University of Alberta

The War of the Boards: Interactive Whiteboards, Actor-Network Theory and the Time-Space Continuum

by

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from "The Blackboard and Chalk"

O Chalk! what a powerful monarch thou art!
In this age of reform, how important thy part;
Those minds that are swaying the world unrestrained,
In childhood and youth in thy empire were trained;
Of the wonderful "power of the press" we may talk—
It never can vie with the blackboard and chalk.

The Educational Monthly, February, 1865 (no author identified)

Abstract

This paper describes how in-service teachers learn to use the interactive whiteboard (IWB). More specifically, it looks at the social and material assemblages related to training in-service teachers on this device. To do this, it uses actor-network theory (ANT) and a "materiality of learning" methodology developed by Estrid Sørensen (2009). It draws heavily on Sørensen's notion of *presence.* This particular combination of theory and methodology reveals the IWB's role in two intricate and competing webs that simultaneously compel teachers to increase *and* decrease the pace of classroom lessons. Focusing on *pace* as an *immutable mobile* in both networks, this analysis exposes a kind of war in today's schools over how IWBs should be used in the service of learning.

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development of a disruptive technology for eight years

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In the world of actor-network theory, you have all helped form the entangled patterns of

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Introduction

This paper describes how in-service teachers learn to use the interactive whiteboard (IWB). More specifically, it looks at the social and material assemblages related to training in-service teachers on this device. To do this, it uses actor-network theory (ANT) and a "materiality of learning" methodology developed by Estrid Sørensen (2009). It draws heavily on Sørensen's notion of *presence,* the application of which allows one to study "the way in which humans are with materials, contrary to how humans make sense of materials—or how they make sense of themselves with the help of materials" (p. 138). This particular combination of theory and methodology reveals the IWB's role in two intricate and competing webs that simultaneously compel teachers to increase *and* decrease the pace of classroom lessons. Focusing on *pace* as an *immutable mobile* in both networks, this analysis exposes a kind of war in today's schools, particularly in relation to IWB adoption, training and use, but also in relation to pedagogy, professional development and curriculum implementation.

I[*] began this exploration informally by observing two day-long IWB training sessions for pre-service teachers at a local university. Recognizing that IWBs are fast becoming a standard piece of educational technology, the university created a full-time contract position. Its mandate is to enhance students' and staff capacity to embed IWBs into education in the classroom, and at administrative and teacher educator levels. This position is also responsible for creating alliances with major technology companies in

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[*] For eight years, I worked for an IWB manufacturer, researching, writing about and crafting language around IWBs in education. As a consequence, I also had the opportunity to engage regularly with staff across the organization and with educators around the world. I shift to first person in order to reflect that degree of direct experience with and understanding of IWBs.

order to bring additional technology into the university. A trainer was hired to take on these responsibilities and, as part of her teaching mandate, she offers training to both pre- and in-service teachers. As part of her alliance-building mandate, she was also instrumental in securing donations from various manufacturers to equip an education classroom with the following:

- A SMART Board 800 series interactive whiteboard system (with short-throw projector and multi-touch capability)

- A SMART Board 800 series interactive whiteboard system (with ultra–short-throw projector and multi-touch capability)

- SMART Notebook version 10.8 software (available free of charge for use on home and school computers, and a variety of SMART products)

- Two SMART document cameras (with mixed reality tools for displaying 3D content)

- A voice amplification system

- Built-in ceiling-mounted speakers

- Two Dell desktop computers and a Dell laptop

- Wi-Fi and Internet access enabled via student or guest access to the university's server

The trainer supplemented these with her own iPad, and students were required to bring their own laptops with SMART Notebook 10.8 software pre-loaded. Informally, some students also brought their own smartphones.

The trainer had 35 years' experience in the K–12 sector, having worked at the school level as a teacher and administrator, and also at jurisdiction and provincial levels. The trainer was also SMART certified; that is, she went through a training and

credentialing process with SMART Technologies, which states she is qualified to teach accredited SMART-created training packages on SMART Notebook software and SMART Board interactive whiteboards. The university then began using the packages, which were designed to provide a day-long session that would provide SMART Notebook software Level I (basic) or Level II (advanced) training. SMART Notebook software is the proprietary whiteboarding software used on SMART Board interactive whiteboards. Access to the training was granted to either pre-service teachers enrolled at the university or to in-service teachers.

The training program had been running for a few months before I took up my observer's seat at the back of the classroom in the spring of 2012. At the same time, I was reading Estrid Sørensen's *The Materiality of Learning* (2009) in which she draws on actor-network theory (ANT) and after-ANT to develop a materiality of learning methodology. I became particularly interested in her notion of forms of presence, through which she studied students and a teacher negotiating space around an old-fashioned blackboard. Sørensen implicated the blackboard, for example, in creating one-to-many patterns of relation, with the teacher at the front of the room, broadcasting knowledge to the students facing her or him. The blackboard, she noted, also performed regional patterns of relation, enabling the teacher to control access to the space near and around the board, which as a consequence defined *here* versus *there* regions within the classroom. The blackboard also helped constitute the teacher as an authority by way of the students, who did not have authority over the board but who were enlisted by it nonetheless in constructing the teacher's authority[†].

[†] This notion is explained in more detail in the literature review.

As I watched the trainer and students in the IWB sessions perform many of the same actions that Sørensen identified in her study, it became clear that the application of her methodology to classrooms with an IWB could provide useful insights. The pre-service teachers I observed, for example, were initially reluctant to use the IWB when the trainer invited them to the front of the class, even when the trainer urged their participation several times—joking that she would sit there until someone came up to the IWB or that they needed to be finished by 4:00 p.m. so she could get ready for a romantic night out. The irony of pre-service teachers being reluctant to take charge of the front of the classroom was particularly curious. Were the notions of regional spaces and authority so entrenched that they prevented even pre-service teachers from using the IWB? Or was it precisely because they were pre-service teachers that they were reluctant to breach this boundary? Were they simply extending a professional courtesy? Were they afraid of looking *un*like an expert in that particular space? Was their expertise still in question? I also wondered about the conditions under which the trainer enabled such apparent breaches of space around the IWB. What facilitated or constrained this behavior? What effect might pre- and in-service teacher transgressions of boundaries have when they took what they learned about IWBs to their own classrooms?

Using ANT as a theoretical lens, the study provides insights into how training for pre- and in-service teachers has performative effects that ripple across a broad actor-network touching on such areas as administration, student achievement, assessment, pedagogy, curriculum, funding and academic scholarship. The outcome of the research is a "materiality of learning" that encapsulates the forms of presence within an IWB-

enabled learning environment. Such a materiality moves educators[‡] beyond questions of how IWBs are employed to meet educational goals and toward a socio-material awareness of how boundaries constructed around IWBs affect learning, how they may be manipulated to encourage different forms of learning and how to imagine the "form(s) of knowledge and presence we want" (p. 187). It may also prove useful for teacher educators and teachers, who find themselves in a position to disrupt traditional boundaries in order to facilitate new or alternative forms of learning.

Literature Review

IWBs in Context

The political and economic. IWBs are best understood within broad political, economic, cultural and social contexts, which often deeply affect IWB implementation and use at the school level. At the political and economic level in the UK, for example, government policy was responsible for mandating whole-class pedagogical approaches (Cooper, 2002; Davison & Pratt, 2002; Kennewell, 2006; Tanner & Jones, 2007). The UK was the first country to mandate the adoption of IWBs within a specific (relatively short) timeframe and one of the only to provide adequate funding, research and resources to back a programmatic and time-limited implementation (Glover, Miller, Averis, & Door, 2005; Higgins, Beauchamp, & Miller, 2007). IWBs, as a whole-class educational device, were embraced by UK politicians at the highest levels as a means of supporting whole-class teaching (Davison & Pratt, 2002; H. J. Smith, Higgins, Wall, & Miller, 2005). The Department for Education and Skills (DfES), after allocating more than £50 million (H. J. Smith et al., 2005) specifically to purchase and deploy IWBs, began

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[‡] i.e., those involved in teacher educator programs, school boards, district administration, curriculum development, academia, district- and board-level technical support programs, and professional development programs; and, of course, pre- and in-service teachers

working with Becta (originally the British Educational Communications and Technology Agency) on a new technology mandate. This organization became responsible for delivering an ongoing comprehensive program of professional development, researching and reporting on implementation and adoption patterns, and developing IWB resources that encouraged teachers to embed IWBs into everyday practice (Higgins et al., 2007) in ways that supported its policy focus on whole-class pedagogy. More particularly, Kennewell (2006) attributes "multimodality, pace and interactivity" (n.p.) directly to normalizing rhetoric in UK policy initiatives. Tanner and Jones (2007) link the UK's national strategies and whole-class pedagogy directives to the belief among UK educators that "[i]nteractive whole-class teaching is assumed to be at the heart of educational practice" (p. 37). Kennewell and Higgins (2007) suggest that while other politically mandated pilots have often failed, the adoption and use of IWBs in the UK has been enormously successful perhaps because educators "share the pedagogic beliefs held by policymakers—particularly the value of whole-class teaching" (p. 208).

Researchers and educators around the world have monitored and studied the UK system for approximately eight years now and often used its experiences to guide their own adoption and implementation efforts. The resulting influence of UK education policy on the development of digital learning environments worldwide has been significant. My own experience indicates that the number of Becta-like, state-sponsored or civil society organizations devoted specifically to technology in education, and operating at national and international levels, is high and continues to increase. Higgins et al (2007) indicate that IWB adoption trends are not unique to the UK, and "a similar picture is emerging internationally" (p. 214).

In the United States, the Department of Education took a less directive approach than the UK, enlisting the Office of Educational Technology, budgeting $600 million for the broader category of educational technology (a smaller amount relative to a larger population) and refraining from mandating particular pedagogical approaches. Classroom installation rates—currently at 35%, or half that of the UK (Futuresource Consulting, 2011)—appear now to be declining (Futuresource, 2012), with increased economic pressures, reduced budgets, no clear links between adoption and achievement, and no policy directives mandating a pedagogical framework supported by IWBs. Yet, as Futuresource Consulting (2011) notes, the U.S. remains one of the largest IWB markets in the world, and IWB purchases continue to be funded locally and through innovative fundraising efforts. In Canada, where provinces, rather than the federal government, are individually responsible for education, there has been an uneven shift toward supporting the purchase and deployment of educational technology, with some provinces standardizing on a particular brand of IWB and moving ahead quickly with programs and funding, while others lag far behind. The trend globally is clear, however: developed and developing countries are embracing IWBs, and as national or regional policies, budgets and resources allow, purchasing patterns continue apace.

The social and cultural. Socially and culturally, the effects of a massive shift away from paper-based media toward digital media continues to revolutionize the whole terrain of education (Lee, 2010; Twiner, Coffin, Littleton, & Whitelock, 2010). Yet, as Lee (2010) indicates, macro-level analyses of this educational context over the last 50 years have been absent from the literature. Lee states that the shift from paper-based to digital forms of schooling, and the shift from discrete technologies to integrated ones, are profoundly affecting not just the classroom environment, but all facets of education. One

of the least proclaimed functions of the IWB has been, for instance, its capacity to function as a "large-screen digital convergence facility, [or] digital hub" (Lee, 2010, p. 135). In fact, the IWB combines a variety of technologies and functionalities (computer, data projector, large-screen display, touch-screen interface, chalkboard, Internet access, and, depending on the model, conferencing)[§]. Gillen et al (2008) characterize the IWB as having "the broad multi-functionality of a major tool" (p. 349) and note that it can be used in many ways in the classroom. One effect of introducing IWBs into this broader context is, then, the enormous burden placed on teachers, technology directors and administrators, who must now perform within an increasingly integrated digital environment that changes with each new version of software and each new model release. Thus, macro-level research on the "impact of the integrated entity" (Lee, 2010, p. 135) is urgently needed.

Contrary to popular misconceptions, IWBs have also been adopted with extraordinary speed (Kennewell, 2006; Kennewell & Higgins, 2007; Lee, 2010). According to Futuresource Consulting (2012), a global research and consulting firm that documents IWB sales, almost 4.5 million IWBs and flat-panel displays had been installed worldwide at the end of 2011, with the majority of those going to the education market. According to another report (Futuresource Consulting, 2011), more than 30 million classrooms worldwide are still without an IWB, and the market, despite economic pressures, continues to be "first-rate" (n.p.). Given that the first IWB appeared in 1991, and IWBs and data projectors were not being widely purchased by schools until approximately 2002, Lee concludes that the "widespread use of IWBs in schools, and in turn the normalisation of the digital in everyday teaching, is thus very recent" (p. 136).

[§] This is perhaps why the IWB seems, at times, to have multiple personalities.

Many studies now suggest that IWBs have minimal impact on student achievement (Digregorio & Sobel-Lojeski, 2009; Higgins, Hall, Wall, Woolner, & McCaughey, 2005), but, given the relatively recent evolution of this new digital landscape, Lee cautions against drawing firm conclusions:

> it will take time before the technology is used to teach in fundamentally different ways … it will not be until the vast majority of the teachers in a school, and eventually a nation, are using the digital technology effectively, and in a significantly different way to the old, [that] marked improvements in student attainment [can] be expected. (p. 138)

Similarly, Schuck and Kearney (2007) also propose that, while IWBs can lead teachers toward greater "ICT proficiency" (n.p.), it will take time and increased familiarity with the interactive affordances of IWBs before they are used to significantly affect student learning and achievement.

Twiner, Coffin, Littleton and Whitelock (2010) also acknowledge broader social and cultural contexts, which include the developed world's pervasive access to and socialization with digital media. They cite a shift away from paper-based forms of communication to forms that are increasingly multimodal and which, as Lee notes, are also shifting the fundamental nature of schooling. Today's teachers are now tasked with not only developing and orchestrating (John & La Velle, 2004; Kennewell, 2006; Kennewell & Beauchamp, 2007; Lee, 2010; Twiner et al., 2010) a variety of multimedia and multimodal lessons, but, in order to make the best use of IWB technology, they must adopt a more interactive pedagogical style, which has proven difficult to achieve (Digregorio & Sobel-Lojeski, 2009; Divaharan & Hwee Ling Koh, 2010; Glover, Miller, Averis, & Door, 2007; Kennewell, 2006; Loveless, 2011; Way et al., 2009).

In fact, as much of the literature acknowledges (Glover, Miller, Averis, & Door, 2007), the IWB often seems to entrench a more didactic teaching approach in which the teacher uses the IWB to instruct students from the front of the class rather than reaching for a level of *enhanced interactivity,* i.e., having "a focus on using the technology [IWBs] as an integral part of most teaching in most lessons, and integrating concept and cognitive development in a way that exploits the interactive capacity of the technology" (Glover et al., 2007, p. 10). Glover et al strongly suggest that simply supplying teachers with IWBs does not automatically lead to increases in student achievement. They found that the best use of IWBs occurred in settings with "whole-school professional development" (p. 11) and the ongoing support of senior management. The number of IWBs available to teachers in each subject area was also found to be significant because teachers with easy, ongoing access could share resources and learn in cooperation with colleagues. In these settings, a "developing 'culture' of IWB use" (p. 11) spurred understanding, integration and an evolving sense of interactivity. Without such supports, however, the dominant pedagogy remained more traditional and teacher-centered. Glover et al also point to the need for pre-service teacher training focused on developing an enhanced interactive teaching style. Glover et al's research documents an inherent demand from policy makers to shift pedagogical styles, often with little support for or understanding of how to help teachers make such a shift.

