers may decide to use the interactive whiteboard sparingly, if at all. Other teachers may interpret the outcomes differently and believe that the interactive whiteboard would serve the lessons and development of student learning wisely. This leaves a situation in which the rules have different influences on how different teachers prepare lessons, deliver curriculum and manage the learning opportunities in class.

Another example of rules that influence teachers' decisions was the appropriate use of agreements that teachers sign at the beginning of the school year which prohibits them from customizing their desktop computers and therefore, by default, limits what they can accomplish in the classroom with an interactive whiteboard. Prescribed by the employer, this rule and expectation affects teachers as the subject in their efforts to create meaningful and successful objects or interactive lessons designed to improve student achievement. Teachers may have the desire, the technical skills, the pedagogical skills

and even personal understanding of their role as teachers with the interactive whiteboard, but if they are not permitted to modify their machines and introduce software, they may find themselves at a disadvantage. Meant to create and maintain order, the rules can also inhibit the capacity of teachers to create and adapt interactive lessons with the interactive whiteboard.

The Community

The community refers to the people or organizations that influence a subject's attempt to achieve an object with the use of instruments (Cole & Engeström, 1993), while working within prescribed rules and expectations through direct or indirect contact. For example, training for Prince Edward Island high school teachers on interactive whiteboards at the time of the study had been the responsibility of the Department of Education and Early Childhood Development. Given that teachers' degrees of success and comfort with interactive whiteboards depends to some extent on the training they received (Haldane, 2007; Slay et al., 2007; Al-Qirim, 2010), training above or below the individual teachers' expected standard may influence how the subject develops a lesson for the classroom. Similarly, the school administration may influence the use of interactive whiteboards as designed through planning for a school year. If administrators build time for high-quality interactive whiteboard professional development into a schedule, more teachers may develop the appropriate skills. As Sipilä noted, when administrators promote or ignore technology, they affect the behaviours of teachers in classrooms and how they use their interactive whiteboards (2011).

Even more broadly, the community could include the interactive whiteboard suppliers and how they affect whether the teachers use the interactive whiteboards

designed. On Prince Edward Island, teacher computers are made available to them as per the instrument and rule elements discussed earlier. However, if the hardware and software recommendations used to develop interactive whiteboards at the manufacturing level are too advanced for the computer systems a teacher can access, the result may be a teacher who uses the technology minimally, if at all.

Informally, as compared to relationships with government and manufacturing companies, can be the influences that extend from the various communities within schools and how those relationships affect the decisions of the teacher to use an interactive whiteboard in class. For example, if a teacher sees another teacher using an interactive whiteboard and they are successful in teaching a class in that manner, then the first teacher may feel pressured to make similar pedagogical attempts as well. Or if students, who most likely experience different teachers throughout a high school are seeing results in one class that they believe are the result of using an interactive whiteboard, they may request that other teachers use interactive whiteboards in the hopes of obtaining similar results. In addition, students learn at different paces and by using different learning strategies. Interactive whiteboards may better enable addressing these differences among students can within a semester or through the years. Overall, the community in which a teacher works is an important aspect of the Activity Theory because there are so many possibilities that can influence teacher behavior within a building or throughout the surrounding educational community

The Division of Labour

Finally we must add to the discussion the idea of division of labour and its role within the Activity Theory framework. As pointed out earlier, training on the interactive

whiteboards was a responsibility of the Department of Education and Early Childhood Development, while lesson planning and delivery rests on the shoulders of teachers. Therefore, to be prepared, teachers bear partial responsibility for their professional development and how their lessons are prepared on a daily basis. If the training provided was not adequate for a teacher to design interactive lessons, the teacher should seek further training. This does not mean that training provided is necessarily inadequate, but that once the teacher has acquired the skills to a certain level further training may be necessary and is the responsibility of the teacher (Sipilä, 2007; Desantis, 2010). Who identifies the scope of training and who is responsible for the delivery of training is an example of the division of labour. For example, teachers searching for templates or interactive lessons on the Internet by themselves might address further training needs. Or they may be required to contact their curriculum consultants about their concerns for more training.

Regardless, this makes an assumption that teachers have the time to respond to this additional responsibility. Between assessing for learning, reporting, emails, preparing lesson plans, coaching, calling parents and many more activities in the school, dividing the time in a teachers' day to self reflect on their interactive whiteboard skills might be unrealistic. It would seem that the challenge of making sure teachers are adequately trained and progressing on their devices at a pace that will encourage improved academic achievement should be shared among different levels of people.

Chapter Summary

The extent to which interactive whiteboards are used as interactive tools is determined by many factors and is a complex process for teachers to balance and think

through. Using Activity Theory as a framework to understanding the difficult decisions of Prince Edward Island high school teachers, it can be said that teachers are influenced by their own experiences, the pressures of others and the expectations of the entire educational setting to see that students achieve academically. Each individual teacher processes these factors differently and as such, the relationships in classrooms require a flexible framework within which the decisions can be understood. Not to be forgotten in all the possible relationships outlined by the Activity Theory framework, is that the end goal of any decision made by Prince Edward Island high school teachers is improved learning.

Chapter IV: Method

Introduction

Teachers are accountable to their students, their employers, and the public (Klinger, Deluca, & Miller, 2009). Therefore, when $500,000 of taxpayer money was used to purchase interactive whiteboards for high school classrooms on Prince Edward Island it is important to know whether the devices are being used in manners consistent with improved academic achievement such as that identified by Marzano and Haystead (2009, 2010). If the devices are not being used to improve academic achievement then it is important know in what capacity they are being used. It is also important to know what factors may be contributing to any shortfalls in the utility of the devices, and what changes are necessary to guide teachers to using the interactive whiteboards to their full potential.

As pointed out in the two previous chapters, the factors influencing teachers' decisions to use interactive whiteboards and the resulting strategies are varied and complex. From developing an understanding of interaction, to recognizing the need for training and skill development on interactive whiteboards, many possibilities suggest why a teacher may or may not be using an interactive whiteboard effectively in their classroom. Considering the challenges and questions raised in the literature review and the theoretical framework, a quantitative instrument using 24 Likert-type items was developed to examine how frequently high school teachers in Prince Edward Island used interactive whiteboards in their classrooms and the factors influencing the extent to which they use them. The reason behind using a Likert-type instrument was to gather information from all high school teachers on Prince Edward Island in a timely and

organized fashion. Further, using the Likert-type instrument afforded the opportunity to survey every high school teacher on Prince Edward Island exactly the same way and it was anticipated that the results would create a data set for analysis that would be robust enough to answer the research questions.

However, not all information can be garnered from a quantitative study relying on Likert-type items. As previously mentioned, teachers are responsible for the vast experiences of many students in the classroom and subsequently, their impressions of what is possible in everyday classrooms might not be fully captured in the Likert-type response options. Therefore, in addition to the 24 Likert-type items, the instrument design (i.e., survey) also included three open-response items that allowed teachers to provide written responses.

The method of data collection involved distributing a questionnaire to high school teachers through e-mail. The survey was designed to examine teachers' decisions to use their interactive whiteboard and the influences behind those decisions regarding interactive whiteboard use. As a reminder, here are the research questions:

1. To what extent are interactive whiteboards being used in Prince Edward Island High Schools as *designed*?
2. What factors lead to the use or non-use of interactive whiteboards as *designed*?

This chapter will introduce the development of the construct map and the survey design that specifically focused on the creation of quantitative and qualitative items. The chapter will then outline the data collection strategy in chronological order from the request of ethics approval to the actual data collection. Finally, it will conclude with

explanations of the data analysis, including descriptions of ANOVA, post-hoc tests and the Pearson correlation coefficient analysis.

Development of the Construct Map

The construct measured the skills and influences of high school teachers with respect to the interactive whiteboard in their Prince Edward Island high school classroom. The map of teachers' abilities was created to determine the characteristics of teachers throughout the spectrum ranging from those highly engaged with interactive whiteboard technology through those not at all engaged. This map was then used to design items throughout the instrument. (see Appendix C).

Table 1

Range of Teachers' Abilities

Type of Teacher	**Description**
Expert	Teachers who use the interactive whiteboard and software daily as an interactive tool in the classroom. Their level of proficiency with the technology and ability to create interactive experiences for their students exemplifies the potential for learning using interactive whiteboard technology.
Power User	Teachers who use their interactive whiteboards to the best of their abilities as an interactive device. They are comfortable with using their interactive whiteboards to a certain degree. Perhaps they know of several features available to them but do not have the skills or knowledge to create and manipulate more than the basic procedures with the devices.
Comfortable	These teachers do not stray beyond the basic examples shown to them during initial training. They require more specific training and time using the interactive whiteboards. They are willing to learn more about the features that can enable more interactive experiences in their classrooms but only if training was provided to them with respect to their specific teaching assignment.

Adequate	These teachers use do not draw upon the interactive aspect of the interactive whiteboards. Their interactive whiteboard activities could very well have been done without the interactive whiteboard (e.g., use a projection screen). They identify their work in the classroom as being interactive despite not meeting the criteria for interactivity previously discussed. These teachers are likely the ones who use their interactive whiteboard to advance slides or navigate links on a predetermined path.
I Need Help	Teachers who do not attempt to use the interactive whiteboard as an interactive device at all. They ignore all the capabilities of the interactive whiteboard and only use the device to project images. These teachers understand that they have an interactive whiteboard in their classroom but have no knowledge of the functionality of the device.

Following the results of the literature review and Activity Theory, and prior to data collection, the construct was conceptualized as having three subcomponents or dimensions: (a) interactive whiteboard knowledge and experience, (b) beliefs about interactive whiteboards and (c) views towards training received with regards to interactive whiteboards. This was completed under the belief that many teachers on Prince Edward Island would likely identify as being comfortable or adequate with technology in classrooms and with their interactive whiteboards but would also allow for

lesser majorities of teachers to find a place within the map. These variations would also permit a focused analysis using the ANOVA test during data testing.

Development of the Items

The items were purposefully created using as many contextual examples, situations, and scenarios as possible. For example, rather than simply posing the question, "How often do you use the interactive whiteboard?", items created for this instrument specifically directed the teacher to think about how often they used the interactive whiteboard to present slides from a slideshow such as PowerPoint, navigate websites (e.g., YouTube) or to create interactive lessons (e.g., engaging students by having them build rectangles by moving triangles and other polygons into appropriate places on the interactive whiteboard). Based upon on these contexts, the items necessitated that teachers think about the specific contexts and the extent to which they engaged in that particular interactive whiteboard practice (Kennewell & Beauchamp, 2007). It was hoped that these types of items would steer teachers away from over-generalizing and thereby solicit more accurate responses of teachers' interactive whiteboard activities.

A total of 27 items (i.e., 24 selected response and 3 open-response) were designed to survey teachers' usage and knowledge of interactive whiteboard operations. Fifteen items were Likert-type items designed to measure the construct. An additional block of nine selected response items was not included as part of the construct but rather gathered information about teachers' frequency of practice with interactive whiteboards using non-equal value intervals (e.g., daily, every other day, once a week). The difference between these blocks of items will be explained in due course. The remaining three items were

open-ended qualitative items. The following table summarizes the number of items and types within each dimension exploring interactive whiteboard use.

Table 2

Summary of Items

Groups of Items	Selected Response	Open Response
Dimension		
Interactive whiteboard knowledge and experience	5	
Beliefs about interactive whiteboards	5	
Training received with regards to interactive whiteboards	5	1
Interactive whiteboard frequency of use	9	2

Four point Likert-type items were used to capture teachers' responses to the 15 items measuring the construct in the three dimensions. These ordinal items implied an equal distance between intervals of (a) strongly agree, (b) agree, (c) disagree, and (d) strongly disagree. Four points were chosen because they limited the teachers' choices and made it easier for them to make decisions. As well, with only four items teachers would need less time to make decisions which was a consideration as it was recognized that teachers' time was valuable and filling out this survey was voluntary. Items in the first dimension, 8a to 8e, determined teachers' self-reported knowledge and beliefs about the relationship between interactivity and interactive whiteboards in the classroom (Betcher & Lee, 2009; Sipilä; 2011). The five items in the second dimension, 12a to 12e, explored

teachers' beliefs about whether interactive whiteboards were a good investment for Prince Edward Island classrooms and enhanced students' learning. This series of questions reflected the research of Marzano (2009), Winzenried et al. (2010), and Sipilä (2011). The five items in the last dimension, 13a to 13e, explored teachers' views towards their training on interactive whiteboards. In particular, these items surveyed the extent to which teachers felt they had been sufficiently trained to use the interactive whiteboard in their classrooms and followed the research by Haldane (2007), Cutrim Schmid (2008), Betcher & Lee (2009), Al-Qirim (2010), Sipilä (2011), and Desantis (2012).

The nine items exploring frequency of activities using the interactive whiteboard presented intervals of (a) daily, (b) every other day, (c) once a week, (d) once every two weeks, (e) seldom, and (f) never. These frequencies were used as they provided teachers plausible ranges of time to chose from that might be reflective of various classroom scenarios such teaching assignments and differentiated instruction strategies. By design, these frequencies are ordinal in that there is order implied ranging from most frequent to least frequent, though the distances of time are not equal.

Additionally, three qualitative open response items (see Appendix C) were placed strategically within the survey to provide opportunities for teachers to describe experiences for which the survey items did not capture. Two of the open response items were listed as items 10 and 11 and were designed to capture teachers' understandings of interactivity and specifics of interactive whiteboard use. The third open response item concluded the study in the position of item 14 by asking for anything else that respondents' thought was necessary and would be helpful to the study.

In addition to the 27 items examining teachers' interactive whiteboard use, seven items at the beginning of the instrument documented teachers' demographic characteristics. The first three items were designed to be independent variables as the responses to these items were not subjective and could not be manipulated by the respondent based upon the options provided in the instrument design. The items focused on gender, years teaching experience and a self-assessment of computer and technology knowledge. With regards to the self-assessment of computer and technology knowledge, teachers were given paragraphs of descriptors that suggested what options a teacher might choose (see Appendix A). While the descriptors were thought to be clear, absolute certainty that a teacher was choosing the accurate option for their interpretation was impossible to guarantee. Items 4 – 7 concentrated on the teachers' self-perceptions of their computer training.

Gender was surveyed to determine whether there was a parallel between interactive whiteboard use in classrooms and current trends that show men dominating the technology scene (Council of Canadian Academies, 2015). Teaching experience was divided into intervals of 0 to 5 years (beginning teachers who may be more current with changes in technology), 6 to 10 (young teachers who have perhaps worked through contracts and are settled into their career and may be comfortable with the technology surrounding them), 11 to 15 (mid career teachers who may have had experience in different areas of technology in the classroom), and 16 years experience or more (teachers who are likely to have lots of personal experience in the classroom and who may have experienced huge changes in direction and availability of technology in the classroom). While Guo, Dobson and Petrina (2008) reported that there were no statistical

differences to suggest that the age of teachers reflects stronger ties to using technology, this demographic variable was included in that the huge advance of different technologies since 2008 may affect males and females differently (i.e., different from the Guo, Dobson and Petrina, (2008) study). With respect to teachers' self-assessment of computer and technology knowledge, Angeli and Valanides (2009) suggested that teachers with many years experience and extensive knowledge of technology, though not specifically trained how to teach with computers, underperformed when preparing and delivering computer mediated lessons for their students. As well, the use of the terms experienced/knowledgeable and inexperienced/beginner do not necessarily reflect skills on the interactive whiteboard, but rather the overall interpretation of skills with respect to computer knowledge as self identified in the demographics section of the survey. The three grouping variables were also selected in response to the predicted small sample size in that a reasonable number of teachers' was anticipated within each group. In comparison, it would have been unethical to use the name of the school as an independent variable given that it was not possible to guarantee the anonymity of participants in the relatively small population of high school teachers.

The survey was initially developed as part of a required graduate course on quantitative statistics at the University of Prince Edward Island and was revised according to feedback from peers as well as the instructor during the course. It was field-tested, including administering the questionnaire to a pseudo-sample, following completion of the course in the spring of 2013, to further refine and enhance its quality, (see Appendix C for a copy of the survey). Once the survey met reliability standards using Cronbach's Alpha standard of 0.70, the final survey was transferred to the online

survey platform, Survey Monkey, for distribution and data collection. Teachers were requested by email to complete the online survey anonymously at a convenient time and place. An electronic survey was selected over a paper and pencil survey because it was thought to be an efficient way to connect with all potential subjects. Using capabilities of the internal email network used in Prince Edward Island schools, every individual high school teacher would be able to receive the survey at the same time, as they would have been grouped together as potential recipients based upon their employment in high schools.