The double discourse of ICT adoption in education. Relevant to making this kind of shift is the work of John and La Velle (2004), who, in relation to teachers' subject-area identities, examine Basil Bernstein's (1996) notion of pedagogic identities. Bernstein identifies two social factors affecting the formation of teachers' pedagogic identities: economic deregulation and devolution of political power, on the one hand, and

an increased form of education regulation, on the other, with its emphasis on assessment, national standards and achievement. John and La Velle investigate how "these apparently contradictory cultures are able to coexist and the sorts of dislocation and confusion felt by teachers in their everyday working lives as they rise to the challenge presented to their pedagogic identity by new technology" (p. 309). Bernstein, they say, argues that these cultures result in a "'retrospective' pedagogic identity of old conservatism [and] a new 'prospective' identity [which] … carries within it the potential for a reinvention of the old progressive identity, which grew out of the curricular and school reforms of the 1960s and 1970s" (p. 309). Teachers with a retrospective identity found a higher degree of comfort in their subject areas but greater uncertainty and anxiety concerning ICT, while those with a prospective identity found a high degree of uncertainty and anxiety around the pace of change and their institution's lack of understanding about its impact on pedagogy. John and La Velle conclude that

> The 'double discourse' of ICT and subject culture was therefore dominated by two overlapping narratives: master and servant. These narratives appeared to represent the fluctuating challenge that ICT presented to both teachers' subject identities and their pedagogical practice. If we are to engage teachers in thinking about their pedagogy and how it might be enhanced through the use of new technology as well as enabling them to use such devices, then the tensions embedded in these two narratives need to be aired and explicated. (pp. 323–324)

John and La Velle make an important point: one's pedagogic identity within educational settings is in many ways defined by competing social and cultural cues. Until we acknowledge that the issues of IWB adoption and use are linked to more than individual resistance or a particular gap in teacher training and professional development programs,

we will continue to suffer this turmoil. John and La Velle are calling for a much clearer examination of technology in context.

Device-mediated change. In examining the overall context for IWBs, one can see that political and economic forces have a direct, performative effect on IWB adoption and use. The UK has led the adoption of IWBs internationally, with policy directives intended to implement whole-class pedagogy and the technology to support it. The shift from paper-based to digital and multimodal media is profoundly affecting the foundations of schooling, "toppling the perceived dominance of text as written and spoken language" (Twiner et al., 2010, p. 216) and putting educators within a constantly shifting, digitally integrated terrain that urges them to adapt, often with little or no direct support. There is also increasing pressure to adopt a more interactive teaching style with very little tactical understanding of what that is or how to achieve it. Much more research needs to occur in this area before training programs can effectively support such a shift. From such trends emerge confused pedagogic identities that cling to traditional educational approaches on the one hand and that push for greater reforms on the other.

Nespor's (2011a) exploration of device-mediated change in education explains and extends the value of John and La Velle's approach to the issues. Nespor also provides additional context for Lee's argument that IWBs are revolutionizing schooling. Devices have a significant influence on our everyday lives: they "shape change by slowing things down … or speeding things up" (pp. 15–16). Within this context, Nespor recognizes that agency is not a particular attribute of human beings but rather a "relational effect" (2011a, p. 17) in Callon and Law's (1995) sense of the phrase. That is, agency is a consequence of our embeddedness in networks of relations that include human and non-human actors. Such networks do not emerge as the result of strategic planning or targeted

outcomes—they become "networks of power [in which people] are defined, enrolled and mobilized along particular trajectories" (p. 9). They are an assemblage of people and entities who, through an ongoing series of negotiations and improvisations, affect all network participants. If we do not understand the network, we will not recognize the effects, which, out of context, often seem random or singular.

Delineating context, or the double discourse of ICT in education, is not, then, simply a way to introduce the issues. Context *is* the issue. We will not understand the ways in which IWBs are variously enlisted to meet conflicting ends unless we examine context, and its network effects, more fully.

The literature on IWBs has grown considerably in the last seven years, and, while much of the early research was action-based and feature-focused, it has now been supplemented with empirical research, longitudinal studies and targeted research into specific areas, such as subject areas, teacher confidence, the novelty factor, pedagogy and achievement. Collectively, these studies have begun to provide reliable, in-depth insights into the development of IWBs and our relationship with them in education over almost two decades, as we move beyond examining technological affordances and use to exploring pedagogy and practice (Glover et al., 2005). Despite this study's ANT underpinnings, it would be remiss were it to gloss over research that did not place IWBs in the context of such emerging research. This literature review will, therefore, provide an overview of the most recent research in a variety of areas with a variety of theoretical underpinnings.

IWB Effectiveness

Much recent literature is focused on high levels of interactivity (i.e., more dialogic and student-centered) as a necessary condition for effective IWB use. The issues have

shifted from early concerns that IWBs support a more traditional, teacher-centered pedagogy (Gillen, Staarman, Littleton, Mercer, & Twiner, 2007; Holmes, 2009; Kennewell, 2006; Schuck & Kearney, 2007; F. Smith, Hardman, & Higgins, 2006; Tanner & Jones, 2007) and have no substantial effects on student achievement (Digregorio & Sobel-Lojeski, 2009; Higgins, Falzon, et al., 2005; Higgins et al., 2007) to a growing recognition that a more interactive pedagogy is possible and should be integrated into IWB and teacher training programs (Glover, Miller, & Averis, 2004; Glover et al., 2007; Kennewell, 2006; Mercer, Hennessy, & Warwick, 2010), at which point more discernable effects on student achievement will occur. Glover et al (2007), after observing 50 video-recorded lessons, develop a system of classifying IWB use, which is now often referenced in more recent literature. The *supported didactic* stage involves using the IWB to present or illustrate teacher-developed concepts and facilitate teacher-led questioning. In the *interactive* stage teachers become more familiar with the features and functions of the IWB, they incorporate it more fully into lessons and they use it to "challenge pupils to think by using a variety of verbal, visual and kinaesthetic stimuli" (p. 9). In the *enhanced interactive* stage, IWBs become a standard part of most lessons. Teachers feel comfortable with the technology, they can use the IWB to structure lessons involving the whole class, individuals or small groups, and they can use it "to prompt discussion, explain processes, develop hypotheses or structures, and then to test these by varied application" (p. 9).

Through the early years of IWB diffusion, teachers reported significant satisfaction with IWBs. Kennewell and Beauchamp (2007) reported that teachers feel IWBs help engage students and keep them focused. They also feel that IWBs "stimulated thinking" (p. 230). Glover et al (2007) found that teachers are enthusiastic about the

introduction of IWBs and students are more motivated and engaged, particularly when the IWB is first introduced. Schuck and Kearney (2008) reported teachers' enthusiastic response to the technology, as did Cogill (2002), Higgins et al (2005) and John and La Velle (2004). Early research seemed to confirm what teachers perceived about IWBs. Beeland (2002) found a link between IWB use and increased student engagement. Cogill (2002) found that IWBs attract and retain students' attention. She also found that IWBs increase the pace of lessons because teachers do not have to spend time writing on dry-erase boards. IWBs also enable easy revisions to learning resources and they encourage "independent thinking skills in children and improve their cognitive skills" (p. 53). Smith et al (2005), in a review of literature drawing on teachers' perceptions of IWBs, indicated that the benefits of IWBs include the following:

- "flexibility and versatility

- multimedia/multimodal presentation

- efficiency

- supporting planning and the development of resources

- modelling ICT skills

- interactivity and participation in lessons" (p. 92)

As more empirical research and longitudinal studies have emerged, the research shifts away from claims about links to student achievement and toward demonstrable connections between teachers' willingness to adopt a more interactive teaching style and positive effects on learning. John and La Velle (2004) emphasized that teachers, not IWBs, determine effective use of the technology. This conclusion is in keeping with several other studies (Glover et al., 2007; Kennewell, 2006; Way et al., 2009).

Teacher Training and Professional Development

Divaharan and Hwee Ling Koh (2010) turned their understanding of the effects of interactive pedagogy on learning into a call for training and professional development in technical skills with appropriate linkages to curriculum and pedagogy. Kennewell (2006) asks how all teachers can reach the level of proficiency currently achieved by only the very best, and links solutions to training with clearer connections to an interactive, or dialogic, pedagogy. Glover et al (2007) called for teacher training focused on understanding interactivity, while Way et al (2009) emphasized "professional development opportunities that go beyond the technical skills and explore pedagogical issues … particularly regarding the promotion of student-centred activities, varied interaction patterns and increased discourse" (p. 3). Way et al and Cogill (2002) emphasized the link between supportive school leadership, an IWB culture and effective use of IWBs. Loveless (2011) noted that professional development focused only on skills training fails to engage "the more substantial nature of pedagogy" (p. 312).

With regard to in-service teachers specifically, Digregorio and Sobel-Lojeski (2009) reported that while technical training on IWBs is necessary, it is typically not very effective. Teachers require time and practice in order to develop their skills. Smith et al (2006) called for more research into how to support teachers' professional development needs so they can move to a more interactive pedagogy. Glover et al (2007) underscored the importance of providing training linked to an understanding of interactivity. They also note the importance of developing an IWB culture, providing adequate numbers of IWBs for each subject-specific area, and delivering opportunities for whole-school professional development. Divaharan and Hwee Ling Koh (2010) stressed in-service training with strategies for integrating IWBs into the curriculum. John and La Velle (2004) suggested

that a certain amount of technical troubleshooting skill is now a requirement if teachers are to integrate IWBs effectively.

The literature on IWBs and pre-service teacher training programs is also significant. Cooper (2002) recommended giving pre-service teachers abundant opportunities for hands-on experience with IWBs, while Hammond et al (2009) suggested that teachers who successfully integrate ICT have had "access, support for and modelling" (p. 59) of ICT in their teacher training. Divaharan and Hwee Ling Koh (2010) reported that considerable evidence exists to support the connection between faculty modeling of IWBs during pre-service training and successful integration of IWBs after graduation. Sessoms (2008) suggested that "[p]re-service teachers who enter the field without a concept of creating interactive learning environments may not develop an interactive philosophy as an in-service teacher" (p. 95).

Pedagogy

The amount of literature on IWBs and the need for pedagogic change is substantial. Cogill (2002) was early to make the link between successful IWB use and pedagogical change. Glover, Miller and Averis (2004) called more specifically for a shift from a didactic teaching style to an interactive one. Glover et al (2007) pushed for technology-enabled environments that "are directed towards enhanced and structured understanding" (p. 18) and suggested that teachers can progress to *enhanced interactivity* (Glover et al., 2005, 2007) if they first become literate with the technology. Kennewell (2006) noted that while it seems possible to use IWBs to support more student-centered learning opportunities, the "pedagogical transformation does not happen automatically when an IWB is installed in a classroom" (n.p.) and needs to be supported with resources, time and training. Mercer, Hennessy and Warwick (2010) suggested that those teachers

with a dialogic teaching style draw on a wider variety of IWB functions to support their approach.

In terms of general pedagogy, IWBs are being used to support a wide array of approaches. The structure of lessons often proceeds as follows: a teacher-led, whole-class activity focused on concept and skill development using the IWB, followed by group work with no IWB, followed by a plenary session in which the teacher uses the IWB to review main points and go over difficulties (Glover et al., 2007; Schuck & Kearney, 2008). Using Glover et al's (2007) categories of interactivity, this would fit the supported didactic stage and align with Kennewell's (2006) and Smith et al's (2006) findings that the introduction of IWBs does not require a fundamental shift in pedagogy. Kennewell went on to suggest that IWBs are particularly suited to this style of teaching and fit well with UK government policy mandating a whole-class teaching paradigm. Schuck and Kearney (2008) reported that most of the classroom interactions they observed were "dominated by the teacher but other instances approached 'dialogic' exchanges" (p. 9). Glover et al (2007) found that among teachers identified as using IWBs particularly well, 28% supported a didactic approach, 30% an interactive approach and 42% an enhanced interactive approach. Gillen et al (2007), in their examination of how IWBs affect pedagogic practice, drew on H.J. Smith et al's (2005) distinction between *technical* and *pedagogical interactivity*. Smith et al suggested that the act of touching an IWB, or physically interacting with its content, is *technical,* while the way that teachers use IWBs to facilitate student participation in whole-class discussion is *pedagogic*. Gillen et al conclude that IWBs, at the level of technical interactivity, have significantly altered teaching. However, at the level of pedagogical interactivity, "the picture is more complex" (p. 253). Teachers are more likely to "engage in a balance of strategies at a

number of levels" (p. 254). Tanner and Jones (2007) drew a similar distinction between the technological affordances of IWBs, which may increase pace, motivation and accuracy, and the "deeper features that are likely to offer more permanent value" (p. 40). Holmes (2009) noted that while IWBs have been quickly embraced by educators, the literature on their use is mixed, "with no clear verdict on the merits of this technology in relation to teaching or student learning outcomes" (p. 351).

Technological Affordances

The IWB's technological affordances, as discussed in this subsection, do not significantly challenge teachers' views of multimedia. That is, the affordances would be familiar to teachers vis-à-vis features from a variety of other multimedia products. Additionally, the term *affordance,* used in Gibson's (1979, as cited in Armstrong et al, 2005), suggests that the physical and cognitive aspects of visual perception in humans are inextricably linked. Armstrong et al (2005) described the phenomenon: "when we see an object we also see it in terms of what we can do with it—a chair is for sitting" (p. 459). An IWB's technical interactivity[**] may thus be exploited only if users perceive it to be interactive—the device does not *afford* interactivity otherwise. If a teacher is not aware that he or she can simply touch an IWB to activate many of its functions, then those functions do not effectively exist. Empirically, this concept finds support in Glover et al (2007), whose study suggests that teachers do not achieve effective learning with IWBs if they do not understand technical interactivity and how it links to pedagogical interactivity, in Smith et al's (2005) sense of these phrases. Armstrong et al link their understanding of *affordance* to an ongoing need for teacher support and training that

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[**] In discussions of why teachers are reluctant to adopt a more "interactive" teaching style, it is important to resist the temptation to blur the distinction between technical and pedagogic interactivity. Technical interactivity refers to the IWB's touch capability, while pedagogic interactivity refers to how teachers enlist IWBs to create a dialogic, rather than didactic, environment. Pedagogic interactivity occurs even without IWBs.

broadens teachers' understanding of how to make the transition from an awareness of technical affordances (or interactivity) to an understanding of how to enlist those affordances in the service of pedagogic interactivity.

One of the most frequently cited IWB affordances is its capacity to attractively display visual information. Many (Cogill, 2002; Davison & Pratt, 2002; Digregorio & Sobel-Lojeski, 2009; Glover et al., 2005; Higgins et al., 2007; Kennewell & Beauchamp, 2007; Schuck & Kearney, 2008; H. J. Smith et al., 2005; Way et al., 2009) drew attention to the IWB's ability to display color, movement, graphics, pictures, illustrations and video, all of which add visual interest and tend to improve the overall quality of lessons and presentations. Davison and Pratt (2002) identified key visual affordances as size, movement, color, pictures and computational graphics. Several (Digregorio & Sobel-Lojeski, 2009; Glover et al., 2005; Higgins et al., 2007; Kennewell & Beauchamp, 2007; H. J. Smith et al., 2005) also linked the IWB's visual characteristics to the teacher's ability to "capture and hold pupils' attention much more strongly than other classroom resources" (Higgins et al., 2007, p. 215).

The IWB's kinesthetic affordances are also widely recognized. Davison and Pratt (2002) identified key kinesthetic affordances as students' movement at the IWB, students observing others' movements at the IWB, teacher's movements and the interest generated by computational graphics (such as dragging an object). Way et al (2009) suggested that features such as zooming, annotating, hiding and revealing, spotlighting and manipulating objects enhance student learning and recall, while Cogill suggested that such features make the teacher's movements "more memorable and dynamic" (p. 31). Similarly, Smith et al (2005), in their review of the literature, suggested that annotating, concealing, manipulating, moving and zooming have been shown to improve learning and that the

"unique physical and tactile nature of the boards" (p. 97) can reinforce learning, particularly when students use the IWB themselves. Glover et al (2005) also discussed the literature's emphasis on kinesthetic affordances, connecting these to an eventual shift from a didactic to an interactive teaching style. Kennewell and Higgins (2007) noted that features such as highlighting, annotating and amending are "particularly supportive of interaction with ideas" (p. 210).