Data Collection Strategy

Ethics approval from the Research Ethics Board of the University of Prince Edward Island and the Research Review Committee of the English Language School Board was obtained in November, 2013. As negotiated with the Chair of the Research Review Committee an e-mail containing a link to the electronic survey, the letter of information for principals (see Appendix A) and the letter of consent for participants (see Appendix B) was to be forwarded to principals by the Chair of the Committee and from principals to high school teachers via another forwarded e-mail. However, that strategy resulted in only 11 responses.

It was subsequently decided that forwarding an email through multiple levels of personnel potentially meant that it could have been lost, deleted, or misunderstood when it arrived at its final destination which was likely responsible for the low response rate. A more streamlined and direct method of distributing the survey was therefore devised that adhered to the ethical policy stating that permission to survey teachers had to be granted by the principal of each school. The 11 high school principals were contacted directly

and the principals then sent the survey out to their staff members. This process reduced the four rounds of e-mail forwarding to two: the initial e-mail sent to principals and subsequently, the e-mail forwarded to teachers. This strategy brought in another 81 responses.

Data Cleaning

Data from Survey Monkey was imported directly into SPSS software and analyzed for anomalies. Four questionnaires were removed from the data set because the respondents had completed less than 10% of the items with the result that there was insufficient data from which to generalize any patterns in response. The remaining 88 questionnaires were deemed acceptable for further examination. The explore function in SPSS was then used to ensure that responses from all Likert-type items fell within the specified ranges for the responses. As teachers entered data electronically when they answered the survey, there was limited possibility for human error in consolidation of responses and the data was confirmed to be acceptable for analysis. The collected data was then reviewed in order to identify any general review of response patterns. Data from the open response items were left as text for analysis according to the qualitative procedures suggested by Parsons and Brown (2002).

Data cleaning also involved re-coding negatively worded items so that all positive interactive whiteboard thinkers or highly engaged teachers responded at one end of the scale while all negative or disengaged teachers responded at the opposite end of the scale. A total of five items were recoded (i.e., 8a, 12a, 12b, 12e, 13a).

Data Analysis (Quantitative)

Given that it was not possible to test the dimensionality of the scale using factor analysis due to the small size, the three dimensions were analyzed as separate scales as the three dimensions were believed to be examining different aspects of the construct. The first step in data analysis involved examining the reliability of the scales. To determine whether the items in each dimension were measuring the same aspect of the construct, Cronbach's Alpha was calculated. The five items exploring teachers' knowledge and experience had an alpha coefficient of 0.71, which was considered acceptable as the minimum accepted coefficient is 0.70 (Vogt, 2007). Similarly, the alpha coefficients for beliefs, and training were 0.70 and 0.73, respectively.

Descriptive analysis. The next step in analyzing the data focused on descriptive statistical procedures. Descriptive statistics included frequencies (raw and percent), which were calculated for all items. The mean and standard deviation were also calculated for each Likert-type item.

Inferential analysis. Inferential statistical analysis focused on the analysis of variance (ANOVA) to examine mean differences between groups. The groups (independent variables) compared in this study were: gender (i.e., males vs. females), years teaching experience (i.e., 0-5 years teaching, 6-10 years teaching, 11-15 years teaching, and 16+ years teaching experience) and a self-assessment of computer and technology knowledge (i.e., I need help vs. adequate vs. comfortable vs. power user vs. an expert). These independent variables were compared with the three separate dimensions of the construct comprising of the dependent variables: knowledge and experience, beliefs toward interactive whiteboards and views towards training. To

enhance the power of the analysis, the items within each dimension were summed together to present one overall variable representing the dimension. The inferential analysis subsequently involved three independent variables and the three dependent variables mentioned above in addition to the 1 x 3 analysis comparing the entire construct (interactive whiteboard use) with the three independent variables.

The ANOVA was chosen as the method of analysis since it allowed for the comparison of mean scores from multiple independent variables. The ANOVA does this by mathematically looking at variations in mean scores and where these variations are found within the comparison. While it may seem that ANOVA is limited to studying the mean differences *between* groups, ANOVA also looks for significant difference *within* groups because variation in responses, which lead to different means, can be affected by how teachers within each group respond to items. If there were differences within the group, then the event may be affected one way or another. Although the ANOVA generates a measure of the variance that could occur within groups, the major concern is the effect variance, which allows us to identify variance outside of the independent variable groups where chance would be less likely to affect scores. These differences are represented through the analysis of means of the groups and how significantly they differ from each other.

This is an important consideration when studying the behavioral sciences, because the interest is in the effects of an event, and not the associated parameters that influence those events. Therefore, if there were any influences within a particular group that swayed variances within a group, the data and differences

associated with the analysis would be categorized as happening due to random chance (Turner & Thayer, 2001) and as a result render that variances being isolated from consideration of statistical significance.

Because multiple independent variables were being considered, it was assumed that the means were going to be different when compared (Rutherford, 2001). As a precaution, ANOVA assumes that there will be a difference in means to some degree and that no difference would signify that all the groups were exactly the same with equal means across the board. Equal means would be highly improbable given the many different relationships possible.

The ANOVA generates two statistics that are of concern; the *F*-ratio and a *p*-value. The *F*-ratio is the ratio between two measures of variance. The first measure represents the variance of the mean scores and can be calculated for means *between* or *within* groups. A larger *F*-ratio indicates that the means were not equal (there is a difference between or within the groups). In the case of a null hypothesis where there is no relation between the measures of variance and that the results are the product of random chance, the two measures would produce a ratio closer to one. Bringing this full circle, if the null hypothesis is false (there is a difference between the mean scores), the *F*-ratio would be large.

The *p*-value is a measure of the probability that the difference between means would appear with or without chance interfering with the relationship measured. A small *p*-value ($p<0.05$) indicates the difference is not due to chance and is therefore statistically significant (Vogt, 2007). If there are more than two groups when a statistically significant difference is found, a post hoc analysis is required to determine where the difference

exists (Turner & Thayer, 2001). For example, a statistically significant difference between males and females when examining beliefs towards interactive whiteboards would mean that males and females have different beliefs about interactive whiteboards. An examination of the mean scores would indicate which of the two groups had the more positive beliefs. However, comparing teaching experience involves four different groups (i.e., 0-5 years teaching, 6-10 years teaching, 11-15 years teaching, and 16+ years teaching experience) and a significant difference here ($p<0.05$) would not indicate immediately where the difference lies. The most commonly used post-hoc analysis is Tukey's Honestly Significant Difference (Tukey HSD). This test would indicate which groups differed significantly among the four measured.

When a significant difference was found, it was necessary to quantify it to determine whether it has any practical significance. In this case, the effect size was calculated using ($h^2 = SS_{between} / SS_{total}$). The effect size provides a measure of the magnitude of the effect independent of sample size (Levine & Hullett, 2002). Although the mathematical calculations for effect size produce objective numerical values, effect size is often represented through descriptive language such as small, medium or large. Each of these descriptors represents an indication of the significance of the difference between one group and another, 0.01 being small, 0.06 medium and greater than 0.14 as a large effect (Cohen, 1988).

In order to perform an ANOVA, four conditions had to be met: (a) each group contained a random sample of the population, (b) the scores in each group were anticipated to have been distributed normally, (c) the scores in each group were independent of one and other, and (d) the variances in each group being questioned were

homogenous (Rutherford, 2001). Although a random sample could not be assumed with respect to the groups in this survey due to the small number of possible participants and the distinct target of responders sought, ANOVA was considered robust enough to handle this violation as it was assumed that the variance of means would be adequately different between groups and within groups. The assumption of normality was not violated given that the sample exceeded the minimum of 30 respondents (Pallant, 2010). Normality was examined using the explore function in SPSS in which a distribution of responses for each item was presented in the form of a histogram. Distribution of the survey to individuals across the province avoided any issues related to independence of groups. Homogeneity of variance was also tested using Levene's test of equality of error variance in SPSS. The assumptions underpinning the use of the ANOVA were all met.

Correlational analysis.

The final step of analysis used the Pearson Product-Moment Correlation Test to measure correlations between two individual sets of data made by the same group of respondents within the same survey (Mertler & Charles, 2011). The Pearson correlation coefficient test, as it is more commonly called, specifically measures the linear relationship between two items of data collected through a Likert-type survey. The Pearson correlation coefficient test allows researchers to see how a response to one individual item compares to responses of a second individual item. The test reports this comparison by measuring the strength or weakness of the relationship in statistical form and is reported through the variable *r*. Results from the Pearson correlation coefficient range from -1.0 to 1.0. For the purposes of this thesis, the following table should be referenced for interpretation.

Table 3

Interpreting Strengths of Pearson Correlations

Value of the Correlation Coefficient	Strength of the Correlation
1	Perfect
0.75 – 0.99	Strong
0.5 – 0.74	Moderate
0.1 – 0.49	Weak
0	Zero

NOTE: from Dancey and Reidy, (2004)

Reading Pearson correlation coefficient test results begins by recognizing how SPSS reports the results. The following is a randomly created example of a reported Pearson correlation coefficient result: $r(79) = .679$, $p<0.001$. In this example, the first part of the statistic to explain is the *r*-value, $r(79) = .679$. In this case, the *r*-value is .679 and as the result falls between 0.5 and 0.74, it is considered a moderate strength correlation. The integer 79, or the *n*-value signifies the degrees of freedom and is representative of the number of data points used in the correlation, minus 2. The second part of the statistic is the *p*-value, which is similar to the ANOVA analysis and represents whether the data is statistically significant. If the *p*-value is less than 0.05, the relationship is statistically significant, suggesting that the correlation is not something that happened by chance; rather, it indicates a relationship under normal circumstances. Contrary, if the *p*-value is higher than 0.05, we can assume that the relationship is not statistically significant and the correlation reported may have happened by chance (Vogt,

2007). In the example provided, the *p*-value is <0.001, which tells us that the correlation is significant.

Interpreting the strength of the relationship between two variables is critical to understanding the two types of correlations produced by the Pearson correlation coefficient test, positive correlations and negative correlations. Positive correlations suggest that as one variable increases in value, the second variable will also increase in value. This would be the case when using the previous example where a moderate strength correlation of *r*= .679 was presented. An interpretation of this statistic represents a situation where the compared variables would both increase moderately in value if one of the variables involved increased. On the contrary, negative correlations suggest that as one variable increases in value, the other variable decreases. Essentially, with both positive and negative correlations, a change in one variable is accompanied by a change in value of the other variable in the measured relationship though the strength of potential changes is dependent on the strength of the correlation.

Whether positive or negative, the Pearson correlation coefficient test can indicate perfect, strong, moderate and weak and no relationships. *R*-values between -1.0 and 0.0 indicate negative correlations and *r*-values between 0.0 and 1.0 indicate positive correlations between two variables. Moderate correlations between -0.74 and -0.5 and 0.5 and 0.74 are not exactly the opposite of strong relationships, but suggest that there may or may not be correlation between two variables. For example, a correlation with a *r*-value of 0.5 is not as strong as an *r*-value of 0.740, though neither example indicates a strong relationship. Opposite to strong correlations are weak correlations that fall between -0.49 and 4.9. Close to zero, which would represent absolutely no correlation, weak

correlations suggest that changes in one variable are not closely related to changes in a second variable. While strong, moderate or weak correlations describe the relationships between variables, the *r*-value alone does not explain causation because the statistic does not take into account the reasons for the correlation.

Variables had to meet five assumptions in order to qualify for the Pearson coefficient test: (a) the variables had to fall under the categories of interval measurement or ratio measurements; (b) the variables in each item had to be distributed normally; (c) an obvious linear relationship had to exist between the two variables compared; (d) outliers had been removed from the data set and/or were kept to a minimum; and (e) homoscedasticity was present with the data. Homoscedasticity refers to all variances of means all being similar and grouped in an organized fashion around the regression line (Pearson, 1896). The variables reported in this thesis met all the assumptions.

Rationale for conducting the correlational analysis.

Testing for correlation was predicated on the literature reviewed, the theoretical framework presented and the research questions that bind all the elements together. As outlined previously, the literature suggested a variety of theories about why teachers use interactive whiteboards as designed while Activity Theory afforded a glimpse into the complexity of relationships that may influence Prince Edward Island high school teachers' uses of interactive whiteboards in the classroom. While these statements are straightforward, explaining the factors affecting teacher use of the interactive whiteboards is not as simple. The Pearson correlation coefficient provided an indication of how the independent variables (i.e., gender, years of teaching and self-assessment of computer skills) correlated with the dependent variables (i.e., perceptions of knowledge

and experience, beliefs towards interactive whiteboards uses, and beliefs towards training). Correlational analysis tested the relationships and generated a strong, moderate or weak positive or negative correlation indicating whether the variables were related. Depending on the result of the analysis, the researcher could attempt to explicate the reasons behind the result but that would be an analysis separate from the results provided by the Pearson correlation coefficient test.

The Pearson correlation coefficient test is also useful in examining the relationships between dependent variables. For example, the Pearson correlation coefficient test could provide evidence to see if participants responding at the high end of the beliefs about interactive whiteboards for one item would do so on other items. This type of result might be valuable when trying to assess reasons for or against interactive whiteboard use in a classroom. Conceivably, the Pearson correlation coefficient test can compare any relationship within the survey and regardless of the possibilities from the results of the ANOVA test, measuring commonalities between the results of different items within the construct of independent and dependent variables helps identify and strengthen any discussion and conclusion.

Overall, the Pearson correlation coefficient test gives us an idea of the strength of relationship between items. A hypothetical example of the relationship between the ANOVA test and the Pearson correlation coefficient test could look like this. If an ANOVA test measuring variances of means within a group of items returned a statistically significant difference, and a researcher wanted to further their understanding of the results, that researcher could then separate the variables within the measured groups, and compare item to item to see which pair of items measured strong, moderate

or weak together. The results of the Pearson correlation coefficient test would not explain the results of an ANOVA test, but it would allow the opportunity for further statistical analyses as required by the parameters of the research questions.

Data Analysis (Qualitative)

Following the quantitative analysis, the answers provided by teachers to the qualitative open response items, 10, 11, and 14, were compiled and analyzed for repeated words or themes using a process based upon Parsons and Brown (2002). This process included organizing the submitted quantitative data into descriptive information based upon the frequencies that key words or themes were mentioned. For example, if one teacher wrote that they used their interactive whiteboards so their students could *take* notes and another teacher said that they used their interactive whiteboard to *provide* notes to students, both of those activities could be grouped together as they subjectively represented similar activities with the interactive whiteboard. Once the tabulation of all the qualitative results was complete, the results were combined to assess the strength of each theme compared to the total amount of responses submitted for each item. It is important to note that many teachers did not provide any qualitative responses and as such, the numbers presented in this thesis are representative only of those who did. To guard against overgeneralizing, the findings and discussion are reported with a descriptive measure (raw score, percent) based upon the number of teachers who provided responses to the qualitative items (see tables 14, 15 and 16) and not the overall sample.

Chapter Summary

This chapter explained the steps taken to develop the survey that was used to gather information about the use of interactive whiteboards in Prince Edward Island high school classrooms by Island high school teachers. The research, which followed standards set out by the Research Ethics Board at the University of Prince Edward Island and the English Language School Board, began in November 2013. It used a quantitative approach to data collection and surveyed teachers using 24 Likert-type items. In addition, three open-ended qualitative data items allowed for teachers' expression of ideas and additional follow-up to Likert-type responses. The chapter also explored and justified the data analysis processes used to interpret the data collected. Data cleaning took place in the winter and spring of 2014. The following chapter discusses the results of the statistical analysis.

Chapter V: Findings

Descriptive Statistics

Forty-two male (47.7%) and 46 female teachers participated in the study for a total of 88 responses. The largest responding group (36.4%) of teachers indicated they had 16+ years of teaching experience. The years of experience for the teachers is summarized in Table 4. In terms of computer knowledge, there was a normal distribution of participants whereby few self-reported that they were at the low end of the scale (needed help) and few at the upper end of the scale (experts). The majority of participants (i.e., 47 or 53.4%) indicated they were comfortable with technology. See Table 4 for the distribution of teachers according to this independent variable. Given the few number of participants at the extreme ends of the knowledge scale, the scale was reduced to three points by combining knowledge levels one and two (i.e., required help and adequate) as well as levels four and five (i.e., power user and expert) for the inferential statistical analysis.

Table 4

Demographic Characteristics (Independent Variables)

	Males	**Females**			
Gender	42 (47.7)	46 (52.3)			
	0-5	**6-10**	**11-15**	**16+**	
Teaching Experience	19 (21.6)	18 (20.5)	19 (21.6)	32 (36.4)	
	Required Help	**Adequate**	**Comfortable**	**Power User**	**Expert**
Computer Knowledge/Skills	2 (2.3)	21 (23.7)	47 (53.4)	16 (18.2)	2 (2.3)

Note: frequency is reported in terms of raw score and percent in parenthesis

The sample of teachers can also be described in terms of their general computer training. Almost all teachers (i.e., 83 or 94.3%) reported that they had no formal technical computer training outside of what they had received as an employee of the English Language School Board. Similarly 86 teachers, or 97.7%, reported no formal training in regard to theoretical knowledge about computer systems. The two teachers (2.3%) who indicated that they did have more specialized training in computer theory obtained it through computer science courses at the undergraduate level, specific training sessions through the Department of Education, certification courses with Microsoft and Novell and a Masters of Education in Learning and Technology. The two teachers who answered in this manner indicated that their technical training took place in the 1970's and in 1995.

Items six and seven inquired about interactive whiteboard training. Close to half of all responding teachers (i.e., 39 or 44.3%) claimed to have had some form of interactive whiteboard training since 2010; however, only 11 or 12.5% indicated that this training was specific to their teaching assignment. Explanations offered through qualitative responses by teachers focused on where and when training took place. Regarding item 6, the majority of those who had received training indicated that it was received through the Department of Education and from colleagues at their respective schools during the school day. The 12.5% who indicated they received interactive whiteboard training specific to their teaching assignments received it through an average of one to five hours worth of training offered via in-school professional development sessions or informally during afterschool training sessions. The only teaching subject mentioned in the qualitative responses was mathematics, mentioned by three out of the 88 teachers. No other areas of specialization (i.e., teaching subjects) were mentioned.

In sum, approximately half of the teachers indicated they received general training on interactive whiteboard use but most did not have specific training on how, for example, to effectively utilize an interactive whiteboard in language arts or science classrooms. The impact of interactive whiteboard training for the majority of teachers (56%) is noted for further inquiry in the analysis below.

With respect to items 9a to 9i regarding teachers' frequency of activities using the interactive whiteboard, there was a trend toward teachers having their interactive whiteboards turned on, but the manners in which teachers chose to use their devices, varied from largely non-interactive practices to minimal opportunities where students were being asked to use the interactive whiteboard. Responses to item 9a (M=3.44,

SD=1.710), showed that 76 (89.6%) of teachers said they used their interactive whiteboards in their classrooms to create interactive lessons with interactive whiteboards at one time or another (see Appendix C), albeit at various frequencies over time.

Supporting this claim is data from items 9b, 9c and 9d. Item 9b (*M*=1.80, *SD*=1.497), asked teachers if they projected images (e.g., assignments, notes, pictures, games, websites) onto the interactive whiteboards. In response to this item, 52 (65.8%) of teachers answered that this type of non-interactive practice happened on a daily basis in their classroom and another 15 (18.9%) said that this happened every other day. Regarding item 9c (*M*=2.43, *SD*=1.824), which asked teachers how often they transitioned through slides in a slideshow using the interactive whiteboard, 53 (67.1%) of teachers said that this practice happened daily or every other day. Finally, similar to situations in which a static image was projected onto the interactive whiteboard, item 9d (*M*=2.70, SD=1.667), asked teachers about how often they navigated through websites using their interactive whiteboards instead of using a mouse while students watched from their seats. Combined, 73.3% of teachers (n = 58) said that this happened daily, every other day or once a week. On the contrary item 9e (*M*=3.80, *SD*=1.471) was posed to teachers to understand how frequently they asked their students to the interactive whiteboard. Despite the possibility for teachers to practice multiple strategies in their classroom, only 4 (5%) of Prince Edward Island high school teachers said that they had students up at the interactive whiteboard on a daily basis. Second, only 16 (20.2%), of teachers said that they had students up at the interactive whiteboard every other day. Without fully understanding if these results meant teachers had students copy notes from the projection, item 9f (*M*=2.85, *SD*=1.802), asked teachers if they presented notes on the

interactive whiteboard that students were required to copy. Of the teachers who responded to this question, 45 (58.8%) said this happened daily or every other day in their classrooms.

Regarding the dimensions of the construct, items 8a, 8b, 8c 8d and 8e (see Appendix C) all questioned teachers about their understanding of what the term "interactivity" meant from a theoretical standpoint and a classroom practices standpoint and was focused on the beliefs toward interactive whiteboard dimension. In general, teachers believed that they had an understanding of what the term "interactivity" meant from a theoretical standpoint and from a classroom practices perspective. Specifically, item 8a asked teachers if they understood what the term "interactivity in a classroom" meant. 97.9% (M=1.74, SD=0.495) of teachers said that they strongly agreed or agreed with this statement. Secondly, item 8b asked if teachers understood the interactive capabilities of the interactive whiteboard in their classroom. 88.2% (M=1.91, SD=0.566) of teachers said that they strongly agreed or agreed to this statement. Item 8c asked teachers about their comfort level in presenting interactive lessons with their interactive whiteboard. 63.4% (M=2.27, SD=0.816) of teachers said that they strongly agreed of agreed to being comfortable with the interactive whiteboard in their classroom. The responses to item 8d were also aligned with the results of 8a, 8b and 8c, in that the results suggested that teachers believed in their understandings of the term "interactivity", but whereas the responses to items 8a, 8b and 8c were all answered positively, the responses provided to item 8d were at the opposite end of the interval scale. Instead of positively agreeing with the statement, 72.3% (M=2.86, SD=0.823) of teachers said that they *disagreed* or *strongly disagreed* with the statement thus suggesting that the interactive

whiteboard was a tool that enabled them to function differently in the classroom, while only 27.4% of teachers said that they strongly agreed or agreed to this statement. Finally, item 8e asked teachers if they were familiar with Smart Notebook software or alternative interactive whiteboard software. Seventy-nine point four percent (*M*=2, *SD*=0.721) of teachers strongly agreed or agreed with this statement.

Items 12a, 12b, 12c 12d and 12e (see Appendix C) all questioned teachers about their views toward interactive whiteboards and is listed as the second dimension in the construct map. The results for this dimension were mixed and cannot be described as being generally positive or negative as a whole as the results varied in strength between items. At the outset was item 12a, which asked teachers if they felt comfortable teaching colleagues about the interactive whiteboard. This item resulted in 50.2% of teachers (*M*=2.5, *SD*=0.864) either strongly agreeing or agreeing with the statement. However, immediately following that result, when asked in item 12b if too much money was spent on interactive whiteboard technology, was 64 teachers (72.7%) disagreed or strongly disagreed with the statement. Next, item 12c (*M*=3.14, *SD*=0.756), asked teachers if they thought interactive whiteboards were a good thing, but they were just too busy to find time to learn more about them. In response to this item, 58.8% (*M*=2.36, *SD*=0.888), of teachers agreed or strongly agreed with the statement. Next, item 12d asked teachers if the interactive whiteboard could enhance student learning experiences. Overwhelmingly 91.8% teachers responded by saying that they strongly agreed or agreed to that statement. Finally item 12e asked teachers if thought interactive whiteboards were just another gadget in the classroom. In response to this statement 76% of teachers (*M*=2.97, *SD*=0.076), disagreed or strongly disagreed to the statement.

Items 13a to 13c asked teachers about their views toward training on the interactive whiteboards and was developed around the third dimension. Item 13a asked teachers if they thought that their training was sufficient to allow them to use the interactive whiteboard as an interactive tool in their classroom. Only 36.5% (M=2.69, SD=0.775) of teachers said that they strongly agreed or agreed with this statement while 63.5% of teachers disagreed with the statement. Consistent with what may be a negative attitude towards their previous training, item 13b asked teachers if they would attend an afterschool training sessions and over half of all responses at 58% (M=2.18, SD=0.762), either agreed or strongly agreed to further training as described. Continuing with the idea of more training, item 13c asked teachers specifically if more basic training would improve their use of the interactive whiteboard in the classroom. With respect to item 13c, 74.9% (M=2.11, SD=0.781) of respondents strongly agreed or agreed with the statement, suggesting that they needed more training on their interactive whiteboards. Item 13d inquired further about training by asking teachers if more curriculum specific training was required on the interactive whiteboard. Consistent with the results of item 13c, 71.2% (M=1.76 SD=0.714) of respondents said that they wanted more curriculum specific training on their interactive whiteboard.

Inferential Analysis

Inferential analysis examined relationships between the independent and dependent variables to determine whether there were variations between the means of groups compared. Three separate ANOVA were conducted to examine these relationships.

Perceptions of knowledge and experience.

The mean scores on the knowledge and experience scale for gender (males and females) were almost identical (i.e., M_m=1.97, *SD*=0.46 and M_f=2.04, *SD*=0.48). As such it was not surprising that the ANOVA, (*F*(1, 71)=.394, *p*=0.532) was not statistically significant. Similarly, the mean scores did not differ significantly when comparing years of teaching experience on this dimension of interactive whiteboards. The mean scores are highlighted in Table 5 below.

Table 5

Means of the knowledge and experience scaled grouped by years teaching

Group	Mean	SD
0-5	2.23	0.46
6-10	1.93	0.45
11-15	2.05	0.53
16+	2.01	0.47

Regarding the comparison between teachers' self-reported levels of computer knowledge/skills and perceptions of knowledge and experience, Table 6 shows teachers' responses on this subscale ranged from a mean of 1.7 (*SD* = 0.44) for Experts (reporting they are very knowledgeable or experienced), to a mean of 2.2 (*SD* = 0.50) (indicating they are less knowledgeable or experienced) for teachers who described themselves as beginning computer users. A statistically significant difference was found on this subscale and the degree of computer expertise (*F*(2, 70)=4.256, *p*=0.018). A post hoc analysis indicated the difference was between those who rated themselves as very knowledgeable/experienced and those who reported being inexperienced or beginners. To

determine whether this significant difference had any practical significance, the effect size was calculated using eta squared. The large effect ($\eta^2 = 0.11$) indicated this statistically significant difference has practical significance, which is interesting considering the literature suggested that teachers, despite them being generally knowledgeable with technology, underperform when faced with specific devices in classrooms for specific tasks, (Angeli & Valanides, 2009). The result suggests that knowledgeable/experienced teachers differ in their approaches to using technology in classrooms from that of inexperienced or beginner teachers.

Table 6

Means of the knowledge and experience scaled grouped by self-assessment

Group	Mean	SD
Expert/Power User	1.72	0.44
Skilled User	2.01	0.44
Need Help/More than a Beginner	2.20	0.50

Beliefs towards interactive whiteboards.

The mean scores on the beliefs towards interactive whiteboards scale for (gender) males and females were spread sufficiently enough to generate a statistically significant difference ($F(1, 69)=4.640$, $p=0.035$), $M_m=2.01$, $SD=0.56$; $M_f=2.26$, $SD=0.43$. Given the small difference in mean scores between males and females it is not likely that the difference had any practical significance and the calculation of effect size ($\eta^2 = 0.06$) confirmed this suspicion.

An examination of the mean scores for this scale grouped by teaching experience is shown in Table 7. Again, the small difference between mean scores suggested there would be no significant difference between groups and the ANOVA confirmed it.

Table 7

Means of the beliefs towards interactive whiteboards scaled grouped by years teaching

Group	Mean	SD
0-5	2.42	0.52
6-10	2.09	0.44
11-15	2.12	0.55
16+	2.08	0.49

The last comparison in the subscale compared interactive whiteboard beliefs with the level of self-reported computer experience. Table 8 summarizes the mean scores and standard deviations for this comparison. Even though there appeared to be more spread between mean scores than in previous comparisons, the variance was not statistically significant.

Table 8

Means of the beliefs about interactive whiteboards scaled grouped by self-assessment

Group	Mean	SD
Expert/Power User	1.89	0.58
Skilled User	2.18	0.38
Need Help/More than a Beginner	2.27	0.64

Views towards training.

The mean scores on the training scale for (gender) males and females were almost identical (i.e., M_m=2.1, SD=0.437 and M_f=2.0, SD=0.603). As such it was not surprising that the ANOVA was not statistically significant.

The mean scores on the training scale grouped by years teaching experience are shown in the table below. Given the small differences between mean scores on this scale, most likely due to the fact that training had only begun and continued for the past three years, there was also no statistically significant difference between the groups.

Table 9

Means of the more training scaled grouped by years teaching

Group	Mean	SD
0-5	2.13	0.77
6-10	2.07	0.56
11-15	1.91	0.47
16+	2.04	0.53

Lastly, Table 10 summarizes the mean scores for comparison between teachers' self-reported rating of their computer knowledge/skill and views towards training on the interactive whiteboard. As shown, those who described themselves at the beginning of the knowledge/skill development are much lower on this dimension than those who describe themselves at the opposite end of the scale. A statistically significant difference was found on this subscale and the degree of computer expertise (F(2, 67)=3.570, p=0.034). A post hoc analysis indicated the difference was between those who rated themselves as very knowledgeable/experienced and those who reported being

inexperienced or beginners. To determine whether this finding had any practical significance, the effect size was calculated using eta squared. The medium effect (η^2 = 0.10) indicated this statistically significant difference has practical significance, which is interesting considering again that the literature suggested that despite being knowledgeable with technology, teachers underperformed in classrooms when using specific technologies (Angeli & Valanides, 2009). This suggests that a difference does exist between how experienced/knowledgeable teachers and inexperienced/beginner teachers operate in a classroom.

Table 10

Means of the more training scaled grouped by self-assessment

Group	Mean	SD
Power User/ Expert	2.23	0.40
Skilled User	2.09	0.55
Need Help/More than a Beginner	1.78	0.49

Correlation Analysis

This report on correlational analysis is divided into two sections. The first section reports on the results of the Pearson correlation coefficient test used to measure for correlations between the responses for two independent scaled variables, years teaching experience and the self-assessment of computer and technology knowledge. The second section reports on correlations using items from the dependent variables. This exploration of relationships between items could identify patterns in responses that would contribute to the overall findings. Perfect correlations measuring 1.0 were not expected. For all correlations, only those results that are categorized as moderate to strong or -1.0 and -0.5

and 0.5 and 1.0 will be reported. Weak correlations will not be presented, although some will be included in the discussion based upon their necessity to support arguments in the following chapter.

Independent Variables

The Pearson correlation coefficient test was used to measure relationships between sets of independent variables. When comparing self-assessment and teaching experience, there were no Pearson correlation coefficient results that require reporting. There were no correlations using the independent variable gender as ordinal data showing rank and order or continuous data was not present within the limits of the variable.

Dependent Variables

In this section, the Pearson correlation coefficient test measured correlations within each dimension and between items from the three dimensions, (a) knowledge and experience (b) beliefs towards interactive whiteboards and (c) views towards training. Overall there were 961 correlations run through SPSS and only 38 that measured above 0.5 and as such are recognized as moderate or strong correlations. Correlations within items in the knowledge and experience dimension resulted in the largest amount of correlations above 0.5 with 26 correlations. The second largest group of correlations was between items from the knowledge and experience dimension and the items in the beliefs towards interactive whiteboards dimension. This group had nine correlations above 0.5. The third group of correlations came from measurements between items within the views towards interactive whiteboards dimension and saw three correlations above 0.5 produced. As well, one correlation measured above 0.5 between items within the beliefs about interactive whiteboards dimension.