The IWB's auditory affordances are also significant, although Schuck and Kearney (2008) in a study of six Australian schools noted that teachers had more difficulty making the effective use of this affordance possibly because it was time-consuming to find resources. Littleton, Twiner and Gillen (2010) examined how a repeated audio-visual cue at the start of each lesson on Aztecs had the effect of orienting students to the subject before the teacher said a word and that this form of "multi-sensory contextualizing" (p. 133) facilitated subject-matter linkages between previous and current content. Many studies also cite the significance of auditory affordances in helping to engage a wider variety of learning styles (Beeland, 2002; Higgins et al., 2007; Way et al., 2009). Smith et al (2005) noted a study in which the combination of sound and visuals helped students learn about music; however, they cautioned that the research about the overall impact of such affordances on learning is varied and the link to student achievement is debatable.

Despite such cautions, the research overwhelmingly suggests that the impact of the IWB's multimedia affordances (regardless of their link to achievement) are substantial (Higgins et al., 2007; Kennewell & Beauchamp, 2007; Schuck & Kearney, 2008; H. J. Smith et al., 2005; Way et al., 2009). Gillen et al (2007) provided the example of a teacher who used a digital camera to videotape herself at her stove at home,

demonstrating how water evaporates in a hot frying pan, and who uses the video on her IWB during a lesson on evaporation. The integration of video, audio and teacher-led discussion enabled an integrated lesson in which students witnessed an event they would not have otherwise been able to view. Virtually all such studies linked these affordances to increased student engagement, while some also linked IWBs to faster-paced lessons with smoother transitions (Gillen et al., 2007; Higgins et al., 2007), as would have been the case with the lesson on evaporation—the teacher did not have to switch between presentation devices in order to show the video. Several (Higgins et al., 2007; Kennewell & Higgins, 2007; H. J. Smith et al., 2005) also suggested that multimedia and multimodal affordances help teachers convey, and students grasp, difficult concepts more easily. Kennewell (2006), taking the concept of multimodality further, said it, in fact, "define[s] the version of knowledge and student identity to be promulgated. IWB resources are seen as multimodal texts, and the features of IWB[s] as affordances and constraints for the design of these" (n.p.).[††]

Kennewell and Beauchamp (2007) took a different approach to affordances in their desire to create a new taxonomy of features that characterize the unique qualities of IWBs over other information and communication technologies (ICTs). They first catalogued and categorized actions observed during many IWB lessons. These were composing, editing, selecting, comparing, retrieving apprehending, focusing, transforming, role playing, collating, sharing, annotating, repeating, modeling, cumulating, revisiting, undoing, questioning, prompting and responding. They then analyzed which features were related to specific actions, and they distinguished between *intrinsic* features, which seem "fundamental to the nature of ICT" (p. 233), and

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[††] For a more complete review of IWB affordances and their connection to pedagogy, see Higgins et al (2007).

constructed features, which appeared to be created out of the intrinsic features "during

the design of the hardware and software resources" (p. 234). A significant intrinsic

feature, for example, is speed; that is, IWBs enable a fundamentally faster pace than other

devices. Speed, in turn, enables a variety of constructed features, such as timeliness,

dynamism, simultaneity and multimodality. Extrapolating from their data, it appears that

speed provides intrinsic support for a majority of constructed features (13 of 19), and

these, in turn, afford or constrain the following actions: composing, selecting, comparing,

retrieving, apprehending, transforming, role playing, collating, sharing, annotating,

modeling, cumulating and responding. Kennewell and Higgins (2007) suggested there is

often "a trade-off between pace and interactivity. It is often the case that deeper thinking

is carried out away from the board" (p. 209). As we will see later in this study, this kind

of trade-off betrays not only unsettled and sometimes contradictory IWB identities, but

also different educational networks whose opposing ideologies attempt to define IWBs in

a particular way and then enlist them for their own purposes.

Disruptive Affordances

In addition to technological affordances that seem familiar to many users

(projection, annotation, a PC interface, video playback and so forth), IWBs offer

disruptive (Christensen, 1997) affordances that invite or challenge users to behave in new

ways. The literature is replete with articles that doubly characterize IWBs in a

contradictory manner: as perpetuating a more traditional, didactic pedagogy, on the one

hand, but also a more interactive, dialogic pedagogy, on the other (Cogill, 2002;

Digregorio & Sobel-Lojeski, 2009; Glover et al., 2007; Holmes, 2009; Kennewell, 2006;

Schuck & Kearney, 2008; Tanner & Jones, 2007; Way et al., 2009). Thus, IWBs can

function as glorified presentation devices supported by behaviorist underpinnings, *and*

they can function as collaborative learning devices supported by situated learning and constructivist underpinnings. The latter characterization appears to emerge from the IWB's disruptive affordances. As Christensen (1997) said in *The Innovator's Dilemma,* "Disruptive technologies bring to market a very different value proposition than had been available previously" (p. xv). In the case of IWBs, digital integration and multimodality make a sequence of actions like the following possible where before it was not:

Whole class	Teacher	Student	Small Group
Watch video, some students in class, some live online	Annotate over video during playback	Research video topic on Internet using student laptop while teacher goes quietly from student to student to answer individual questions	Analyze research and report/broadcast findings to whole class by linking personal laptop (individual learning device) to IWB (collaborative learning device)

The IWB functions not only as a digital integration hub (Lee, 2010) that supports multimodal texts, but as one device[‡‡] among many that fundamentally shifts the pace, content and sequencing of information and access in the classroom. As Twiner et al (2010) noted, "it is the combination, sequencing and easy alignment of information presented in different modes, *resulting in a composite text,* that use of the IWB can add to the classroom in addition to that provided by previous technologies" (p. 215, emphasis added). In a similar turn, Gillen et al (2008) referenced the IWB's *multiplying effect,* as defined by Baldry and Thibault (2006): i.e., its ability "'to capture the way in which different semiotic modalities co-contextualize each other in ways that are not predictable on the basis of the different semiotic resources seen as separate modalities'" (as cited in Gillen et al, 2008, p. 357). In other words, a kind of collective coherence, or text, emerges where there would be none if various modalities and media were enlisted separately. Like

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[‡‡] or one actor, as will become apparent later

Twiner et al, Gillen et al also noted that the ease with which IWBs facilitate "interactions with multiple modes of representation" (p. 357) significantly affects the pace and continuity of lessons because teachers can use their laptops and IWBs to rapidly access, assemble and deploy "complex combinations of artefacts" (p. 357)—activities that would have been previously prohibitive. Haldane (2007) made a related observation:

> it is the stability afforded by the IWB and the way that teachers and learners are able to interact with the symbol systems displayed on it that make the IWB very different from television, video, books or static boards. It is also engagement in the social and cognitive learning experiences that take place whilst other learners are interacting with the symbol systems displayed on the IWB that makes it different from individual PCs, books and hand-outs. (p. 265)

As educational technology evolves, it becomes increasingly important to distinguish between personal computing devices and collaborative computing devices, that is, between devices such as student laptops or tablets, which enable private (or personal) explorations, and devices such as IWBs, which enable whole-class (or collaborative[§§]) discussions and learning. How students attend class—in person or virtually, synchronously or asynchronously—also plays a role in teachers' ability to orchestrate learning, with lessons potentially becoming more of a seamless flow of synchronous and asynchronous experiences rather than a series of discrete, unrelated subjects delivered in linear fashion via multiple media in a physical classroom over a specified period.[***]

[§§] I do want to retain a distinction between whole-class and collaborative activities. Whole-class activities can be teacher-centered and didactic or student-centered and dialogic. Collaborative activities are student-centered and dialogic.
[***] For a somewhat different approach to this question, see Gillen et al, 2008.

The literature itself is beginning to reflect the significance of such distinctions in studies highlighting a need to orchestrate modalities and media (Gillen et al., 2008; John & La Velle, 2004; Kennewell, 2006; Kennewell & Beauchamp, 2007; Twiner et al., 2010). A few years ago, one-to-one computing was believed to be a significant new trend. However, the need for whole-class pedagogy did not go away and neither did the need for IWBs, so one-to-one computing simply became one possibility among several. There is now an emerging focus on navigating personal and public space, enabling fluid transitions between the physical classroom and cyberspace, between teacher-led instruction, student exploration and small group work, and between technologies that connect classroom, digital resources, school, administration and home. Within this context, IWBs offer a common place to construct and review new kinds of continuous and discontinuous texts and symbol systems. Haldane (2007), in her study of four English primary schools over two years, provides an excellent example of the extent of orchestration now occurring:

> content originally generated for IWB lessons was [later] accessed via the schools' suite of PCs… These suites were also available for homework clubs etc. to improve access, particularly for those without PC internet access at home. Pupils who accessed the internet from school or under guidance at home were encouraged, in one school in particular, to recommend websites relevant to the current topic and time was set aside each week to explore those sites together via the IWB. (p. 269)

Higgins, Mercer, Burd and Hatch (2011) added multi-touch tables to the technology mix in educational settings, while Yang and Lin (2010) addressed the issue of enabling

smoother transitions between personal computing devices and shared displays with shared display groupware.

Another disruptive, yet not often acknowledged, affordance of IWBs is pace. Nespor (2011b) said that devices "shape change by slowing things down (orienting work around devices that don't exist yet and require development processes), or speeding things up (creating devices that seems to do in a short span what otherwise requires long, complex interaction)" (pp. 15–16). John and La Velle (2004), in their study of teachers' views of ICT more generally, observed increases in pace, or speed, with ICT, because it "speeds up the search for and relay of information" (p. 316). All teachers in the study acknowledged how ICTs helped speed up the creation of classroom resources, and "many used ICT to carry out basic administration including record keeping, assessment and the storage of data" (p. 317). What is true of ICTs more generally is also true of IWBs in this case. One consistently reported, recurring effect of IWB use is an increase in the pace of lessons. Kennewell (2006) noted that teachers "implement the notion of pace through preloading materials, rapid movement between screens/programs, and revising material for review)" (n.p.). Twiner et al (2010) noted that with fewer requirements to shift between pieces of equipment in order to add more multimedia and multimodal resources, there is no "enforced loss of pace" (p. 214). Higgins et al (2005), in their report on embedding ICT in the UK literacy and numeracy strategies, stated that the IWB lessons they observed were faster paced than non-IWB lessons, as measured by "an increase in the total number of interactions between the teacher and pupils" (p. 4). They also noted that while teachers did not follow up on student responses as much in the IWB lessons, there were "more open questions, repeat questions, probes … longer answers from pupils, and general talk in these lessons" (p. 4). Gillen et al (2007) also found an increase in the

pace of lessons, but they noted the opposite with regard to how much time is spent in discussion. Smith et al (2006), in their study of how IWBs affect teacher–student interactions, demonstrated that the lessons were faster paced and, as Gillen et al suggested, more generally focused on the whole class. Smith et al also concluded that while students answered more often in IWB lessons, their answers were shorter. Tanner and Jones (2007) noted that the tension between pace "and allowing children time to think, reflect and offer more complex answers is often resolved in favor of pace" (p. 37). Holmes (2009) suggested that the possibilities for increased interactivity with IWBs is, however, confounded by the literature. All the research that links IWBs to increases in student achievement shifts the burden of change from IWBs to teachers themselves, who now must strive for a level of enhanced (Glover et al., 2007) or pedagogical interactivity (H. J. Smith et al., 2005).

Within this context, Lee's (2010) notion of the IWB as a large-screen digital convergence device takes on more significance: What is the new context for IWBs? What, for example, is the role of IWBs within a technology-enabled collaborative learning environment? What new technologies and affordances converge upon the IWB in this kind of environment? There is a growing recognition, for example, that proprietary IWB software that enables teacher and student access to lessons and resources from a variety of devices, including the cloud, has become an increasingly important way to navigate between devices—in effect, creating an ecosystem of affordances and access that extends ubiquitously beyond the classroom to the home, library, coffee shop or wherever one may be. What are the new pre-service and in-service teacher training requirements for these environments? Should IWB training occur in isolation from other educational technologies? How do we forge links between technology, education theory,

curriculum and pedagogy? In a recent examination of the performative effects of educational technologies on teaching practice in higher education, Hannon and Bretag (2010) observed a disconnection between policy and "the actual work of organizing people, technology, and resources [which] is complex and does not match the abstracted model of the delivery platform" (p. 117). The history of IWB diffusion into education follows a similar pattern. In 2003, former Secretary of State for Education and Skills in the UK declared that IWBs would revolutionize schooling, and yet, eleven years on, we struggle with how that may happen. In fact, as the literature would suggest, the potential is there, the enthusiasm is there, the research base has grown substantially and determined teachers are making progress in this direction. But perhaps, eleven years on, the revolution is happening under a different banner: one which includes a multiplicity of devices, modes, styles, texts, timeframes and spaces. One which requires a different way of thinking about educational technology. One which places IWBs and teacher training within this complex environment and then exploits theories and pedagogies more suited it.

Theoretical Underpinnings

Actor-Network Theory

In terms of this project, I was initially focused on how students and teachers negotiate the space around IWBs in a classroom. During observations of IWB training, I could see that the space around the IWB was very much controlled by the teacher. But the students, the placement of the IWB, the room design and layout, the learners' reluctance to come up to the board when asked, and what appeared to be the prior expectations of an appropriate learning experience—all seemed to contribute to the definition, or

constitution, of that space. The co-construction of boundaries and the negotiations related to those boundaries were compelling.

Several aspects of actor-network theory (ANT) and after-ANT came to mind as lenses for reasonably assessing what was happening in the IWB classroom. But before proceeding to these, some central concepts related to ANT need definition[†††]. The first is Callon and Latour's (1981) notion of *actor*:

> 'What is an actor? Any element which bends space around itself, makes other elements dependent upon itself and translates their will into a language of its own. An actor makes changes in the set of elements and concepts habitually used to describe the social and natural worlds. By stating what belongs to the past, and of what the future consists, by defining what comes before and what comes after, by building up balance sheets, by drawing up chronologies, it imposes its own space and time. It defines space and its organization, sizes and their measures, values and standards, the stakes and rules of the game—the very existence of the game itself. Or else it allows another, more powerful than itself, to lay them down.' (Callon and Latour, as cited in Nespor, 1994, p. 21)

This study assumes IWBs have the ability to act, in Callon and Latour's sense of the word, on educational practice. The focus here is on *how* IWBs affect educational practice and what kind of particular network emerges as a result of their presence in the classroom. More particularly, I am interested in the effects IWBs have on space and time and how these may contribute to the co-construction of boundaries around IWBs.

Another critical term, for my purposes, is *agency*, an understanding of which I take from Jan Nespor (1994, 2011a), among others. Like all scholars of ANT, Nespor

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[†††] This paper assumes some familiarity with ANT and after-ANT, so rather than providing a basic overview of ANT, I examine only the terms and concepts that are relevant to this study.

rejects the notion that humans are the only entities with agency, i.e., with "'the capacity to act and to give meaning to action'" (Callon, as cited in Nespor, 2011b, p. 16). Agency is related to both human and nonhuman actors, and it is not an inherent quality of single entities. It is, said Nespor (citing Law, 1994, and Callon and Law, 1995), an effect of network relations. Agency could not exist except for entities' entanglement in networks, and these may both enhance and mitigate their agency. Although those familiar with ANT will understand that acknowledging agency in nonhuman entities does not lead to technological determinism, it is useful to reiterate Law (1999), who reminds us that technology is relational rather than deterministic.

Applying the foregoing terms in the context of this study, the IWB is an actor with agency, "produced by and simultaneously produc[ing]" (Law, 1999, p. 3) effects within a particular network of relations concentrated in education.

Another concept critical to this study is an understanding of actor-networks as spatial and temporal. Nespor (1994) defines ANT as portraying "activity in terms of the efforts of an explicitly distributed and spatialized network of entities whose linkages to one another are ongoing accomplishments" (p. 12). Nespor's definition emphasizes network space and distribution, which invites a view of the IWB classroom that extends far beyond the classroom itself: "we have to treat interaction," he says, "as involving not just physically co-present humans but artifacts and environments which congeal past action … and mediate the ongoing transactions of people widely separated in time and space" (2011b, p. 17).