Qualitative Analysis

This section summarizes the frequency of terms and themes teachers provided in qualitative open responses throughout the survey. As a reminder, the raw numbers do not reflect the entire sample of teachers, but solely those who provided qualitative responses. The percentages shown in this section reflect calculations based upon the total number of responses received in the qualitative open response items. Item 10 (Describe what interactivity means to you), item 11 (If you indicated you use interactivity whiteboards in your lessons, describe your lessons), and item 14 (This last section is reserved for you to tell us about any other interactive whiteboard experience that might help us researching its use in PEI schools) were open response items. The results are as follows.

In total there were 63 responses collected for item 10. Most teachers (35, 55.5%) indicated that interactivity meant student engagement while the second most commonly noted meaning was summarized as involving students with interactive whiteboards (12, 19.0%). It is important to note that there was no indication whether student engagement represented engagement at the interactive whiteboard or with the interactive whiteboard as the focal point. If the response stated interactive whiteboard, it was recorded separately from student engagement.

Table 11

Item 10 – Describe what interactivity means to you.

Response	Frequency (Percent)
Student engagement	35 (55.5)
Students at interactive whiteboards	12 (19)
Hands on Assignments	8 (12.7)
Accessing Software	6 (9.5)
Playing	1 (1.5)
Labeling	1 (1.5)

Item 11 delved further into the interactive practices of teachers who completed the survey. The item asked teachers to describe their lessons with the interactive whiteboards. In total, 95 responses were collected for item 11. Based on teachers' comments, there appeared to be a mix of pedagogical and administrative practices such as advancing slides in a PowerPoint presentation, navigating a website, and accessing learning videos. Table 12 displays a complete list of the types of activities teachers reported doing with their interactive whiteboards.

Table 12

Item 11 – If you indicated that you use the interactive whiteboard in your lessons, please describe your lesson with the interactive whiteboard.

Activity	Frequency (Percent)
Advancing teacher slides	23 (24.2)
Teachers navigating Websites	13 (13.7)
Teachers accessing learning videos	12 (12.6)
Using Notebook Software	10 (10.5)
Students at the Interactive Whiteboard	9 (9.5)
Classroom Management	7 (7.4)
Using Apps or playing Games	6 (7.4)
Enhancing Subject	5 (5.3)
Graphics	5 (5.3)
Clickers	3 (3.1)
Student Presentations	2 (2.1)

Item 14, the last open response question in the survey, provided the opportunity for teachers to add any type of comment they felt was relevant to the study. Twenty-eight responses were provided by teachers, which indicates that many teachers did not respond to the opportunity to share ideas, as there were only 88 teachers who completed the survey. Within the 28 responses, many teachers shared multiple stories with respect to interactive whiteboard experiences. These multi-variable responses were then broken down into ideas that were very similar to each other and as a result, the results of item 14

were measured and are presented together as themes. The most common theme reported by teachers centered on the need for more interactive whiteboard training (10 times it was mentioned or present in 24% of total responses). However, this result was tempered by the seven responses from teachers (17%) who said thematically the use of interactive whiteboards seemed to be acceptable as is in their classrooms. Table 13 summarizes the combined themes found in teachers' responses.

Table 13

Item 14 – Anything you would like to add to help us understand interactive whiteboard use on Prince Edward Island?

Response	Frequency (Percent)
More training is required	10 (24.4)
Everything is perfect as is	7 (17.1)
I would explore more	5 (12.2)
I am self-taught	4 (9.8)
There is a tough learning curve	3 (7.3)
Time issues are a factor	3 (7.3)
Nothing works	3 (7.3)
It's used non-interactively	2 (4.9)
I use alternatives to this	2 (4.9)
It is an interactive tool	1 (2.4)
It needs polishing	1

Chapter Summary

This chapter presented the quantitative and qualitative statistical analysis based on the data that was collected following a survey of Prince Edward Island high school teachers on their use of interactive whiteboards in their classrooms. Findings were presented according to descriptive statistical procedures followed by inferential statistical findings from the ANOVA including the post-hoc tests (where needed). Findings from correlational analysis completed using the Pearson correlation coefficient test were also presented. Finally, the frequencies and percentages of the qualitative open responses items were presented. Only those results that merited reporting according to the statistical guidelines set out by Pearson (1896), Levine and Hullet (2002), Parsons and Brown, (2002) and Dancey and Reidy (2004) were presented. These results will be discussed in the following chapter.

Chapter VI: Discussion of the Research Findings

This chapter discusses results of the survey completed by high school teachers on Prince Edward Island in the fall of 2013. The survey (see Appendix C) focused on how teachers used interactive whiteboards installed in their classrooms by the Government of Prince Edward Island in 2010. Completed by 88 teachers, the survey was designed after review of the available literature which revealed that teachers from different countries do not use interactive whiteboards as interactive devices for a variety of reasons such as self-efficacy and a lack of professional development planning and implementation.

Recalling the consolidated definition of interactivity, Cutrim Schmid (2008) and Betcher and Lee (2009) said that part of the process of using interactive strategies and interactive whiteboards effectively in the classroom required students to be at the interactive whiteboard board using them. Cutrim Schmid (2008), and Betcher and Lee (2009) further indicated that learning with interactive whiteboards needed to be designed with tactile strategies in place that had students working through problems and developing learning skills while operating the interactive whiteboard. Not to be forgotten though, Solvie (2007) and Haldane (2009) said that any work completed at the interactive whiteboard, regardless of the strategy used by teachers had to be focused on the content of the lesson and the curriculum outcomes. In short, students have to be physically and intellectually engaged through meaningful tasks that allow them to build knowledge as opposed to following a preordained learning path created by the teacher. Teachers who plan lessons with the interactive whiteboard that embody this multidimensional role may expect to see an improvement in academic scores for their students (Marzano & Haystead, 2009, 2010). According to this logic, use of an interactive whiteboard,

designed to enable learning through interaction between teachers, students, and content can lead to improvements in academic achievement for students. What follows in this chapter is a discussion of the results of the survey presented in line with each of the research questions. As a reminder, the research questions were:

1. To what extent are interactive whiteboards being used in Prince Edward Island high schools as *designed*?
2. What factors lead to the use or non-use of interactive whiteboards as *designed*?

Research Question 1 – To what extent are Interactive Whiteboards being used in Prince Edward Island high school as designed?

The response to the first research question is that the majority of Prince Edward Island high school teachers admitted to using their interactive whiteboards in their classrooms; however, the pedagogical practices of the teachers who were using interactive whiteboards in their classrooms did not permit students to have direct interactive experiences with the devices. Thus the interactive whiteboards were not being used to their full potential as interactive devices as designed.

Items 9a – 9f which asked teachers about their practices with interactive whiteboards in the classroom on a frequency scale of daily, every other day, once a week, once every two weeks, seldom and never, support this interpretation. The data provided insight into teachers' activities with respect to how they used their interactive whiteboards, and as such warrant exploration. To begin the exploration, the overall response to item 9a (M=3.44, SD=1.710), showed that 76 (89.6%) of teachers said they used their interactive whiteboards in their classrooms to create interactive lessons with interactive whiteboards at one time or another (see Appendix C), albeit at various

frequencies. This combined percentage suggests that teachers believed that they used their interactive whiteboard in Prince Edward Island high school classrooms interactively. However, the responses from items 9b to 9f that asked teachers about specific activities that occurred in their classroom with interactive whiteboards suggest that the majority of practices used by teachers were *non-interactive* within the context of the framework as presented in chapters one and two.

For example, item 9b (*M*=1.80, *SD*=1.497), asked teachers if they projected images (e.g., assignments, notes, pictures, games, websites) onto the interactive whiteboards. In response to this item, 52 (65.8%) of teachers answered that this type of non-interactive practice happened on a daily basis in their classroom and another 15 (18.9%) said that this happened every other day. Without fully understanding if this result meant teachers had students copy notes from the projection, item 9f (*M*=2.85, *SD*=1.802), asked teachers if they presented notes on the interactive whiteboard that students were required to copy. Of the teachers who responded to item 9f, 45 (58.8%) said this happened daily or every other day. Another example of teachers using their interactive whiteboards in a non-interactive manner comes from item 9c (*M*=2.43, SD=1.824), where teachers were asked how often they transitioned through slides in a slideshow using the interactive whiteboard. Fifty-three (67.1%) of teachers said that this activity happened daily or every other day. Continuing with this the theme of static images being projected onto the interactive whiteboard, item 9d (*M*=2.70, *SD*=1.667), asked teachers about how often they navigated through websites using their interactive whiteboards instead of using a mouse while students watched from their seats.

Combined, 73.3% of teachers (n = 58) said that this happened daily, every other day or once a week.

Though these statistics suggest that a large number of teachers were practicing non-interactive strategies, the statistics did not capture how often the actual activities occurred within a class. For example, teachers may have had students copying notes every day or every other day and answered as such to the survey, but they could also have had students at the board exploring and directing their own learning as suggested by the consolidated definition throughout an 80-minute class. In light of this possibility, item 9e (*M*=3.80, *SD*=1.471), was posed to teachers to understand how frequently they asked their students to the interactive whiteboard. Despite the possibility of teachers practicing multiple strategies, only 4 (5%) teachers said that they had students up and out of their seats working at the interactive whiteboard on a daily basis. Second, only 16 (20.2%), of Prince Edward Island high school teachers said that they had students up and out of their seats working at the interactive whiteboard every other day.

What also bolsters this claim are the results from item 9h (*M*=3.86, *SD*=1.752), which asked teachers if they used Smart Notebook software, or an alternative interactive whiteboard software in their classrooms. Provided directly from Smart Technologies, the Smart Notebook software is designed to enable and foster interactive opportunities in the classroom, yet only 23.8% of Prince Edward Island teachers said that they used the proprietary software daily or every other day.

These results suggest that although they are being used, the interactive whiteboards in Prince Edward Island high school classrooms are being used heavily as teacher-centered tools and within the context of Activity Theory, the teacher is using the

interactive whiteboard to teach lessons but students are not at the interactive whiteboard exploring and discovering at their own pace. These results also suggest that students are relegated to watching and/or learning from the teacher who retains control of the interactive whiteboard during the lesson, effectively illustrating a contradiction between what teachers believe about their practices and what they understand about interactivity. Generally speaking, these results call into question the perceptions of the 89.6% of Prince Edward Island high school teachers who reported through the options available in item 9a (M=3.44, SD=1.710), that they used interactive whiteboards to create interactive learning in their classroom. This analysis suggests that, the students are rarely getting an opportunity to be at the interactive whiteboard in most cases, and are therefore less likely to be learning or seeing academic improvement from an interactive environment (i.e., as espoused by Marzano & Haystead, 2009, 2010) that would result if interactive whiteboards were being used as designed.

However, contrary to the claims by Marzano and Haystead, (2009, 2010) using the typology of Moore (1989) in this case, it is possible to suggest that despite not having students at the interactive whiteboard working, interaction was still happening in classrooms on Prince Edward Island but on the instructor-learner level and also possibly at the learner-learner level and the learner content level. Throughout classroom experiences, many relationships are formed and students have opportunities to collaborate with teachers and peers on the evolution of the lesson but not to the extent that their experiences represent the interactive whiteboard being a significant catalyst for a change in academic achievement. As mentioned previously, the decision to use an interactive whiteboard as designed, can be influenced by many factors.

Nonetheless, despite acknowledging that interaction can happen in many different ways, the data emerging from Pearson correlation coefficient tests between items 9a to 9h supports the claim that teachers were associating non-interactive practices with their beliefs that they were creating interactive learning opportunities in the classrooms.

As a reminder, positive correlations suggest that as one variable increases in value, the second variable will also increase in value while negative correlations suggest that as one variable increases in value, the other variable decreases. Further, although discussion of correlations is permissible, the Pearson correlation coefficient test does not assign reasons or causes behind correlational evidence. It is also important to recall that items in the instrument were designed to examine how teachers thought about the specific contexts and the frequency to which they engaged in particular interactive whiteboard practices with the interactive whiteboard (Kennewell & Beauchamp, 2007), thereby steering their thoughts and decisions away from over-generalizing and allowing for a focused response to the specific question at hand.

As with the reporting of the demographic statistics, this section will begin with the presentation of analysis using items 9a, 9g and 9h, which asked teachers about their frequency with respect to interactive strategies in the classroom, but not specific activities with their interactive whiteboards using onto Pearson coefficients correlations between items 9a, 9g, and 9h. The first Pearson coefficient correlation measured teachers' responses to items 9g and 9h, which asked teachers if they (9g) created interactive lessons for their students, and (9h) created interactive lessons using Smart Notebook software. Between item 9g and item 9h, a strong positive correlation of $r(78) = .854$, $p<0.001$ was reported.

The second and third correlation between items 9a, 9g, and 9i, were very similar in strength. Item 9g which asked teachers if they (9g) created interactive lessons for their students and (9a) used the interactive whiteboard to create interactive learning opportunities produced a strong positive correlation of $r(77) = .777$, $p<0.001$ while the Pearson coefficient correlation between items 9a and 9h, which asked teachers if (9a) they used the interactive whiteboard to create interactive learning opportunities and (9h), they created interactive lessons using Smart Notebook software resulted in $r(78) = .773$, $p<0.00\ 1$

As the correlations are strong, there is an indication that teachers were responding positively to all three items presented to them in the instrument and suggests that teachers are thinking in similar fashions when considering the frequency of their interactive whiteboard use in the classroom (See Appendix C). None of these correlations were surprises considering that teachers answered positively to all three items. Further, as these relationships were also expected, and in conjunction with the other two correlations, there is a clear demonstration of the strength of the scale between the responses in the group of items.

However, when the beliefs of teachers, as questioned in items 9a, 9g, and 9h were correlated with items 9b, 9c, 9d and 9f (see Appendix C) that measured specific practices with the interactive whiteboards in classrooms, the results suggested that teachers were not using their interactive whiteboards in manners that promoted interactivity by way of having students at the interactive whiteboards exploring and discovering.

Using items 9b, 9c, 9d, and 9f provides the first indication that suggests that teachers' practices and their beliefs are not what is to be expected from a classroom were

interactivity is created through the use of an interactive whiteboard. Interactivity using the interactive whiteboard required the space at the interactive whiteboard to be shared by students and teachers. The results of these four items rather suggest that teachers are using their interactive whiteboards heavily as a projector for images. Projecting images could perhaps develop into discussions and alternative learning through other forms of interaction, but as far as using an interactive whiteboard to develop interaction among students, it does not seem to be occurring in Prince Edward Island high schools within the context of the theoretical framework.

Looking at these items, which asked teachers about projections on the interactive whiteboard images, overwhelmingly demonstrated that their responses are positive on the Likert-type scale and suggest that teachers are firm believers in projecting images for students to look at. How these exercises match up in correlations with beliefs of teachers in items 9a, 9g, and 9h is interesting because they imply that positive relationships exist between what teachers believe is interactive while using the interactive whiteboard and the non-interactive strategies that they are actually using. This is not a bad thing as it shows that teachers believe in their practices and that is important, though it does suggest that their beliefs and practices contradict each other. This submission suggests that teachers may be misinterpreting their practices as being interactive. If teachers believe that presenting images on interactive whiteboards is an example of an interactive lesson, then these correlations make sense. However, as submitted earlier through the contextual examples provided in chapters one and two, having students at the interactive whiteboard is necessary to create interactive lessons using the interactive whiteboard and these

results, based upon that assumption, are indicative of teachers being up at the interactive whiteboard as opposed to students.

A Pearson correlation coefficient was computed to assess the relationship between item 9b (M=1.80, SD=1.497), which asked about the frequency of a teacher projecting images and item 9a (M=3.94, SD=1.710), which asked whether the teacher believed they used the interactive whiteboard to create interactive learning opportunities in their classroom. Between these two variables, there was a positive correlation of $r(79) = .495$, $p<0.001$. A second correlation was computed between item 9b, which asked about the frequency of a teacher projecting images and item 9g (M=3.53, SD=1.688), which asked whether the teacher believed that they created interactive lessons. Between these two variables, there was also a positive correlation of $r(78) = .466$, $p<0.001$. Finally, a third correlation coefficient was computed to assess the relationship between item 9b which asked about the frequency of a teacher projecting images and item 9h (M=3.86, SD=1.752), which asked whether the teacher created interactive lessons with Smart notebook software. Again a positive correlation of $r(79) = .449$, $p<0.001$ resulted.