This idea is similar to Law's notions of distance and space, which are not geographical so much as conceptual: "spatiality isn't just about the Euclidean space of the globe, the space dealt with in physical geography … it is also about material networks

which imply a different form of space" (p. 3). An ANT analysis of space related to IWBs may, for example, look at regional boundaries within the physical classroom, but it may also look at how those boundaries fold in, or represent, other, more distant spaces, such as the district school board, education scholarship, administrators or education policy. Law asks whether certain network elements that are present in one location—a government education department, for example—can "hold their shape" (p. 5) as they fan out into another location—the classroom, for instance. He refers, of course, to Latour's (1987) notion of the *immutable mobile,* wherein "a network of elements … holds its shape as it moves" (Law, 1999, p. 5). Using again the example of the education department and the classroom, an immutable mobile in this case could be mandatory curriculum materials and their related implementation guidelines. Applying Law's insight to this example, we would want to ask if these elements "hold their shape" as they disperse into the classroom, and in many ways they do—school boards, schools, principals and teachers are professionally bound to deliver the mandated curriculum.

For Law (1999), such questions "are ways of talking both about *action at a distance* or domination, and about *knowledge at a distance* or surveillance" (p. 5). Immutable mobiles are like foot soldiers for command and control centers, doing the work of the center away from the center, and, in the process, *performing "distance or space* … into being…. Which means that distances and space don't exist by themselves as part of the order of things. But rather that they are created" (p. 5). In the process of being created, space and the knowledge that travels through it are compressed vis-à-vis representations that stand in for a larger, centralized body of knowledge and seat of power. Behind each point in a curriculum, for instance, is a larger body of knowledge that exists at the school board level or education department level and that educators draw on

to determine what students should or should not learn. That larger body of knowledge is scaled down into curriculum items and guidelines that travel as immutable mobiles through the educational network.

In this study, I examine a particular disruptive affordance of the IWB—pace—as an immutable mobile, enlisted as a delegate in two competing networks, each fighting for its own definition of the IWB. One is a *neoliberal* network[‡‡‡] comprised of teacher-centered learning paradigms, managerialist approaches to administration, achievement and testing standards, curriculum guidelines, standardized learning materials, and a tight focus on data, dollars and budgets. The other network is a *collaborative* one comprised of constructivist and situated learning theories, student-centered learning paradigms, and greater integration of interactive and collaborative technologies in the classroom. Far from being a stabilized technology, the IWB is in a state of fluid evolution, and the networks struggling to define it will eventually determine whether the IWB's value is found in the service of traditional teacher-directed educational paradigms or in a yet-to-be-defined collaborative education enterprise. From an actor-network perspective, the IWB is both constructing and being constructed by these assemblages.

Returning to Nespor's definition of ANT, a network is also inherently tenuous. In his study of device-mediated change in education, Nespor specifically examines the potential for devices to alter education and organizations. Devices

> re-shape relations among organizations by enrolling allies, or weaken
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> organizational boundaries by making them vulnerable to formerly excluded
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> claimants. Finally, devices can be used to reorganize agency itself in core

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[‡‡‡] Neoliberalism grew out of a 19th-century *laissez-faire* interpretation of economic policy and freedom. In education, it often refers to the belief that schooling should be run like a business and that its primary purposes is to train or prepare students for jobs in a globalized marketplace.

organizational activities—shifting the location or attribution of who does what, shifting participants from one actor category to another, or creating new categories of agents. (2011b, p. 16).

Given my own experience with IWBs and my sense of how pre-service and in-service teachers learn to use IWBs, the IWB seems to be shaking the roots of a previous network, demanding change and offering new ways to engage with content and learning. It is this form of agency that troubles the current educational network, whose locus of domination and surveillance must shift if the new network is to come genuinely into play.

Estrid Sørensen' Methodology

I adopted the lens of actor-network theory and Estrid Sørensen's conception of *presence,* which seemed relevant because it provided a framework for ways of viewing how certain forms of participation are enabled or constrained. Her focus is on how humans behave with materials and not on how they "make sense of materials" (2009, p. 138). She also examines forms of technology and forms of knowledge, but her study of forms of presence differs in that it focuses specifically on human (as opposed to nonhuman) activity as a "performative effect" (2009, p. 139) of the socio-material educational network. Humans are enacted as a consequence of their participation in networks. She attends to the patterns of relations "through which humans are performed" (2009, p. 138) and examines teacher and student use of the blackboard in order to identify these patterns. For this study, and the pre-service and in-service teachers I observed, the IWB represents a relatively new addition to the classroom, one which physically replaces and, at the same time, conceptually extends blackboards and dry-erase whiteboards. Without adopting a humanist perspective, what new forms of *human* are being enabled or constrained by its presence in this new assemblage?

To explain her conception of presence, Sørensen draws on "the notions of subject (*Althusser*), collective (*Asplund*), and agent (*Giddens*), which are widely used terms concerning human presence" (p. 139). More specifically, she suggests that each of these is a form of presence that interacts with the other forms, each co-constructing the other, thus resulting in a pattern of relations related to presence in the classroom. Rather than explaining ways of being, however, the concepts are "performed in interaction and … may change from moment to moment" (p. 139).

Regional materialities. She begins her examination of the blackboard by providing an example of a teacher writing each letter of the alphabet on the board while students sing the alphabet song, with each written letter emerging as each letter in the song is sung. The blackboard focuses students' attention because, she notes, "The teacher and the emerging visual materiality of the letters she was writing on the blackboard co-constituted one single and central geographic place to which the pupils' attention was drawn" (p. 141), thus constituting a *one-to-many relationship,* with the teacher as *one* and the students as *many*. She then contrasts this event with another in which the students sing a commonly known song together. In this activity, because the students know the words to the song, they do not need to look at the board. Rather, they look around the room, smile at each other, move their bodies in rhythm to the song and sing. These behaviors together constitute a form of *collective*.

Drawing inspiration from Asplund's (1985) sense of *collective*, Sørensen describes how the song, the students' movements, the smiles and eye contact all mutually co-construct the collective, with no single person standing out more than another and with all of them focused on the task of singing the song. The activity involving the alphabet song and the blackboard, however, created no collective—the teacher and

emerging letter forms were central, and the students' gazes were fixed there. In this activity, a separation existed between teacher, board and students, so no collective action could emerge. This activity had the effect of creating two separate regions in the classroom—one for students and one for the teacher. The blackboard's role in this environment was to facilitate the creation of "regional patterns of relations" with the board acting as a "pivotal material" (p. 144). This particular function of the board was evident not just here but in most of the lessons Sørensen observed. Its particular purpose was to create a space that was separate from students but to which their attention could be drawn.

Not only were students separate from the board, observes Sørensen, but the vocabulary associated with its use also defined regions of separation. The teacher called students "up" to the board and then asked them to return "down" to their seats. The "lines of attention" (p. 145), or students' gazes, also constructed this separation between students and the blackboard, with students sitting (*here*) and facing the board (*there*). The teacher, on the other hand, was connected to the region of the blackboard in ways that students were not. Students had to receive permission to come to the board, and when at the board, they received the same kind of attention given to the teacher writing on the board. When finished, however, they were often applauded. The teacher, by contrast, did not require permission to enter the board's space, and no one ever clapped for actions performed there. The teacher was part of that region. The board was also associated with particular kinds of activities that further entrenched notions of separation, regionality and patterns of interaction. Writing was the most critical activity, and the teacher most frequently performed it.

In the same way that students sometimes entered the teacher's region, the teacher sometimes entered the students'. However, the visit was always seen as temporary and never long-lived. Sørensen describes it as such: "The pupils as well as the teacher always stayed only briefly in the 'Other' region, as if a rubber band was attached to them, always pulling them back to their 'own' region" (p. 147). This understanding of regions performed students and teachers as outsiders when they were not in their own space.

Sørensen also notes that the physical layout of the classroom contributes to performing these regions, with students' desks physically separate from and facing the blackboard (and teacher), while the teacher was situated comfortably in the region of the blackboard and facing the students. The one-to-many relationship also constitutes students as homogeneous, as *them*, and easily enables "a broadcasting mode of interaction" (p. 148), which is typically also associated with a didactic form of pedagogy.

Subject–authority relationships. Given how the blackboard is enlisted to perform regions and patterns of relation in the classroom, Sørensen suggests that it also contributes "to performing the teacher's presence as that of an authority vis-à-vis the pupils" (p. 148). The board's large visual appeal and placement at the front of the classroom work in concert with the students, the direction the students face, the teacher's control of the space around the board, the teacher's regular stance beside and around the board, what the teacher says to the students and what the teacher writes on the board. Through this constellation of situated performances, the teacher's presence as an authority is maintained.

Sørensen then discusses how the students and teacher co-construct one another. If the teacher is *authority*, then the students are *subjects*. Sørensen discusses Althusser's (1971) concept of *interpellation,* which is a process of domination and subjugation

[that] can be imagined along the lines of the most commonplace everyday police

(or other) hailing: 'Hey, you there!' … the hailed individual will turn round. By

this mere one-hundred-and-eighty-degree physical conversion, he becomes a

subject. (Althusser, 1971, p. 174)

In other words, someone is interpellated, or hailed, by another, and in the simultaneous

moment of hailing and recognition, the person hailed recognizes and accepts the

designation, or subjugation, of the hailer. Althusser then goes on to suggest that the act of

recognition and hailing, while occurring sequentially in the example above, are not

temporal constructs, because people are

always-already subjects…. Before its birth, the child is therefore always-already a

subject, appointed as a subject in and by the specific familial ideology

(paternal/maternal/conjugal/fraternal) in which the unborn child is expected … it

is in this implacable and more or less 'pathological' … structure that the former

subject-to-be will have to 'find' 'its' place…. (Althusser, 1971, p. 176)

Before students even walk into the classroom, then, they are always-already *subjects*,

"born" into a highly structured educational environment that subjugates them into the role

of student.

Sørensen is careful to clarify her understanding of subject–authority relationships

with three points. First, Sørensen, extends her understanding of *interpellation* to the

material, or nonhuman. The relationship that comes into being via interpellation cannot

occur, she contends, outside the context of "quite specific spatial—regional—

arrangements of humans and nonhumans" (p. 150). She is also concerned that we

acknowledge the performative effects of specific materials. Foucault (1971) notes, for

example, that students respond instinctively to the authority of the teacher's voice.

Sørensen questions whether it is the voice, specifically, or if something else could elicit the same respond—snapping fingers or clapping hands, for instance. "It has become clear," she says, "that the materialities are not arbitrary. Not just any material can be formed to work as an instrument for discipline or authority … different materialities make different actions and presences available" (p. 151). Sørensen observed that the blackboard is much better at securing and maintaining whole-class attention than is the teacher's voice (as opposed to individual children occupied with other things), and as a consequence, it plays a critical role in constituting the subject–authority relationship.

Secondly, Sørensen reasons that if different materialities create different kinds of presence, then many forms of presence are possible. Her third point is also about interpellation and concerns the reciprocal nature of the relationships—the teacher's and students' presence are co-constructed; one could not exist without the recognition of the other. Even when students are engaged in non-educational activities, such as secretly passing notes to each other or playing discreet games with a pencil and eraser, the students' alternative presence does not challenge the teacher's authority; in fact, the secrecy of the activities "contributed to performing the authority of the teacher" (p. 154). As well, the activities undertaken in the students' region were markedly different from those undertaken in the blackboard's region. Alternative forms of student presence could be enacted in the students' region, but not in the blackboard's region.

The physical layout of the classroom also contributes to creating regional boundaries within which only certain forms of presence are enacted. The separation between the teacher's region and students' region is clear, as are acceptable behaviors for each region. Students become students (subjects) when they enter the classroom and take their seat at a desk facing the blackboard, and the teacher becomes the teacher (authority)

when he or she enters the classroom and takes a position at the front of the room near the blackboard. The teacher can surveil each student simply because the walls in a typical K–12 classroom enable it. The students can easily fix their attention on the teacher because their desks all face toward the teacher and the blackboard. Were the teacher and students in a virtual learning environment, surveillance and attention would not be as straightforward.

Discontinuities and fluidity. Sørensen leaves her examination of the blackboard to look more closely at patterns of relation and presence in a virtual world, wherein students choose avatars and are given some general rules and a broad task to rebuild a section of their world. In comparison to the classroom, they act quite autonomously. It may appear at first glance that a virtual world is not relevant to classrooms with IWBs. However, the virtual does come into play when the IWB functions as a collaboration device that provides small groups of students with access to digital resources and the Internet, when students work individually on their laptops to develop an IWB lesson as part of their training, or when the IWB is used as a conferencing tool to enable student to join the class from a distance. In the case of pre-service and in-service teacher training on IWBs, the classroom takes on a number of roles: it resembles a university classroom with tables and chairs, a computer lab where students may use computers to enter virtual space and access digital resources, and a kind of group-work lab where students can use space more spontaneously and informally to collaborate on projects using personal or collaborative computing devices. If, as Sørensen notes, the forms of presence shift with different, specific materialities, then her analyses of a virtual world may provide insights for an examination of the digital and virtual space in an IWB classroom.

Patterns of relation in the computer lab are unlike the subject–authority/one-to-many patterns of the classroom. Sørensen describes the relation between an offline researcher (who functions like a teacher in the computer lab environment) and an online child as *one-to-a-half* because, while online, the child gives only half of his or her attention to the offline researcher. The other half goes to the online environment. This pattern does not lead to a strong connection between student and researcher, and, in Sørensen's case, it even enables one online student to disregard the offline researcher without much fear of repercussion. Another pattern of relation specific to virtual environments is described as *one-to-one,* in which both the student and researcher are online, each with an avatar, in the same part of the virtual world. Again the connection between student and researcher is perilous. In one instance, the student made his avatar run away from the researcher's avatar because he did not want to engage in the researcher's activity. As Sørensen notes, "This would never happen in the classroom" (p. 159).

The researchers' patterns consist of temporary sequences of one-to-one or one-to-a-half relationships. They are either seated between two children and shift their attention from one to the other, or they are walking around the computer lab from child to child, which makes them appear restless and uneasy. The students' relationships are, however, continuously focused on the online world, and the "researcher was an exchangeable and optional part of the process" (p. 160). Sørensen compares the separations that occur within virtual space to the boundaries in classrooms. The extent of the virtual world was vast compared to the classroom. It was impossible for researchers or a teacher to monitor all students, and it could even prove difficult to keep track of one student–avatar if he or she chose to get away from the researcher. The teacher or researchers had limited access

to the children and their work. And one cannot, as Sørensen notes, compare this scenario to students working individually in workbooks, because the teacher can get an immediate overview of a student's workbook and progress by looking at the page. All students' workbooks are the same and do not, as in the virtual world, extend beyond what is presented on the page. Thus, as Sørensen notes, the extent of the virtual world is substantially greater than that of the classroom, which, as a consequence, performs different patterns of relation and presence.

In addition to having far more room to roam outside the teacher's view than in a regular classroom, students in the virtual world were all doing different things, most of which were spontaneous and unpredictable. These activities, in turn, affected the nature of the world being built. So the terrain of the virtual world was constantly in flux, and the children's activities were unpredictable. This created a "fluid pattern of relations [that] allowed the activities to turn in all sorts of directions" (p. 163). In a regular classroom, exercise books do not change, and children's responses to them are more or less predictable. The workbooks help to maintain boundaries between teacher-and-student, authority-and-subject. In the virtual world, Sørensen calls the separations and connections occurring between teacher and students a *discontinuity*:

> the children and teacher were sometimes connected, sometimes separated. When
> connected, they were intimately connected. The teacher logged on to the virtual
> environment and collaborated with the child. In the regional pattern of relations of
> the classroom, the teacher and pupils did not collaborate … In the virtual
> environment, however, the teacher and child met at eye level, so to speak. (p. 164)

This kind of pattern creates a "symmetric relationship" (p. 164) in which both the teacher and students are *agents*, in Giddens' (1984) sense of the word: "'[T]o be an agent is to be

able to deploy … a range of causal powers, including that of influencing those deployed

by others. Action depends upon the capability of the individual to make a difference, that

is, to exercise some sort of power'" (as cited in Sørensen, 2009, p. 164). Quite unlike the

subject–authority form of presence in the classroom, this form of presence is fluid and

adaptable as agents interact and respond to each other's activities.