Simply using an interactive whiteboard to transition through websites while students watch from their desks is another example of a non-interactive practice because students are not the ones at the interactive whiteboard and consequently have little or no control of the interactive whiteboard. This penchant of teachers not using their interactive whiteboards as tools to develop the kinds of interactivity discussed in chapter one and two is also demonstrated by the correlations between item 9d and items 9a, 9g, and 9h. Similar to situations in which a static image was projected onto the interactive whiteboard, item 9d (M=2.70, SD=1.667) asked teachers about how often they navigated

through websites using their interactive whiteboards instead of using a mouse while students watched from their seats. Combined, 73.3% of teachers (n = 58) said that this happened daily, every other day or once a week. Correlating item 9d, which asked teachers about how often they navigated through websites using their interactive whiteboards instead of using a mouse while students watched from their seats with item 9a, which asked whether the teacher believed they use the interactive whiteboard to create interactive learning opportunities in their classroom determined a positive correlation of $r(78) = .497$, $p<0.001$ which can be rounded up to $r=.50$ which is equivalent to a moderate correlation. A second correlation to assess the relationship between item 9d which asked teachers about how often they navigated through websites using their interactive whiteboards instead of using a mouse while students watched from their seats and item 9g, which asked whether the teacher believed that they created interactive lessons also resulted in a moderate correlation of $r(78) = .538$, $p<0.001$. Finally, a correlation coefficient to assess the relationship between item 9d which asked teachers about how often they navigated through websites using their interactive whiteboards instead of using a mouse while students watched from their seats and item 9h which asked whether the teacher created interactive lessons with Smart notebook software resulted in a moderate correlation of $r(79) = .512$, $p<0.001$.

At this point, it is becoming clearer by way of the descriptive data and the correlational analysis that teachers are not using their interactive whiteboards as interactive devices despite claims that they believe they are creating interactive learning opportunities. To bring together thematically all examples of what is happening in Prince Edward Island high schools is difficult but possible considering that the examples used in

the analysis thus far all consist of links between non-interactive practices fueling interactive beliefs and understandings and /or vice versa. Teachers are definitely associating activities and thoughts which in the context of the available literature and Activity Theory should not go together if interactive programming is the goal in classrooms.

Yet, at this point in the discussion, the evidence shifts in another direction for a moment. Given the consistency of data already presented in this discussion, it would be logical to expect that correlations between item 9f (M=2.85, SD=1.802) and items 9a, 9g, and 9h would result in similar moderate coefficients by virtue of teachers misinterpreting their non-interactive practices with beliefs about interactive whiteboard use. However, unlike the previous series of correlations which settled in the moderate category or just below, correlations between items 9f and items 9a, 9g, and 9h resulted in weak correlations and suggest that teachers were less likely to associate the activity of note-taking using the interactive whiteboard as a projection screen with beliefs about their uses with the interactive whiteboard. While the results may not be r=0 or negative, being weaker than other correlations already submitted is a step in a direction which is more desired when comparing non-interactive practices at the interactive whiteboard with beliefs about how teachers created interactive lessons.

Between item 9f, which asked teachers if they used the interactive whiteboard to present notes to students which they have to copy, and item 9a, which asked teachers used their interactive whiteboards to create interactive learning opportunities, there was a weak positive correlation of $r(77) = .246$, $p<0.031$. A second correlation between item 9f, which asked teachers if they used the interactive whiteboard to present notes to

students which they have to copy and item 9g, which asked whether the teacher believed that they created interactive lessons resulted in another weak correlation between of $r(77) = .302$, $p<0.008$. Finally, when item 9f, which asked teachers if they used the interactive whiteboard to present notes to students which they have to copy, was compared to item 9h, which asked whether the teacher created interactive lessons with Smart notebook software, a third weak correlation resulted of $r(78) = .340$, $p<0.002$. While these situations offer the possibility for interaction at the instructor-learner level and the learner-content level, this result, where teachers were not equating note taking with interactive practices is an encouraging observation in light of the framework presented in chapters one and two.

Overall, though, these correlations show a definite statistical disjuncture between what teachers believe they are doing with respect to interactivity and the pedagogical strategies they actually use with interactive whiteboards. For the relationship between teachers' beliefs and strategies to develop into strong interactive lessons with the interactive whiteboard, teachers would have to develop such things as increased opportunities for students being at the interactive whiteboards while limiting the time they themselves spend there. That being said, students and teachers need to share the interactive whiteboard (Cutrim Schmid, 2008), and measurements concerning the frequency of calling students in class to the interactive whiteboard are important.

With only 4 (5%) of Prince Edward Island high school teachers saying that they had students up at the interactive whiteboard on a daily basis, and only 16 (20.2%) saying that they had students up at the interactive whiteboard every other day, correlations using item 9e ($M=3.80$, $SD=1.471$), with items 9a, 9g, and 9h should have resulted in strong

positive correlations because students being physically up at the interactive whiteboard is one characteristic of the organized framework for interactivity with the interactive whiteboard as presented in chapter one and two. However, moderate correlations were reported when comparing item 9e with items 9a, 9g, and 9h. While this is not necessarily bad as it suggests that teachers understand the relationship between student participation at the interactive whiteboard and the premise of interactivity, if teachers really understood the role of the potential of direct physical interaction with the interactive whiteboard by students, the results would be a stronger positive correlation.

The correlation between item 9e, and item 9a resulted in a moderate positive correlation between the two variables of $r(78) = .603$, $p<0.001$. A second correlation, this time between item 9e and item 9g, also showed a moderate positive correlation of $r(79) = .595$, $p<0.001$. Finally, correlating item 9e with item 9h, resulted in a moderate positive correlation of $r(79) = .571$, $p<0.001$.

To summarize, teachers are using their interactive whiteboards as non-interactive devices despite the collective understanding and belief that they are creating interactive lessons for their students. In addition, what is known from the literature and from using Activity Theory is that the activities and strategies involved in teaching curriculum with the interactive whiteboard must include opportunities for students to be at the interactive whiteboard exploring and discovering if the academic improvement expectations presented by Marzano and Haystead (2009, 2010) are to be realized. These types of student-centered practices were not happening at the time of data collection on Prince Edward Island.

Open Responses

Evidence that teachers were not using their interactive whiteboards as designed based upon the descriptive data and correlation coefficients, is further supported by the teachers' responses to the open-response items, coded from items 10 and 11. In item 10, teachers were asked, "Describe what interactivity means to you". Not every teacher responding to the survey provided an answer to this item but of the 63 total responses submitted, the choice of language suggesting students were at the interactive whiteboard was only reported in 12 responses (19%). The potential for student engagement was brought forward in 35 responses (55.5%) but there was no further indication of whether those responses represented engagement at the interactive whiteboard or otherwise in the classroom. Therefore, the responses of engagement cannot be equated with direct interactive whiteboard use and thus says very little about the extent of interaction with the interactive whiteboard as presented in the organized framework presented in chapter one and two. Certainly though, in light of the possibilities the correlations provided with respect to teachers believing their practices were associated with the creation of interactive learning opportunities, the prospect of interactivity and learning being developed through other means is a possibility considering that 55.5% of teachers who responded spoke of student engagement. Unfortunately, correlations do not exist with respect to the qualitative data collected; it would have been interesting to see whether a relationship existed between the quantitative responses to items regarding students spending time at the interactive whiteboard and qualitative responses that mention engagement.

More specifically, in open-response item 11, teachers were asked, "If you indicated that you use the interactive whiteboard in your lessons, please describe your lesson with the interactive whiteboard." The 95 total responses provided by teachers also support the submission that teachers believed they were using their interactive whiteboards as interactive devices in Prince Edward Island high school classrooms, whereas their descriptive answers suggested it was teachers at the interactive whiteboard or a mix of teacher-centered and student-centered activities developing in classrooms. To be clear, there were only 88 respondents to the survey and 95 responses to this item, which suggests that some teachers likely provided multiple answers to the open question. See Table 12 for complete details in chapter V. The following examples are selected from the item 11 data.

In this first example, teachers provided evidence of two distinctly opposite practices in their classroom. First is the teacher-centered approach in which students are relegated to their seats while discussion and further activities over presented images are used to develop understanding of materials. Additionally, the teacher provides evidence that students at times are present at the interactive whiteboard sharing in the learning experience and development of the class.

> Students are provided a paper copy of the slides that will be highlighted on the interactive whiteboards. The slides (notes) provided are enhanced by summary statements, additions important points, and short skill practice sessions. There are often opportunities for students to use the interactive whiteboards for learning and/or assessment. Student presentations also incorporate the abilities of the

> interactive whiteboards to enhance the delivery and interaction among audience and presenters. (Participant # 1)

In the second example (below), a teacher provided evidence that primarily represented teacher-centered approach to using the interactive whiteboard focusing on the dissemination of notes and information through a projected image. The teacher did say that they invited students to the front of the classroom, but that was to allow students the opportunity to write answers to questions on the interactive whiteboard, a practice that could be completed with many other technologies such as a blackboard or an overhead projector.

> I begin by using it to review over assigned homework from the day before, keeping my answers covered until the students reveal the answers or I have students come up to write in their answers. Then I use it to present new material by use of notes. The notes I do are something written down, fill in the blanks or revealed through imagery. (Participant # 7)

The third example is from a teacher who suggested that their interactive whiteboard was used for the development of notes and the embedding of video and links into lessons. Present in this response was also evidence of opportunities for students to "sometimes" fill in answers, which is an example of interactivity, but as suggested by the rest of the response, the teacher primarily used the multimedia affordances of the software, in the classroom.

> I teach math and social studies, and I project basic notes onto the board, which I fill in (sometimes getting the students to fill in) and discuss as we go. Video clips

> i.e. (YouTube) and related websites are used to supplement and enhance the lessons where available/appropriate." (Participant # 14)

The fourth example shows a definitive non-interactive approach to using the interactive whiteboard. This teacher's evidence suggests that students are not at the interactive whiteboard at all although the response did indicate that the teacher shared notes with students, which could be a catalyst for interaction on multiple levels.

> I use Google docs a lot and share my pages and links with students. However, my lessons are often just showing them what I have found for them on the Internet, assignments that they are to do, etc. (Participant #15)

The fifth and final example provided evidence of yet another teacher who used their interactive whiteboard primarily as a teacher centered tool but in a manner that suggests more advanced mastery of the technical capabilities. Instead of just using the interactive whiteboard to present notes and develop discussion, this teacher is drawing and explaining artistic values with the interactive whiteboard. While the response provided does not suggest that students are at the interactive whiteboard, one can presume that different forms of interaction could develop throughout the lesson for everyone involved in the art and photography class.

> I use the whiteboard to teach art and photography. I create presentations that are similar to a slide show but I am able to analyze and draw on the screen to explain concepts like composition, balance, etc. – almost like a weather map, I can discuss where the viewer's eye will travel on a photograph or piece of art. (Participant # 21)

There were examples among the available responses that are recognized as occasions where teachers had students touching the interactive whiteboards, however these examples described activities where students were completing tasks that had little to do with exploration and discovery in the classroom but rather activities that were designed for making the classroom more efficient or not associated with exploration and discovery of educational material. The first of such an example shows how the interactive whiteboard was used as a classroom management tool for substitute teachers. The teacher responded to item 11 by saying, "Attendance for substitute teachers (the students move their name under present)" (Participant # 3)

The next example represents an opportunity where students came to the interactive whiteboard as part of classroom review. While at the interactive whiteboard, this is an example of students following a prescribed path designed by the teacher and does not afford opportunities for exploration and discovery. The following example is from an extra help class.

> I use it a great deal in introductory lessons (as a gradual release strategy) to visually represent more abstract concept. Sometimes students come to the front of the class to use the screen during these lessons but more often I have students working at the board on activities that I have developed during extra help sessions. (Participant # 16)

A third example reinforces this idea that students are performing tasks at the interactive whiteboard that a teacher directed and do not allow for student input into the direction of the learning in the classroom, "I would have them do a quick classroom entry

game as in fill in the blank, or labeling maps related to the geographic area we are studying". (Participant # 22)

Of the 95 total responses, there were no definitive responses provided by teachers that suggested students were using the interactive whiteboard as a means to explore and discover curriculum with as suggested by the framework presented in chapter one and two.

Research Question #1 – Summary

The data suggests that Prince Edward Island high school teachers are not using their interactive whiteboards as tools to support classroom interaction. Teachers have their interactive whiteboards turned on, but the pedagogical strategies for creating interactive opportunities for students are limited and do not appear to correspond to teachers' beliefs about how often they create interactive lessons with the interactive whiteboard. This is not to imply that teachers are making incorrect decisions when it comes to teaching strategies; however, it perhaps reflects what teachers were actually able to do with their interactive whiteboards at this point in time. More and deeper interactive practices may not have been possible for teachers because of such things as limited understandings of "interactivity" and "engagement" or, more simply, because of the day-to-day constraints of teaching. Nevertheless, given the assumption that interactive whiteboards were installed to enhance student learning at least to some extent, the evidence suggests that students may not be making the learning gains that could result from interactivity with an interactive whiteboard as demonstrated by Marzano and Haystead (2009, 2010).

Research Question 2 – What are the factors leading to the use or non-use of Interactive Whiteboards as designed?

This section of the discussion explores possible factors that influenced the use of interactive whiteboards in Prince Edward Island high school classrooms. Influences can come from many directions for teachers as suggested by Activity Theory and in this research, it is submitted that five major factors contributed to the non-interactive practices of Prince Edward Island high school teachers: (a) knowledge (b) training, (c) time (d) the sharing of skills between teachers and (e) how teachers value their interactive whiteboards.

Knowledge

The role knowledge played as a factor contributing to the use of interactive whiteboards being used less optimally as interactive tools in Prince Edward Island high school classrooms will be presented by analyzing the descriptive statistics from items 8a, 8b, 8d, and 8e. Additionally, correlations between items 8a, 8b, 8e, and 8d regarding teachers' understanding of interactivity with items 9a, 9g, and 9h that discuss the beliefs of teachers about their interactive whiteboard use will be presented. Obvious because of its absence from the list of correlations is item 8c which reads, "I feel comfortable presenting interactive lessons with my interactive whiteboard in my classroom" (see Appendix C). This item has been omitted due the wording of the item which suggests an emotional reaction to the use of interactive whiteboards and not necessarily the knowledge a teacher has regarding interactive whiteboard use. This was an oversight in the item design phase.

Items 8a, 8b, 8d and 8e (see Appendix C) questioned teachers about their understanding of what the term "interactivity" meant from a theoretical standpoint and a classroom practices standpoint. Based upon the results of the survey, teachers believed that they had an understanding of what the term "interactivity" meant. For example, when item 8a asked teachers if they understood what the term "interactivity in a classroom" meant, 97.9% (M=1.74, SD=0.495) of teachers said that they strongly agreed or agreed with this statement. Without being unanimous, that is about as strong an indicator that a shared belief can be. Though when correlated with items that also scored strongly with respect to teachers' beliefs about how interactivity is happening in a class, there were weak correlations. Comparing item 8a, which asked if teachers understood what the term "interactivity in the classroom" meant, with item 9g, which asked teachers if they created interactive lessons, and item 9h, which asked teachers if they created interactive lessons with Smart Notebook software, resulted in $r(77) = .270$, $p<0.018$ and $r(78) = .295$, $p<0.009$ respectively, while between item 8a and item 9a, which asked if teachers created interactive learning opportunities in their classroom, there was nothing statistically significant to report.

Second, item 8b asked if teachers understood the interactive capabilities of the interactive whiteboard in their classroom. Another positive group of responses was reported with this item as 88.2% (M=1.91, SD=0.566) of teachers said that they strongly agreed or agreed to this statement. Considering the results, this data also suggests that the majority of teachers are confident that they know what the interactive whiteboard can do in their classroom, yet when compared with question 9a which discuses how frequent teachers created interactive learning opportunities in the classroom, the sets of data do not

match up. In fact, correlations between item 8b and frequency of use items 9a, 9g, and 9h, produced only two statistically significant correlations, both of which were weak. Between item 8b and 9a, which asked if teachers created interactive learning opportunities in their classroom, there was a weak correlation of $r(77) = .368$, $p<0.001$. Between item 8b and 9g, which asked teachers if they created interactive lessons, there was a weak correlation of $r(77) = .382$, $p<0.001$.

The third knowledge item, 8e, asked teachers if they were familiar with Smart Notebook software or alternative interactive whiteboard software. Comparatively the descriptive statistics were not as high as the percentages of 8a and 8b, but still 79.4% (M=2.0, SD=0.721) of teachers strongly agreed or agreed that they were familiar with the software applications. This is interesting because working with software designed to aid interactive opportunities, compared with items 9a, 9g, and 9h, should have resulted in strong positive relationships; however, as with items 8a and 8b, no strong correlations were reported. Instead there was one weak correlation and one moderate. Between item 8e which asked teachers how familiar they were with Smart Notebook software and item 9a, which asked teachers if they created interactive learning opportunities, there was a weak correlation of $r(78) = .464$, $p<0.001$. A second correlation between item 8e and item 9h, which asked teachers if they created interactive lessons with Smart Notebook software demonstrated a moderate positive correlation of $r(78) = .567$, $p<0.001$. Although the moderate correlation was closer to what was expected in terms of their stated understanding of the SMART Notebook software and their uses of it to produce interactive lessons, it still fell short of indicating a strong connection. There was no statistically significant correlation between item 8e and item 9g.

As a result of the analysis regarding the knowledge a teacher reports to have and how frequent they access that knowledge to create interactive opportunities for teachers is a trend that is developing out of the results. Teachers believed they understood the term "interactivity in the classroom" and were committed to using the interactive whiteboards in various ways to produce interactive lessons; however, they did not appear to let this guide their plans for using interactive whiteboards. Despite positive answers in all of the items, the results suggest that the teachers are not allowing their knowledge to help in the development of interactive lessons with the interactive whiteboard whereas perhaps they should have.

Lastly and intentionally being reported at the end of the list, item 8d asked teachers if everything they did with an interactive whiteboard could have been done with just a projector and a computer. The results of this item were consistent with items 8a, 8b, and 8e in that they suggested that teachers believed in their understandings of the term "interactivity", but whereas the responses to items 8a, 8b, and 8e were all answered positively, the responses provided to item 8d were at the opposite end of the interval scale. Instead of positively agreeing with the statement, 72.3% (M=2.86, SD=0.823) of teachers said that they *disagreed* or *strongly disagreed* with the statement thus suggesting that the interactive whiteboard was a tool that enabled them to function differently in the classroom, while only 27.4% of teachers said that they strongly agreed or agreed to this statement.

In short, responses to these four items indicate that the majority of Prince Edward Island high school teachers reported knowing about interactivity, understood the capabilities of the interactive whiteboard, and were familiar with Smart Notebook

software. The difficulty with interpreting responses to these items is that they are evidence of how teachers' conceptualized interactive whiteboards rather than accurate accounts of their true knowledge. Responses to items 8a, 8b, and 8d showed high frequency of using the interactive whiteboards in teacher-centered activities; activities that could otherwise have been carried out using a projector and computer (e.g., MS Powerpoint presentation). In foresight of this, items 9b, 9c, 9d, and 9e, were designed to provide opportunity for teachers to showcase their interactive whiteboard knowledge by answering on frequency scales, how often they used their interactive whiteboards in non-interactive manners. Despite the scenarios or examples of interactive whiteboard activities, teachers overwhelmingly reported that they used their interactive whiteboards non-interactively with respect to the contextual framework presented in chapters one and two.

In short, Prince Edward Island high school teachers' beliefs that they were using their interactive whiteboard, as interactive tools in the classroom were not reflected in their classroom strategies. What could have been influencing their knowledge of and practices with interactive whiteboards was the training they received. This discussion will now look at the data that suggests training for Prince Edward Island high school teachers was a factor in the non-interactive use of interactive whiteboards.

Training

Prince Edward Island high school teachers provided a range of answers to items 13a, 13c, 13d, 13e, and 13b which asked them about their beliefs about training on the interactive whiteboard. As the following section shows, training was something that teachers valued for skill development; however, further training seemed unlikely to

change how they would use their interactive whiteboards in their classrooms. Item 13a asked teachers if they thought that their training was sufficient to allow them to use the interactive whiteboard as an interactive tool in their classroom. Only 36.5% (*M*=2.69, *SD*=0.775) of teachers said that they strongly agreed or agreed with this statement while 63.5% of teachers disagreed with the statement. Item 13c asked teachers specifically if more basic training would improve their use of the interactive whiteboard in the classroom. Given the shortfall in training reported above, it is not surprising that 74.9% (*M*=2.11, *SD*=0.781) of respondents strongly agreed or agreed with the statement, suggesting that they needed more training on their interactive whiteboards. Item 13d inquired further about training by asking teachers if more curriculum specific training was required on the interactive whiteboard. Consistent with the results of item 13c, 71.2% (*M*=1.76 *SD*=0.714) of respondents said that they wanted more curriculum specific training on their interactive whiteboard.

These percentages suggest that a substantial number of Prince Edward Island high school teachers are open to the premise of more training on a variety of ways to improve their interactive whiteboard use. Assuming this might have been the case, item 13b asked teachers if they would be willing to stay after school to attend a training session. This item examined the priority for training by posing a training time outside of the regular school day. The results of item 13b were consistent with the call for more training as 71.7% (M=2.18, SD=0.762) of teachers indicated they would attend an afterschool training session (i.e., agreed or strongly agreed to the statement).

While these results indicate positive attitudes towards additional training, in general, when correlated with beliefs about practices from items 9a, 9g, and 9h, the

strength of the training teachers have received and to which they would be open to in the future mathematically varied. Specifically, comparing items 13a, 13b, 13c, 13d, and 13e, with items 9a, 9g, and 9h, resulted in only three statistically significant correlations.

Not surprisingly, item 13a resulted in weak correlations when correlated with items 9a and 9g, as teachers stated in their responses to item 13a (M=2.69, SD=0.775) that training was insufficient. Considering this between items 13a and 9a, there should have been no correlation, or a negative correlation between the two items. Weak opinions about training and strong belief about interactive learning opportunities do not match up in theory nor in statistical analysis as suggested by the Pearson correlation coefficient between the two variables of $r(73) = .386$, $p<0.001$. This result does beg the question, though, of whether teachers might have acquired the skills to create interactive learning activities with interactive whiteboards outside of their initial training. To assume that would imply causality in the result and that would be inaccurate and irresponsible from the statistical perspective. What is known is that teachers provided no suggestions by way of evidence of further training through the quantitative responses to items 10, 11, or 14.

Following this up, a second correlation coefficient was computed between item 13a, which asked teachers if their interactive whiteboard training was sufficient and item 9h, which asked teachers if they created lessons with Smart Notebook software. This produced another weak strength correlation between the two variables of $r(73) = .383$, $p<0.001$. These two results, along with where each set of data fell on their individual scales suggest that teachers' beliefs about the inadequacy of their training was reflected in the inadequacy of the interactivity created with interactive whiteboards and with Smart

Notebook Software. Whereas the majority of the correlations discussed here have been unexpected, these two correlations were exactly what were expected based upon the results of the descriptive statistics. Other correlations using the training items 13b, 13c, 13d, and 13e all recorded *p*-values greater than 0.05 and thus are not reported due to lack of statistical significance.

Three Correlations Within the Training Group

Three other Pearson correlation coefficients strengthen the suggestion that training is a factor in the use of interactive whiteboards by Prince Edward Island high school teachers come from within the training grouping itself but for a variety of possible reasons. These correlations are between items 13b, 13c, and 13d. To begin, a correlation coefficient to assess the relationship between item 13b (M=2.18, SD=0.762), which asked teachers if they would be willing to stay after school for training, and item 13c (M=2.11, SD=0.781), which asked teachers if more basic training would improve their use of interactive whiteboards demonstrated a moderate correlation of $r(71) = .535$, $p<0.001$ This indicates a possible case for more basic training which might occur outside the school day. However, two additional correlations suggest that teachers would not be in favour of staying afterschool to have specific software training or to learn materials previously created by someone else.

The first correlation on this idea is between item 13b (M=2.18, SD=0.762) and item 13d (M=1.76, SD=0.714), which asked teachers about the need for training on the Smart Notebook software. This correlation resulted in a weak correlation of $r(71) = .271$, p=0.022. What is interesting about this result is that 58% of teachers indicated they would attend a training session afterschool in item 13b and 71% of teachers agreed or

strongly agreed that they needed training on the Smart Notebook software in item 13d. Using the descriptive information as a first indicator of possible relationships, this correlation is surprising and provides support to the concerns presented in the Activity Theory framework that attests to the complexity of the competing priorities, which teachers must balance (Cole & Engeström, 1993).

As well, the correlation between item 13b (M=2.18, SD=0.762), and item 13e (M=1.79, SD=0.763), revealed a weak correlation of $r(7) = .391$, p=0.001. The expectation was that the indication that teachers who would attend after-school training would likely correlate strongly with their use of the interactive whiteboard more often if they had the premade interactive whiteboard lessons. Both correlations, as a result of being weak suggest that changes to any variable in either comparison would not result in positive changes to the other variable in the relationship.

Time

Time has also been identified as a possible factor into how Prince Edward Island high school teachers used their interactive whiteboards. The time invested in learning and developing interactive whiteboard skills was explored by item 12c (M=2.36, SD=0.888), which asked teachers if they thought interactive whiteboards were good things, but were too busy to find time to learn about them more, presumably through training. What is interesting is the fact that Prince Edward Island teachers seemed to be open to specific types of training, yet when presented the opportunity to commit to those types of training, their attitudes changed. To explore this, item 12c will be presented using the descriptive statistics and through four statistically significant correlations.

Item 12c offered a look into the attitudes of teachers with respect to their interactive whiteboards and the time they had to invest in training. In response to item 12c, 58.8% of teachers said that they strongly agreed or agreed to the item saying that they thought interactive whiteboards were good things but that they were too busy to spend more time on training. However, as a disclaimer, and what may be an explanation for the results that follow is the way item 12c was presented to teachers. Overlooked when designing the item are what appears to be two parts to the item: (a) the first part, which recognizes teachers' positive attitude towards interactive whiteboards, and (b) the second part that arguably measures if the teacher has alternative attitudes towards interactive whiteboards. In other words, the item suggests a combination of ideas within itself, namely, that teachers' general support for interactive whiteboards is offset by a belief that they don't have time to learn to take advantage of them. Considering the four following comparisons resulted in weak strength correlations, it may suggest that teachers were responding to the second part of the item and not the first.

Between item 12c, which asked teachers if they though interactive whiteboards were a good thing... but were too busy to find time to learn more about them, and item 13b (M=2.18, SD=0.762) which asked teachers if they would be willing to stay after school to work on skills resulted in a weak correlation of $r(70) = .360$, $p = 0.002$. A second Pearson correlation coefficient was assessed between item 12c, which asked teachers if they though interactive whiteboards were a good thing... but were too busy to find time to learn more about them and item 13c, which asked teachers if more basic training would improve their interactive whiteboard skills produced another weak strength correlation of $r(73) = .398$, $p<0.001$.

A third Pearson correlation coefficient assessing the relationship between the attitudes of teachers with respect to their interactive whiteboards and the time they had invested in learning more about them and item 13d, which asked teachers if they required more curriculum specific training on the Smart Notebook software, also demonstrated a weak correlation of $r(73) = .459$, $p=0.001$. This correlation was expected as it reflects the attitudes of teachers being too busy to improve their skills and the results of item 12c in which 62.5% of teachers disagreed and strongly disagreed with the notion that additional basic training would improve their use of the interactive whiteboards. If teachers do not see the value in additional training, then they are unlikely to find time to attend additional training sessions. Being too busy to learn more about interactive whiteboards and being willing to stay afterschool for addition training on basic interactive whiteboard skills are contradictory and should have resulted in a negative correlation. On the other hand, had teachers been answering the first part of the item, perhaps this correlation would have been stronger.

This relative strength of this correlation as compared to the previous two correlations possibly reflects the openness of teachers to additional training on Smart Notebook software as 72.5% of teachers strongly agreed or agreed with the suggestion of needing more curriculum specific training on that. Nevertheless, the overall conclusion is that teachers stated they were too busy to work on the skills and a positive increase in value of either variable is not expected despite a positive change in the other variable.

The final correlation coefficient in this section assessed the relationship between the attitudes of teachers with respect to their interactive whiteboards and the time they had invested in learning more about them and item 13e, which asked teachers if they

would use their interactive whiteboard more often as an interactive tool if they had access to already tried and tested interactive lesson plans. It resulted in a weak correlation of $r(71) = .352$, $p = 0.003$. Based upon how teachers answered items 12c (M=2.36, SD=0.888) and 13e (M=1.79, SD=0.763), this weak correlation was a surprise because using already tried and tested interactive lesson plans would not require additional training sessions.

Sharing

The discussion to this point indicates that Prince Edward Island high school teachers are not using their interactive whiteboards as interactive tools and suggests that factors contributing to this may include a lack of understanding of what interactivity is, inadequate training and time on the devices. However, as suggested by the Community element of the Activity Theory framework, non-interactive practices may be passed on if teachers share their interactive whiteboard materials and practices. For this reason, this section explores the possibility that sharing interactive whiteboard practices among teachers may be a factor that contributes to the extent that Prince Edward Island high school teachers use their interactive whiteboards non-interactively. This possibility is reinforced by item 9i (see Appendix C), which asked teachers if they shared their interactive lessons with other teachers. Fifty-eight teachers (73.5%) indicated that they had shared their interactive lessons. Despite this, item 9i resulted in only one statistically significant Pearson correlation coefficient with respect to every other item in the instrument. A Pearson correlation coefficient test was computed between item 9i (M=4.52, SD=1.535), which asked teachers about sharing lessons with colleagues and item 9h (M=3.96, SD=1.752), which asked if teachers created interactive lessons with

Smart Notebook software. This relationship resulted in a weak correlation of $r(73) = .459$, $p=0.001$. This correlation suggests that there is a positive relationship between teachers sharing lessons with each other and their beliefs about how they create lessons with Smart Notebook software.

While the connection exists with teachers using Smart Notebook software and sharing interactive whiteboard lessons, evidence does not exist to suggest that teachers were actually sharing viable interactive practices that have students interacting with the interactive whiteboard with each other. Using the qualitative data responses from items 10, 11, and 14, there were no indications from teachers that they were sharing their exercises with each other with respect to their use of Smart Notebook software or any other aspect of interactive whiteboard use. It is true that teachers were not asked directly in a qualitative forum for examples of this, but as other themes were proposed by teachers through responses to items 10, 11 and 14 without prompting, it is not unreasonable to assume that sharing ideas could have surfaced as well. However, that was not the case and the interest that teachers have with regards to sharing interactive whiteboard lessons that encompass lessons using Smart Notebook software remains unanswered.

Therefore, to add to what is known at this juncture in the discussion is that pedagogical choices with respect to how and why interactive whiteboards are largely used in the classroom are decided upon by the individual teachers by way of how they balance their personal decisions, the community in which they work and the professional expectations entrusted to them as suggested through the context of Activity Theory. Further to this, the data suggests another factor affecting the use of interactive

whiteboards for Prince Edward Island high school teachers, which is less physical, but more abstract in nature. This factor is how teachers value their interactive whiteboard.

The Value of the Interactive Whiteboard

Simply put, exploring the value that Prince Edward Island high school teachers put on the interactive whiteboard begins with looking at the three items designed to measure the opinions of teachers with respect the value of the interactive whiteboards in their classrooms. The items were 8d, 12b, and 12e (see Appendix C). As previously reported, teachers responded quite favorably to the statements of each of these three items to the tune of item 8d (M=2.86, SD=0.823), item 12b (M=3.14, $SD=0.756$), and item *12c* (M=2.36, $SD=0.888$). Though measured as three individual items, together they suggest that teachers recognized the value in their interactive whiteboards, though when formally considered through Pearson correlations, the connections between items were not overwhelmingly strong.

Between item 8d and item 12b, there was a weak positive correlation of $r(72) = .436$, $p<0.001$ and between item 8b and item 12e there was a moderate strength correlation of $r(72) = .525$, $p<0.001$. Although both of these correlations are not strong, they are more reflective of what would be expected if the teachers believed the interactive whiteboards were uniquely valuable.