Unlike Butler's (1997) or Mead's (1932) understanding of presence, which insist

on a distinction between self/subject and Other, says Sørensen, forms of presence can

also be enacted in patterns of relation that are not regional but agential and fluid. It

follows, then, says Sørensen, that authority, which is regionally performed and depends

on a subject for its existence, is not enacted in the virtual world—hence, the restlessness

of the teacher, who is literally displaced by an agential form of presence that performs

equality rather than authority. Sørensen then asks whether one can have a form of

authority in fluid space and reasons that one can: "Creating fluid authority could involve

supporting the teacher in giving feedback to the children in the blog and through the

virtual environment in a way that better feeds into the fluid processes" (pp. 167–168).

This approach would make it possible to influence the behavior of the students in ways

similar to an authority, but in ways that also recognize the tenuousness and discontinuity

of that authority.

In a final turn of thought on presence, Sørensen discusses Andrew Barry's (2001)

notion of interactive technologies, which contrasts markedly with Foucault's (1979)

understanding of disciplinary technologies:

'Whereas discipline is exhaustive in its application, interactivity is specific,

instantaneous and intensive. Whereas disciplinary technology manipulates and

manages the body in detail, interactive technology is intended to channel and

excite the curiosity of the body and its sense … Whereas discipline is direct and

authoritative, interactivity is intended to turn the user … into a more creative,

participative or active subject without the imposition of a direct form of control.'

(Barry, as cited in Sørensen, pp. 168–169)

Sørensen relates Barry to David Shutkin (1998), who proposes that while educational

technology is still, as Foucault suggests, about power, it is a form of power that says *yes*

rather than *no*. Sørensen believes this form of power is fluid: "a power that makes

available ongoing mutation and flexibility but that also creates discontinuities and

unreliability" (p. 169).

In conclusion, Sørensen carefully reiterates her belief in "the spatial character of

presence" (p. 170). Her position is decidedly post-humanist and socio-material. "Human

presence is formed," she notes, "through arrangements to which materials greatly

contribute" (p. 171), and through these arrangements, we may begin to see how forms of

presence may displace authority, or even our traditional notions of regional space, with

other possibilities. She also makes connections between forms of presence and forms of

learning. In an authority–subject form of presence, for example, learning may resemble

imitation and transmission. In an agential form, learning may look more collaborative and

participatory. In closing, she acknowledges the need for more empirical research,

particularly as it relates to ethnic and language minority students, who, according to

Warschauer (1998), can be left out of "collaborative, reflexive, and communicative

participation in the implementation of interactive software in schools" (p. 174).

Methods

The methods for this study involved unstructured, nonparticipant observation, note-taking and video capture of four IWB training sessions for in-service teachers[§§§]: two SMART Notebook Software Level 1 (basic) sessions and two SMART Notebook Software Level 2 (advanced) sessions. Three sessions were open to in-service teachers only; one session was open to pre-service and in-service teachers. A few weeks prior to observing, I had also observed (without notetaking or video capture) two SMART Notebook Software sessions for pre-service teachers, one Level 1 and one Level 2. During the recorded sessions, I focused attention specifically on the movements, activities and conversations related to spatial navigations in the classroom, particularly around the IWB.

Consent was obtained from the instructor for the observation component and from the students and instructor for the video capture. The consent form followed the guidelines specified in the university's "Model Clauses for a Consent Form for Academic Research Conducted in Accordance with Research Ethics Policy and Guidelines." Copies of the forms are provided in appendices A, B and C.

The study was designed to ensure as little interruption to the sessions as possible, so I could capture, inasmuch as possible, what would typically happen in a training session of this nature. I sat outside of the coterie of students, at the back of the room with a small, table-mounted video camera and a laptop. The video camera recorded each session, and I took notes on the laptop. I arrived ten to fifteen minutes early so I could set up my equipment at the back of the room and distribute consent forms. I used the remaining few minutes before the session to sketch out the seating arrangements and identify where students sat in relation to the two SMART Board interactive whiteboards

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[§§§] One session had three participants, one of whom was a pre-service teacher.

and small technology stations in the room (see Figures 1–4 below). Once the session began, the instructor introduced me, at which point I explained the nature of the study and went through the process of obtaining participant consent. I then returned to my position at the back of the room and stayed there for the duration of the session. The instructor used (as she normally did) a classroom amplification system, which involved wearing a microphone whose sound was projected through ceiling-mounted speakers across the room. So sound quality in the video was not an issue. The field notes and video files were later analyzed using Estrid Sørensen's methodology for understanding human presence in the classroom.

The methodological assumptions of the study are those that go along with actor-network theory (ANT). These include the belief that both human and nonhuman actors have agency and that agency is a relational effect; that is, human and nonhuman actors both create and are created by agency, which is an effect of a series of interactions between actors connected precariously by a web of intricate relations. The study also assumes that space and time are network (or relational) effects, because they are, as Law (1999) says, created as a consequence of network interactions, rather than existing autonomously as physical phenomenon.
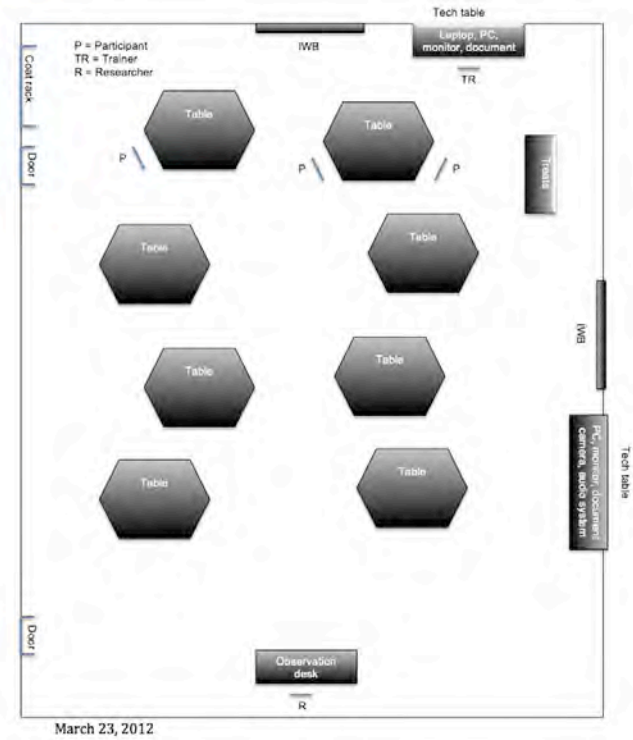
Figure 1 – Three participants. A sudden snow storm keeps many from attending.
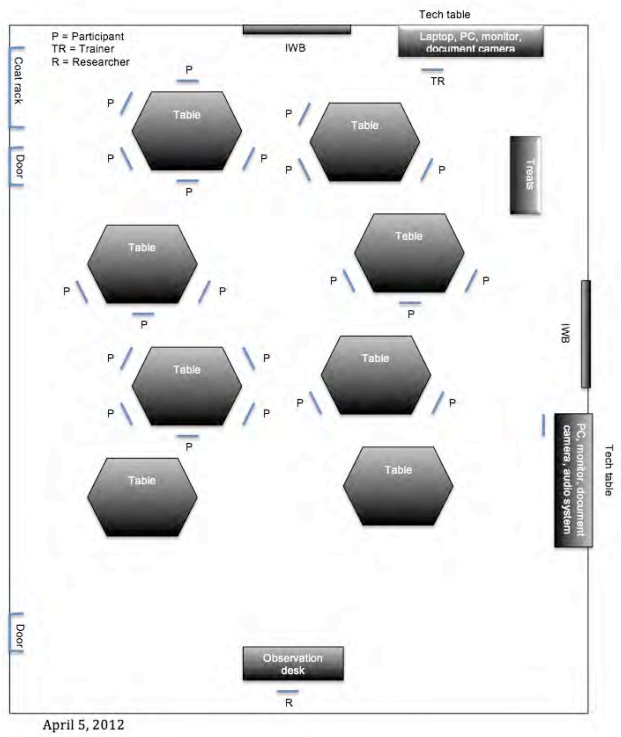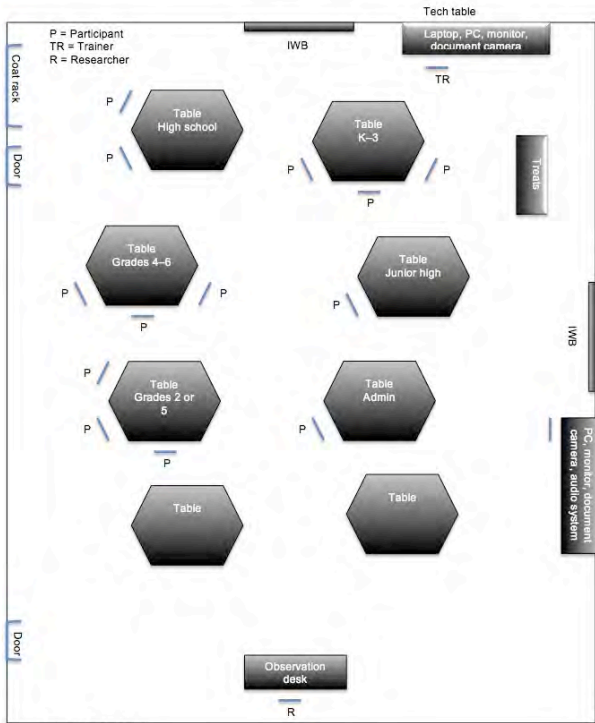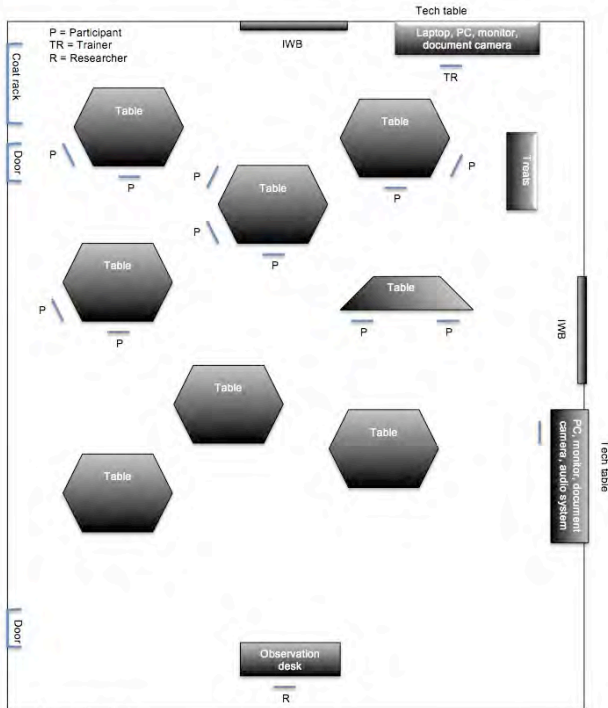

Figure 2 – Twenty-one participants

Figure 3 – Thirteen participants

Figure 4 – Eleven participants

Overview of Sessions

      Beginning with the layout of the room, this particular classroom was different from blackboard-equipped classrooms in several key ways. Social norms for classrooms suggest that the board—whether it is a blackboard, dry-erase whiteboard or IWB—is at the "front" of the room, or more accurately, the board plays a role in signifying the front. Convention also suggests that if the room's shape is rectangular, the front would be at one of the narrow ends. The act of identifying the front is part of what enables students and the teacher to take their appropriate positions upon entering the room. In this IWB-equipped classroom, there were two IWBs: one on a narrow wall and one on a long, side wall (see Figure 5 below). Participants entering the room quickly assessed clues to determine where to sit. Although one IWB was positioned atypically, on a side wall, participants quickly identified the trainer, who was always near the IWB at the narrow end of the room, often welcoming participants as they came in the door. The role assumption process was further enabled when the trainer encouraged participants to choose seats closer to her and the IWB at the narrow end of the room.
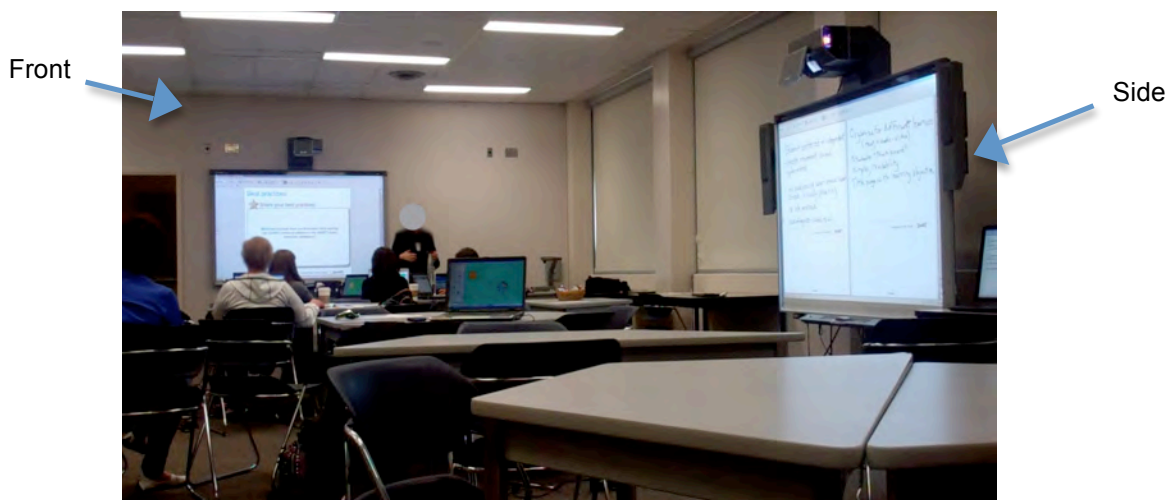

Figure 5 – Trainer standing at "front" with students clustered around her

Seating was ambiguous and, on its own, would not have been enough to signal the front of the room. Chairs were not behind desks in rows all facing the board and the trainer, as they would have been in a traditional blackboard-equipped classroom. Chairs were positioned randomly around most sides of a number of hexagonal tables. This table-style of seating is more common in classrooms today, whether they have IWBs or not. It typically enables small-group work to occur, as needed, without having to shuffle desks around. In a classroom like the one in Figure 5 (above), group work may or may not have been assumed, as students were in a multi-use classroom that was used by a variety of teachers and set up for an assortment of learning scenarios.

Upon entering the room, it was clear that both IWBs were going to be used. The IWB screens invited participants to sign in, indicate their level of familiarity with the IWB software and say what they wanted from the session (see Figures 6–7 below). Once participants were settled in their seats, they would go up to the IWBs and do what was requested. For some, this requirement represented their first contact with an IWB. A few needed some instruction from the trainer or another participant on how to drag their name to the appropriate column on the experience sheet. The sign-in requirement also meant that participants immediately crossed into physical space that was typically associated with the trainer. They also entered IWB space that was not at the front of the room.

Once the sign-in process was complete, participants unpacked and turned on their laptops. Most needed instruction on how to log on to the university's server. Some needed to plug in their computer, so plug-ins and cords were found and arranged. Much of this part of the process was collaborative and nonhierarchical, unless technical support was needed. Then the trainer called the IT help desk so someone could come to the room to help.
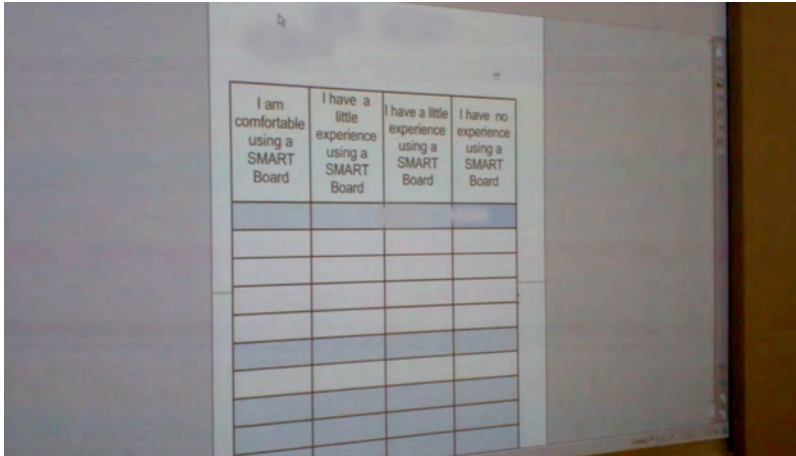
Figure 6 – Experience sheet on IWB at front of room. Participants were to drag their name from a clump of names at the top of the screen to the column that indicated their level of experience with a SMART Board interactive whiteboard. *NOTE: Names have been removed to ensure anonymity.*
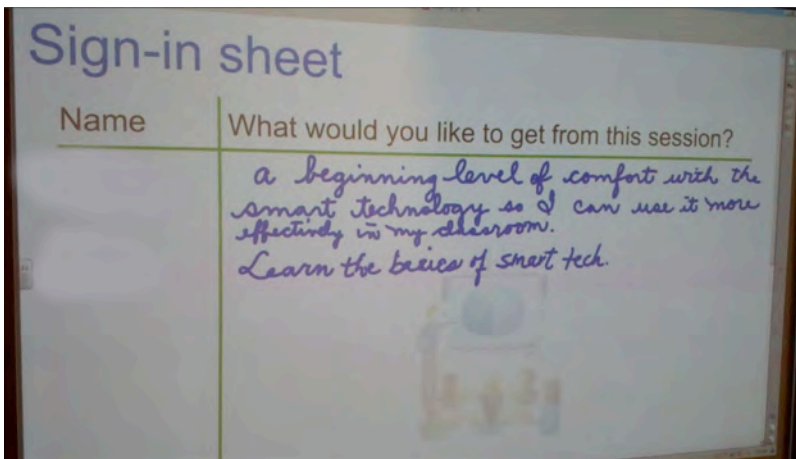
Figure 7 – Sign-in sheet on IWB at side of room. Participants were to write their name in one column and describe their expectations in the adjacent column. *NOTE: Names have been removed to ensure anonymity.*

Sessions began at 9:00 a.m. At that point, the trainer queued up her SMART

Notebook presentation on the IWB at the front of the room and introduced herself. Once

that was done, she introduced me and I went through the process of obtaining consent for

video recording. Then the trainer played an introductory video from YouTube (Nesbitt,

2007) (see http://www.youtube.com/watch?v=_A-ZVCjfWf8), which contextualized

educational technology within collaborative learning environments supported by a

student-centered, inquiry-based pedagogy. It also portrayed today's students as heavy

technology users, who engage with games, television, computers, books and other digital

media for 33 hours per week on average. Today's teachers were portrayed as authority

figures who often do not allow students to use technology. Overall, the film was designed

as a plea from students to teachers to let them use technology in their lessons because it

will help them learn and it will prepare them for tomorrow's jobs. Once the film was over,

the trainer asked participants what the film showed that is important to children today.

Participants answered, "engagement," things that are "relevant" and "interactivity." As

each answer was spoken, the trainer wrote the answer over top of the still film image on

the IWB (see Figure 8 below).

She then linked the film's view of students and teachers to a number of provincial

guidelines and policies, and to learning theory:

- A provincial framework for student learning, which identifies the
  characteristics of a 21st-century learner

- A provincial assessment consortium's student assessment cycle with
  stages that included planning for assessment, coaching through the
  learning phase, and judging and reporting

- A visual representation of Bloom's taxonomy

- A visual representation of Bloom's taxonomy with technology integration

- In one session, participants watched a video created by SMART
  Technologies in which teachers talk about the effectiveness of SMART
  Board interactive whiteboards and SMART Notebook software

In sessions where students indicated an interest in accessibility issues, the trainer referenced Bloom's taxonomy and spoke of the importance of creating universally designed lessons that ensure success for all students. In a couple of sessions, she demonstrated how a tennis ball can be used as an IWB pen tool for students who do not have enough fine motor control to hold a pen. Twelve to fifteen minutes elapsed from the time the Nesbitt film (which was 4 mins 09 secs) started to the end of this sequence. The trainer did not have to change media to access her presentation, the video, and the visual representations—she simply touched a tab on the screen to launch what was needed; nor did she have to switch to a blackboard in order to write notes that everyone could see— she simply wrote over top of IWB images that were being discussed.

Figure 8 – Trainer writing over top of still images on the IWB

At the end of this introductory sequence, the trainer began instructing students on the basic features and functions of the hardware and the software, using the session

materials provided by SMART Technologies. She would often supplement these

materials with relevant, education-specific examples and stories of her own experiences

as a teacher, principal and provincial policy consultant. Participants were encouraged to

try using the features and functions on their laptops as the trainer continued. This

technical training took the rest of the morning, and for most of it, the trainer remained at

the front of the room. Occasionally, the trainer asked participants to come to the IWB to

try completing a particular function. She asked, for instance, four participants to come to

each IWB and then walked them through modifying the IWB's default pen colors using

the Properties tab. This kind of activity occurred more often in the advanced training

sessions. In one session, during the morning break, a participant went to the IWB at the

side of the room and was attempting to do something on her own, but she was struggling.

The trainer approached her there, and the participant asked her a question. The trainer

then guided her through the process of orienting the IWB. There appeared to be a link

between the informality of the morning break, participants walking about or leaving the

room and this participant's decision to approach the IWB on the side wall.

Part of the morning training also involved demonstrating how other technology

integrates with the IWB. The 3D document camera, for example, integrates directly with

SMART Notebook software, so to demonstrate this feature, the trainer walked over to the

document camera, turned it on and then went back to the IWB and pressed a document

camera icon in the menu bar of SMART Notebook. She returned to the document camera

to place a piece of paper under the camera lens and manipulated the paper while watching

the live image of the paper on the IWB screen (see Figure 9 below). Later in the session,

she also demonstrated the value of hooking up an iPad to the IWB. This process was

trickier than the one for the document camera, because the iPad is not integrated into

SMART Notebook software, but participants nodded and smiled as the trainer accessed a stored video file on her iPad.

The latter half of the sessions (in the afternoon) were more focused on having participants create their own SMART Notebook lesson or, in the advanced sessions, getting them up to the IWB to try different IWB functions. The trainer actively encouraged participants to try out the IWB and linked this to effective learning. In one instance, a participant was at the IWB on the side of the room, trying to create and order three SMART Notebook pages. The other participants were in their seats, doing the same activity on their laptops. In attempting to write a number one with her finger, the

Trainer

Figure 9 – Document camera (far right, behind trainer) is integrated into SMART Notebook software and its image is displayed on the IWB

participant at the IWB instead created a heart shape because the appropriate tool was not selected (see Figure 10 below). The rest of the class laughed at the error, and the participant looked momentarily confused, but the trainer jumped in immediately to say

See—that's why you need to *do* it … this is why you need to get up there, you

need to be hands on, you need to *do,* because … you know, it's easy for me to tell

you what happened, but if you haven't experienced it … And it's no different for your students. If all I'm doing is standing up at the front of the room and telling you…

Nonplussed, the student at the IWB was trying to correct her mistake, so the trainer stopped and guided her to the right tool. The student selected the tool, wrote the number one with her finger and, with some additional guidance, deleted the heart shape. The trainer continued to explain the value of doing: "See what learning is going on there? So you have to be sure you're *do*ing it on your computer so that you *know* what you're doing." She was doing what Gillan et al (2007) suggested in their study of pedagogic practice and IWBs: "Errors and mistakes need to become stepping stones to understanding as opposed to potential sources of ridicule … with the IWB resourcing the revision and re-consideration of ideas" (p. 253).

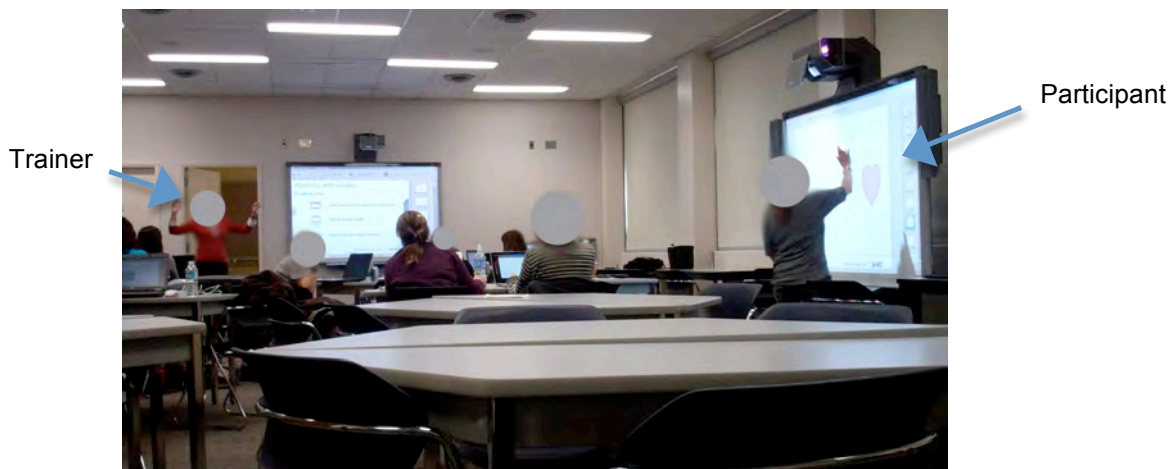**Figure 10** – Trainer linked *doing* with *learning* as participant figured out why she ended up with a heart shape rather than the number one

During such activities, there was often more than one focus in the room. The instructor might be at the front, using the IWB and talking to a small group of participants nearby, while other groups were working on their laptops at the tables—some of them

collaborating and some working individually (see Figure 11 below). Still other groups might collaborate at the IWB.
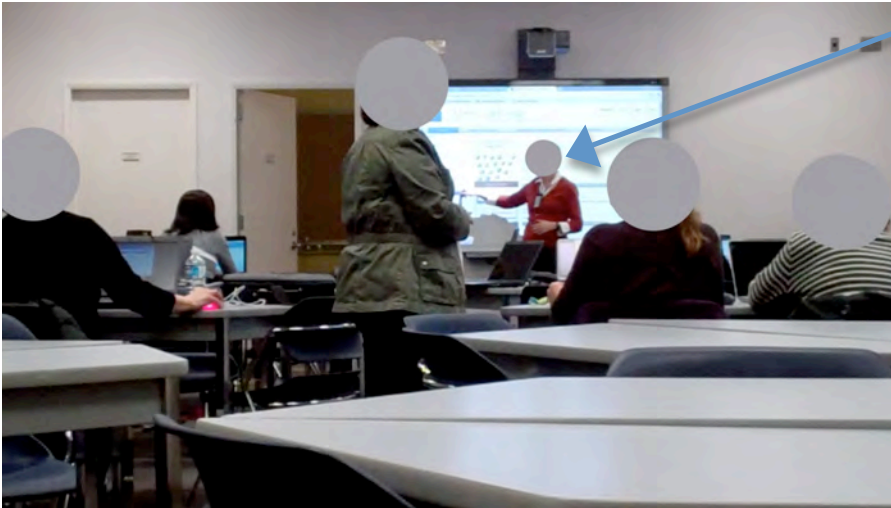
Figure 11 – Multiple focuses at once

Applying Estrid Sørensen's Methodology

Regional materialities. Using Sørensen's methodology, we can examine how regional materialities are performed in a classroom with two IWBs. Similarities to regions performed in a blackboard-equipped classroom emerge because, in this case, the IWB at the so-called front of the room was enlisted in much the same way as a traditional blackboard, inasmuch as regional materialities are concerned. Key differences do emerge, however, when examining the second IWB, the room layout, participants' use of laptops, the IWB's interactive multimedia content and the fluid evolution of space as the sessions progressed.

One critical similarity is the *one-to-many relationship* that emerged between the trainer and participants, just as it had in Sørensen's blackboard-equipped classroom. When participants entered the classroom, they saw the trainer and an IWB positioned at what is typically considered the front of the room. Although the physical layout of the room immediately helped to perform regional materialities, the markers were not as

rigidly defined as they were in the blackboard-equipped classroom. There were hexagonal tables and chairs whose layout did not immediately suggest that participants should be facing a particular direction. There were two IWBs in the room, one of which was positioned atypically on a side wall. However, using the trainer's position near the IWB at the narrow end of the room as a cue, participants assumed positions typical of a blackboard-equipped classroom. In doing so, they took on the role of participant, entered participant space, and enabled the trainer to enter broadcast mode and easily establish a one-to-many relationship. Typical of this relationship, the pedagogy was more didactic than dialogic, and the level of interaction was at Glover et al's (2007) *interactive* stage, in which students were challenged "to think by using a variety of verbal, visual and kinaesthetic stimuli" (p. 9).

The trainer was typically in broadcast mode when she delivered technical training on various features and functions of the IWB, that is, she was in this mode most of the morning. Occasionally, participants were asked to perform a task at the IWB, but the trainer was very much in control of the activity, carefully guiding participants through steps to completion. Questions emerged from time to time, but during these technical segments, there was a great deal of material to cover and not much time for questions, collaboration or exploration. At no time was there any sense of *collective*, as there was when the students Sørensen observed sang a song together.

The pace of the technical training seemed quick in all of the sessions. The trainer moved rapidly through the material, because there was a lot to cover. In one session, on April 19th, there had been so many questions in the morning that she had to skip some things in the afternoon plan in order to get through all the technical material. A few excerpts from the field notes capture the issue:

Pace of instruction is very fast. Speaks fast, goes through material quickly. Uses the board quickly. Wonder about ability of students to keep up when they don't know a lot about what she's talking about. Time for reflection and absorbing? That seems to emerge when they are asked to do something on their own. e.g., changing object properties practice. (March 23)

Pace of instruction is very fast. Hard to keep all the details in mind, although the repetition, the familiarity with other programs like PPT and the fact that they have their own computers to play with, seems to help overcome some of these issues. (April 5)

Students are not working on their own files as much in this session as they have been in previous sessions. That's probably because they are behind (so many questions this morning) and [the trainer] wants to get through as much material as possible. Students are not, therefore, working on their computers as much. So the synchronicity between board, teaching and their own computers isn't as apparent. She makes faces and says she knows it's a lot of material: "Think of it like driving a car: at first you're learning things and then you're driving and talking on the phone, etc. It'll happen." So she's receiving a sense of pace and volume of information from the students. (April 19)

Pace is relevant to the construction of regional materialities because a faster pace is associated with a more didactic, teacher-centered pedagogy—there is simply too much material to get through to allow many questions or much in the way of student-centered exploration—and a more didactic pedagogy is associated with a teacher at the front of the

room in broadcast mode, controlling the space around the board.

The role of the IWB in this scenario was much the same as it was in the blackboard-equipped classroom—it created trainer space apart from participants but space to which their attention could be drawn. It also created participant space, as opposed to trainer space. The vocabulary of separation associated with each space was similar to the vocabulary used for the blackboard-equipped classroom. The trainer would ask participants to "come up to" or "go to" the IWBs; that is, they were granted permission to leave participant space and enter trainer space. The willingness of participants to leave their space varied with each session—participants in some sessions were more willing than those in others. But no participants crossed into IWB space without explicit permission when the trainer was in broadcast mode. Sørensen witnessed many of the same behaviors in the young students in her study, although she does not say whether the teacher in the blackboard-equipped classroom ever left broadcast mode.

The IWB at the front of the room played, then, a crucial role in performing regional patterns of relation. It was enlisted by both the trainer and participants to solidify an already established pattern of relations. When participants entered the room, they looked for the position of the trainer and the IWB in order to determine the location of their space, that is, where they should sit. The trainer greeted participants as they entered, and her position near the IWB at the narrow end of the room confirmed that she was in fact the trainer and in control of that space, which as a consequence became the front of the room. These two regions enabled participants to focus on the IWB and the trainer and the trainer to focus on participants. When the trainer was interacting with content on the IWB, either by writing on it or by moving through her interactive, multimedia presentation, participants were, by and large, focused there. The attentional gaze was,

then, a performative effect of the position and behavior of the trainer when participants entered the room, the placement of the main IWB, the interpellation of trainer and participants as it related to space and negotiated boundaries during training sessions, and the lure of ever unfolding, visually appealing, interactive multimedia content. Each of these contributed to constructing a one-to-many relationship that enabled the trainer to enter broadcast mode when delivering technical training. If any of these elements were not present, the effect would have been diminished.