The last Pearson correlation coefficient assessed the relationship between item 12b, which asked teachers if too much money was spent on interactive whiteboards and item 12e, which asked if teachers thought that the interactive whiteboard was just another gadget. This resulted in a moderate correlation between the two variables of $r(72) =$

.588, $p<0.001$ as was to be expected given that teachers responded negatively to the items 12b (*M*=3.14, *SD*=0.756) and 12e (*M*=2.97, *SD*=0.763).

These three correlations and the statistics from items 8d, 12b and 12e support the possibility that interactive whiteboards have a place in Prince Edward Island high school classrooms. They suggest that teachers believe in the value of interactive whiteboards, but despite this, it is already understood that teachers do not see the discrepancy between what they think they are doing and what they actually are doing. Regardless, the majority of teachers believed that interactive whiteboards gave them access to classroom strategies otherwise inaccessible; they also believed the cost of the program was acceptable, thus corroborating the idea that interactive whiteboards are not just a waste of money or space in the classroom.

ANOVA

As a reminder**,** the ANOVA was chosen as a method of comparing mean scores from multiple independent variables. The groups (independent variables) compared in this study were: gender (males vs. females), self-reported teaching experience (0-5 years teaching, 6-10 years teaching, 11-15 years teaching, and 16+ years teaching experience) and a self-assessment of computer and technology knowledge (I need help vs. adequate vs. comfortable vs. power user vs. an expert). These independent variables were compared initially with items representing the entire construct and then with the three groupings from the three dimensions representing the construct comprising of the dependent variables: knowledge and experience, beliefs toward interactive whiteboards and views towards training.

Using the results of the ANOVA test affords the opportunity to understand where statistical differences exist within and between groups of independent variables and can be used to suggest which groups of teachers specifically are differing in their support for interactive whiteboards. The ANOVA will not answer research question #1, but it can provide context to help explain research question #2 which explores the factors leading to the use and non-use of interactive whiteboards as described. As well, the ANOVA provides no indication of what causes any variation in means.

Further as a reminder, presented in chapter four, the use of the terms experienced/knowledgeable and inexperienced/beginner do not necessarily reflect skills on the interactive whiteboard, but rather the overall interpretation of skills with respect to computer knowledge as self identified in the demographics section of the survey. To explicitly say that a teacher will not benefit from practical intervention and therefore will remain an experienced or an inexperienced teacher does not reflect competency with the interactive whiteboard and interactive lessons. With time and training on interactive whiteboards, teachers may gain experience but may not change their position of self-assessment as overall computer technology users.

The first ANOVA test produced a statistically significant difference when comparing the independent variable, self-assessment of computer knowledge and the dependent variable, the scale representing beliefs about training. The post hoc analysis showed that a difference existed between the means of teachers who responded as being knowledgeable/experienced (M= 2.23, SD=0.399) and the means of teachers who responded as being inexperienced/beginners (M = 1.77, SD=0.494*)* at (F(2, 67)=3.570,

p=0.034) with the beliefs about the training group of items. This result is not surprising considering the large gap between the means of teachers who self-assessed as knowledgeable/experienced with computers and those teachers who self assessed as inexperienced/beginners.

Following the positive ANOVA test, the necessary test revealed a medium to large effect of $\eta^2 = 0.10$ suggesting that there was a medium possibility of practical significance on the current situation in Prince Edward Island high school classrooms with regards to the relationship between experience and interactive whiteboard training. This means that under the current conditions where teachers are provided limited training on their interactive whiteboards and in line with the framework presented in chapters one and two, changes to training on the interactive whiteboards for further development of interactive whiteboard skills would may result in a measurable difference in skills or usage. However, the statistic is not large enough to ensure further inquiry would result in changes to the means of either group of teachers.

The second ANOVA test that produced a statistically significant difference compared the independent variable, gender, and the dependent variable, beliefs towards the interactive whiteboard. The analysis showed that a difference existed between the means of genders with respect to beliefs about the interactive whiteboard. The result of the test was ($F(1, 69)=4.640$, $p=0.035$). This result is interesting because there was not a large gap in means between the means of males ($M=2.00$, $SD=0.560$) and females ($M=2.26$, $SD=0.432$) (males having slightly more positive beliefs towards interactive whiteboards), nor was there a vastly unequal distribution between male and female responders to the survey (see Table 4).

Following this significant ANOVA test, the calculation of Eta-Squared generated a small effect of $\eta^2 = 0.06$. Although males and females do significantly differ in their perspectives about interactive whiteboards such that males are slightly more positive than females, this significant difference has little practical significance as was determined using eta squared. With respect to the literature previously submitted, this result does not support the claim that men dominate the technology fields. Rather the suggestion stemming from the eta squared test is that there is more parity among technology use in Prince Edward Island high schools based upon gender then perhaps there is in other parts of the world.

The third ANOVA producing a statistically significant difference came from comparing the independent variable, self-assessment of computer knowledge and the dependent variable, the scale representing knowledge and experience on the interactive whiteboard. The analysis showed that a difference existed between the means of teachers who responded as being knowledgeable/experienced (M=1.72, SD =0.436) and the means of teachers who responded as being inexperienced/beginners (M=2.2, SD =0.499) at (F(2, 70)=4.256, p=0.018) with the knowledge and experience on the interactive whiteboards group of items. This result is in place because the distance in means between the experienced/knowledgeable teachers (M=1.72) and the inexperienced/beginner teachers (M=2.20) was a large gap.

Following this positive ANOVA result, Eta-Squared test confirmed a medium effect. ($\eta^2 = 0.11$). This finding seems reasonable in that teachers' who self-reported their abilities at the high end of the scale, also responded at the high end of the knowledge and experience scale and the opposite is true for teachers' who self-reported

their abilities at the low end of the scale. In sum, this study has provided evidence that teachers' knowledge and experience in using interactive whiteboards is a factor affecting the utility of interactive whiteboards; however, the statistic is not large enough to ensure further inquiry would result in changes to the means of either group of teachers.

Based upon the limitations of the ANOVA test, the specific reasons for these results are unknown because speculation using ANOVA outcomes would be inaccurate and misleading. What is suggested from the ANOVA tests, however, is that gender and a teachers' self assessment of their computer knowledge are the independent variables that in some way influenced how and why interactive whiteboards were used in Prince Edward Island high school classrooms in November 2013. Also, of the three ANOVA results, the dependent variables that were used to create the positive ANOVA tests were training, beliefs about interactive whiteboards and knowledge and experience – all of which have been submitted as factors into why interactive whiteboards were not being used in Prince Edward Island high school classrooms. In short, the results of the ANOVA tests provide opportunity for further assessment into how gender and self-assessment factor into how a teacher uses their interactive whiteboard and also supports the Pearson correlation coefficient results.

Chapter Summary

Overall, the data suggests that the majority of Prince Edward Island high school teachers were generally not using their interactive whiteboards as interactive devices, which according to previous studies would lead to improved student achievement. Although Prince Edward Island high school teachers used the devices in their classrooms, for a variety of reasons they chose alternatives to strategies that would have supported the

types of interactivity (Moore, 1989) that might be expected to improve student learning without the interactive whiteboard. The data suggested that teachers believed that they were creating interactive lessons with their interactive whiteboards when they were actually more focused on lessons that weighed heavily on the instructor-learner interaction. This ran counter to the physical or intellectual interaction between the students and the interactive whiteboard that would potentially contribute to the types of improved student achievement reported by Marzano and Haystead (2009, 2010).

In addition, the research identified reasons for non-interactive use of interactive whiteboards in Prince Edward Island high school classrooms. Factors that led to teachers not using their interactive whiteboards in manners consistent with the framework in chapter one and two are (a) knowledge, (b) training (c) time, (d) sharing of skills and (e) belief of the value of the interactive whiteboard. Finally, this analysis also suggested that teachers would not see improvements in their skills as the result of more resources and training being provided.

These explanations illustrate the complex positions in which teachers find themselves every day. Teachers have a responsibility to address the curriculum outcomes as they teach students by balancing the resources to which they have access. With respect to interactive whiteboards in Prince Edward Island high school classrooms, the attempt to provide teachers with an appropriate resource may not been supported by the skills necessary to teach interactive lessons with them. As a result, high school students on Prince Edward Island may not get as much of an opportunity as they might to explore and discover with the interactive whiteboards. As derived from the literature, one important dimension of interactivity suggests that students need to be out of their seats

and at the interactive whiteboard performing intellectually stimulating tasks. Student experiences are limited if teachers do not or cannot provide the opportunities for them to explore and discover using the interactive whiteboards.

Chapter VII: Conclusion

This thesis has explored the use of interactive whiteboards by Prince Edward Island high school teachers following a government decision to purchase these devices for every high school classroom in 2010. It assessed teachers' beliefs, attitudes and practices on these interactive whiteboards. Teachers' practices with respect to interactive whiteboards have been investigated globally within educational institutions in which interactive whiteboards have been introduced to teach students (Celik, 2012; Isman, Abanmy, Hussein, & Al Saadany, 2012; Abuhmaid, 2014) and although there are differences between the structures of government and education systems presented in the literature compared to Prince Edward Island, the technical and pedagogical challenges of using interactive whiteboards were similar. With respect to interactive whiteboards on Prince Edward Island, this thesis specifically aimed to answer the following research questions:

1. To what extent are interactive whiteboards being used in Prince Edward Island High Schools as *designed*?
2. What factors lead to the use or non-use of interactive whiteboards as *designed*?

To answer these questions, a 24-item Likert-type scale, plus three qualitative open response items were used to survey Prince Edward Island high school teachers in November 2013; analysis of the survey responses resulted in the following major conclusions:

1. Prince Edward Island high school teachers were using their interactive whiteboards but in non-interactive ways, that is, they were not being used to support the kinds of interaction that have been shown in previous studies to stimulate improved

student learning (as suggested by Marzano and Haystead, 2009, 2010). Teachers have their interactive whiteboards turned on but the majority reported using them predominantly as projection screens or extensions of their desktop computer. Rarely were students asked to visit the interactive whiteboard board to engage in learning.

2. Prince Edward Island high school teachers were not using their interactive whiteboards as interactive devices most likely because of an absence of training received on the devices, and an absence of time to develop the requisite skills. These factors appeared to affect using the interactive whiteboards as designed.

To conclude this thesis, I am going to return to the framework of Activity Theory to explain possible results and consequences of the use of interactive whiteboards as noted through the data. As a reminder, the Activity Theory model was introduced in chapter three to allow for an understanding of the elements that could influence the decisions of teachers about the uses of their interactive whiteboards. Activity Theory was explained as a triangle with arrows leading to and from every element that fell within that triangle. Initially, the triangle was discussed as having a top part and a bottom part of the triangle – the top part was made up of the elements Subject, Instrument and Object whereas the bottom elements were the Rules, the Community and the Division of Labour.

Activity Theory can also be expressed through a linear perspective in that one element directly influences another element, but as will be shown in this conclusion, the influences a teacher must balance comes from multiple elements creating mixed interpretations behind decisions. Finally, as a reminder, any scenario provided by Activity Theory is not definitive but rather represents a field of potential approaches to understanding relationships and should be accepted only as such. Through the

development of this argument, we cannot create every possible relationship, and for that reason, this conclusion focuses on the training factor, which was highlighted as a reason why Prince Edward Island high school teachers were not using their interactive whiteboards based upon the data collected and analyzed in this thesis.

Beginning with a linear approach to how the rules component of the theory can influence teachers' decisions, initial training on interactive whiteboards for Prince Edward Island high school teachers in 2010 came from the Department of Education and Early Childhood Development. It was noted that the government purchased the interactive whiteboards, had them installed in classrooms and, subsequently followed up by offering training to every high school teacher in the province. The data suggested that for the most part teachers received one session of basic training on their interactive whiteboards. Using the literature to suggest more time and training were necessary to facilitate higher understanding of how to create interactive lessons (Lee, 2010; Al-Qirim, 2010; Desantis, 2012), it is plausible to propose that more resources from the government, or the rules element who control the resources in schools, would have influenced teachers to learn and develop more skills on their interactive whiteboards.

For example, imagine the learning possibilities that could have developed if the government in 2010 had established a procedure of training around a two-tier process where every Prince Edward Island high school teacher received one session of training on the basic operations of interactive whiteboards and then multiple training sessions on curriculum specific applications. Through these hypothetical additional training sessions teachers might have developed better skills and knowledge of how to use the interactive whiteboard in their class for educational purposes, which in turn could have led to more

students exploring with the interactive whiteboards and potentially improving their academic success.

However, this depth of training did not happen and while this linear approach focused on the relationship surrounding official training, Activity Theory provided a framework to understand series of complex influences that help shape teachers' decisions to use an interactive whiteboard with respect to training. drawing on data that suggested training was inadequate, within a school community (another element within Activity Theory), there was evidence to suggest that a small amount of sharing was occurring between high school teachers on Prince Edward Island, but as a result of teachers not understanding or using interactive lessons as suggested by correlations and qualitative responses, presumably at the hands of not enough training with their interactive whiteboards, non-interactive lessons and experiences could have been shared among teachers. Sharing lesson strategies is important, but when the information being shared is not reflective of the kinds of interactive lessons or skills as suggested by the framework provided in chapter one and two, then the sharing becomes counter-productive in that teachers come to accept less than ideal teaching strategies as the norm or exemplary practice. In summary, within the school community, if teachers were sharing non-interactive practices as the result of insufficient training, those non-interactive practices may dominate teachers' uses of their interactive whiteboard.

While the entire previous example may suggest that specific groups of people were solely responsible for the absence of training and time on machines, nothing could be further from the truth. The preceding was just an example of a possible web of events that could have led to the interactive whiteboards being used as non-interactive devices in

Prince Edward Island classrooms. This example is not exhaustive in that it does not mention the other results of this thesis that explain why Prince Edward Island high school teachers are using their interactive whiteboards as non-interactive devices

Therefore, decision-makers in the future should consider including in their strategies for installation or purchases of large-scale technology units a plan so that end users understand the process and intended purposes that are necessary to build skills in order to be able to use technology in the classroom for student achievement. If the technology was chosen for the benefit of students, it does no good if the teachers in the classroom do not understand how to use the devices or even why the particular devices were chosen. As stated very early on, interactive whiteboards were designed to enhance learning opportunities for students in ways that did not exist prior to their invention. It can be argued that students and teachers could discuss and explore curriculum objectives using other objects in the classroom as they did over the years, but with interactive whiteboards, the internet and computers, the modern day affordances available to students arguably allow and provide for instantaneous and unlimited knowledge building and sharing. If decisions regarding which specific technologies in schools continue to happen without discussion around adequate resources, the students who are ultimately at risk in all this, will not see the academic achievements associated with specific devices, as is suggested by this thesis.

In closing, if ever there was a time where technology earned its rightful place in our education system, it is now, if only because of its increasing presence in our society today. But with the rapid pace that technologies evolve, the ability of teachers to successfully integrate the technologies into classrooms to enhance student learning and

improve student achievement is proving to be challenging and may very well be the root cause that affected implementation and use of interactive whiteboards in Prince Edward Island classrooms. There is solace for teachers in the words of Manzo (2010), though, who paraphrased a position of Marzano by saying:

> Teachers who were most effective using the whiteboards displayed many of the characteristics of good teaching in general: They paced the lesson appropriately and built on what students already knew; they used multiple media, such as text, pictures, and graphics, for delivering information; they gave students opportunities to participate; and they focused mainly on the content, not the technology" (2010).

Teachers are in difficult positions of balancing everything and anything that arises in their classrooms on a daily basis while maintaining standards that are ultimately designed to benefit student achievement. Regardless of what happens in a classroom and regardless of what is installed, the focus of the teacher must be on the path to student achievement.

Recommendations

A number of recommendations regarding integration of technology into schools are suggested from the results of this study into how interactive whiteboards were used in PEI high school classrooms.

- The purposes of new technologies in schools should be identified and presented to teachers in advance or during the process of introducing a new technology. It has been shown in this thesis that although high schools teachers admitted to understanding interactive whiteboards and strategies with the device, their

practices suggested otherwise. As a result of this misaligned knowledge, how the teachers used their new technologies was affected. In the future, if teachers are made aware of the capabilities of the interactive whiteboard and the purposes for the introduction by the government or leadership bodies within the school, then perhaps their choices with new devices might match their level of acceptance of the device as a tool in the classroom.