To address the secondary IWB at the side of the room, the expertise associated with that space was evident even when the trainer was using the main IWB, but the region did not draw the attention of participants unless the trainer explicitly drew their attention to it. When the IWB space was not active—that is, when the trainer was not using it—participants still respected the boundary it represented, and they never transgressed the boundary when the trainer was in broadcast mode at the front of the room. Thus, the trainer and the IWB together performed expert space. But the IWB at the side of the room had enough of its own force to designate expert space even in the trainer's absence and thus to separate participants into non-expert space. The same was true of the main IWB if the trainer was at the secondary IWB.

The similarities between an IWB- and a blackboard-equipped classroom ended there, however. Many elements in the IWB classroom were not present in Sørensen's blackboard-equipped classroom, and these created a more fluid, agential environment, although not to the same degree as in Sørensen's online environment. While it was true that when the trainer was in broadcast mode, a one-to-many pattern of relations dominated the classroom space, it was also true that the trainer was not always in broadcast mode. Throughout the session, the trainer asked participants to feel free to

work on their laptops, doing there what she was demonstrating on the IWB. Not everyone chose to do this, but those who did would direct their attention at their laptop or to other participants at the table who were quietly discussing how to do what was being demonstrated. Neither the laptops nor the quiet discussions disrupted the performance of the trainer's one-to-many relationship, and, in fact, they seemed to solidify it in the sense that participants supplemented the trainer's information with their own attempts to ground it in practice with the devices they had in front of them.

The trainer also often stepped out of broadcast mode to give participants time to develop their own material. At these times, the presence of the tables, their layout, participant laptops and the presence of two IWBs became critical in enabling fluid shifts to different patterns of relation. Had the room been equipped with traditional rows of desks all facing toward the front of the room, such shifts would have been much more difficult to achieve. Co-participants at each of the tables often pointed, for example, to one another's screens, reminding each other how to achieve certain effects, or they gathered around one participant's screen to discuss what was there, or they sometimes went to an IWB to discuss one of the features. The presence of tables, their layout, participant laptops and the IWBs enabled, in these cases, the performance of one-to-one relationships (two participants in discussion), one-to-a-half relationships (a participant and laptop) and many-to-many relationships (a table or group of participants in discussion), depending on the nature of the activity. Often, while the trainer was in broadcast mode performing a one-to-many relationship, the participants were performing a one-to-a-half relationship or a one-to-one relationship with others at their table.

Collectively, these elements reduced the rigidity of regional boundaries in the classroom. Physical boundaries gave way to conceptual boundaries that were activated

depending on the nature of the activity. The ebb and flow of boundaries related to whole-class, group and personal space was more evident than in Sørensen's blackboard-equipped classroom. This increased fluidity enabled the trainer to shift from a didactic to dialogic pedagogy as the need arose, and it gave participants more agency to act within different kinds of space. It also enabled more patterns of relations to emerge than the blackboard-equipped classroom. As in Sørensen's online world, when the trainer was not in broadcast mode, participants acted more autonomously and the trainer had a narrower view of what they were working on. When participants were developing their own material, for example, the trainer walked around the room from table to table, answering questions rather than directing the discussion. Each participant's work was unique and prompted different responses from the trainer. The relationship was more egalitarian and informal—it was focused more on achieving what the student had envisioned than on transferring knowledge from trainer to participant. The participants had more control over their own learning trajectory, although the trainer's expertise was still very much in play, unlike it was in Sørensen's online world. As a consequence, the trainer did not appear restless or confused about her identity when participants were not directly focused on her. She still had a key role to play, and she simply adopted the mantle of facilitator, moving into and out of personal or group space, as needed.

Subject–authority relationships. As in the classroom that Sørensen observed, the IWB contributed to performing the trainer's presence as that of an authority and the participants' presence as subjects. Not only did the IWB help to create regional boundaries and patterns of relations—it performed the trainer's presence as an authority along with the layout of the room, the placement of the IWBs, the trainer's control of IWB space, the voice amplification system and the trainer when she was in broadcast

mode. Althusser's (1971) notion of interpellation came into play not only when participants walked into the room, were greeted by the trainer and sat willingly in seats designated for participants, but prior to that. Participants were already *subject* and the trainer was already *authority*. As Althusser noted, "an individual is always-already a subject" (p. 176). Before participants and trainer arrived in the classroom, they had certain expectations about how training should be delivered and received, a fuzzy notion of how the room would probably look, an understanding that IWBs and laptops would be used during their training and some sense that an expert would guide their instruction. All this "ideological constraint and pre-appointment" (p. 176), as Althusser called it, ensures that the subject–authority relationship is always-already manifest in this environment.

However, as Sørensen notes, the materialities in the environment (such as the IWB, the room layout and so forth) are not arbitrary. They have situated, performative effects. In the case of the blackboard-equipped classroom, the rows of desks facing the front, the teacher's position at the front, the blackboard's location at the front—all contributed to creating well-defined regional boundaries that constituted the subject–authority relationship. The forms of presence enacted in the IWB classroom were somewhat different. Although the subject–authority relationship was evident, the separation between subject and authority was not as great. The materialities of the IWB classroom weakened the intensity of the authority and enhanced the agency of the subject, creating a more *egalitarian* relationahip. Hexagonal tables and chairs replaced rows of desks. One IWB replaced a single blackboard under the direct control of the teacher. Another IWB was at the side of the room. Laptops and Internet access replaced

notebooks and textbooks.[****] Just as they helped to reduce the intensity of the regional boundaries, these different materialities helped to perform, as Sørensen surmises, alternative forms of presence for both the trainer and participants.

When the trainer was not in broadcast mode, she retained her expertise, as noted above, but her control of the room relaxed to the point where participants felt they could move around the room, enter IWB space, converse with colleagues while the trainer was talking elsewhere or collaborate with peers. These activities occurred in the open and not in secret, although some of that secrecy also occurred. The key signal for when such activities could officially occur rested in whether the trainer was in broadcast mode. During broadcast mode, the subject–authority relationship was strong and in force. Participants knew when the trainer was in this mode because she went to the front of the room (occasionally to the side of the room), often picked up her pen tool and stood next to the IWB—the IWB was critical to the signal regardless of whether the trainer was at the front or the side of the room. She also wore a mike that was connected to a voice amplification system which she switched on when (literally) broadcasting and switched off when she was in what may be called *facilitation* mode, that is, walking around the classroom helping individuals or small groups of students while others worked autonomously or in small groups. Thus, based on the mode of the trainer, during the course of the session, participants became familiar with the signals for what forms or degrees of presence were to be enacted.

During the technical training segments, for example, the trainer was in broadcast mode and the pace of the sessions was brisk. The amount of material to cover was so great that the trainer went quickly, so there was little time for reflection. In this scenario,

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[****] Prior to the session, participants were asked to download and print a SMART Notebook training manual. However, no reference was made to manual during the sessions.

an underlying objective of the training seemed to be to give participants as much information about and exposure to the various features and functions of SMART Notebook software as possible so that they could leave the session and reflect on that information later; time for reflection became, in effect, an after-class activity. Although the sessions did offer hands-on experiences and self-directed learning opportunities, these were slotted into a carefully managed schedule. During the technical training segments, then, the subject–authority pattern of relations and the regional boundaries associated with it were clear.

Discontinuities and fluidity. The specific patterns of relation enacted in a more fluid physical environment included one-to-many, one-to-one (in the physical environment; not online), one-to-a-half (participant- or trainer-to-laptop) and many-to-many (in the physical environment). The trainer was included in all of these during the course of a session. Participants were included in all but the one-to-many pattern. As in Sørensen's virtual world, these participants had more room to roam than students in a traditional blackboard-equipped classroom, but they did not have the degree of autonomy of students in a virtual world. The concepts of *discontinuities* and *fluidity* are particularly significant in a learning environment that shifts frequently between the physical and the virtual.

When the trainer was in facilitation mode, the *discontinuities*, or the separations and connections between trainer and participants, were frequent. A few questions arise, then: Does this environment and this particular configuration of materialities insist on a subject–authority relationship or is it agential and fluid, as in a virtual environment? Or is that question too dichotomous? In Sørensen's virtual world, there was a great deal of fluidity and agency—so much so that Sørensen did not observe a subject–authority

relationship at all. This relationship was replaced with an agential form of presence that performed equality rather than authority. She asked, then, if a form of fluid authority could emerge instead and suggested that it could via support and feedback mechanisms built into the virtual world.

In the IWB classroom, agential forms of presence shifted with the trainer's regular transitions between broadcast and facilitation modes. However, the degree of these transitions was not as marked as it was in Sørensen's virtual world. During facilitation mode, the trainer's presence was still apparent; that is, she did not simply blend in with participants and begin working on her own materials, asking questions of others and so forth. She enabled participants' work to proceed even though they were very much in charge of it and the nature of their work was as unpredictable as it was in Sørensen's virtual world. In this manner, the trainer influenced participants' behavior in ways that suggested her authority, but that also recognized the tenuousness of her authority. The temporal sequence of chats that emerged when the she was in facilitation mode emphasized the discontinuity of her authority. She could, at any moment however, take back charge of the room, simply by taking up her position near an IWB, switching on her mike, picking up a pen tool and speaking to the entire room. Thus, the questions posed above reflect a temptation to view the issues as one thing or another rather than as multiple. In much the same way that IWBs can act as both a glorified presentation device and a truly collaborative educational technology, the materialities of this environment supported both a didactic *and* a dialogic pedagogy, with the trainer moving fluidly from one to the other.

Finally, it is important to understand IWB technology in light of its power to enable—rather than "discipline" in Foucault's (1979) sense of the word—multiple forms

of presence. It is, as Sørensen notes about Shutkin (1998), a form of power that says *yes*. It is a centralizing agent that provides a way to easily manage transitions between physical and virtual space, between mono- and multimedia, between single and multiple modalities. Through this very material effect, the IWB has enabled, in this particular classroom, the trainer and participants to share power more equitably, acknowledging the value of both expertise and agency in the learning process. In this IWB classroom, the material arrangement of the IWBs, the IWB software, the seating arrangements, the participants' laptops with access to the Internet and other digital resources, the voice amplification system and other devices in the room, and the regular stream of visually appealing multimedia content via the whiteboarding software all contributed to unsettling (rather than displacing) the traditional subject–authority relationship by interjecting a more agential, or collaborative and participatory, form of learning.

Discussion and Conclusions

The literature review in this study acknowledged the effects of broad social, political, economic and cultural movements on the diffusion and adoption of IWBs into education. While Sørensen's methodology provides a unique glimpse into the IWB classroom specifically, it cannot adequately account for the issue of pace and its effect on how IWBs are defined and used in the classroom. For that we must turn to some key concepts in actor-network theory.

Taking a step back from the classroom and following its extended networks out into the world of school boards, district administration, and government policy, my initial observations of these sessions revealed competing assemblages or networks at play in the classroom:

- A neoliberal framework concentrated on traditional teacher-directed

learning paradigms, student achievement and testing standards, curriculum

guidelines, standardized learning materials and a managerialist form of

accountability and reporting focused on data, dollars and budgets

- A constructivist and situated learning theory framework (i.e., a

    participatory, collaborative learning environment) focused on student-

    centered learning models, accountability and reporting focused on quality

    of learning outcomes, and greater presence of interactive technologies in

    the classroom

It is useful to reiterate our earlier definition of IWBs as actors with agency,

"produced by and simultaneously produc[ing]" (Law, 1999, p. 3) effects within a

particular network of relations concentrated in education. Sørensen's methodology

revealed the actor-network immediately within the classroom. It consisted of IWBs, the

position of the trainer, the chair-and-table arrangement, individual laptops, a voice

amplification system, interactive multimedia content, Internet access, document cameras,

didactic versus dialogic pedagogy, broadcast versus facilitation mode, subject–authority

patterns of relation versus agential–egalitarian patterns of relation and the relative fluidity

of regional boundaries within the space.

Yet, when looking within the classroom for "artifacts and environments which

congeal past action … and mediate the ongoing transactions of people widely separated

in time and space" (2011b, p. 17), a number of other elements also become apparent. The

trainer's whiteboarding presentation provides one example. The trainer has inserted her

own education-related material throughout the presentation, but the manufacturer

prepared the majority of the presentation. With pre-fabricated packages and a certified

trainer, organizations delivering this training can assure potential participants that the

sessions meet the manufacturer's quality control standards. These standards are a selling point for organizations wanting to offer sessions because potential participants feel more secure that the time and money they spend on the training will be effective. But the packages do more than provide a level of quality assurance—they also mandate the content of the sessions, much like curriculum standards. As in our earlier example of how a government education department may in fact be present in the classroom vis-à-vis mandatory curriculum materials, the IWB manufacturer is present in the classroom vis-à-vis it training packages and certified trainers.

I do not point this out to reveal any insidious commercial intent associated with multinational or transnational corporations. Training programs such as these are in high demand and provide a great deal of mutual benefit to both those delivering and taking the training.[††††] Rather, I point to it because of the unintended consequences of such packages when they become part of a larger network of elements working sometimes at cross purposes. In this case, the training package is designed to introduce participants to a long list of features and functions related to IWBs, i.e., it is a technical training package. This particular trainer was aware of the value of linking pedagogy to technology training, implementation and use, so she supplemented the materials with her own experiences, links to Bloom's Taxonomy, links to provincial education policy and so forth. She was also committed to dialogic and collaborative approaches to learning, so she regularly encouraged participants to cross regional boundaries into IWB and trainer space, and she insisted that they develop some of their own materials. However, there is only so much that she can insert without losing the manufacturer's, and presumably the university's,

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[††††] In fact, they are one small part of an entire ecosystem that has evolved around IWBs and which includes third-party software manufacturers, standards organizations, third-party ancillary product developers, lesson development organizations and individuals, market research organizations, IT and procurement staff, and so on. The IWB, like a true *actor*, "makes elements dependent upon itself and translates their will into a language of its own" (Callon and Latour, 1981, as cited in Nespor, 194, p. 21).

intended focus on technical training. As well, participants are already interpellated into this network as subjects, so their expectation of the training is already somewhat formed when they sign up for the session: It should be effective because it is SMART certified, the trainer is SMART certified and it will cover the basics of SMART Notebook software. To a certain extent, participants expect to *receive* technical training rather than *create* their learning experience, in part because as subjects in education they have a long legacy of learning experiences with didactic pedagogy.

Introduce into that environment a product with two critical, disruptive capacities: (a). to increase the pace at which educational content may be covered, and (b). to enable a form of collaboration that shifts the pattern of relations from subject–authority to agential–egalitarian. As various elements from an entrenched neoliberal, managerialist education network wrangle with a newly emerging *collaboration network*[‡‡‡‡], the outcome is war and the IWB provides a unique glimpse of the battlefield. Enter again the humble SMART Notebook training presentation. Represented in this training package are, among other things

- A manufacturer's focus on features and, much prior to that, its participation in a global technology research network focused on commercializing haptic technology

- A university's interest in credible, pre-fabricated training

- Participants' desire to learn about IWB hardware and software

- Participants' interpellation as subjects

- A dominant neoliberal education practice with an attendant focus on quantity vis-à-vis standards, curriculum coverage and testing

[‡‡‡‡] For lack of a commonly used term.

In such a network, time-space and the elements contained within it cohere despite any degree of physical and temporal separation. As Law (1999) notes, the elements within time-space perform time-space—they are a performative effect of this particular network. So the training package dovetails nicely into a network that subscribes to delivering a certain measurable quantity of standardized technical content that is developed and packaged by the manufacturer, approved by the university, delivered by a certified trainer, presented on a device that enables lessons to proceed faster, and received by a somewhat expectant group of participants. Many would consider this a high-functioning network.