- Further to this point, accompanying any new piece of technology being introduced into high school classrooms on Prince Edward Island should be a fully developed and specific training plan for teachers to build upon. Using the framework of Activity Theory to progress this recommendation, the development of training plans, should include communication between teachers, department heads, curriculum specialists and other stakeholders to ensure that teachers are prepared to teach using new technologies. Training takes time and money to complete and therefore, the community surrounding and influencing teachers and their decision should be prepared to meet any concerns that teachers bring up that will help better prepare to teach students.

Further Study

Starting in 2014 another new technology was broadly introduced into high schools on Prince Edward Island – WIFI. Using the results and recommendation of this thesis, it would be interesting to see how and why high school teachers on Prince Edward Island were using the wireless environment for teaching, presumably to help enhance the student learning experience. Considering the flexibility that a wireless environment could create for learning, possible research topics could be:

- A mixed methods comparative study into what are the perceived expectations for the use of wireless technologies from the perspective of (a) teachers and (b) those who decided to create and develop wireless learning environments.
- A qualitative study into successful and/or unsuccessful protocols and procedures required for implementation of new wireless technologies into schools in small education systems of less than 15,000 students.
- A mixed methods study looking into how success of students using wireless technologies is evaluated. For example, is success assessed by academic achievement using grades and quantitative results, or is success measured through the learning experience?

Each one of these possible further studies encompasses the premise that relationships exist between a teacher and how they use a device to teach their students. While at the heart of the WIFI project is technology, the use of the devices in the classroom and the training that goes along with the implementation of technology will most likely, if this thesis is to suggest a possible outcome, determine the success of the initiative and investment by the government. The development of understanding and practical uses must be a shared activity within the school system.

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Appendix A

Letter to Principals

Dear Principals, November 6, 2013

Please find enclosed in this email a message from University of Prince Edward Island Master of Education student, Mr. Ryan Casey. Mr. Casey is working towards a Masters' Thesis on the use of interactive whiteboards in Prince Edward Island high school classrooms. Mr. Casey's research will look at how Island high school teachers are using their interactive whiteboards in their classrooms and the reasons why.

On behalf of Mr. Casey, I am asking you to consider forwarding the **Informed Consent Form** and **Survey Link** to your teachers. The data gathered from your teachers will help Mr. Casey fulfill the requirements for his thesis.

Mr. Casey has successfully submitted his research proposal and appropriate forms to the University of Prince Edward Island Research Ethics Board and the External Research Review Committee at the English Language School Board. It is understood by all parties that the data collected will be thoroughly analyzed using Survey Monkey, and that every attempt to keep respondents anonymous has been considered.

Mr. Casey will send out two attempts at data collection between November 15, 2013 and the last day of school in December 2013, this being the first. Through the months of December and January, Mr. Casey will compile the data and write up the results of the research. Editing the thesis will take place in February and March and a defense will occur in April if all goes as planned. All Island high school teachers will be invited to witness that presentation through an email using this same process. As well,

the results of the research will be made available through the University of Prince Edward Island Library and through the National Archives of Canada.

Forwarding this survey to your staff on behalf of Mr. Casey is your decision. You do not need to contact Mr. Casey to confirm your decision, nor do you have to add anything to the forwarded message. This procedure of me contacting you on behalf of Mr. Casey was arranged between Curriculum Delivery at the English Language School Board and Mr. Casey and should not be read as an endorsement of the project, but rather as means to delivering the survey appropriately to our staff members.

Thank you for your time.

David Costello

Appendix B

Informed Consent

The Use of Interactive Whiteboards by Prince Edward Island High School Teachers

Mr. Ryan Casey - Lead Investigator, M. Ed Student, University of Prince Edward Island.

Dr. Alexander McAuley - Supervisor, Faculty of Education, University of Prince Edward Island.

Dr. Tess Miller - Committee Member, Faculty of Education, University of Prince Edward Island

The Purpose of the Research

This research project is a requirement for the Masters of Education program at the University of Prince Edward Island and focuses on the use of interactive whiteboards in high schools. Interactive whiteboards are being used in many Prince Edward Island school classrooms at all levels of study. However, in 2010, they were legislated into every high school classroom on the Island, presumably to improve the teaching and learning. This research project aims to answer the following research questions:

1. To what extent are interactive whiteboards being used in Prince Edward Island High Schools as designed?
2. What factors lead to the use or non-use of interactive whiteboards as designed?

You are invited to participate in this research project because you are a high school teacher in the English Language School Board who has an Interactive Whiteboard at your disposal on a daily basis.

Your participation is voluntary and you may withdraw from the study at any time during your participation.

In addition, if you do choose to participate, you retain the right to skip any question you do not wish to answer.

This invitation to participate is being sent to all High School teachers in the English Language School Board.

What Will The Participant Be Asked To Do?

You are being asked to respond to an online survey about your use with the interactive whiteboard in your classroom. A series of questions will be provided to you along with space for you to answer the questions. All the questions provide you with choices for answers. You do not have to write any sentences. It is anticipated that this survey can be completed in 10 - 15 minutes.

Access to Research Information:

Mr. Casey will have access to the collected data throughout the research process. Once the data is received from Survey Monkey, the questions and answers will be removed from the Survey Monkey website and stored locally. All the data will be stored on a secure portable flash drive in a fire proof lock box. Any printed data will be stored in binders in the fire proof lock box. The data will be stored for a period of five years after the completion of the study, at which time the flash drive will be securely reformatted and erased and printed records will be destroyed accordingly by shredding.

A password to the Survey Monkey account will be kept in a secure spot separate from the results.

Once the research has been competed, you will receive an email inviting you to review the results of the Masters' thesis. This will include an invitation to the thesis defence and an invitation to view the published material at your leisure. The Masters thesis document will be made available to the library at the University of Prince Edward Island and online through the National Archives of Canada.

Risks / Benefits

Considerations of risk, harm or inconvenience have been undertaken. The research team understands that the Prince Edward Island teaching community is small and as such, responding to a research tool about a device that has been provided to you by the government may seem risky to your career. We have taken steps to ensure that your confidentiality and anonymity will be protected. We will not ask your name. We will not ask for your school. We will not ask for follow-up interviews. We only wish to gather information about how you use your Interactive Whiteboard in your classroom and compare it to the results of other teachers.

The benefit of this research project will include a better understanding on why Island high school teachers are using their Interactive Whiteboards in the manners that they are. In addition, the research may enlighten teachers about ways they can improve their use of interactive whiteboards, and as a result the learning experiences of their students.

Compensation / Expenses

There is no financial compensation for your participation.

You should incur no expenses for your participation aside from 10 - 15 minutes of your time.

Confidentiality / Publication of Results

As a research team, we have planned to provide you with a high level of confidentiality and anonymity by limiting the demographic questions in our instrument. We ask that you only identify yourself with respects to gender, time teaching, a self-assessment of computer knowledge, and training. Survey Monkey, the online statistical software we will be using, uses secure web connections and encryption to minimize data intrusion or identification.

As this project is a requirement for the Masters of Education program at University of Prince Edward Island, a public defence summarizing the results will be made. Both the defence and the thesis will focus and analyze the data as a whole and identification of individuals will be impossible.

Contact Information:

If you have any questions about this study, please contact:

Mr. Ryan Casey, (902) 218-4226

Collect calls will be accepted.

If you have questions about your rights as a research participant, you may contact:

Dr. Alexander McAuley

Supervisor, Faculty of Education.

University of Prince Edward Island

(902) 894-2814

amcauley@upei.ca

As well, understand that you can contact the UPEI Research Ethics Board at (902) 620-5104, or by email at reb@upei.ca if you have any concerns about the ethical conduct of this study. This project has been granted ethical approval through the Research Ethics Board at the University of Prince Edward Island and by the External Research Review Committee at the English Language School Board.

Appendix C

The Instrument with Raw Data, Percentiles, SD and Means

Background Information

1. Identify your gender

o M	42 (42.7)	M	SD
o F	46 (52.3)	1.52	.502

2. How many years have you been teaching high school on PEI in years as a contract, probationary or tenured teacher?

o 0-5	19 (21.6)	M	SD
o 6-10	18 (20.5)	2.73	1.172
o 11-15	19 (21.6)		
o 16+	32 (36.4)		

3. Rate your overall computer knowledge. Check the circle that applies to you.

- **An expert** (EX. I am able to build a computer from scratch and then manipulate the operation of my machine through advanced programming knowledge for better efficiency.) 2 (2.3)
- **Power User** (EX. I am able to install, run, update and manipulate any program I would need with little assistance.) 16 (18.2)
- **Comfortable** (EX. I am able to install basic programs, install video cards or RAM, and can troubleshoot minor problems.) 47 (53.4)
- **Adequate** (EX. I can turn on the machine, navigate the Internet, check emails and do word processing.) 21 (23.9)

- **I need help** (EX. With everything I do on the computer, I need support.) 2 (2.3)

  M SD

  3.06 .778

4. Do you have formal "technical" computer training (e.g., Microsoft Certificate, CCNA Certificate, C++ Administration) outside of what you may have received as an employed teacher on PEI?

- Y 5 (5.7) M SD
- N 83 (94.3) 1.94 .233

If yes, please describe your training.

5. Do you have any formal "theoretical" computer training (e.g., a certificate in computer studies, diploma, or degree in computer science) outside of what you may have received as an employed teacher on PEI?

- Y 2 (2.3) M SD
- N 86 (97.7) 1.98 .150

If yes, please describe your training.

6.Have you received any interactive whiteboard training since 2010?

- Y 39 (44.3) M SD
- N 49 (55.7) 1.556 .499

If yes, state **when** and **where** you were trained, and for how many hours.

7. Have you received any interactive whiteboard training specific to your teaching assignment since 2010?

o Y	11 (12.5)	M	SD
o N	77 (87.5)	1.875	.332

If yes, state **when** and **where** you were trained, and for how many hours.

Interactive Whiteboard Knowledge and Experience

8. Indicate how informed you are about Interactive Whiteboard Capabilities

8a. I understand what the term "interactivity in a classroom" means.

SA	A	D	SD	M	SD
22	54	2		1.74	0.495
(25)	(61.4)	(2.3)			

8b. I understand the interactive capabilities of the interactive whiteboard in my classroom.

SA	A	D	SD	M	SD
16	52	9		1.91	0.566
(18.2)	(59.1)	(10.2)			

8c. I feel comfortable presenting interactive lessons with my interactive whiteboard in my classroom.

SA	A	D	SD	M	SD
12	35	22	5	2.27	0.816
(13.6)	(39.8)	(25)	(5.7)		

8d. Everything I do with my interactive whiteboard, I could do with just a projector and a computer.

SA	A	D	SD	M	SD
5	17	39	19	2.86	0.823
(5.7)	(19.3)	(44.3)	(18.2)		

8e. I am familiar with Smart Notebook Software or alternative interactive whiteboard software.

SA	A	D	SD	M	SD
18	44	14	2	2.00	0.721
(20.5)	(50)	(15.9)	(2.3)		

9. Indicate the frequency that you use the interactive whiteboard for the purposes listed below.

9a. I use the interactive whiteboard to create interactive learning opportunities in my classroom.

D	EOD	OW	OETW	S	N
16	10	13	10	21	8
(18.2)	(11.4)	(14.8)	(11.4)	(23.9)	(9.1)

M	SD
3.44	1.710

9b. I project images, (e.g., assignments, notes, pictures, games, websites, etc.), onto the interactive whiteboard.

D	EOD	OW	OETW	S	N
52	15	3		3	6
(59.1)	(17)	(3.4)		(3.4)	(6.8)

M	SD
1.80	1.497

9c. I use the interactive whiteboard to transition between slides in a slideshow (e.g., PowerPoint).

D	EOD	OW	OETW	S	N
38	15	7	1	9	9
(43.2)	(17)	(8)	(1.1)	(10.2)	(10.2)

M	SD
2.43	1.824

9d. I navigate websites (e.g., show students different places to find information) using the interactive whiteboard (instead of my mouse) in my classroom while students watch in their seats.

D	EOD	OW	OETW	S	N
26	17	15	2	14	5
(29.5)	(19.3)	(17)	(2.3)	(15.9)	(5.7)

M	SD

2.70	1.667

9e. Students in my class are called upon to use the interactive whiteboard.

D	EOD	OW	OETW	S	N
4	16	14	11	26	8
(4.5)	(18.2)	(15.9)	(12.5)	(29.5)	(9.1)

M	SD
3.80	1.471

9f. I use the interactive whiteboard to present notes to students (similar to using an overhead transparency), which they have to copy.

D	EOD	OW	OETW	S	N
23	23	6	4	13	9
(26.1)	(26.1)	(6.8)	(4.5)	(14.8)	(10.2)

M	SD
2.85	1.802

9g. I create interactive lessons for my students.

D	EOD	OW	OETW	S	N
14	10	13	13	18	10
(15.9)	(11.4)	(14.8)	(14.8)	(20.5)	(11.4)

M	SD

3.53	1.688

9h. I create interactive lessons with Smart Notebook software or alternative interactive whiteboard software.

D	EOD	OW	OETW	S	N
12	9	10	12	19	17
(13.6)	(10.2)	(11.4)	(13.6)	(21.6)	(19.3)

M	SD
3.86	1.752

9i. My colleagues and I share interactive whiteboard related lessons and skills.

D	EOD	OW	OETW	S	N
7	5	4	8	34	21
(8.0)	(5.7)	(4.5)	(9.1)	(38.6)	(23.9)

M	SD
4.52	1.535

10. Describe what interactivity means to you.

11. If you indicated that you use the interactive whiteboard in your lessons, please describe your lesson with the interactive whiteboard.

Beliefs about Interactive Whiteboards

12. Indicate your views towards interactive whiteboards.

12a. I feel comfortable teaching a colleague about the interactive whiteboard and its capabilities.

SA	A	D	SD	M	SD
8	31	25	10	2.5	0.864
(9.1)	(35.2)	(28.4)	(11.4)		

12.b Too much money has been spent on interactive whiteboard technology.

SA	A	D	SD	M	SD
4	4	42	22	3.14	0.756
(4.5)	(4.5)	(47.7)	(25.0)		

12c. Interactive whiteboards are a good thing…but I'm just too busy to find time to learn more about them.

SA	A	D	SD	M	SD
12	31	22	8	2.36	0.888
(13.6)	(35.2)	(25)	(9.1)		

12d. Interactive whiteboards can enhance student learning experiences in my classroom in they are used to their full potential.

SA	A	D	SD	M	SD
28	40	6		1.70	0.613
(31.8)	(45.5)	(6.8)			

12e. Interactive whiteboards are just another gadget in the classroom.

SA	A	D	SD	M	SD
2	16	37	18	2.97	0.763

(2.3)	(18.2)	(42)	(20.5)		

13. Indicate the extent you agree or disagree with the questions related to Interactive Whiteboard Training

13. a The interactive whiteboard training I have received was sufficient to allow me to use the interactive whiteboard as an interactive tool in my classroom.

SA	A	D	SD	M	SD
5	22	38	9	2.69	0.775
(5.7)	(25)	(43.2)	(10.2)		

13.b I really want to know more about the interactive whiteboard and would attend a training session even if it were offered at the end of the school day (e.g., 4:00 – 5:00).

SA	A	D	SD	M	SD
11	40	16	4	2.18	0.762
(12.5)	(45.5)	(18.2)	(4.5)		

13c. More basic training would improve my use of the interactive whiteboard in the classroom.

SA	A	D	SD	M	SD
15	42	15	4	2.11	0.781
(2.3)	(18.2)	(42)	(20.5)		

13d. I require more curriculum-specific training on the Smart Notebook software.

SA	A	D	SD	M	SD
30	33	12		1.76	0.714
(34.1)	(37.4)	(15.6)			

13e. I would use my interactive whiteboard more often as an interactive tool if I was given already developed and tested interactive lesson plans.

SA	A	D	SD	M	SD
28	34	9	2	1.79	0.763
(31.8)	(38.6)	(10.2)	(2.3)		

14. This last question is reserved for you to tell us about any interactive whiteboard experience that might help us in researching its use in PEI Schools.