In Law's (1999) universe, the warping of time-space in actor-networks enables a center of power to be represented throughout the network as if it were immediately present in all parts of the network. This capacity provokes "ways of talking both about *action at a distance* or domination, and about *knowledge at a distance* or surveillance" (p. 5). If the dominant or established network is a neoliberal one, then immutable mobiles (i.e., the network's foot soldiers) perpetuate that dominance, and the dominator's attendant philosophy, as they travel throughout the network. As Paulo Freire (1998) notes, if "what is essential [of neoliberal networks] is technical training, so that the student can adapt and, therefore, service" (p. 27) the dominant ideology, then pace and IWBs do the work of that network in the classroom. In other words, pace acts as an immutable mobile because it leverages the capacity of the IWB to make lessons go faster, which ensures that a certain quantity of technical material is covered—which fits nicely within a neoliberal education framework, but not as well within a collaboration one.

Another effect of this approach is the continuous promotion of the subject–authority relationship. The technical training segments in the sessions I observed were all run by the trainer, and the subject–authority relationship never wavered during these

periods. Although the trainer may have wished for more hands-on time for students, a slower pace and a more agential relationship, she had to proceed quickly in order to get through the mandated material—her options were limited by the nature of the package she was given to deliver.

In a collaboration network, as noted in the literature review in this study, research increasingly demonstrates that the most effective use of IWBs comes from the deep entanglement of pedagogy and technical training, from dialogic rather than didactic approaches and from ongoing rather than one-off or time-limited sessions. In this network, and in the training sessions I observed, IWBs can function as collaboration devices that enable fluid shifts between subject–authority and agential–egalitarian patterns of relation. In the IWBs I observed, when the trainer was not in broadcast mode, she sent groups of participants to the IWBs to work collaboratively on a problem, asked questions and encouraged reflection, and engaged in exploration alongside participants. During these segments, the pace was much slower, the focus was dispersed among the various groups in the room and the outcomes were different for each group. On the surface of it

Yet, technical training and subject–authority patterns of relation still dominate the IWB landscape in education. Developing and implementing a dialogic form of pedagogy in IWB practice is typically presented with caveats: it is more complicated to teach teachers how to embed pedagogy in their technology use, results are not as easily measured or predicted, and it takes more class time to cover the same amount of material. It would reasonable to assume that this option is also more expensive. What appear, however, to be "caveats" in the neoliberal network are simple necessities in the collaboration network. "Caveats" act as warnings or limitations in one network, while necessities seek attention in the other.

These competing directives play themselves out repeatedly in relation to IWBs. In the war of the boards, some teachers are able to reach a level of enhanced interactivity, but are beaten back by time constraints (Lee, 2010; Schuck & Kearney, 2007) and mandates to focus attention elsewhere. Some elements in the collaboration network have a great deal of credibility in the larger educational network, but they still appear weak in the face of a large neoliberal army. For instance, academic research, which is at the heart of education itself, compels educators at all levels to acknowledge consistently reported findings about the positive effects of dialogic forms of pedagogy on student achievement. There is even a glimmer in the research of new forms of learning that IWBs may support. As a "large-screen digital convergence facility, [or] digital hub" (Lee, 2010, p. 135), the IWB offers, as I noted earlier, a central location to construct and review new kinds of continuous and discontinuous texts and symbol systems. We do not currently understand what those might look like or what their effects might be. Although the collaboration network is attempting to eek out more time to examine them, the neoliberal network's response seems to be, "There is no time for that." Its desire for quantification means it can so effectively enlist pace as a foot soldier in the IWB classroom that even where children's learning is concerned, the tension between pace "and allowing children time to think, reflect and offer more complex answers is often resolved in favor of pace" (Tanner & Jones, 2007, p. 37). It remains, in other words, committed to a technical training model of professional development whose efficacy is determined by how much material can be covered and delivered to potentially large numbers of participants.

Pace, whose form becomes manifest vis-à-vis the IWB, is an immutable mobile in this network because it is a critical element that must act relentlessly in order to preserve the neoliberal ideology. In the neoliberal network, the IWB becomes a presentation

device that supports *technical interactivity* (H. J. Smith et al., 2005), and teachers reach the *supported didactic* or *interactive* stages, rarely reaching the level of *enhanced interactivity* (Glover et al., 2007). The IWB also maintains a subject–authority pattern of relations and the regional boundaries that go along with it.

In the collaboration network, pace also behaves as an immutable mobile, demanding that lessons become more dialogic and reflective, that true dialogue and critical thinking be embedded in IWB use, and that ongoing professional development and a commitment to developing an IWB culture need to emerge. In this network, the IWB becomes a collaborative learning device that supports *pedagogical interactivity* (H. J. Smith et al., 2005), and teachers have a professional development trajectory that helps more of them reach the enhanced interactive stage—as long as all the elements are given enough time to achieve these ends. The IWB also enables fluid shifts between subject–authority and agential–egalitarian patterns of relation, and regional boundaries become conceptual rather than physical, shifting with the pedagogical style of the teacher.

In a world where educators are experiencing a tectonic shift from paper- to digital-based media, the need to imagine other forms of learning and a new collaboration network are urgent. There are other options, ones that acknowledge the need for didactic, dialogic and collaborative pedagogies and that make the most of the technology now appearing in today's schools. One small example can be seen in the building where I once worked for an IWB manufacturer. It was a new building designed to encourage a variety of ways of working and collaborating. Meeting rooms were of many sizes, and each of the rooms had a number of IWBs that suited the size and purpose of the room. Some rooms were intended for quick, impromptu meetings, so they were small and narrow with one IWB and room for two people standing at the IWB. Some rooms were intended for

group work and brainstorming sessions, so they accommodated four or five people, and they had a round table with chairs and one or two IWBs. Some rooms were intended for large gatherings, where information was being disseminated and questions were encouraged, so there were two or three IWBS at the front of the room and tables and chairs around a large line of tables arranged in a U shape. Whole-company gatherings occurred in a large atrium area with a huge electric projection screen and a projector that connected to a podium-mounted interactive display and computer with IWB software on it. There were also IWBs in the hallways for wayfinding or announcements.

In this environment, IWBs and the rooms they were in were suited to different kinds of working relationships; some were hierarchical and intended for one-to-many transmissions; some were collaborative and intended for many-to-many meetings that involved brainstorming or informal group work; some were intended for meetings that sat somewhere in the middle of those two extremes. All rooms were equipped with conference room phone systems and video or data-conferencing options.

This kind of configuration acknowledged and enabled various patterns of relation to emerge. While the pace of working life at this organization was brisk, not using IWBs was never an option, and in fact, they were often used to support the kind of brainstorming and collaborative work that leads to greater creativity and innovation. In a classroom setting, collaboration is supported by systems that are always in place, easy to access or launch and relatively easy to operate. The ubiquity of the IWBs in my place of work ensured that people used them, regardless of time constraints. The room designs and layout ensured that people used them for a variety of purposes. New staff were embraced into an IWB culture they moment they walked in the door. In the IWB classroom that I observed, the room design enabled the full range of pedagogies and patterns of relation,

but the session content and desire to get through a large package of materials in a short period worked against exploiting the room's and the IWB's full potential.

Should the war of the boards be won by the neoliberal network, IWBs may never achieve their potential as collaborative learning devices. If we refuse to view IWBs in larger contexts, which place them in the midst of a massive shift to digital media, we risk, ironically, slowing the pace of change and teachers' ability to adapt to a newly emerging digital world, where multiple devices, media and modes of communication are enlisted in the creation of new forms of learning. If we refuse to acknowledge, as Nespor (2011b) said, the human and nonhuman actors that "mediate the ongoing transactions of people widely separated in time and space" (p. 17), we will not see how regional boundaries, patterns of relation and negotiated space around IWBs reflect much larger networks warring over how to enlist the IWB into their service.

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Request for Your Participation in a Research Project

Study Title: Interactive whiteboards and negotiated space in educational practice: Facilitating new forms of learning

Research Investigator:	**Supervisor:**
NAME: Carolyn Grogan	NAME: Dr. Catherine Adams
ADDRESS: c/o 441 Education South	ADDRESS: 441 Education South
University of Alberta	University of Alberta
Edmonton, AB, T6G 2G5	Edmonton, AB, T6G 2G5
EMAIL: cpd@ualberta.ca	EMAIL: caadams@ualberta.ca
PHONE NUMBER: 780-905-1643	PHONE NUMBER: 780-492-5769

Background
- You are being asked to be in this study because you are a preservice or in-service teacher who will be learning to use an interactive whiteboard
- The instructor of this session has given me permission to request your consent to participate in this research
- The results of this study will be used in support of final project requirements for my masters degree

Purpose
- The objective of this research is to shed light on how preservice and in-service teachers use interactive whiteboards in introductory and advanced training sessions.

Study Procedures
- Types of data to be collected
  - o Observation: I will observe the entire session and take notes throughout
  - o Video recording: I will record the session with a standard digital video camera, which will be situated unobtrusively near the edge of the room
- Observations and notes will be verified using the video camera as back-up

Benefits
- If you wish, you can have access to the final study, which may provide new insights into your own experience with interactive whiteboards
- Rather than exploring whether interactive whiteboards meet existing educational goals (many of these studies already exist), the study will provide new insights into the social and material effects of a particular, very popular form of educational technology: the interactive whiteboard. The research approach is relatively new, drawing on actor network theory and new a materiality of learning framework that requires additional field testing. The study may provide additional support for this methodological approach for education.
- No costs are associated with being involved in this research
- You will not receive any compensation (or reimbursements) for your participation

Risk
- There are no foreseeable risks associated with this study

Voluntary Participation
- You are under no obligation to participate in this study. Participation is completely voluntary.
- Even if you agree to be in the study, you can change your mind, provided this withdrawal takes place within one month of today's completed training session. Once the withdrawal is requested, I will ensure that identifying information in my observation notes is changed and that your voice (if required) and image are masked in the video footage, so no identifying information remains.

Confidentiality & Anonymity
- I intend to use the research as part of the final project requirements for my masters degree, and also for research presentations, reports or other scholarly manuscripts for publication; regardless, all identifying information will be changed (in the case of observation notes) and blurred (in the case of videotapes) to protect your anonymity
- The identifying data in both the observation notes and original videotapes will be kept strictly confidential, with only me and my supervisor having access to it
- Data will be kept in a secure, locked place for a minimum of 5 years following completion of the research project, and all digital data will be password-protected. After that time, data will be destroyed in a way that ensures privacy and confidentiality.
- You may receive a copy of a report of the research findings and indicate your interest in receiving such materials by indicating so on the consent form attached to this letter
- I may use the data I obtain from this study in future research, but this must first be approved by a Research Ethics Board.

Further Information
- If you have any further questions regarding this study, please do not hesitate to contact me, Carolyn Grogan, at cpd@ualberta.ca, or Dr. Catherine Adams at caadams@ualberta.ca.
- The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding your rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.

Appendix B

Participant Informed Consent

Project Title: Interactive whiteboards and negotiated space in educational practice: Facilitating new forms of learning

Principal Investigator: Carolyn Grogan, Faculty of Extension, University of Alberta, cpd@ualberta.ca
Supervisor: Dr. Cathy Adams, Faculty of Secondary Education, University of Alberta, caadams@ualberta.ca

I give my consent to have research collected about my experiences regarding this topic. More specifically,

- I agree that my participation in all aspects of the study is voluntary.
  Yes   No

- I understand that the training session will be videotaped and the researcher will take written notes.
  Yes   No

- I understand that I am free to withdraw from the study and/or to otherwise withdraw my participation at any time, provided this withdrawal takes place within one month of today's completed training session.
  Yes   No

- I understand that the information collected will be kept anonymous and neither the group nor I will be personally identified in any dissemination of the research.
- Yes   No

- I understand that collected data (digital field notes and videotapes) may be used in research presentations, reports or other scholarly manuscripts for publication, but that all identifying information will be changed (in the case of field notes) and blurred (in the case of videotapes) to protect my anonymity.
  Yes   No

- I understand that the supervisor involved in this study will have access to the content of the field notes and videotapes and that the supervisor has signed a confidentiality agreement.
  Yes   No

- I acknowledge that the research procedures have been adequately described and that any questions I have asked have been answered to my satisfaction. In addition, I know that I may contact the Principal Investigator, Carolyn Grogan (cpd@ualberta.ca; phone 780-905-1643) or her supervisor, Dr. Cathy Adams

(caadams@ualberta.ca, phone 780-492-5769), if I have further questions either now or in the future.

Yes . No .

I understand my rights as a participant and agree to take part in this study.

Please **<u>sign and date</u>** below indicating your willingness to participate in an interview.

_____ _____

(Date) **(Signature of Participant)**

_____ _____

(Date) **(Signature of Researcher)**

If you would like to receive a report on the research results, please provide your e-mail address below. This contact information will at no time be linked to your interview data.

Name:

_____

E-mail:

_____

The plan for this study has been reviewed for its adherence to ethical guidelines by the Faculties of Education, Extension, Augustana and Campus Saint Jean Research Ethics Board (EEASJ REB) at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Chair of the EEASJ REB c/o (780) 492-2614.

Appendix C

Request for Faculty Participation in a Research Project

Study Title: Interactive whiteboards and negotiated space in educational practice: Facilitating new forms of learning

Research Investigator:	**Supervisor:**
NAME: Carolyn Grogan	NAME: Dr. Catherine Adams
ADDRESS: c/o 441 Education South	ADDRESS: 441 Education South
University of Alberta	University of Alberta
Edmonton, AB, T6G 2G5	Edmonton, AB, T6G 2G5
EMAIL: cpd@ualberta.ca	EMAIL: caadams@ualberta.ca
PHONE NUMBER: 780-905-1643	PHONE NUMBER: 780-492-5769

Background
- You are being asked to be in this study because you are teaching preservice or in-service teachers how to use an interactive whiteboard
- The results of this study will be used in support of final project requirements for my masters degree

Purpose
- The objective of this research is to shed light on how preservice and in-service teachers use interactive whiteboards in introductory and advanced training sessions.

Study Procedures
- Types of data to be collected
  - Observation: I will observe the entire session and take notes throughout
  - Video recording: I will record the session with a standard digital video camera, which will be situated unobtrusively near the edge of the room
- Observations and notes will be verified using the video camera as back-up

Benefits
- If you wish, you can have access to the final study, which may provide new insights into your own experience with interactive whiteboards
- Rather than exploring whether interactive whiteboards meet existing educational goals (many of these studies already exist), the study will provide new insights into the social and material effects of a particular, very popular form of educational technology: the interactive whiteboard. The research approach is relatively new, drawing on actor network theory and new a materiality of learning framework that requires additional field testing. The study may provide additional support for this methodological approach for education.
- No costs are associated with being involved in this research
- You will not receive any compensation (or reimbursements) for your participation

Risk

- There are no foreseeable risks associated with this study

Voluntary Participation
- You are under no obligation to participate in this study. Participation is completely voluntary.
- Even if you agree to be in the study, you can change your mind, provided this withdrawal takes place within one month of the completion of the four training sessions that I will observe. Once the withdrawal is requested, I will ensure that identifying information in my observation notes is changed and that your voice (if required) and image are masked in the video footage, so no identifying information remains.

Confidentiality & Anonymity
- I intend to use the research as part of the final project requirements for my masters degree, and also for research presentations, reports or other scholarly manuscripts for publication; regardless, all identifying information will be changed (in the case of observation notes) and blurred (in the case of videotapes) to protect your anonymity
- The identifying data in both the observation notes and original videotapes will be kept strictly confidential, with only me and my supervisor having access to it
- Data will be kept in a secure, locked place for a minimum of 5 years following completion of the research project, and all digital data will be password-protected. After that time, data will be destroyed in a way that ensures privacy and confidentiality.
- You may receive a copy of a report of the research findings and indicate your interest in receiving such materials by indicating so on the consent form attached to this letter
- I may use the data I obtain from this study in future research, but this must first be approved by a Research Ethics Board.

Further Information
- If you have any further questions regarding this study, please do not hesitate to contact me, Carolyn Grogan, at cpd@ualberta.ca, or Dr. Catherine Adams at caadams@ualberta.ca.
- The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding your rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.